2106 JEPPIAAR INSTITUTE OF TECHNOLOGY

Self Belief | Self Discipline | Self Respect

QUESTION BANK

REGULATION :2017

YEAR: II

SEMESTER: 04

BATCH :2018-2022

DEPARTMENT

OF

INFORMATION TECHNOLOGY

JEPPIAAR INSTITUTE OF TECHNOLOGY

"Self-Belief | Self Discipline | Self Respect"

INSTITUTION VISION

Jeppiaar Institute of Technology aspires to provide technical education in futuristic technologies with the perspective of innovative, industrial and social application for the betterment of humanity.

INSTITUTIONMISSION

- To produce competent and disciplined high quality professionals with the practical skills necessary to excel as innovative professionals and entrepreneurs for the benefit of the society.
- To improve the quality of education through excellence in teaching and learning, research, leadership and by promoting the principles of scientific analysis, and creative thinking.
- To provide excellent infrastructure, serene and stimulating environment that is most conducive to learning.
- To strive for productive partnership between the Industry and the Institute for research and development in the emerging fields and creating opportunities for employability.
- To serve the global community by instilling ethics, values and life skills among the students needed to enrich their lives.

JEPPIAAR INSTITUTE OF TECHNOLOGY

"Self-Belief | Self Discipline | Self Respect"

DEPARTMENT VISION

To facilitate the evolution of problem solving skills along with knowledge application in the field of Information Technology, understanding industrial and global requirements for the benefit of the society.

DEPARTMENT MISSION

- To produce creative and productive computing graduates in software development being aware of global requirements and maximize employability.
- To enhance evolution of professional skills and development of leadership traits among the students to grow into successful entrepreneurs.
- To offer students an advantageous infrastructure to apply their research thoughts and develop their technical expertise.
- To escalate the moral code and honesty in the professional activities.

Program Educational Objectives (PEOs)

PEO1: To provide students with a fundamental knowledge in Science, mathematics and computing skills for creative and innovative application.

PEO2: To enable students competent and employable by providing excellent Infrastructure to learn and contribute for the welfare of the society.

PEO3: To channelize the potentials of the students by offering state of the art amenities to undergo research and higher education.

PEO4: To evolve computing engineers with multi-disciplinary understanding and maximize Job Opportunities.

PEO5: To facilitate students obtain profound understanding nature and social requirements and grow as professionals with values and integrity.

Program Specific Outcomes (PSOs)

PSO 1: To create the ability to analyze and enhance coding skills by participating in various competitions.

PSO 2: Students are able to provide solutions for Social Problems by creating Mobile Application Development using Android Studio and Chatbot.

PSO 3: Students are able to deal with real time problems using Machine Learning Tools and Big data Analytics.

BLOOM'S TAXONOMY

Definition:

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition like thinking, learning, and understanding.

Objectives:

- To classify educational learning objectives into levels of complexity and specificity. The classification covers the learning objectives in cognitive, affective and sensory domains.
- To structure curriculum learning objectives, assessments and activities.

Levels in Bloom's Taxonomy:

- **BTL 1** – **Remember** - The learner recalls, restate and remember the learned information.
- **BTL 2** – **Understand** - The learner embraces the meaning of the information by interpreting and translating what has been learned.
- **BTL3**–**Apply**-Thelearnermakesuseoftheinformationinacontextsimilartothe one in which it was learned.
- **BTL 4** – **Analyze** - The learner breaks the learned information into its parts to understand the information better.
- **BTL 5** – **Evaluate** - The learner makes decisions based on in-depth reflection, criticism and assessment.
- **BTL6**–**Create**-The learner creates new ideas and information using what has been previously learned.

TABLE OF CONTENTS

MA8391 PROBABILITY AND STATISTICS L T P C

4 0 0 4

OBJECTIVE:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.

- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Probability – The axioms of probability – Conditional probability – Baye‘s theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS 12

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS 12 One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT V STATISTICAL QUALITY CONTROL `12 Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL :60 PERIODS

OUTCOMES:

Upon successful completion of the course, students will be able to:

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.

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- Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund‘s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences‖, Cengage Learning, New Delhi, 8th Edition, 2014.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum‘s Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.

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REGULATION :2017 **ACADEMIC YEAR : 2019-2020**

Subject Code:MA8391 **Year/Semester: II /03**
Subject Name: Probability & Statistics **Subject Handler: Dr. M. Ranjith Kumar**

UNIT I –PROBABILITY & RANDOM VARIABLES
Probability – Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

PART *A

Q.No.	**Questions**
1.	**Find the probability of a card drawn at random form an ordinary pack, is a diamond.** BTL2 Total number of ways of getting 1 card = 52 Number of ways of getting 1 diamond card is 13 $\text{Probability} = \frac{\text{Number of favourable events}}{\text{Number of exhaustive events}}$ $= \frac{13}{52} = \frac{1}{4}$
2	**A bag contains 7 white, 6 red and 5 black balls. Two balls are drawn at random. Find the probability that they both will be white.** BTL2 Total balls = 18 From these 18 balls 2 balls can be drawn in $18C_2$ ways Total number of ways of drawing 2 balls = 153 ----------(1) 2 White balls can be drawn from 7 white balls in $7C_2$ ways. Therefore number of favourable cases = 21 Probability of drawing white balls $= \frac{\text{No., of favourable events}}{\text{Total no., of cases}}$ $= \frac{21}{153} = \frac{7}{51}$
3	**Write the axioms of probability**. BTL1 Let S be a sample space. To each event A, there is a real number P(A) satisfying the following axioms. (i) For any event A, $P(A) \geq 0$ (ii) P(S) = 1 (iii) If $A_1, A_2, ..., A_n$ are finite number of disjoint events of S then $P(A_1 \cup A_2 \cup A_3 \cup ...) = P(A_1) + P(A_2) + P(A_3) + ...$
4	**A and B are events such that** $P(A \cup B) = \frac{3}{4}$; $P(A \cap B) = \frac{1}{4}, P(\bar{A}) = \frac{2}{3}$, *Find* $P(\bar{A}/B)$**.** BTL2

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$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$\frac{3}{4} = \frac{1}{3} + P(B) - \frac{1}{4}$

$P(B) = \frac{2}{3}$

$P(\overline{A}/B) = \frac{P(\overline{A} \cap B)}{P(B)} = \frac{P(B) - P(A \cap B)}{P(B)} = \frac{\frac{2}{3} - \frac{1}{4}}{\frac{2}{3}} = \frac{5}{8}$

5 **Define Baye's theorem.** BTL1

Let $A_1, A_2, ..., A_n$ be 'n' mutually exclusive and exhaustive events with $P(A_i) \neq 0$ for I = 1,2,…n. Let 'B' be an event such that $B \subset \bigcup_{I=1}^{N} A_i$, $P(B) \neq 0$ then $P(A_i/B) = \frac{P(A_i).P(B/A_i)}{\sum_{i=1}^{n} P(A_i).P(B/A_i)}$

6 **Define Random variable. (Nov/Dec2013, Apr/May 2017)** BTL1

A random variable is a function that assigns a real number X(S) to every element $s \in S$ where 'S' is the sample space corresponding to a random experiment E.

7 **Prove that the function P(x) is a legitimate probability mass function of a discrete random variable X, where** $p(x) = \begin{cases} \frac{2}{3}\left(\frac{1}{3}\right)^x, & x = 0,1,2... \\ 0, & otherwise \end{cases}$ **(Apr/May 2017)** BTL5

$$\sum p(x) = \sum_{x=0}^{\infty} \frac{2}{3}\left(\frac{1}{3}\right)^x = \frac{2}{3}\left(\frac{1}{3}\right)^0 + \frac{2}{3}\left(\frac{1}{3}\right)^1 + \frac{2}{3}\left(\frac{1}{3}\right)^2 + ...$$

$$= \frac{2}{3}\left[1 + \frac{1}{3} + \left(\frac{1}{3}\right)^2 + ...\right]$$

$$= \frac{2}{3}\left[1 - \frac{1}{3}\right]^{-1} = \frac{2}{3}\left[\frac{2}{3}\right]^{-1}$$

$$= \frac{2}{3}\left[\frac{3}{2}\right] = 1$$

Since $\sum p(x) = 1$, the given function P(x) is a legitimate probability mass function of a discrete random variable 'X'.

8 **A random variable X has the following probability function.**

X=x	0	1	2	3	4	5	6	7	8
P(x)	a	3a	5a	7a	9a	11a	13a	15a	17a

Find the value of 'a'. BTL5

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$\sum P(x)=1$

$a+3a+5a+7a+9a+11a+13a+15a+17a=1$

$81a=1$

$a=\frac{1}{81}$

9 **If the random variable X takes the values 1,2,3 and 4nsuch that 2P[X=1] = 3P[X=2] = P[X=3] = 5P[X=4]. Find the probability distribution (Nov/Dec 2016)** BTL3

Let P[X=3] = k

2P[X=1] = k $\Rightarrow$ $p[X=1]=\frac{k}{2}$

3P[X=2] = k $\Rightarrow$ $p[X=2]=\frac{k}{3}$

5P[X=4] = k $\Rightarrow$ $p[X=4]=\frac{k}{5}$

We know that $\sum P(x)=1$

$$\frac{k}{2}+\frac{k}{3}+k+\frac{k}{5}=1\Rightarrow\frac{61}{30}k=1\Rightarrow k=\frac{30}{61}$$

The probability distribution of X is given by

X	1	2	3	4
P(x)	$\frac{15}{61}$	$\frac{10}{61}$	$\frac{30}{61}$	$\frac{6}{61}$

10 **Find the variance of the discrete random variable X with the probability mass function**

$P_x(X)=\begin{cases}\frac{1}{3};x=0\\ \frac{2}{3};x=2\end{cases}$ **(Nov/Dec 2015 , Nov/Dec 2015)** BTL3

The probability distribution of X given by

X	0	2
P(x)	$\frac{1}{3}$	$\frac{2}{3}$

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	$E[X]=\sum x\,P(x)=(0)\left(\frac{1}{3}\right)+(2)\left(\frac{2}{3}\right)=0+\frac{4}{3}=\frac{4}{3}$ $E[X^2]=\sum x^2P(x)=(0)^2\left(\frac{1}{3}\right)+(2)^2\left(\frac{2}{3}\right)=\frac{8}{3}$ $VarX=E[X^2]-(E[X])^2=\frac{8}{3}-\left(\frac{4}{3}\right)^2=\frac{8}{3}-\frac{16}{9}$
11	**Test whether the function defined as follows a density function ?** $f(x)=\begin{cases}0 & x<2\\ \frac{1}{18}(3+2x) & 2\le x\le 4\\ 0 & x>4\end{cases}$ BTL4 $\int_2^4 f(x)\,dx=\int_2^4\frac{1}{18}(3+2x)dx=\frac{1}{18}\left[3(x)_2^4+2\left(\frac{x^2}{2}\right)_2^4\right]$ $=\frac{1}{18}[3(4-2)+(16-4)]=\frac{1}{18}(18)=1$ Hence the given function is a density function.
12	**Show that the function** $f(x)=\begin{cases}e^{-x} & x\ge 0\\ 0 & x<0\end{cases}$ **is a probability density function of a random variable X.** BTL5 $\int f(x)\,dx=\int_0^\infty e^{-x}\,dx=\left[-e^{-x}\right]_0^\infty=-[0-1]=1$ Hence the given function is a density function.
13	**Assume that X is a continuous random variable with the probability density function** $f(x)=\begin{cases}\frac{3}{4}(2x-x^2) & 0<x<2\\ 0 & otherwise\end{cases}$ **. Find P(X>1).** BTL3 $P[X>1]=\int_1^2\frac{3}{4}(2x-x^2)dx=\frac{3}{4}\left[2\left(\frac{x^2}{2}\right)_1^2-\left(\frac{x^3}{3}\right)_1^2\right]$ $=\frac{3}{4}\left[(4-1)-\left(\frac{8}{3}-\frac{1}{3}\right)\right]=\frac{1}{2}$
14	**A random variable X is known to have a distributive function** $F(x)=u(x)\left[1-e^{-x^2/b}\right], b>0$ **is a constant. Determine density function.** BTL 3

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	$f(x)=F_x(x)=\frac{d}{dx}\left[u(x)\left(1-e^{-x^2/b}\right)\right]$ $=u(x)\left(e^{-x^2/b}\left(-\frac{2x}{b}\right)\right)+u'(x)\left(1-e^{-x\ /b}\right)$ $=\frac{2}{b}xu(x)e^{-x^2/b}+u'(x)\left(1-e^{-x^2/b}\right)$
15	**If $f(x)=\frac{x^2}{3},-1<x<2$ is the PDF of the random variable X then find P[0<X<1]. (Apr/May 2018)** BTL3 $\int f(x)\,dx=\int_0^1\frac{x^2}{3}dx=\frac{1}{3}\left[\frac{x^3}{3}\right]_0^1=\frac{1}{9}[1-0]=\frac{1}{9}$
16	**A continuous random variable X has probability density function $f(x)=\begin{cases}3x^2 & 0\le x\le 1\\ 0 & otherwise\end{cases}$ Find 'k' such that P[X>k]=0.5** . BTL4 $\Rightarrow\int_k^1 f(x)\,dx=0.5$ $\Rightarrow\int_k^1 3x^2dx=0.5$ P[X>k] = 0.5 $\Rightarrow 3\left[\frac{x^3}{3}\right]_k^1=0.5\ \Rightarrow 1-k^3=0.5$ $\Rightarrow k^3=1-0.5=0.5\Rightarrow k=(0.5)^{\frac{1}{3}}=0.7937$
17	**The cdf the random variable X is given by $F_x(X)=\begin{cases}0 & ;x<0\\ x+\frac{1}{2} & ;0\le x\le\frac{1}{2}\\ 1 & ;\ x>\frac{1}{2}\end{cases}$. Find $P[X>\frac{1}{4}]$** . BTL3 $P\left[X>\frac{1}{4}\right]=1-P\left[X\le\frac{1}{4}\right]=1-F\left[\frac{1}{4}\right]=1-\left[\frac{1}{4}+\frac{1}{2}\right]=\frac{1}{4}$
18	**Find the moment generating function of Binomial distribution. (May/June 2013)** BTL3 The P.M.F of Binomial distribution is $P[X=x]=nC_x p^x q^{n-x}$, $x=0,1,2,...,n$

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	$M_x(t)=\sum_{x=0}^{n} e^{tx} p(x) = \sum_{x=0}^{n} e^{tx} nC_x p^x q^{n-x}$ $= \sum_{x=0}^{n} nC_x q^{n-x} \left(pe^t\right)^x$ $= nC_0 q^{n-0}\left(pe^t\right)^0 + nC_1 q^{n-1}\left(pe^t\right)^1 + nC_2\, nC_0 q^{n-0}\left(pe^t\right)^0 q^{n-2}\left(pe^t\right)^2 + \ldots + nC_n q^{n-n}\left(pe^t\right)$ $= q^n + nC_1 q^{n-1}\left(pe^t\right) + nC_2 q^{n-2}\left(pe^t\right)^2 + \ldots + \left(pe^t\right)^n = \left(q + pe^t\right)^n$
19	**The mean & variance of Binomial distribution are 5 and 4. Determine the distribution.(Apr/May 2015)** BTL4 Given: Mean = np = 5, variance = npq =4 $= 5q = 4 \Rightarrow q = \frac{4}{5}$ $p = 1 - q = 1 - \frac{4}{5} = \frac{1}{5}$ $np = n\left(\frac{1}{5}\right) = 5 \Rightarrow n = 25$ The P.M.F of the binomial distribution is $P[X = x] = nC_x p^x q^{n-x} \quad x = 0,1,2, \ldots n$ $P[X = x] = 25C_x \left(\frac{1}{5}\right)^x \left(\frac{4}{5}\right)^{n-x}, \; x = 0,1,2,\ldots,25$
20	**Balls are tossed at random into 50 boxes. Find the expected number of tosses required to get the first ball in the fourth box. (Apr/May 2017)** BTL3 Let probability of success be $p = \frac{1}{50}$ According to Geometric distribution, Expected number of tosses to get the first ball in the fourth box = $E[x] = \frac{1}{p} = 50$
21.	**A random variable is uniformly distributed between 3 and 15. Find the variance of X. (Nov/Dec 2015)** BTL3 $Var\, X = \frac{(b-a)^2}{12}$ $= \frac{(15-3)^2}{12} = \frac{144}{12} = 12$
22.	**Messages arrive at a switchboard in a poisson manner at an average rate of six per hour. Find the probability for exactly 2 messages arrive within one hour. (Apr/May 2018)** BTL3

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	$Mean = \lambda = 6\ per\ hour$ $P[X = x] = \frac{e^{-\lambda}\lambda^x}{x!} = \frac{e^{-6}6^x}{x!}$ $P[X = 2] = \frac{e^{-6}6^2}{2!} = 0.0446$
23.	**Find the moment generating function of Poisson distribution. (Nov/Dec 2014, Apr/May 2015)** BTL2 The P.M.F of Poisson distribution is $P[X = x] = \frac{e^{-\lambda}\lambda^x}{x!}, x = 0,1,2,... \quad \lambda > 0$ $M_x(t) = E[e^{tx}] = \sum e^{tx} p(x)$ $= \sum_{x=0}^{\infty} e^{tx} \frac{e^{-\lambda}\lambda^x}{x!} = e^{-\lambda} \sum_{x=0}^{\infty} \frac{(\lambda e^t)^x}{x!}$ $= e^{-\lambda}\left[1 + \frac{(\lambda e^t)^1}{1!} + \frac{(\lambda e^t)^2}{2!} + ...\right]$ $= e^{-\lambda} e^{\lambda e^t}$
24.	**Let X be a random variable with M.G.F $M_x(t) = \frac{(2e^t + 1)^4}{81}$. Find its mean and variance. (May/June 2016)** BTL3 $M_x(t) = \frac{(1 + 2e^t)^4}{81} = \left(\frac{1 + 2e^t}{3}\right)^4 = \left(\frac{1}{3} + \frac{2e^t}{3}\right)^4$ Comparing the M.G.F of Binomial distribution , $M_x(t) = (q + pe^t)^n$, we have $p = \frac{2}{3}, q = \frac{1}{3}, n = 4$ $Mean = np = 4\left(\frac{2}{3}\right) = \frac{8}{3}$ Hence $Variance = npq = 4\left(\frac{2}{3}\right)\left(\frac{1}{3}\right) = \frac{8}{9}$
25.	If **X and Y are independent random variables with variance 2 and 3. Find the variance of 3X+4Y. (May/June 2014)** BTL3 Given : Var(x)= 2 and Var(y) = 3 Var(aX+bY)= a^2Var(X) + b^2Var(Y) Var(3X+4Y) = 9(2)+16(3)=66
26.	**If $f(x) = \begin{cases} cxe^{-x} & x > 0 \\ 0 & elsewhere \end{cases}$ is the p.d.f of a random variable X. Find 'c'.** BTL5 $\int_0^{\infty} cxe^{-x}\,dx = 1$

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$$c\left[x\left(\frac{e^{-x}}{-1}\right)-(1)\left(e^{-x}\right)\right]_0^{\infty}=1$$

W.K.T $c[(0)-(0-1)]=1$

$c=1$

PART * B

A random variable X has the following probability distribution

X=x	-2	-1	0	1	2	3
P(X=x)	0.1	K	0.2	2k	0.3	3k

Find (i) The value of 'k'

(ii) Evaluate P(X>2) and P(-2<X<2)

(iii)Find the cumulative distributation of X

(iv) Evaluate the mean of X (8M)(May/June 2010, Nov/Dec 2011, Nov/Dec 2017) BTL5**.**

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Answer:Page: 1.80-Dr.A. Singaravelu

- Total Probability $\sum P(x)=1$
- C.D. F $F(x)=P(X\le x)=\sum_{t\le x}p(t)$
- Mean $E(x)=\sum xP(x)$
- $E(x^2)=\sum x^2P(x)$
- $VarX=E(X^2)-[E(x)]^2$
  - Using $\sum P(x)=1$, we have $k=\frac{1}{15}$. (1M)
  - P(X<2)=0.5, $P(-2<X<2)=\frac{2}{5}$. (2M)
  - C.D. F , F(-2)=0.1, F(-1)= 0.17, F(0)= 0.37, F(1)=0.5, F(2)= 0.8, F(3)=1. (3M)
  - Mean E(x) = $\frac{16}{15}$. (2M)

A random variable X has the following probability function

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

2

Find (i) the value of 'k'

(ii) Evaluate $P[1.5<X<4.5/X>2]$

(iii) **The smallest value of** λ **for which** $P[X\le\lambda]>\frac{1}{2}$ **(8M) (Nov/Dec 2012,May/June 2012,**

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	May/June 2014, A/M 2015) BTL5 **Answer:Page: 1.74-Dr.A.Singaravelu** • Total Probability $\sum P(x)=1$ • C.D. F $F(x)=P(X\le x)=\sum_{t\le x}p(t)$ • Mean $E(x)=\sum xP(x)$ • $E(x^2)=\sum x^2P(x)$ • $VarX=E(X^2)-[E(x)]^2$ • Value of $k=\frac{1}{10}$. (2M) • $P[1.5<X<4.5/X>2]=\frac{P[1.5<X<4.5\cap X>2]}{P(X>2)}=\frac{5}{7}$. (3M) • The minimum value of $\lambda=4$. (3M)
3	**If the probability mass function of a random variable X is given by** $P(X=r)=kr^3$ ***r=1,2,3,4*** **Find the value of 'k',** $P\left(\frac{1}{2}<X<\frac{5}{2}/X>1\right)$**, mean and variance of X. (8M)(Apr/May 2015)** BTL5 **Answer:Page: 1.24- Dr.G. Balaji** • Total Probability $\sum P(x)=1$ • C.D. F $F(x)=P(X\le x)=\sum_{t\le x}p(t)$ • Mean $E(x)=\sum xP(x)$ • $E(x^2)=\sum x^2P(x)$ • $VarX=E(X^2)-[E(x)]^2$ • Value of $k=\frac{1}{100}$. (2M) • $P\left(\frac{1}{2}<X<\frac{5}{2}/X>1\right)=\frac{P\left(\frac{1}{2}<X<\frac{5}{2}\cap X>1\right)}{P(X>1)}=\frac{8}{99}$. (3M) • Mean $E(X)=3.54$, Var(X)= 0.4684. (3M)
4	**If the moments of a random variable 'X' are defined by E(X^r) =0.6; r=1,2,3,… Show that P(X=0)=0.4, P(X=1)=0.6,** $P(X\ge 2)=0$ BTL5 **Answer: Page: 1.70-Dr.G. Balaji** • $M_x(t)=E\left(e^{tx}\right)=\sum_{x=0}^{\infty}e^{tx}p(x)$ • $M_x(t)=\sum_{x=0}^{\infty}\frac{t^r}{r!}\mu_r'$

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	• $M_x(t)=\sum_{x=0}^{\infty}\frac{t^r}{r!}\mu_r{}' = 0.4+(0.6)e^t$ • But $M_x(t)=E(e^{tx})=\sum_{x=0}^{\infty}e^{tx}p(x)=p(0)+e^t p(1)+e^{2t}p(2)$. (3M) • Comparing P(X=0) = 0.4, P(X=1)=0.6. (3M) • $P(X\geq 2)=0$. (2M)
5	**A continuous random variable X that can assume any value between x=2 and x=5 has a density function f(x) = k(1+x). Find P[X<4]. (8M) (Nov/Dec 2012, Apr/May 2015)** BTL5 **Answer: Page: 1.88- Dr.A.Singaravelu** • Total probabability $\int_{-\infty}^{\infty}f(x)dx=1\Rightarrow\int_{2}^{5}k(1+x)dx=1$. (2M) • The value of $k=\frac{2}{27}$. (3M) • $P[X<4]=\int_{2}^{4}f(x)dx=\frac{16}{27}$. (3M)
6	**If the density function of a continuous random variable X is given by** $f(x)=\begin{cases}ax & ,0\leq x\leq 1\\ a & ,1\leq x\leq 2\\ 3a-ax & ,2\leq x\leq 3\\ 0 & ,otherwise\end{cases}$ **.Find the value of 'a, and find the c.d.f of X. (8M) (Apr/May 2015)**BTL5 **Answer : Page: 1.118- Dr. A. Singaravelu** • $\int_{-\infty}^{\infty}f(x)dx=1\Rightarrow\int_{0}^{1}ax\,dx+\int_{1}^{2}a\,dx+\int_{2}^{3}(3a-ax)\,dx=1$ (1M) • Value of a=0.5. (1M) • For c.d.f , If x<0, F(x)=0. (1M) • If $0\leq x\leq 1, F(x)=\frac{x^2}{4}$. (1M) • $1\leq x\leq 2, F(x)=\frac{x}{2}-\frac{1}{4}$. (2M) • $2\leq x\leq 3, F(x)=-\frac{x^2}{4}+\frac{3}{2}x-\frac{5}{4}$, For x>3, F(x)=1. (2M)
7	**A continuous random variable 'X' has the density function f(x) given by .** $f(x)=\frac{k}{1+x^2}, -\infty<x<\infty$ **Find the value of 'k' and the cumulative distribution of 'X'.(8M) (Nov/Dec 2014, Apr/May 2018)** BTL5 **Answer: Page: 1.123- Dr. A. Singaravelu**

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	• $\int_{-\infty}^{\infty} f(x)dx=1 \Rightarrow \int_{0}^{1} \frac{k}{1+x^2}dx=1$. (2M) • The value of $k=\frac{1}{\pi}$. (2M) • The c.d.f is $F(x)=\int_{-\infty}^{x} f(x)dx=\int_{-\infty}^{x} \frac{1}{\pi}\left(\frac{1}{1+x^2}\right)dx=\frac{1}{\pi}\left[\tan^{-1}x+\frac{\pi}{2}\right]$. (4M)
8	**Let 'X' be the random variable that denotes the outcome of the roll of a fair die. Compute the mean and variance of 'X'.(8M)(Apr/May 2018)** BTL4 **Answer : Page: 1.177- Dr. A. Singaravelu** • $P(X=i)=\frac{1}{6}, i=1,2,...,6$. (1M) • $M_x(t)=\sum_{i=1}^{6} e^{it}P(X=i)=\frac{1}{6}\left[e^t+e^{2t}+...+e^{6t}\right]$. (2M) • $E(x)=\left[M_x'(t)\right]_{t=0}=\frac{7}{2}$. (2M) • $E(x^2)=\left[M_x''(t)\right]_{t=0}=\frac{91}{6}$. (2M) • $Var(X)=E(X^2)-\left[E(X)\right]^2=\frac{35}{12}$. (1M)
9	**For the triangular distribution** $f(x)=\begin{cases} x & ,0<x\le 1 \\ 2-x, & 1\le x\le 2 \\ 0 & ,otherwise \end{cases}$ **.Find the mean , variance, moment generating function. (8M) (Nov/Dec 2013)** BTL5 **Answer : Page: 1.180- Dr. A. Singaravelu** • $M_x(t)=E[e^{tx}]=\frac{\left[e^t-1\right]^2}{t^2}$. (3M) • Mean $E(X)=\int_{-\infty}^{\infty} x\,f(x)\,dx=1$. (2M) • $E(X^2)=\int_{-\infty}^{\infty} x^2\,f(x)\,dx=\frac{7}{6}$. (2M) • $Var(X)=E(X^2)-\left[E(X)\right]^2=\frac{1}{6}$ (1M)
10	**Find the M.G.F of the random variable X having the probability density function** $f(x)=\begin{cases} \frac{x}{4}e^{-x/2} & ,x>0 \\ 0 & ,elsewhere \end{cases}$ **(8M) (May/June2012, May/June 2014)** BTL5 **Answer: Page:1.74-Dr. G. Balaji**

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	• $M_x(t)=E[e^{tx}]=\int_0^{\infty} e^{tx}\frac{x}{4}e^{-x/2}\,dx=\frac{1}{(1-2t)^2}$. (1M) • $M_x(t)=1+\frac{t}{1!}\mu_1'+\frac{t^2}{2!}\mu_2'+\frac{t^3}{3!}\mu_3'+\ldots$ (1M) • $M_x(t)=1+\frac{t}{1!}(4)+\frac{t^2}{2!}(24)+\frac{t^3}{3!}(192)+\ldots$ (2M) • $\mu_1' = coefficient\ of\ \frac{t}{1!}=4$. (1M) • $\mu_2' = coefficient\ of\ \frac{t^2}{2!}=24$. (1M) • $\mu_3' = coefficient\ of\ \frac{t^3}{3!}=192$. (1M) • $\mu_4' = coefficient\ of\ \frac{t^4}{4!}=1920$. (1M)
11	**Find the MGF of the Binomial distribution and hence find the mean and variance. (8M)(Apr/May 2011, May/June2014)**BTL2 **Answer : Page: 1.190- Dr. A. Singaravelu** • $P(x)=nC_x p^x q^{n-x}$, $x=0,1,2,\ldots,n$. (1M) • $M_x(t)=E[e^{tx}]=(q+pe^t)^n$. (2M) • Mean $E(X)=\left[M_x'(t)\right]_{t=0}=np$. (2M) • $E(X^2)=\left[M_x''(t)\right]_{t=0}=n^2p^2+npq$. (2M) • Var(X)= npq. (1M)
12	**Derive Poisson distribution form Binomial distribution. (8M)(Nov/Dec 2014, Nov/Dec 2017)**BTL2 **Answer : Page: 1.219 – Dr. A. Singaravelu** The Binomial distribution becomes Poisson distribution under the following conditions (2M) • The number of trials is very large • The probability of success is very small • $np=\lambda$ • $P(X=x)=\lim_{n\to\infty} nC_x p^x q^{n-x}=\lim_{n\to\infty}\frac{(1-1/n)(1-2/n)\ldots(1-(x-1)/n)}{x!}\lambda^x\frac{(1-\lambda/n)^n}{(1-\lambda/n)^x}$. (4M) • $P(X=x)=\frac{e^{-\lambda}\lambda^x}{x!}$. (2M)
13	**It is known that the probability of an item produced by a certain machine will be defective is 0.05. If the produced items are sent to the market in packets of 20, find the number of packets containing**

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	atleast, exactly and atmost 2 defective items in a consignment of 1000packets using binomial and Poisson distribution.(8M) (Nov/Dec 2017) BTL5 **Answer : Page: 1.116 – Dr. GBalaji** Probability of Binomial Distribution $P(X=x)=nC_x p^x q^{n-x}$ Probability of Poisson Distribution $P(X=x)=\frac{e^{-\lambda}\lambda^x}{x!}$ Binomial Distribution • Number of packets containing atleast 2 defective items $=NP(X\geq 2)=264$. (2M) • Number of packets containing exactly 2 defective items $=NP(X=2)=189$. (1M) • Number of packets containing atmost 2 defective items $=NP(X\leq 2)=925$. (1M) Poisson Distribution • Number of packets containing atleast 2 defective items $=NP(X\geq 2)=264$. (2M) • Number of packets containing exactly 2 defective items $=NP(X=2)=184$. (1M) • Number of packets containing atmost 2 defective items $=NP(X\leq 2)=920$. (1M)
14	**The number of monthly breakdown of a computer is a random variable having a Poisson distribution with mean equal to 1.8. Find the probability that this computer will function for a month (1)without a breakdown, (2)with only one breakdown and (3)with atleast one breakdown(8M) (Nov/Dec 2017)** BTL5 **Answer : Page: 1.227- Dr. A. Singaravelu** Probability of Poisson Distribution $P(X=x)=\frac{e^{-\lambda}\lambda^x}{x!}$ • P(without a breakdown) = P(X=0) = 0.1653. (2M) • P(with only one breakdown) = P(X=1)=0.2975. (2M) • P(with atleast 1 breakdown)= $P(X\geq 1)=1-P(X<1)=0.8347$. (4M)
15	**State and prove the Memoryless property of Geometric distribution.(8M)(Nov/Dec2015, May/June 2016)** BTL1 **Answer : Page: 1.254- Dr. A. Singaravelu** Probability of Geometric distribution P(X=x) = $q^{x-1}p$, x=1,2,… • $P[X>m+n/X>m]=\frac{P[X>m+n\cap X>m]}{P[X>m]}$. (2M) • $P[X>k]=q^k$ (4M) • $P[X>m+n/X>m]=\frac{P[X>m+n]}{P[X>m]}=q^n$. (2M)
16	**If the probability that an applicant for a driver's license will pass the road test on any given trial is 0.8, what is the probability that he will finally pass the test (a) on the fourth trial , (b) in fewer than 4 trials. (8M) (May/June2015)** BTL5 **Answer : Page: 1.137- Dr. G. Balaji** Probability of Geometric distribution P(X=x) = $q^{x-1}p$, x=1,2,…

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	• P(on the fourth trial) = P(X=4) = 0.0064. (4M) • P(fewer than 4 trials) = P(X<4) = 0.992. (4M)
17	**A coin is tossed until the first head occurs. Assuming that the tosses are independent and the probability of a head occurring is 'p', find the value of 'p' so that the probability that an odd number of tosses is required, is equal to 0.6. Can you find a value of 'p' so that the probability is 0.5 that an odd number of tosses is required? (8M)(Nov/Dec 2010, Nov/Dec 2016)** BTL4 **Answer : Page: 1.135- Dr. G. Balaji** Probability of Geometric distribution P(X=x) = $q^{x-1}p$, x=1,2,… • P[X= odd number of tosses] $= \frac{1}{1+q} = 0.6$ (3M) • $q = \frac{2}{3}, p = 1-q = \frac{1}{3}$. (1M) • P[X= odd number of tosses] $= \frac{1}{1+q} = 0.5$ (3M) • q=1, p=0 . (1M)
18	**Determine the moment generating function of Uniform distribution in (a,b) and hence find the mean and variance. (8M) (Nov/Dec 2017, Apr/May 2018)** BTL2 **Answer : Page: 1.256- Dr. A. Singaravelu** The probability function of Uniform distribution is $f(x) = \begin{cases} \frac{1}{b-a}, a < x < b \\ 0 \quad , otherwise \end{cases}$ • $M_x(t) = E[e^{tx}] = \int_a^b e^{tx} f(x)dx = \frac{(e^{bt} - e^{at})}{t(b-a)}$. (3M) • Mean $E(X) = \int_a^b x f(x)\,dx = \frac{b+a}{2}$. (2M) • $E(X^2) = \int_a^b x^2 f(x)\,dx = \frac{b^2+ab+a^2}{3}$. (2M) • $Var(X) = \frac{(b-a)^2}{12}$. (1M)
19	**Suppose 'X' has an exponential distribution with mean=10, Determine the value of 'x' such that P(X<x)=0.95. (8M) (Nov/Dec 2015, Apr/May 2017)** BTL5 **Answer : Page: 1.143- P. Sivaramakrishna Dass**

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	The probability function of exponential distribution is $f(x)=\begin{cases}\lambda e^{-\lambda x}, x \geq 0 \\ 0 \quad\quad , otherwise\end{cases}$ • $Mean=\frac{1}{\lambda}=10 \Rightarrow \lambda=\frac{1}{10}$. (2M) • P(X<x)= 1-P(X>x) =0.95. (2M) • $1-e^{-\frac{x}{10}}=0.95 \Rightarrow x=29.96$. (4M)
20	**The time in hours required to repair a machine is exponentially distributed with perimeter $\lambda=\frac{1}{2}$.** (i) **What is the probability that the repair time exceeds 2h** (ii) **What is the conditional probability that a repair takes atleast 10h given that its duration exceeds 9h? (8M) (May/June 2012, Nov/Dec 2016, Nov/Dec 2017)** BTL3 **Answer : Page: 1.274- Dr. A. Singaravelu** The probability function of exponential distribution is $f(x)=\begin{cases}\lambda e^{-\lambda x}, x \geq 0 \\ 0 \quad\quad , otherwise\end{cases}$ • P(the repair time exceeds 2h) $P(X>2)=\int_2^\infty \frac{1}{2}e^{-x/2}dx$ (2M) • $P(X>2)=0.3679$. (2M) • $P(X \geq 10/X>9)=P(X>1)=\int_1^\infty \frac{1}{2}e^{-x/2}dx$. (2M) • $P(X \geq 10/X>9)=0.6065$. (2M)
21	**In a test 2000 electric bulbs, it was found that the life of a particular make, was normally distributed with an average life of 2040 hours and S.D. of 60 hours. Estimate the number of bulbs likely to burn for (i)more than 2150 hours, (ii)less than 1950 hours and (iii) more than 1920 hours but less than 2160 hours. (8M) (Nov/Dec 2017)** BTL5 **Answer: Page:1.293 -A. Singaravelu** • $z=\frac{X-\mu}{\sigma}$ • P(more than 2150 hrs) = P(X>2150) =P(z > 1.833) = 0.5-P(0 < z < 1.833) = 0.0336. (2M) • The number of bulbs expected to burn for more than 2150hrs = 2000 x 0.0336 = 67. (1M) • P(Less than 1950 hrs) = P(X< 1950) = P(z< -1.5) = 0.5 – P(0< z< 1.5) = 0.0668. (2M) • The number of bulbs expected to burn for less than 1950hrs = 2000 x 0.0668 = 134. (1M) • P(more than 1920 hrs but less than 2160 hrs) = P(1920 <X < 2160) = P(-2 < z < 2) = 0.9546.(1M) • The number of bulbs = 2000 x 0.9546 = 1909. (1M)
22	**In a normal distribution 31% of the items are under 45 and 8% are over 64. Find the mean and variance of the distribution. (8M) (Nov/Dec 2012, Nov/Dec 2015)** BTL5 **Answer:Page: 1.295- A. Singaravelu**

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	• $z = \frac{X - \mu}{\sigma}$ • $45 - \mu = -0.49\sigma$. (2M) • $P(Z > Z_1) = 0.8$ or $P(0 < Z < Z_2) = 0.42$. (1M) • From tables , $Z_2 = 1.40$. (1M) • $64 - \mu = 1.40\sigma$. (2M) • Solving, $\sigma = 10, \mu = 50$. (2M)
23	**The contents of urns I, II, III are as follows:** **1 white, 2 red and 3 black balls** **2 white, 3 red and 1 black balls and** **3 white, 1 red and 2 black balls.** **One urn is chosen at random and 2 balls are drawn. They happen to be white and red. What is the probability that they came from urns I, II, III.** BTL5 **Answer: Page: 1.60-Dr. A. Singaravelu** Let $A_1, A_2, ..., A_n$ be 'n' mutually exclusive and exhaustive events with $P(A_i) \neq 0$ for I = 1,2,…n. Let 'B' be an event such that $B \subset \bigcup_{I=1}^{N} A_i$, $P(B) \neq 0$ then $P(A_i / B) = \frac{P(A_i).P(B/A_i)}{\sum_{i=1}^{n} P(A_i).P(B/A_i)}$ • $P(E_1) = P(E_2) = P(E_3) = \frac{1}{3}$ (1M) • $P(A/E_1) = \frac{1C_1 \times 2C_1}{6C_2} = \frac{2}{15}$, $P(A/E_2) = \frac{2C_1 \times 3C_1}{6C_2} = \frac{6}{15}$, $P(A/E_3) = \frac{3C_1 \times 1C_1}{6C_2} = \frac{3}{15}$ (2M) • $P(E_2/A) = \frac{P(E_2).P(A/E_2)}{\sum_{i=1}^{3} P(E_i).P(A/E_i)} = \frac{6}{11}$ (2M) • $P(E_3/A) = \frac{P(E_3).P(A/E_3)}{\sum_{i=1}^{3} P(E_i).P(A/E_i)} = \frac{3}{11}$ (2M) • $P(E_1/A) = 1 - P(E_2/A) - P(E_3/A) = \frac{2}{11}$ (1M)

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UNIT II – TWO - DIMENSIONAL RANDOM VARIABLES

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

PART *A

Q.No.	Questions
1.	**State the basic properties of joint distribution of (X,Y) where X and Y are random variables. (May/June 2014)** BTL1 Properties of joint distribution of (X,Y) are (i) $F[-\infty, y] = 0 = F[x, -\infty]$ *and* $F[-\infty, -\infty] = 0, F[\infty, \infty] = 0$ (ii) $P[a < X < b, Y \le y] = F(b, y) - F(a, y)$ (iii) $P[X \le x, c < Y < d] = F(x, d) - F(x, c)$ (iv) $P[a < X < b, c < Y < d] = F(b, d) - F(a, d) - F(b, c) + F(a, c)$ (v) At points of continuity of f(x,y), $\frac{\partial^2 F}{\partial x \partial y} = f(x, y)$
2	**The joint probability mass function of a two dimensional random variable (X,Y) is given by p(x,y) = f(2x + y); x = 1,2 and y = 1,2 where 'k' is a constant. Find the value of 'k'.(Nov/Dec 2015)** BTL5 The joint pmf of (X,Y) is x \ y: 1 | 2 1 | 3k | 4k 2 | 5k | 6k We have $\sum\sum p(x, y) = 1$ Therefore, 3k + 4k + 5k + 6k = 1 18 k=1 $k = \frac{1}{18}$.
3	**The joint probability density function of the random variables (X,Y) is given by** $f(x, y) = kxye^{-(x^2+y^2)}$, $x > 0, y > 0$**. Find the value of 'k'. (Apr/May 2015)** BTL5

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$$\iint f(x,y)\,dkx\,dy=1$$

$$\int_0^\infty\int_0^\infty kxy\,e^{-\left(x^2+y^2\right)}\,dx\,dy=1$$

$$k\int_0^\infty ye^{-y^2}\,dy\int_0^\infty x\,e^{-x^2}\,dx=1 \qquad Put\ x^2=t$$

$$2xdx=dt$$

$$k\int_0^\infty ye^{-y^2}\,dy\int_0^\infty e^{-t}\,\frac{dt}{2}=1 \qquad xdx=\frac{dt}{2}$$

$$\frac{k}{2}\int_0^\infty ye^{-y^2}\left[-e^{-t}\right]_0^\infty dy=1$$

$$\frac{k}{2}\int_0^\infty ye^{-y^2}\left[0+1\right]dy=1$$

$$\frac{k}{2}\int_0^\infty e^{-t}\,\frac{dt}{2}=1$$

We have $\frac{k}{4}\left[-e^{-t}\right]_0^\infty=1$

$$\frac{k}{4}[0+1]=1\Rightarrow k=4$$

4 **If the function f(x,y) = c(1-x)(1-y) , 0 < x < 1 , 0 < y < 1 is to be a density function, find the value of 'c'.(8M) (Nov/Dec 2017)** BTL5

$$\iint f(x,y)\,dx\,dy=1$$

$$\int_0^1\int_0^1 c(1-x)(1-y)dx\,dy=1$$

$$c\int_0^1(1-y)dy\int_0^1(1-x)dx=1$$

$$c\left[y-\frac{y^2}{2}\right]_0^1\left[x-\frac{x^2}{2}\right]_0^1=1$$

$$c\left[1-\frac{1}{2}\right]\left[1-\frac{1}{2}\right]=1$$

$$c\left[\frac{1}{2}\right]\left[\frac{1}{2}\right]=1$$

$$c\left[\frac{1}{4}\right]=1\Rightarrow c=4$$

5 **The joint pdf of (X,Y) is** $f_{xy}(x,y)=xy^2+\frac{x^2}{8},0\le x\le 2,0\le y\le 1$**. Find P(X<Y). (May/June 2013,**

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	Apr/May 2017)BTL5 $P(X<Y)=\int_0^1\int_0^y\left(xy^2+\frac{x^2}{8}\right)dx\,dy$ $=\int_0^1\left[y^2\left(\frac{x^2}{2}\right)_0^y+\frac{1}{8}\left(\frac{x^3}{3}\right)_0^y\right]dy$ $=\int_0^1\left[\frac{y^2}{2}(y^2)+\frac{1}{24}(y^3)\right]dy=\int_0^1\left[\frac{y^4}{2}+\frac{y^3}{24}\right]dy$ $=\frac{1}{2}\left(\frac{y^5}{5}\right)_0^1+\frac{1}{24}\left(\frac{y^4}{4}\right)_0^1=\frac{1}{10}(1-0)+\frac{1}{96}(1-0)=\frac{53}{480}$
6	**If the joint pdf of (X,Y) is** $f(x,y)=\begin{cases}\frac{1}{4} & ,0<x,y<2\\ 0 & ,otherwise\end{cases}$ **. Find** $P[X+Y\le 1]$BTL5 $P[X+Y\le 1]=\int_0^1\int_0^{1-y}\left(\frac{1}{4}\right)dx\,dy=\frac{1}{4}\int_0^1(x)_0^{1-y}dy$ $=\frac{1}{4}\int_0^1(1-y)dy \quad =\frac{1}{4}\left[y-\frac{y^2}{2}\right]_0^1$ $=\frac{1}{4}\left[1-\frac{1}{2}\right]=\frac{1}{8}$
7	**Find the marginal density function of X and Y if** $f(x,y)=\begin{cases}\frac{6}{5}\left(x+y^2\right) & ,0\le x,y\le 1\\ 0 & ,otherwise\end{cases}$ **(Nov/Dec 2012)** BTL5 Marginal density function of X is $f_x(x)=\int f(x,y)\,dy=\int_0^1\frac{6}{5}\left(x+y^2\right)dy=\frac{6}{5}\left[xy+\frac{y^3}{3}\right]_0^1=\frac{6}{5}\left[x+\frac{1}{3}\right]\ 0\le x\le 1$ Marginal density function of Y is $f_y(y)=\int f(x,y)\,dx=\int_0^1\frac{6}{5}\left(x+y^2\right)dy=\frac{6}{5}\left[\frac{x^2}{2}+y^2x\right]_0^1=\frac{6}{5}\left[\frac{1}{2}+y^2\right]\ 0\le y\le 1$
8	**The joint probability density function of the random variable X and Y is** $f(x,y)=\begin{cases}25e^{-5y} & ,0<x<0.2,y>0\\ 0 & ,otherwise\end{cases}$ **.Find the marginal PDF of X and Y. (Nov/Dec 2016)** BTL5

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	Marginal density function of X is $f_x(x)=\int f(x,y)\,dy=\int_0^{\infty}25e^{-5y}dy=25\left[\frac{e^{-5y}}{-5}\right]_0^{\infty}=-5[0-1]=5\ \ 0\le x\le 0.2$ Marginal density function of Y is $f_y(y)=\int f(x,y)\,dx=\int_0^{0.2}25e^{-5y}dx=25e^{-5y}[x]_0^{0.2}=2e^{-5y}[0.2-0]=5e^{-5y}\quad y>0$
9	**If X and Y are independent random variables having the joint density function** $f(x,y)=\frac{1}{8}(6-x-y),0<x<2,\ 2<y<4$ **. Find P[X+Y<3].** BTL5 $P[X+Y<3]=\frac{1}{8}\int_2^3\int_0^{3-y}(6-x-y)dx\,dy$ $=\frac{1}{8}\int_2^3\left[(6-y)(x)-\frac{x^2}{2}\right]_0^{3-y}dy=\frac{1}{8}\int_2^3\left[(6-y)(3-y)-\frac{(3-y)^2}{2}\right]dy$ $=\frac{1}{8}\int_2^3\left[18-9y+y^2-\frac{1}{2}(3-y)^2\right]dy$ $=\left[18y-9\frac{y^2}{2}+\frac{y^3}{3}-\frac{1}{2}\frac{(3-y)^3}{-3}\right]_2^3$ $=\left[18(3)-\frac{9}{2}(9)+\frac{27}{3}+\frac{1}{6}(0)\right]-\left[18(2)-\frac{9}{2}(4)+\frac{8}{3}+\frac{1}{6}(1)\right]$ $=\left[18-\frac{45}{2}+\frac{19}{3}-\frac{1}{6}\right]=\frac{5}{24}$
10	**Let X and Y be random variables with joint density function** $f(x,y)=\begin{cases}4xy & ,0\le x\le 1,\ 0\le y\le 1\\ 0 & ,otherwise\end{cases}$ **Find E[XY].** BTL5 $E[XY]=\int\int xy\,f(x,y)\,dx\,dy=\int_0^1\int_0^1 xy\,(4xy)dx\,dy$ $=4\int_0^1 x^2dx\int_0^1 y^2dy$ $=4\left[\frac{x^3}{3}\right]_0^1\left[\frac{y^3}{3}\right]_0^1=\frac{4}{9}(1)(1)=\frac{4}{9}$
11	**Let X and Y be a two-dimensional random variable. Define covariance of (X,Y). If X and Y are independent, what will be the covariance of (X,Y)? (May/June 2016)** BTL2

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	Covariance of (X,Y) is defined as *Cov(X,Y) = E[XY] – E[x]E[Y]* If X and Y are independent, then *Cov(X,Y) =0.*
12	**Two random variables X and Y have the joint pdf** $f(x,y)=\begin{cases}\frac{xy}{96} & ;0<x<4,1<y<5\\ 0 & ;otherwise\end{cases}$ **. Find *Cov(X,Y)*. (May/June 2016)** BTL5 *Cov(X,Y) = E[XY] – E[x]E[Y]* $E[X]=\int\int x\,f(x,y)\,dx\,dy=\int_1^5\int_0^4 x\left(\frac{xy}{96}\right)dx\,dy=\frac{1}{96}\int_1^5 y\,dy\int_0^4 x^2\,dx$ $=\frac{1}{96}\left[\frac{y^2}{2}\right]_1^5\left[\frac{x^3}{3}\right]_0^4=\frac{1}{576}[25-1][64]=\frac{8}{3}$ $E[Y]=\int\int y\,f(x,y)\,dx\,dy=\int_1^5\int_0^4 y\left(\frac{xy}{96}\right)dx\,dy=\frac{1}{96}\int_1^5 y^2\,dy\int_0^4 x\,dx$ $==\frac{1}{96}\left[\frac{y^3}{3}\right]_1^5\left[\frac{x^2}{2}\right]_0^4=\frac{1}{576}[125-1][16]=\frac{31}{9}$ $E[XY]=\int\int xy\,f(x,y)\,dx\,dy=\int_1^5\int_0^4 xy\left(\frac{xy}{96}\right)dx\,dy=\frac{1}{96}\int_1^5 y^2\,dy\int_0^4 x^2\,dx$ $=\frac{1}{96}\left[\frac{y^3}{3}\right]_1^5\left[\frac{x^3}{3}\right]_0^4=\frac{1}{864}[125-1][64]=\frac{248}{27}$ $\therefore\ Cov(X,Y)=\left[\frac{248}{27}\right]-\left[\frac{8}{3}\right]\left[\frac{31}{9}\right]=0$
13	**Let X and Y be any two random variables a,b be constants. Prove that Cov(aX,bY)=abCov(X,Y).** BTL5 *Cov(X,Y) = E[XY] –E[X]E[Y]* *Cov(aX,bY)= E[aX bY] – E[aX] E[bY]* =ab E[XY] –ab E[X]E[Y] =ab[*E[XY] –E[X]E[Y]]* = ab *Cov(X,Y)*
14	**If Y = - 2X + 3, Find Cov(X,Y).** BTL3 *Cov(X,Y) = E[XY] –E[X]E[Y]* =E[X(-2X+3)]-E[X]E[-2X+3]

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	$= E[-2X^2+3X] - E[X][-2E[X]+3]$ $= -2E[X^2]+3E[X]+2(E[X])^2-3E[x]$ $= -2(E[X^2]-(E[X])^2) = -2\text{Var } X$
15	**If X_1 has mean 4 and variance 9 while X_2 has mean -2 and variance 5 and the two are independent , find Var($2X_1+X_2-5$).** BTL3 $E[X_1]=4$, $E[X_2] = -2$ $\text{Var}[X_1] = 9$, $\text{Var}[X_2] = 5$ $\text{Var}(2X_1+X_2-5) = 4\,\text{Var}X_1 + \text{Var}X_2$ $= 4(9) + 5 = 41.$
16	**If X and Y are independent random variables then show that E[Y/X] = E[Y] , E[X/Y] = E[X]. (Nov/Dec 2016)** BTL5 $E[Y/X]=\int y.\frac{f(x,y)}{f(x)}dy$ Since X and Y are independent, $E[Y/X]=\int y.\frac{f(x).f(y)}{f(x)}dy=\int y.f(y)\,dy = E[Y]$ $E[X/Y]=\int x.\frac{f(x,y)}{f(y)}dx$ Since X and Y are independent, $E[X/Y]=\int x.\frac{f(x).f(y)}{f(y)}dx=\int x.f(x)\,dx = E[X]$
17	**Find the acute angle between the two lines of regression. (Apr/May 2015, Apr/May 2018)** BTL3 The equations of the regression are $y-\bar{y}=r\frac{\sigma_y}{\sigma_x}(x-\bar{x})$ ----------(1) $x-\bar{x}=r\frac{\sigma_x}{\sigma_y}(y-\bar{y})$ ----------(2) Slope of line (1) is $m_1=r\frac{\sigma_y}{\sigma_x}$ Slope of line (2) is $m_2=\frac{1}{r}\frac{\sigma_y}{\sigma_x}$ If θ is the acute angle between the two lines, then $\tan\theta=\frac{\lvert m_1-m_2\rvert}{1+m_1m_2}$

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	$= \frac{\left\| r\frac{\sigma_y}{\sigma_x} - \frac{\sigma_y}{r\sigma_x} \right\|}{1 + r\frac{\sigma_y}{\sigma_x}.\frac{\sigma_y}{r\sigma_x}} = \frac{\left\| \frac{\left(r^2-1\right)}{r}\frac{\sigma_y}{\sigma_x} \right\|}{1+\frac{\sigma_y^2}{\sigma_x^2}}$ $= \frac{\left\| \frac{-\left(1-r^2\right)}{r}\frac{\sigma_y}{\sigma_x} \right\|}{\frac{\sigma_x^2+\sigma_y^2}{\sigma_x^2}} = \frac{\left(1-r^2\right)\sigma_x\sigma_y}{\|r\|\left(\sigma_x^2+\sigma_y^2\right)}$
18	**The regression equations are 3x + 2y = 26 and 6x + y = 31. Find the correlation coefficient between X and Y.** BTL5 Let 3x + 2y = 26 be the regression equation of Y on X. Therefore, $2y = -3x + 26 \Rightarrow y = -\frac{3}{2}x + \frac{26}{2}$. The regression coefficient $b_{yx} = -\frac{3}{2}$ Let 6x + y = 31 be the regression equation of X on Y. Therefore, $6x = -y + 31 \Rightarrow x = -\frac{1}{6}y + \frac{31}{6}$ The regression coefficient $b_{xy} = -\frac{1}{6}$ Hence, correlation coefficient r_{xy} is given by $r_{xy} = \pm\sqrt{b_{yx} \times b_{xy}} = \pm\sqrt{\left(\frac{-3}{2}\right)\left(\frac{-1}{6}\right)} = \pm\sqrt{\frac{1}{4}} = \pm 0.5$ =-0.5, since both the regression coefficients are negative.
19	**The two regression equations of two random variables X and Y are 4x – 5y +33 = 0 and 20x – 9y =107. Find the mean values of X and Y. (Nov/Dec 2015)** BTL5 Replace x and y as $\bar{x}$ and $\bar{y}$, we have $4\bar{x} - 5\bar{y} = -33$ ------(1) $20\bar{x} - 9\bar{y} = 107$ ------(2) Solving the equations (1) and (2), we have $\bar{x} = 13$ and $\bar{y} = 17$.
20	**Can y=5+2.8x and x=3-0.5y be the estimated regression equations of y on x and x on y respectively, explain your answer. (Nov/Dec 2016)** BTL4 Since the signs of regression co-effieients are not the same, the given equation is not estimated regression equation of y on x and x on y.
21	**If X has an exponential distribution with parameter 1. Find the pdf of $y = \sqrt{x}$.** BTL3 Since $y = \sqrt{x} \Rightarrow x = y^2$ $dx = 2y\,dy \Rightarrow \frac{dx}{dy} = 2y$ Since X has an exponential distribution with parameter 1, the pdf of X is given by, $f_x(x) = e^{-x}, x > 0$ $[f(x) = \lambda e^{-\lambda x}, \lambda = 1]$

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	$\therefore f_y(y) = f_x(x)\left\|\frac{dx}{dy}\right\|$ $= e^{-x}2y = 2ye^{-y^2}\ y>0$
22	**State Central limit theorem.** BTL1 If $X_1, X_2, \ldots, X_n, \ldots$ be a sequence of independent identically distributed random variables with $E(X_i)=\mu$ and $Var(X_i)=\sigma^2$, i=1,2,… and if $S_n = X_1 + X_2 + \ldots + X_n$, then under certain general conditions, S_n follows a normal distribution with mean $n\mu$ and variance $n\sigma^2$ as $n \to \infty$
23	**If X and Y have joint pdf of** $f(x,y)=\begin{cases} x+y, & 0<x,y<1 \\ 0 & ,elsewhere \end{cases}$ **. Check whether X and Y are independent.** BTL4 The marginal function of X is $f(x)=\int_0^1 (x+y)dy=\left[xy+\frac{y^2}{2}\right]_0^1 = x+\frac{1}{2}$, 0<x<1 The marginal function of Y is $f(y)=\int_0^1 (x+y)dx=\left[\frac{x^2}{2}+y\right]_0^1 = y+\frac{1}{2}$, 0<y<1 Now, $f(x).f(y)=\left(x+\frac{1}{2}\right)\left(y+\frac{1}{2}\right)=xy+\frac{1}{2}(x+y)+\frac{1}{4}\neq x+y\neq f(x,y)$ Hence X and Y are not independent.
24	**Assume that the random variables X and Y have the probability density function f(x,y). What is E[E[X/Y]]? (Apr/May 2017)** BTL5 $E[[X/Y]]=\int_{-\infty}^{\infty} E[X/Y]f(y)dy$ $=\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} x\,f(x/y)dx\,f(y)dy$ $=\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} x\,f(x/y)\ f(y)dxdy$ $=\int_{-\infty}^{\infty} x\int_{-\infty}^{\infty} f(x,y)dy\,dy\,dx$ $=\int_{-\infty}^{\infty} x\,f(x)dx = E(X)$
25	**Define the joint density function of two random variables X and Y.** BTL1 If (X,Y) is a two dimensional continuous random variables such that $P\left[x-\frac{dx}{2}\le X\le x+\frac{dx}{2}, y-\frac{dy}{2}\le Y\le y+\frac{dy}{2}\right]=f(x,y)dxdy$, then f(x,y) is called the joint pdf of (X,Y), provided f(x,y) satisfies the following conditions (i) $f(x,y)\ge 0,\ for\ all\ (x,y)\in R$ (ii) $\iint_R f(x,y)dxdy=1$

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	Part*B
1	**The joint pmf of (X,Y) is given by P(x,y) = k(2x + 3y), x = 0,1,2 ; y = 1,2,3. Find all the marginal and conditional probability distributions. Also, find the probability distribution of (X+Y). (10M) (Nov/Dec 2014, Nov/Dec 2015)** BTL5 **Answer: Page. 2.8 – Dr. A. Singaravelu** • $k=\frac{1}{72}$. (1M) • Marginal distribution of X: $P(X=0)=\frac{18}{72}, P(X=1)=\frac{24}{72}, P(X=2)=\frac{30}{72}$ (1M) • Marginal distribution of Y: $P(Y=1)=\frac{15}{72}, P(Y=2)=\frac{24}{72}, P(Y=3)=\frac{33}{72}$ (1M) • Conditional distribution of X given Y: $P[X=x_i/Y=y_1]=\frac{1}{5},\frac{1}{3},\frac{7}{15}$ (1M) • $P[X=x_i/Y=y_2]=\frac{1}{4},\frac{1}{3},\frac{5}{12}$. (1M) • $P[X=x_i/Y=y_3]=\frac{9}{33},\frac{1}{3},\frac{13}{33}$. (1M) • Conditional distribution of Y given X: $P[Y=y_i/X=x_0]=\frac{1}{6},\frac{1}{3},\frac{1}{2}$. (1M) • $P[Y=y_i/X=x_1]=\frac{5}{24},\frac{1}{3},\frac{11}{24}$. (1M) • $P[Y=y_i/X=x_2]=\frac{7}{30},\frac{1}{3},\frac{13}{30}$. (1M) • Total probability distribution of X+Y is 1. (1M)
2	**The two dimensional random variable (X,Y) has the joint pmf** $f(x,y)=\frac{x+2y}{27}, x=0,1,2; y=0,1,2$ **Find the conditional distribution of Y for X=x. (8M) (Nov/Dec 2017)** BTL5 **Answer : Page. 2.13 – Dr. A. Singaravelu** • Marginal distribution of X: $P(X=0)=\frac{6}{27}, P(X=1)=\frac{9}{27}, P(X=2)=\frac{12}{27}$ (1M) • Marginal distribution of Y: $P(Y=0)=\frac{3}{27}, P(Y=1)=\frac{9}{27}, P(Y=2)=\frac{15}{27}$ (1M) • Conditional distribution of Y given X: $P[Y=y_i/X=x_0]=0,\frac{1}{3},\frac{2}{3}$. (2M) • $P[Y=y_i/X=x_1]=\frac{1}{9},\frac{1}{3},\frac{5}{9}$. (2M) • $P[Y=y_i/X=x_2]=\frac{1}{6},\frac{1}{3},\frac{1}{2}$. (2M)
3	**Three balls are drawn at random without replacement from a box containing 2 white, 3 red and 4 black balls. If X denotes the number of white balls drawn and Y denote the number of red balls drawn, find the joint probability distribution of (X,Y). (8M)(Apr/May 2015, May/June 2016)** BTL5 **Answer: Page: 2.20- Dr. G. Balaji** • Let X denote number of white balls drawn and Y denote the number of red balls drawn.

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	• $P(X=0,Y=0)=\frac{1}{21}$, $P(X=0,Y=1)=\frac{3}{14}$, $P(X=0,Y=2)=\frac{1}{7}$, $P(X=0,Y=3)=\frac{1}{84}$ (3M) • $P(X=1,Y=0)=\frac{1}{7}$, $P(X=1,Y=1)=\frac{2}{7}$, $P(X=1,Y=2)=\frac{1}{14}$ (3M) • $P(X=2,Y=0)=\frac{1}{21}$, $P(X=2,Y=1)=\frac{1}{28}$ (2M)
4	**The joint pdf of the random variable (X,Y) is given by** $f(x,y)=Kxye^{-(x^2+y^2)}, x>0, y>0$**. Find the value of 'K' and also prove that X and Y are independent. (8M) (Apr/May 2015)** BTL5 **Answer : Page. 2.25 – Dr.A. Singaravelu** • Marginal density function of X : $f(x)=\int_{-\infty}^{\infty} f(x,y)dy$ • Marginal density function of Y: $f(y)=\int_{-\infty}^{\infty} f(x,y)dx$ • X and Y are independent if f(x,y) = f(x). f(y) • $\int_0^{\infty}\int_0^{\infty} Kxye^{-(x^2+y^2)}dx\,dy=1 \Rightarrow K=4$. (2M) • Marginal density function of X : $f(x)=\int_0^{\infty} Kxye^{-(x^2+y^2)}dy=2xe^{-x^2}$. (2M) • Marginal density function of Y : $f(y)=\int_0^{\infty} Kxye^{-(x^2+y^2)}dx=2ye^{-y^2}$. (2M) • f(x). f(y) = $2xe^{-x^2}.2ye^{-y^2}=4xye^{-(x^2+y^2)}=f(x,y)$. (2M)
5	**Given** $f_{XY}(x,y)=Cx(x-y), 0<x<2, -x<y<x$ **and 0 elsewhere. (a)Evaluate C; (b)Find** $f_x(x)$ **; (c)** $f_{y/x}\left(\frac{y}{x}\right)$ **(d)**Find $f_y(y)$. **(8M) (May, June 2013May/June 2016)**BTL5 **Answer : Page. 2.40 – Dr. A. Singaravelu** • $\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f(x,y)dx\,dy=1$ • Marginal density function of X : $f(x)=\int_{-\infty}^{\infty} f(x,y)dy$ • Marginal density function of Y: $f(y)=\int_{-\infty}^{\infty} f(x,y)dx$ • $\int_0^{2}\int_{-x}^{x} Cx(x-y)dy\,dx=1 \Rightarrow C=\frac{1}{8}$. (1M) • $f_x(x)=\int_{-x}^{x} Cx(x-y)dy=\frac{x^3}{4}, 0<x<2$. (2M)

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	• $f\left(\frac{y}{x}\right)=\frac{f(x,y)}{f(x)}=\frac{x-y}{2x^2}, -x<y<x$. (2M) • $f_y(y)=\begin{cases}\int_{-y}^{2}\frac{1}{8}x(x-y)dx, if\ -2\le y\le 0 = \frac{1}{3}-\frac{y}{4}+\frac{5}{28}y^3 \\ \int_{y}^{2}\frac{1}{8}x(x-y)dx, if\ 0\le y\le 2 = \frac{1}{3}-\frac{y}{4}+\frac{1}{28}y^3\end{cases}$ (3M)
6	**The joint pdf of (X,Y) is given by $f(x,y)=e^{-(x+y)}, 0\le x,y\le\infty$. Are X and Y independent. (8M)(Nov/Dec 2015, Apr/May 2018)** BTL4 **Answer : Page:2.28 – Dr. A. Singaravelu** • Marginal density function of X : $f(x)=\int_{-\infty}^{\infty}f(x,y)dy$ • Marginal density function ofY: $f(y)=\int_{-\infty}^{\infty}f(x,y)dx$ • X and Y are independent if f(x,y) = f(x). f(y) • $f(x)=\int_{0}^{\infty}e^{-(x+y)}dy=e^{-x}$. (3M) • $f(y)=\int_{0}^{\infty}e^{-(x+y)}dx=e^{-y}$. (3M) • $f(x).f(y)=e^{-x}e^{-y}=e^{-(x+y)}=f(x,y)$. (2M)
7	**The joint p.d.f of a two dimensional random variable (X,Y) is given by $f(x,y)=xy^2+\frac{x^2}{8}, 0\le x\le 2, 0\le y\le 1$. Compute (i) $P\left(X>1/Y<\frac{1}{2}\right)$, (ii) $P\left(Y<\frac{1}{2}/X>1\right)$, (iii) P(X<Y), (iv) $P(X+Y\le 1)$ (8M) (Apr/May 2017)** BTL5 **Answer : Page. 2.43 – Dr.A. Singaravelu** • $P\left(X>1/Y<\frac{1}{2}\right)=\frac{P\left(X>1,Y<\frac{1}{2}\right)}{P\left(Y<\frac{1}{2}\right)}=\frac{\frac{5}{24}}{\frac{1}{4}}=\frac{5}{6}$ (2M) • $P\left(Y<\frac{1}{2}/X>1\right)=\frac{P\left(X>1,Y<\frac{1}{2}\right)}{P(X>1)}=\frac{\frac{5}{24}}{\frac{19}{24}}=\frac{5}{19}$ (2M) • $P(X<Y)=\int_{0}^{1}\int_{0}^{y}\left(xy^2+\frac{x^2}{8}\right)dx\,dy=\frac{53}{480}$ (2M) • $P(X+Y\le 1)=\int_{0}^{1}\int_{0}^{1-y}\left(xy^2+\frac{x^2}{8}\right)dx\,dy=\frac{13}{480}$ (2M)
8	**Let X and Y have j.d.f f(x,y) = k , 0<x<y<2, Find the marginal pdf. Find the conditional density functions.(8M) (Nov/Dec 2016, Nov/Dec 2017)** BTL5

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Answer : Page. 2.33 – Dr. A. Singaravelu

- $\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f(x,y)dx\,dy=1$
- Marginal density function of X : $f(x)=\int_{-\infty}^{\infty} f(x,y)dy$
- Marginal density function ofY: $f(y)=\int_{-\infty}^{\infty} f(x,y)dx$
- The conditional density function of X given Y: $f(X/Y)=\frac{f(x,y)}{f(y)}$
- The conditional density function of Y given X: $f(Y/X)=\frac{f(x,y)}{f(x)}$
- $\int_0^2\int_0^y k\,dx\,dy=1\Rightarrow k=\frac{1}{2}.$ (2M)
- $f(x)=\int_x^2 \frac{1}{2}dy=\frac{1}{2}(2-x), 0<x<1$ (2M)
- $f(y)=\int_0^y \frac{1}{2}dx=\frac{y}{2}, 0<y<2$ (2M)
- $f(X/Y)=\frac{1}{y}, 0<x<y$ (1M)
- $f(Y/X)=\frac{1}{2-x}, x<y<2$ (1M)

9 **If the joint distribution function of X and Y is given by** $F(x,y)=(1-e^{-x})(1-e^{-y}), x>0, y>0$**. Find the marginal density function of X and Y. Check if X and Y are independent. Also find P(1<X<3 / 1<Y<2). (8M) (Apr/May 2015, May/June 2016)** BTL5

Answer : Page. 2.50 – Dr. A. Singaravelu

- $f(x,y)=\frac{\partial^2 F(x,y)}{\partial x\partial y}=e^{-(x+y)}$
- $f(x)=\int_0^{\infty} e^{-(x+y)}dy=e^{-x}.$ (2M)
- $f(y)=\int_0^{\infty} e^{-(x+y)}dx=e^{-y}.$ (2M)
- $f(x).f(y)=e^{-x}e^{-y}=e^{-(x+y)}=f(x,y).$ (2M)
- $P(1<X<3,1<Y<2)=\left(\frac{1-e^2}{e^3}\right)\left(\frac{1-e}{e^2}\right).$ (2M)

10 **Find the co-efficient of correlation between X and Y from the data given below.(8M) (May 2016)** BTL5

X	65	66	67	67	68	69	70	72
Y	67	68	65	68	72	72	69	71

Answer : Page: 2.71- Dr. A. Singaravelu

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	• $\bar{X}=\frac{\sum X}{n}=\frac{544}{8}=68$ (1M) • $\bar{Y}=\frac{\sum Y}{n}=\frac{552}{8}=69$ (1M) • $\sigma_x=\sqrt{\frac{1}{n}\sum X^2-\bar{X}^2}=2.121$ (2M) • $\sigma_y=\sqrt{\frac{1}{n}\sum Y^2-Y^2}=2.345$ (2M) • $r(X,Y)=\frac{Cov(X,Y)}{\sigma_x.\sigma_y}=0.6031$ (2M)
11	**Let X and Y be discrete random variables with pdf** $f(x,y)=\frac{x+y}{21}, x=1,2,3; y=1,2$**. Find** $\rho(X,Y)$ **(8M)** BTL5 **Answer : Page. 2.78- Dr. A. Singaravelu** • $E(X)=\sum x\,f(x)=\frac{46}{21}$ (1M) • $E(Y)=\sum y\,f(y)=\frac{33}{21}$ (1M) • $E(X^2)=\sum x^2\,f(x)=\frac{114}{21}$ (1M) • $E(Y^2)=\sum y^2\,f(y)=\frac{57}{21}$ (1M) • $Var\,X=\sigma_x^2=E(X^2)-[E(X)]^2=\frac{278}{441}$ (1M) • $Var\,Y=\sigma_y^2=E(Y^2)-[E(Y)]^2=\frac{108}{441}$ (1M) • $E(XY)=\sum xy\,f(x,y)=\frac{72}{21}$ (1M) • $r(X,Y)=\frac{Cov(X,Y)}{\sigma_x.\sigma_y}=\frac{-6}{173.20}=-0.035$ (1M)
12	**If the joint pdf of (X,Y) is given by** $f(x,y)=x+y, 0\le x,y\le 1$**. Find** ρ_{xy}**. (8 M)** BTL3 **Answer : Page : 2.99 – Dr. A. Singaravelu** • $f(x)=\int_0^1 (x+y)dy=x+\frac{1}{2}, 0<x<1$ (1M) • $f(y)=\int_0^1 (x+y)dx=y+\frac{1}{2}, 0<y<1$ (1M) • $E(X)=\int x\,f(x)dx=\int_0^1 x\left(x+\frac{1}{2}\right)dx=\frac{7}{12}$ (1M) • $E(Y)=\int y\,f(y)dy=\int_0^1 y\left(y+\frac{1}{2}\right)dy=\frac{7}{12}$ (1M)

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	• $E(X^2)=\int x^2 f(x)dx=\frac{5}{12}$, $E(Y^2)=\int y^2 f(y)dy=\frac{5}{12}$ (1M) • $Var\ X=\sigma_x^2=E(X^2)-[E(X)]^2=\frac{11}{144}$, $Var\ Y=\sigma_y^2=E(Y^2)-[E(Y)]^2=\frac{11}{144}$ (1M) • Cov(X,Y) = E(XY) – E(X). E(Y) = $\frac{-1}{144}$ (1M) • $r(X,Y)=\frac{Cov(X,Y)}{\sigma_x.\sigma_y}=\frac{-1}{11}$ (1M)
13	**Two independent random variables X and Y are defined by,** $f(x)=\begin{cases}4ax,0\le x\le 1\\0\quad ,otherwise\end{cases}$ $f(y)=\begin{cases}4by,0\le y\le 1\\0\quad ,otherwise\end{cases}$ **. Show that U=X + Y and V=X – Y are uncorrelated. (8 M)** BTL4 **Answer : Page: 2.105 – Dr. A. Singaravelu** • $\int_0^1 f(x)\,dx=1\Rightarrow a=\frac{1}{2}$; $\int_0^1 f(y)\,dy=1\Rightarrow b=\frac{1}{2}$ (1M) • $E(U)=E(X)+E(Y)=\frac{2}{3}+\frac{2}{3}=\frac{4}{3}$. (2M) • $E(V)=E(X)-E(Y)=\frac{2}{3}-\frac{2}{3}=0$. (2M) • $E(UV)=E(X^2)-E(Y^2)=\frac{1}{2}-\frac{1}{2}=0$. (2M) • Cov(U,V) = E(UV) – E(U).E(V) =0. (1M)
14	**If X and Y are two random variables having joint pdf** $f(x,y)=\frac{1}{8}(6-x-y)$**, 0<x<2, 2<y<4. Find (i)** r_{xy} **(ii)P(X<1 /Y<3) (8 M)** BTL5 **Answer : Page : 2.109 – Dr. A. Singaravelu** • $f(x)=\int_2^4 \frac{1}{8}(6-x-y)dy=\frac{6-2x}{4}$ (1M) • $f(y)=\int_0^2 \frac{1}{8}(6-x-y)dy=\frac{10-2y}{8}$ (1M) • $E(X)=\int x f(x)dx=\frac{5}{6}$ (1M) • $E(Y)=\int y f(y)dy=\frac{17}{6}$ (1M) • $E(X^2)=\int x^2 f(x)dx=1$ (1M) • $E(Y^2)=\int y^2 f(y)dy=\frac{25}{3}$ (1M) • $E(XY)=\int\int x f(x)dx=\frac{7}{3}$ (1M)

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	• $\sigma_x^2 = \frac{11}{36},\ \sigma_y^2 = \frac{11}{36}$ (1M) • $r_{xy} = \frac{Cov(X,Y)}{\sigma_x.\sigma_y} = -\frac{1}{11}$ (1M)
15	**The two lines of regression are *8x – 10y +66 = 0; 40x -18y -214 = 0.* The variance of 'x' is 9. Find th4e mean values of 'x' and 'y'. Also find the correlation coefficient between 'x' and 'y'.(8 M) (Apr/May 2015, May/June 2016)** BTL4 **Answer: Page : 2.129 – Dr.A. Singaravelu** • $\bar{x} = 13$, $\bar{y} = 17$ • From first equation $x = \frac{10}{8}y - \frac{66}{8} \Rightarrow b_{xy} = \frac{10}{8}$. (2M) • From the second equation $y = \frac{40}{18}x - \frac{214}{18} \Rightarrow b_{yx} = \frac{40}{18}$. (1M) • Correlation coefficient $r = 1.66$ which is not less than 1. (1M) • Now, From first equation $y = \frac{8}{10}x + \frac{66}{10} \Rightarrow b_{yx} = \frac{8}{10}$. (1M) • From the second equation $x = \frac{18}{40}y - + \frac{214}{40} \Rightarrow b_{yx} = \frac{18}{40}$. (1M) • Correlation coefficient $r = \pm 0.6$. (2M)
16	**If the pdf of a two dimensional random variable (X,Y) is given by $f(x,y) = x + y, ; 0 \le (x,y) \le 1$. Find the pdf of U=XY. (8 M) (Apr/May 2015, Nov/Dec 2017)** BTL4 **Answer : Page : 2.156 – Dr.A.Singaravelu** • Take $u=xy$ and $v=y$. • $J = \frac{\partial(x,y)}{\partial(u,v)} = \begin{vmatrix} \frac{\partial x}{\partial u} & \frac{\partial x}{\partial v} \\ \frac{\partial y}{\partial u} & \frac{\partial y}{\partial v} \end{vmatrix} = \frac{1}{v}$. (2M) • $f(u,v) = \lvert J \rvert f(x,y) = 1 + \frac{u}{v^2}$. (3M) • $f(u) = \int_u^1 \left(1 + \frac{u}{v^2}\right) dv = 2 - 2u$. (3M)
17	**Let (X,Y) be a two-dimensional non-negative continuous random variable having the joint density $f(x,y) = \begin{cases} 4xye^{-(x^2+y^2)} & , x, y \ge 0 \\ 0 & , elsewhere \end{cases}$. Find the density function of $U = \sqrt{X^2 + Y^2}$. (8 M) (May/June 2016, Apr/May 2018)** BTL5 **Answer : Page : 2.179 – Dr.A. Singaravelu** • Take $u^2 = x^2 + y^2$, $v = x$ • $J = \frac{\partial(x,y)}{\partial(u,v)} = \begin{vmatrix} \frac{\partial x}{\partial u} & \frac{\partial x}{\partial v} \\ \frac{\partial y}{\partial u} & \frac{\partial y}{\partial v} \end{vmatrix} = \frac{u}{\sqrt{u^2 - v^2}}$. (2M) • $f(u,v) = \lvert J \rvert f(x,y) = 4uve^{-u^2}$. (3M)

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	• $f(u)=\int_0^u \left(4uve^{-u^2}\right)dv=2u^3e^{-u^2}$. (3M)
18	**If X and Y are independent random variables with pdf $e^{-x}, x\geq 0$; $e^{-y}, y\geq 0$ respectively. Find the density function of $U=\frac{X}{X+Y}$ and $V=X+Y$. Are X and Y independent? (8 M)** BTL5 **Answer : Page : 2.176- Dr. A. Singaravelu** • Take $U=\frac{X}{X+Y}$ and $V=X+Y$. • $J=\frac{\partial(x,y)}{\partial(u,v)}=\begin{vmatrix}\frac{\partial x}{\partial u} & \frac{\partial x}{\partial v}\\ \frac{\partial y}{\partial u} & \frac{\partial y}{\partial v}\end{vmatrix}=v$. (2M) • $f(u,v)=\lvert J\rvert f(x,y)=ve^{-v}$. (1M) • $f(u)=\int_0^\infty \left(ve^{-v}\right)dv=1$ (2M) • $f(v)=\int_0^\infty \left(ve^{-v}\right)du=ve^{-v}$. (2M) • $f(u).f(v)=1.ve^{-v}=ve^{-v}=f(u,v)$. (1M)
19	**If $X_1, X_2, \ldots, X_n$ are Poisson variables with parameter $\lambda=2$, use the central limit theorem to estimate P(120 < S_n < 160) where $S_n = X_1+ X_2+ \ldots +X_n$ and n=75. (8M)** BTL5 **Answer:Page: 2.187-Dr.A. Singaravelu** • $n\mu=150; n\sigma=\sqrt{150}$. (1M) • $z=\frac{S_n-n\mu}{\sigma\sqrt{n}}$; If $S_n=120, z=\frac{-30}{\sqrt{150}}$. (2M) • If $S_n=160, z=\frac{10}{\sqrt{150}}$. (2M) • $P(120<S_n<160)=P(-2.45\leq S_n\leq 0.85)=P(-2.45\leq S_n\leq 0)+P(0\leq S_n\leq 0.85)=0.7866$. (3M)

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	UNIT III – TESTING OF HYPOTHESIS
	Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.
	PART *A
Q.No.	**Questions**
1.	**Mention the various steps involved in testing of hypothesis. (A.U.A/M 2010)** BTL1 (i) Set up a null hypothesis H0. (ii) Set up the alternative hypothesis H1. (iii) Select the appropriate level of significance (α). (iv) Compute the test statistic under H0 (v) We compare the "calculate value" with "critical value " at given level of significance (α).
2	**Define Chi–Square test for goodness of fit. (A.U.A/M 2010)** BTL1 Chi–Square test of goodness of fit is a test to find if the deviation of the experiment from theory is just by chance or it is due to the inadequacy of the theory to fit the observed data. By this test, we test whether difference between observed and expected frequencies are significant or not. Chi–Square test statistic of goodness of fit is defined by $\psi^2 = \sum \frac{(O-E)^2}{E}$, where O-observed frequency and E-expected frequency.
3	**What are the parameters and statistics in sampling? (A.U.N/D 2010, 2011)** BTL2 Parameters : μ - mean, σ - standard deviation of population Statistics : x - mean, s - standard deviation of sample.
4	**Write two applications of ψ^2 test. (A.U.N/D 2010, M/J 2012)** BTL3 (i) To test the goodness of fit (ii) To test the independent of attributes (iii) To test the homogeneous of independent estimations.
5	**What are the applications of *t*-distributions? (A.U.A/M 2011)** BTL3 (i) To test the significance of a single mean. (ii) To test the significance of the difference between two sample means. (iii) To test the significance of the coefficient of correlation.
6	**Define Type I and Type II errors in taking a decision.(A.U.A/M 2011,M/J 2012, M/J 2014)** BTL1 Type I error : Reject H_0 when it is true. Type II error : Accept H_0 when it is wrong.
7	**Define Null and Alternate Hypothesis. (A.U. M/J 2012)** BTL1 For applying the test of significance, we first set up of a hypothesis a definite statement about the population parameter. Such a hypothesis is usually a hypothesis of no difference and it is denoted by H0. Any hypothesis which is complementary to the null hypothesis **(H_0)** is called an alternative hypothesis, denoted by H_1.
8	**Define Level of significance. (A.U M/J 2011,A.U.N/D 2013)** BTL1 The probability that the value of the statistic lies in the critical region is called the level of significance. In general, these levels are chosen as 0.01 and 0.05, called 1% level and 5% level of significance

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	respectively.
9	**State the conditions for applying ψ^2 –test . (A.U.M/J 2014)** BTL1 (i) The sample observations should be independent. (ii) Constraints on the cell frequencies, if any, must be linear. (iii) N, the total frequency should be at least 50. (iv) No. of theoretical cell frequency should be less than 50.
10	**Give the formula for the ψ2 –test of independence for** $\begin{vmatrix} a & b \\ c & d \end{vmatrix}$ **(A.U.N/D 2012,N/D2014)** BTL3 Formula is $\frac{(a+b+c+d)(ad-bc)^2}{(a+c)(b+d)(a+b)(c+d)}$
11	**Define Error. (A.U.N/D 2009)** BTL1 In sampling theory to draw valid inferences about the population parameter on the basis of the sample results we decide to accept or to reject the H0 after examining a sample from it. Type I error : Reject H_0 when it is true. Type II error : Accept H_0 when it is wrong.
12	**The heights of college students in Chennai are normally distributed with S.D 6cm and sample of 100 students had their mean height 158cm. Test the hypothesis that the mean height of college students in Chennai is 160cm at 1% level of significance. (A.U.N/D 2011)** BTL5 $H_0 : \mu = 160;\ H_1 : \mu \neq 160$ $Z = \frac{X-\mu}{\frac{s}{\sqrt{n-1}}} = \frac{158-160}{\frac{6}{\sqrt{100}}} = -3.33 > 2.58$ H_0 is rejected.
	Part*B
1	**A sample of 900 members has a mean 3.4cm and standard deviation 2.61cm. Is the sample from a large population of mean 3.25cms and standard deviation of 2.61cms? (8M) (A.U.A/M 2010)** BTL2 **Answer: Page : 3.17 – Dr.A. Singaravelu** $H_0 : \mu = 3.25;\ H_1 : \mu \neq 3.25$ (2M) $Z = \frac{X-\mu}{\frac{s}{\sqrt{n-1}}} = \frac{3.4-3.25}{\frac{2.61}{\sqrt{900}}} = 1.724 > 1.96$ (4M) Accept H_0. (2M)
2	**The means of 2 large samples 1000 and 2000 members are 67.5 inches and 68.0 inches respectively. Can the samples the regarded as drawn from the same population of SD 2.5inches. (8M)** BTL4 **Answer: Page : 3.19 – Dr.A. Singaravelu** $H_0 : \mu_0 = \mu_1;\ H_1 : \mu_0 \neq \mu_1$ (2M)

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$$Z = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}} = \frac{67.5 - 68}{\sqrt{(2.5)^2\left(\frac{1}{1000} + \frac{1}{2000}\right)}} = -5.16 > 1.96 \quad (4M)$$

H_0 is rejected at 5% level of significance**.** (2M)

3 **A machinist is making engine parts with axle diameters of 0.7 inch. A random sample of 10 parts shows a mean diameter if 0.742 inch with a S.D. of 0.040 inch. Compute the statistic you would used to test whether the work is meeting the specification. (8M)** BTL3

Answer: Page : 3.25 – Dr.A. Singaravelu

$H_0 : \mu_0 = \mu_1;\ H_1 : \mu_0 \neq \mu_1$ (2M)

$$t = \frac{X - \mu}{\frac{s}{\sqrt{n-1}}} = \frac{0.742 - 0.7}{\frac{0.040}{\sqrt{9}}} = 3.15 > 2.26 \quad (4M)$$

H_0 is rejected at 5% level of significance**.** (2M)

4 **The average number of articles to be produced by 2 machine per day are 200 and 250 with S.D of 20 and 25 respectively on the basis of record, of 25 days production can you regard the machines equally efficient at 1% level of significance. (8M)** BTL4

Answer: Page : 3.38 – Dr.A. Singaravelu

$H_0 : \mu_0 = \mu_1;\ H_1 : \mu_0 \neq \mu_1$ (2M)

$$t = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{S^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} = 7.65 > 2.58 \quad (4M)$$

H_0 is rejected at 1% level of significance**.** (2M)

5 **The following data gives the number of aircraft accidents that occurred during the various days of a week Find whether the accidents are uniformly distributed over the week. (8M)** BTL3

Day :	**SUN**	**MON**	**TUE**	**WED**	**THUR**	**FRI**	**SAT**
No. of accidents:	**14**	**16**	**8**	**12**	**11**	**9**	**14**

Answer: Page : 3.61 – Dr.A. Singaravelu

H_0**:** The accidents are uniformly distributed over the week. (2M)

Observed Frequency	Expected Frequency	$(O-E)^2$	$\frac{(O-E)^2}{E}$
14	14	0	0
18	14	16	1.143
12	14	4	0.286
11	14	9	0.643
15	14	1	0.071
14	14	0	0
			2.143

$$\psi^2 = \sum \frac{(O-E)^2}{E} = 2.143 < 11.07 \quad (4M)$$

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Accept H_0, the accidents are uniformly distributed over the week. (2M)

6 **Theory predicts that the proportion of beans in four groups A, B, C, D should be 9:3:3:1. In an experiment among 1600 beans, the numbers in the four groups were 882, 313, 287 and 118. Does the experiment support the theory? (A.U.M/J 2012) (8M)** BTL5

Answer: Page : 3.62 – Dr.A. Singaravelu

H_0**:** The experimental result support the theory. (2M)

Observed Frequency	Expected Frequency	$(O-E)^2$	$\frac{(O-E)^2}{E}$
882	900	324	0.360
313	300	169	0.563
287	300	169	0.563
118	100	324	3.240
			4.726

$$\psi^2 = \sum \frac{(O-E)^2}{E} = 4.726 < 7.81 \quad (4M)$$

Accept H_0, the experimental results supports the theory. (2M)

7 **A soap manufacturing company was distributing a particular brand of soap through a large no of retail shops. Before a heavy advertisement campaign, the mean sales per week per shop were 146.3 dozens. After the campaign, a sample of 22 shops was taken and the mean sales was found to be 153.7 dozens with SD =17.2. Can you consider the advertisement effective? (8M)** BTL6

Answer: Page : 3.25 – Dr.A. Singaravelu

$H_0 : \mu_0 = \mu_1;\ H_1 : \mu_0 > \mu_1\ (One\ Tail)$ (2M)

$$t = \frac{X-\mu}{\frac{s}{\sqrt{n-1}}} = \frac{153.7-146.3}{\frac{17.2}{\sqrt{21}}} = 1.97 > 1.72 \quad (4M)$$

H_0 is rejected at 5% level of significance**.** (2M)

8 **The following table gives the classification of 100 workers according to sex and nature of work. Test whether the nature of work is independent of the sex of the worker. (8M)** BTL4

	Stable	**Unstable**	**Total**
Males	**40**	**20**	**60**
Females	**10**	**30**	**40**
	50	**50**	**100**

Answer: Page : 3.65 – Dr.A. Singaravelu

H_0 : the nature of work is independent of the sex of the workers. (2M)

Observed Frequency	Expected Frequency	$(O-E)^2$	$\frac{(O-E)^2}{E}$
40	30	100	3.33
20	30	100	3.33
10	20	100	5
30	20	100	5

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			16.66

$$\psi^2 = \sum \frac{(O-E)^2}{E} = 16.66 < 3.84 \quad (4M)$$

Accept H_0, there is difference in the nature of work on the basis of sex. (2M)

9 **Given the following contingency table for hair colour and eye colour. Find the value of ψ^2. Is there good association between the two.** **(8M)** BTL5

		Hair Colour			Total
		Fair	Brown	Black	
Eye Colour	Blue	15	5	20	40
	Grey	20	10	20	50
	Brown	25	15	20	60
	Total	60	30	60	150

Answer: Page : 3.69 – Dr.A. Singaravelu

H_0 : The two attributes Hair colour and Eye colour are independent (2M)

Observed Frequency	Expected Frequency	$(O-E)^2$	$\frac{(O-E)^2}{E}$
15	16	1	0.0625
5	8	9	1.125
20	16	16	1
20	20	0	0
10	10	0	0
20	20	0	0
25	24	1	0.042
15	12	9	0.75
20	24	16	0.66

$$\psi^2 = \sum \frac{(O-E)^2}{E} = 3.6458 < 9.488 \quad (4M)$$

Accept H_0, The hair colour and eye colour are independent. (2M)

10 **Test whether there is any significant difference between the variance of the population from which the following samples are taken: (A.U.N/D 2012)** **(8M)** BTL3

Samples I :	**20**	**16**	**26**	**27**	**23**	**22**	
Samples II:	**27**	**33**	**42**	**35**	**32**	**34**	**38**

Answer: Page : 3.53 – Dr.A. Singaravelu

$\overline{x_1} = 22.3 \quad \overline{x_2} = 34.4$

$s_1^2 = 16.268 \quad s_2^2 = 22.29$ (2M)

H_0: There is no significant difference between the variances. (1M)

$F = \frac{S_2^2}{S_1^2} = 1.37 < 4.95$ (4M) Accept H_0. (1M)

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	UNIT IV DESIGN OF EXPERIMENTS
	One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 22 factorial design.
	PART *A
Q.No.	**Questions**
1.	**Discuss the advantages and disadvantages of Randomized block design. (A.U.A/M 2010)** BTL2 **Advantage:** (i) Analysis is possible, even if some observations are missing. (ii) The analysis of the design is sample as it result in a two-way classification analysis of variance. **Disadvantage:** (i) If the interactions are large, the experiment may yield misleading results. (ii) The shape of the experimental material should be rectangular.
2	**State the advantages of a factorial Experiment over a simple experiment. (A.U.A/M 2010, 2014)** BTL2 Factorial experiment is the procedure of varying all factors simultaneously. A major conceptual advancement in experimental design is exemplified by factorial design. In factorial designs, an assessment of each individual factor effect is based on the whole set of measurements so that a more efficient utilization of experimental resources is achieved in these designs.
3	**Compare one-way classification model with two-way classification model. (A.U.N/D 2010, 2011)** BTL2 **One way Classification** — **Two way classification** One factor is involved — Two factors involved One set of hypothesis — Two set of hypothesis
4	**What is meant by Latin square? (A.U.N/D 2010)** BTL3 The Latin Square model assumes that interactions between treatments and row and column groupings non-existent. Since each treatment occurs only once in each row or column, if interactions are present, it is possible for them to cause an apparently significant difference between treatment.
5	**What are the applications of *t*-distributions? (A.U.A/M 2011)** BTL2 (i) To test the significance of a single mean. (ii) To test the significance of the difference between two sample means. (iii) To test the significance of the coefficient of correlation.
6	**State the assumptions involved in ANOVA. (A.U.M/J 2012)** BTL1 (i). Normality (ii). Homogeneity (iii). Independence of error.
7	**What are the advantages of a Latin square design? (A.U.M/J 2012)** BTL2 (i) The analysis is simple, it is only slightly more complicated than that for the randomized complete block design. (ii) The analysis remains relatively simple even with missing data. Analytical procedures are available for omitting one or more treatment, rows or columns.
8	**State the basic principles of design of Experiments. (A.U.N/D 2012), (A.U.M/J 2014)** BTL2 The basic principles of the design of experiments are (i) Replication (ii) Randomization (iii) Local control.

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9 **Define :RBD** BTL1

Let us consider an agricultural experiment using which we wish to test the effect of „k‟ fertilising treatment on the yield of crops. We assume that we know some information about the soil fertility of the plots. Then we divide the plots into „h‟ blocks, according to the soil fertility each block containing „k‟ blocks.

Thus the plots in each block will be of homogeneous fertility as far as possible within each block, the „k‟ treatments are given to the „k‟ plots in a perfectly random manner, such that each treatment occurs only once in any block. But the same k treatment are from block to block. This design is called **Randomized Block Design.**

10 **What do you understand by "Design of Experiments"? (A.U.A/M 2013)** BTL2

The design of experiment may be defined as the logical construction of the experiment in which the degree of uncertainty with which the inference is drawn may be well defined.

11 **Define types of Error. (A.U.N/D 2009)** BTL1

In sampling theory to draw valid inferences about the population parameter on the basis of the sample results we decide to accept or to reject the H0 after examining a sample from it.

Type I error : Reject H_0 when it is true.

Type II error : Accept H_0 when it is wrong.

12 **Write down the ANOVA table for one way classification. (A.U.A/M 2013)** BTL4

Analysis of Variance:

Source of Variation	SS(Sum of Squares)	Degree of Freedom	Mean Square	Variance Ratio of F
Between Sample	SSC	$V_1 = c - 1$	$MSC = \frac{SSC}{(c-1)}$	$F_C = \frac{MSC}{MSE}$
Within Sample	SSE	$V_2 = n - c$	$MSE = \frac{SSE}{(n-c)}$	
Total	TSS	n- 1		

13 **Define 2^2 factorial design. (A.U.N/D 2013)** BTL1

A complete replicate of such a design requires $2 \times 2 \times \ldots\ldots\ldots \times 2 = 2^k$ observations is called a 2^k factorial design 2^2 is the simplest design 2^k.

i.e., Two factors A and B each at two level that it may be low and high levels of the factor.

14 **State any two advantages of a CRD . (A.U.M/J 2014)** BTL2

(i) It has a simple lay out.

(ii) There is complete flexibility as the number of replication is not fixed.

(iii) Analysis can be performed, if some observation are missing.

Part*B

1 **Three different machines are used for a production. On the basis of the outputs, set up one-way ANOVA table and test whether the machines are equally effective.**

Outputs		
Machine I	**Machine II**	**Machine III**
10	**9**	**20**
15	**7**	**16**

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11	**5**	**10**
10	**6**	**14**

Given that the value of F at 5% level of significance for (2, 9) is 4.26. (16M) BTL3

Answer: Page : 4.10 – Dr.A. Singaravelu

H_0: The machines are equally effective

1. H_0 2. H_1 3. Find the correction factor $\frac{T^2}{N}$ =1704.08 (2M)

4. $TSS = \sum X_1^2 + \sum X_2^2 + \cdots - \frac{T^2}{N}$ =284.92 (2M)

5. $SSC = \frac{(\sum X_1)^2}{N_1} + \frac{(\sum X_2)^2}{N_2} + \frac{(\sum X_3)^2}{N_3} \cdots - \frac{T^2}{N}$ =162.17 (2M)

6. $SSE = TSS - SSC$ =122.75 (2M)

7. Prepare the ANOVA table to calculate F-ratio, it should be calculated in such a way that $F_C > 1$.
8. Conclusion (6M)

Source of variation	Sum of squares	d.f.	Mean square	Variance ratio	Table value at α % level
Between columns	SSC=162.17	$C-1$ =2	$MSC = \frac{SSC}{C-1}$ =81.085	$F_C = \frac{MSC}{MSE}$ =5.95	4.26
Error	SSE=122.75	$N-C$ =9	$MSE = \frac{SSE}{N-C}$ =13.63		

Reject the hull hypothesis H_0. That is the three machines are not equally effective. (2M)

2

The following data represent the number of units of production per day turned out by 5 different workers using 4 different types of machines : (A.U.N/D 2011) (A.U.A/M 2013) (16M) BTL4

		Machine type			
		A	**B**	**C**	**D**
Workers	**1**	**44**	**38**	**47**	**36**
	2	**46**	**40**	**52**	**43**
	3	**34**	**36**	**44**	**32**
	4	**43**	**38**	**46**	**33**
	5	**38**	**42**	**49**	**39**

(a) Test whether the mean production is the some for the different machine type.

(b) Test whether the 5 mean differ with mean productivity.

Answer: Page : 4.30 – Dr.A. Singaravelu

Code the data by subtracting 40 from each value.

1. H_0 2. H_1 3. $C.F. = \frac{T^2}{N}$ =20 4. $TSS = \sum X_1^2 + \sum X_2^2 + \cdots - \frac{T^2}{N}$ =574

5. $SSC = \frac{(\sum X_1)^2}{N_1} + \frac{(\sum X_2)^2}{N_2} + \frac{(\sum X_3)^2}{N_3} \cdots - \frac{T^2}{N}$ =338.8

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6. $SSR = \frac{(\sum Y_1)^2}{N_1'} + \frac{(\sum Y_2)^2}{N_2'} + \frac{(\sum Y_3)^2}{N_3'} \cdots - \frac{T^2}{N}$ =161.5

7. $SSE = TSS - SSC - SSR$ =73.7 8. Prepare ANOVA table for two way classification:

Source of variation	Sum of squares	d.f.	Mean square	Variance ratio	Table value at α % level
Between columns	SSC =338.8	$C-1$ =3	$MSC = \frac{SSC}{C-1}$ =112.93	$F_C = \frac{MSC}{MSE}$ =18.38	3.49
Between rows	SSR =161.5	$R-1$ =4	$MSR = \frac{SSR}{R-1}$ =40.37	$F_R = \frac{MSR}{MSE}$ =6.574	3.26
Error	SSE =73.7	$(C-1).(R-1)$ =12	$MSE = \frac{SSE}{(R-1)(C-1)}$ =6.142		

9. Conclusion

The workers differ with respect to mean productivity.

3

A variable trial was conducted on wheat with 4 varieties in a Latin square design. The plan of the experiment and the per plot yield are given below. (16M) (A.U.N/D 2011) BTL4

C25 B23 A20 D20
A19 D19 C21 B18
B19 A14 D17 C20
D17 C20 B21 A15

Answer: Page : 4.46 – Dr.A. Singaravelu

Code the data by subtracting 20 from each value.

1. H_0 2. H_1 3. $C.F. = \frac{T^2}{N}$ =9 (2M)4. $TSS = \sum X_1^2 + \sum X_2^2 + \cdots - \frac{T^2}{N}$ =113 (2M)

5. $SSC = \frac{(\sum X_1)^2}{N_1} + \frac{(\sum X_2)^2}{N_1} + \frac{(\sum X_3)^2}{N_1} \cdots - \frac{T^2}{N}$ =7.5 (2M)

6. $SSR = \frac{(\sum Y_1)^2}{N_1} + \frac{(\sum Y_2)^2}{N_1} + \frac{(\sum Y_3)^2}{N_1} \cdots - \frac{T^2}{N}$ =46.5 (2M)

7. $SSK = \frac{(\sum Z_1)^2}{N_1} + \frac{(\sum Z_2)^2}{N_1} + \frac{(\sum Z_3)^2}{N_1} \cdots - \frac{T^2}{N}$ =48.5 (2M)

8. $SSE = TSS - SSC - SSR - SSK$ =10.5 9. ANOVA table: (4M)

Source of variation	**Sum of squares**	**d.f.**	**Mean square**	**Variance ratio**	**Table value at 5% level**

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Between columns	SSC =7.5	3	$MSC=\frac{SSC}{K-1}$ =2.5	$F_C=\frac{MSC}{MSE}$ =1.429	4.76
Between rows	SSR =46.5	3	$MSR=\frac{SSR}{K-1}$ =15.5	$F_R=\frac{MSR}{MSE}$ =8.85	4.76
Between treatment	SSK =48.5	3	$MSK=\frac{SSK}{K-1}$ =16.17	$F_K=\frac{MSK}{MSE}$ =9.24	4.76
Error	SSE =10.5	6	MSE=1.75		

10. Conclusion (2M)

Row-varieties and treatments-varieties are rejected and Column-yields is accepted.

4 **A farmer wishes to test the effect of 4 fertilizers A,B,C,D on the yield of wheat. The fertilizers are used in a LSD and the result are tabulated here. Perform an analysis of variance. (A.U.N/D 2012) (16M)** BTL5

A18 C21 D25 B11
D22 B12 A15 C19
B15 A20 C23 D24
C22 D21 B10 A14

Answer: Page : 4.60 – Dr.A. Singaravelu

Code the data by subtracting 20 from each value.

1. H_0 2. H_1 3. $C.F.=\frac{T^2}{N}$ =14.06 (2M) 4. $TSS=\sum X_1^2+\sum X_2^2+\cdots-\frac{T^2}{N}$ =354.94 (2M)

5. $SSC=\frac{(\sum X_1)^2}{N_1}+\frac{(\sum X_2)^2}{N_1}+\frac{(\sum X_3)^2}{N_1}\cdots-\frac{T^2}{N}$ =19.69 (2M)

6. $SSR=\frac{(\sum Y_1)^2}{N_1}+\frac{(\sum Y_2)^2}{N_1}+\frac{(\sum Y_3)^2}{N_1}\cdots-\frac{T^2}{N}$ =19.19 (2M)

7. $SSK=\frac{(\sum Z_1)^2}{N_1}+\frac{(\sum Z_2)^2}{N_1}+\frac{(\sum Z_3)^2}{N_1}\cdots-\frac{T^2}{N}$ =288.19 (2M)

8. $SSE=TSS-SSC-SSR-SSK$ =27.87 (2M)

9. ANOVA table: (4M)

Source of variation	**Sum of squares**	**d.f.**	**Mean square**	**Variance ratio**	**Table value at 5% level**
Between columns	SSC =19.69	3	$MSC=\frac{SSC}{K-1}$ =6.397	$F_C=\frac{MSC}{MSE}$ =1.413	4.76
Between rows	SSR =19.19	3	$MSR=\frac{SSR}{K-1}$ =6.563	$F_R=\frac{MSR}{MSE}$ =1.377	4.76
Between treatment	SSK =288.19	3	$MSK=\frac{SSK}{K-1}$ =96.06	$F_K=\frac{MSK}{MSE}$ =20.68	4.76

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Error	*SSE* =27.87	6	MSE=4.645		

11. Conclusion (2M)

Row and column-varieties are accepted treatment-yields is rejected.

5 **Find out the main effects and interaction in the following 2^2 - factorial experiment and write down the analysis of variance table. (16M)** BTL4

Block	**Treatments**			
I	**l**	**kp**	**k**	**p**
	64	**6**	**25**	**30**
II	**k**	**l**	**kp**	**p**
	14	**75**	**33**	**50**
III	**kp**	**p**	**k**	**l**
	17	**41**	**12**	**76**
IV	**p**	**k**	**l**	**kp**
	25	**33**	**75**	**10**

Answer: Page : 4.69 – Dr.A. Singaravelu

Code the data by subtracting 37 from each value.

1. H_0 2. H_1 3. $C.F. = \frac{T^2}{N}$ =2.25 (2M) 4. $TSS = \sum X_1^2 + \sum X_2^2 + \cdots - \frac{T^2}{N}$ =8933.75 (2M)

5. $SSC = \frac{(\sum X_1)^2}{N_1} + \frac{(\sum X_2)^2}{N_1} + \frac{(\sum X_3)^2}{N_1} \cdots - \frac{T^2}{N}$ =281.25 (2M)

6. $SSR = \frac{(\sum Y_1)^2}{N_1} + \frac{(\sum Y_2)^2}{N_1} + \frac{(\sum Y_3)^2}{N_1} \cdots - \frac{T^2}{N}$ =7744.75 (2M)

7. $SSE = TSS - SSC - SSR$ =907.75 (2M)

8. [K]=[KP]-[P]+[K]-[L]=-286 [P]=-162 [KP]=126 $S_K = 5112.25$; $S_P = 1640.25$; $S_{KP} = 992.25$

9. ANOVA table: (6M)

Source of variation	**Sum of squares**	**d.f.**	**Mean square**	**Variance ratio**	**Table value at 5% level**
K	5112.25	1	5112.25	=50.69	6.99
P	1640.25	1	1640.25	=16.26	6.99
KP	992.25	1	992.25	=9.84	6.99
Residual	907.75	9	MSE=100.86		

6 **Analyse the variance in the Latin square of yields(in kgs) of paddy where P,Q,R,S denote the different methods of cultivation.**

S122 P121 R123 Q122
Q124 R123 P122 S125

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P120 Q119 S120 R121
R122 S123 Q121 P121

Examine whether different method of cultivation have significantly different yields.(16M)(A.UA/M 2014)BTL3

Answer: Page : 4.55 – Dr.A. Singaravelu

Code the data by subtracting 120 from each value.

1. H_0 2. H_1 3. $C.F.=\frac{T^2}{N}$ =56.25 (2M) 4. $TSS=\sum X_1^2+\sum X_2^2+\cdots-\frac{T^2}{N}$ =35.75 (2M)

5. $SSC=\frac{(\sum X_1)^2}{N_1}+\frac{(\sum X_2)^2}{N_1}+\frac{(\sum X_3)^2}{N_1}\cdots-\frac{T^2}{N}$ =2.75 (2M)

6. $SSR=\frac{(\sum Y_1)^2}{N_1}+\frac{(\sum Y_2)^2}{N_1}+\frac{(\sum Y_3)^2}{N_1}\cdots-\frac{T^2}{N}$ =24.75 (2M)

7. $SSK=\frac{(\sum Z_1)^2}{N_1}+\frac{(\sum Z_2)^2}{N_1}+\frac{(\sum Z_3)^2}{N_1}\cdots-\frac{T^2}{N}$ =4.25 (2M)

8. $SSE=TSS-SSC-SSR-SSK$ =4 (2M)

9. ANOVA table: (2M)

Source of variation	**Sum of squares**	**d.f.**	**Mean square**	**Variance ratio**	**Table value at 5% level**
Between columns	SSC =2.75	3	$MSC=\frac{SSC}{K-1}$ =8.25	$F_C=\frac{MSC}{MSE}$ =1.369	4.76
Between rows	SSR =24.75	3	$MSR=\frac{SSR}{K-1}$ =0.917	$F_R=\frac{MSR}{MSE}$ =1.231	4.76
Between treatment	SSK =4.25	3	$MSK=\frac{SSK}{K-1}$ =1.42	$F_K=\frac{MSK}{MSE}$ =2.119	4.76
Error	SSE =4	6	MSE=0.67		

12. Conclusion: Row, column and Treatment-varieties are accepted. (2M)

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	UNIT V STATISTICAL QUALITY CONTROL
	Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.
	PART *A
Q.No.	**Questions**
1.	**What is the purpose of using control chart?** BTL4 A control chart is essentially a diagrammatic presentation of data designed to reveal the frequency and extent of variations from established specifications or standards or goals. It is a very simple useful graphic device easy to construct and interpret, used to find out at a glance whether or not the process is in control.
2	**Distinguish between variables and attributes in connection with the quality characteristics of a product. (Ap. AU.2015)** BTL4 Variables: The quality characteristics of a product that are measurable are called variables. Attributes: The quality characteristics that are not amenable to measurement are called attributes.
3	**Define Process control.** BTL1 Statistical quality control may be applied to any repetitive process and control charts constructed by using statistical techniques help us to find out whether the manufacturing process, for example, is under control or it has a tendency to go out of control soon.
4	**What are the distinct cases in quality control?** BTL2 1. Process control 2. Product control or Lot control or sampling inspection
5	**State the advantages of statistical quality control?** BTL3 1. Cost reduction 2. More efficiency 3. Early detection of faults in quality 4. Effect of change in process can be studied
6	**Define: Producer's risk and consumer's risk.** BTL1 Producer's risk is that risk a producer takes in a situation where a lot is rejected by a sampling plan when infact it confirms to the quality standards. This is called Type I error. The consumer's risk is that risk a consumer takes in a situation where a lot is accepted when it is infact of bad quality. This is called Type II error.
7	**How will you calculate UCL and LCL for $\overline{X}$ -chart?** BTL4 $UCL = \overline{\overline{X}} + 3\sigma_{\overline{X}} = \overline{\overline{X}} + A_2\overline{R}$ $LCL = \overline{\overline{X}} - 3\sigma_{\overline{X}} = \overline{\overline{X}} - A_2\overline{R}$
8	**How will you calculate UCL and LCL for R-chart?** BTL4 $UCL = \overline{R} + 3\sigma_R = D_4\overline{R}$ $LCL = \overline{R} - 3\sigma_R = D_3\overline{R}$
9	**Define Control chart.** BTL1 A control chart is essentially a diagrammatic presentation of data designed to reveal the frequency and

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	extent of variations from established specifications of standards or goals. It is a very simple useful graphic device easy to construct and interpret, used to find out at a glance whether or not the process is in control.
10	**Define Statistical Quality control.** BTL1 When the variability present in a production process is due to chance variations alone the process is said to be in a state of statistical quality control.
11	**How will you calculate UCL and LCL for R-chart?** BTL3 $UCL = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$ $LCL = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$
	Part*B
1	**Samples of 4 items each are taken from a company's manufacturing process at regular intervals and their diameters are measured. After 25 samples it was noted that $\bar{X}$ =1.561 and $\sum R = 41.1$. Construct $\bar{X}$ and R chart for the diameters of the items produced. (16M)** BTL4 **Answer: Page : 5.4 – Dr.A. Singaravelu** (i) $\bar{X}$ **Chart:** $\bar{X}$ =1.561 central line $\bar{R}$ =1.644 (2M) $UCL = \bar{X} + 3\sigma_{\bar{X}} = \bar{X} + A_2\bar{R} = 1.813$ $LCL = \bar{X} - 3\sigma_{\bar{X}} = \bar{X} - A_2\bar{R} = 1.309$ (4M) Diagram for $\bar{X}$ chart (2M) **(ii) R-chart:** $\bar{R}$ =1.644 (2M) $UCL = \bar{R} + 3\sigma_R = D_4\bar{R} = 2.533$ $LCL = \bar{R} - 3\sigma_R = D_3\bar{R} = 0.756$ (4M) Diagram for R-chart . (2M)
2	**Construct $\bar{X}$ chart and R chart for the following data:** **(Given that sample is 5) (16M)** BTL4 **Answer: Page : 5.6 – Dr.A. Singaravelu** (iii) $\bar{X}$ **Chart:** $\bar{X} = \frac{\sum X}{n} = 14.9$ central line (2M) $\bar{R} = \frac{\sum R}{n} = 2$ $UCL = \bar{X} + 3\sigma_{\bar{X}} = \bar{X} + A_2\bar{R} = 16.054$ $LCL = \bar{X} - 3\sigma_{\bar{X}} = \bar{X} - A_2\bar{R} = 13.746$ (4M)

Sample No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
$\bar{X}$	**14**	**1**	**14**	**13**	**12**	**10**	**16**	**17**	**18**	**20**
R	**3**	**1**	**2**	**1**	**1**	**1**	**2**	**2**	**3**	**4**

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Diagram for $\overline{X}$ chart (2M)

(iv) R-chart:

$\overline{R}$ =2 (2M)

$UCL = \overline{R} + 3\sigma_R = D_4\overline{R} = 4.228$

$LCL = \overline{R} - 3\sigma_R = D_3\overline{R} = 0$ (4M)

Diagram for R-chart (2M)

Regarding that the process is not out of control regarding process variability but the process is not in control regarding the process mean.

3 **20 samples of each containing 100 items were takes at regular intervals of time. Construct a p-chart for the following observed data of those samples.**

Sample No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Number of defectives	**2**	**2**	**3**	**6**	**1**	**3**	**6**	**4**	**7**	**2**
Sample No.	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Number of defectives	**5**	**0**	**3**	**2**	**4**	**5**	**3**	**8**	**1**	**4**

State whether the process is under control or not. (16M) BTL5

Answer: Page : 5.10 – Dr.A. Singaravelu

$\overline{p} = \frac{0.71}{20\times100} = 0.0355$ (6M)

$UCL = \overline{p} + 3\sqrt{\frac{\overline{p}(1-\overline{p})}{n}} = 0.09$

$LCL = \overline{p} - 3\sqrt{\frac{\overline{p}(1-\overline{p})}{n}} = -0.019(-ve) = 0$ (4M)

Chart for $\overline{p}$ (4M)

Conclusion: The process is under control. (2M)

4 **The following table gives the data on completed spark-plugs for 10 samples each of 100 plugs.**

Sample No	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
No. of defectives	**5**	**12**	**6**	**6**	**3**	**4**	**8**	**3**	**5**	**6**

Construct a suitable control chart and comment on your result. (16M) BTL4

Answer: Page : 5.12 – Dr.A. Singaravelu

Since the sample size does not vary and this is a problem involving defectives np chart is suitable.

$\overline{p} = average\ no.\ of\ \ defectives\ = \frac{58}{10\times100} = 0.058$ (4M)

$n\overline{p} = 6$ (2M)

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$UCL = n\bar{p} + 3\sqrt{n\bar{p}(1-\bar{p})} = 12.9 = 13(nearly)$

$LCL = n\bar{p} - 3\sqrt{n\bar{p}(1-\bar{p})} = -5.09(-ve) = 0$ (4M)

Chart for $\bar{p}$ (6M)

Conclusion: the process in under control. (2M)

5 **Ten units were inspected for non-confirming welds with the total number of defects as 360. Construct a C-chart for the number of non-conforming welds. (16M)** BTL4

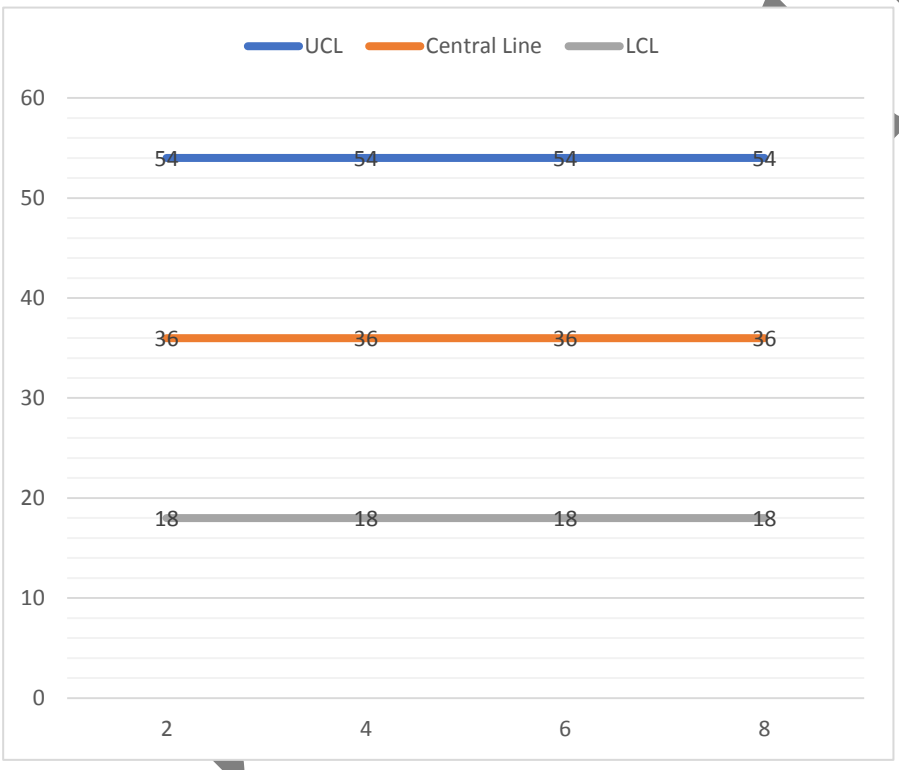
Answer: Page : 5.14 – Dr.A. Singaravelu

$\bar{C} = \frac{360}{10} = 36$ *central line* (4M)

$UCL = \bar{C} + 3\sqrt{\bar{C}} = 36 + 3\sqrt{36} = 54$

$LCL = \bar{C} - 3\sqrt{\bar{C}} = 36 - 3\sqrt{36} = 18$ (6M)

Chart for $\bar{C}$:



(4M)

Conclusion: the process under control (2M)

CS8491 COMPUTER ARCHITECTURE L T P C 3 0 0 3

OBJECTIVES:

• To learn the basic structure and operations of a computer.

• To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit.

• To learn the basics of pipelined execution

. • To understand parallelism and multi-core processors.

• To understand the memory hierarchies, cache memories and virtual memories.

• To learn the different ways of communication with I/O devices.

UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM 9

Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations – decision making – MIPS Addressing.

UNIT II ARITHMETIC FOR COMPUTERS 9

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations – Subword Parallelism

UNIT III PROCESSOR AND CONTROL UNIT 9

A Basic MIPS implementation – Building a Datapath – Control Implementation Scheme – Pipelining – Pipelined datapath and control – Handling Data Hazards & Control Hazards – Exceptions.

UNIT IV PARALLELISIM 9

Parallel processing challenges – Flynn‘s classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors. 60

UNIT V MEMORY & I/O SYSTEMS t49

Memory Hierarchy - memory technologies – cache memory – measuring and improving cache performance – virtual memory, TLB‘s – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits - USB.

TOTAL : 45 PERIODS

OUTCOMES:

On Completion of the course, the students should be able to:

- Understand the basics structure of computers, operations and instructions
- .Design arithmetic and logic unit.
- Understand pipelined execution and design control unit.
- Understand parallel processing architectures.
- Understand the various memory systems and I/O communication.

TEXT BOOKS:

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014.

2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. William Stallings, Computer Organization and Architecture – Designing for Performance, Eighth Edition, Pearson Education, 2010.

2. John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.

3. John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach‖, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.

JIT

Subject Code: CS8491 **Year/Semester :II/04**

Subject Name : Computer Architecture **Subject Handler: Ms.S.Ancy**

UNIT I BASIC STRUCTURES OF COMPUTER SYSTEMS	
Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Compute Operations, Operands – Instruction representation – Logical operations – decision making – MI Addressing.	
PART* A	
Q.NO	**QUESTIONS**
1.	**What are the eight great ideas invented by computer architecture?(May-2015)**BTL1 • Design for Moore's Law • Use abstraction to simplify design • Make the common case fast • Performance via Parallelism • Performance via Pipelining • Performance via Prediction • Hierarchy of Memory • Dependability via Redundancy
2.	**Define power wall.**BTL1 • Old conventional wisdom • Power is free • Transistors are expensive • New conventional wisdom: "Power wall" • Power expensive • Transistors"free" (Can put more on chip than can afford to turn on
3.	**What is uniprocessor?** BTL1 A **uniprocessor system** is defined as a computer system that has a single central processing unit that is used to execute computer tasks. As more and more modern software is able to make use of multiprocessing architectures, such as SMP and MPP, the term uniprocessor is therefore used to distinguish the class of computers where all processing tasks share a single CPU.
4.	**What is multicore processor?**BTL1 A multi-core processor is a single computing component with two or more independent actual central processing units (called "cores"), which are the units that read and execute program instructions.The instructions are ordinary CPU instructions such as add, move data, and branch, but the multiple cores can run multiple instructions at the same time, increasing overall speed for programs amenable to parallel computing
5.	**Write the basic functional units of computer?**BTL2 The basic functional units of a computer are input unit ,output unit, memory unit, ALU , control unit and Data path unit.
6.	**Define multiprocessing.**BTL1 A multiprocessor is a computer system having two or more processing units (multiple processors) each sharing main memory and peripherals, that simultaneously process programs.
7.	**Differentiate super computer and mainframe computer.**BTL4 A computer with high computational speed, very large memory and parallel structured hardware is known as a super computer.

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	EX: CDC 6600. Mainframe computer is the large computer system containing thousands of IC's. It is a room- sized machine placed in special computer centers and not directly accessible to average users. It serves as a central computing facility for an organization such as university, factory or bank.
8.	**What is instruction register?**BTL2 The instruction register (IR) holds the instruction that is currently being executed. Its output is available to the control circuits which generate the timing signals that control the various processing elements involved in executing the instruction.
9.	**Differentiate between minicomputer and microcomputer.**BTL4 Minicomputers are small and low cost computers are characterized by Short word size i.e. CPU word sizes of 8 or 16 bits. They have limited hardware and software facilities. They are physically smaller in size.Microcomputer is a smaller, slower and cheaper computer packing all the electronics of the computer in to a handful of IC's, including CPU and memory and IO chips.
10.	**What is program counter?**BTL2 The program counter (PC) keeps track of the execution of a program. It contains the memory address of the next instruction to be fetched and executed.
11.	**Expand and give a note on RISC and CISC?BTL3** The processors with simple instructions are called as Reduced Instruction Set Computers(RISC). The processors with more complex instructions are called as Complex Instruction Set Computers (CISC).
12	**What is superscalar execution?BTL2** In this type of execution, multiple functional units are used to create parallel paths through which different instructions can be executed in parallel. So it is possible to start the execution of several instructions in every clock cycle. This mode of operation is called superscalar execution.
13	**What are clock and clock cycles?**BTL1 The timing signals that control the processor circuits are called as clocks. The clock cycle defines the regular time intervals. Clock Cycles= $\frac{\text{seconds}}{\text{program}} = \frac{\text{cycles}}{\text{program}} \times \frac{\text{seconds}}{\text{cycle}}$
14	**List out the methods used to improve system performance?**BTL2 The methods used to improve system performance are • Processor clock • Basic Performance Equation • Pipelining • Clock rate • Instruction set • Compiler
15	**Define addressing modes and its various types.**BTL1 The different ways in which the location of a operand is specified in an instruction is referred to as addressing modes. The various types are • Immediate Addressing, • Register Addressing, • Based or Displacement Addressing, • PC-Relative Addressing, • Pseudodirect Addressing.
16	**Define register mode addressing.**BTL1 In register mode addressing, the name of the register is used to specify the operand. Eg. Add $s3, $s5,$s6.

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	Advantage: Only a small address field is needed in the instruction and no memory is referenced. **Disadvantage:** Address space is very limited.
17	**Define Based or Displacement mode addressing.**BTL1 In based or displacement mode addressing, the operand is in a memory location whose address is the sum of a register and a constant in the instruction. Eg. lw $t0,32($s3).
18.	**How architectures are influenced by the background and experience of the architects ?**BTL5 • If the architects for a system have had good results using a particular architectural approach, such as distributed objects or implicit invocation, chances are that they will try that same approach on a new development effort. • Conversely, if their prior experience with this approach was disastrous, the architects may be reluctant to try it again. • Architectural choices may also come from an architect's education and training, exposure to successful architectural patterns, or exposure to systems that have worked particularly poorly or particularly well.
19.	**Define immediate mode addressing.**BTL1 In immediate mode addressing, the operand is given explicitly in the instruction. Eg. Add $s0, $s1,20. **Advantage** No memory reference other than the instruction fetch is required to obtain the operand. D**isadvantage** The size of the number is restricted to the size of the address field.
20.	**Define Relative mode addressing.(Nov 2014)**BTL1 The relative addressing mode is similar to the indexed addressing mode with the exception that the PC holds the base address. This allows the storage of memory operands at a fixed offset from the current instruction and is useful for 'short' jumps. Example: jump 4
21.	**State Amdahl's Law.(Nov 2014)**BTL1 Amdahl's Law tells us the improvement expected from specific enhancements. The performance improvement or speedup due to improvement is calculated as follows **Speedup= Execution time before improvement/ Execution time after improvement**
22.	**Define Little Endian arrangement.(Nov 2014)**BTL1 Little-endian describes the order in which a sequence of bytes is stored in computer memory. Little-endian is an order in which the "little end" (least significant value in the sequence) is stored first. For example, in a little-endian computer, the two bytes required for the hexadecimal number 4F52 would be stored as 524F (52 at address 1000, 4F at 1001).
23.	**Distinguish pipelining from parallelism. (May 2015)**BTL3 • Pipelining is a method of increasing system performance and throughput. It takes advantage of the inherent parallelism in instructions. Instructions are divided into 5 stages: IF, ID, EX, EME, WB. • Parallelism means we are using more hardware for the executing the desired task. In Parallel computing more than one processor are running in parallel. It increases performance but the area also increases.
24.	**What is Instruction set architecture? (Nov 2015)**BTL2 The ISA serves as the boundary between the software and hardware. It is the structure of a computer that a machine language programmer (or a compiler) must understand to write a correct (timing independent) program for that machine. It also specifies a processor's functionality • what operations it supports

	• what storage mechanisms it has & how they are accessed • how the programmer/compiler communicates programs to processor
25.	**How CPU execution time for a program is calculated? (Nov 2015)**BTL4 CPU execution time for a program is given by the formula Execution time=Instruction Count * Clock cycles per instruction * Clock cycle time.
26.	**Consider three processors P1, P2 and P3 executing the same instruction set. They have clock rates of 3 GHz, 2.5 GHz and 4.0 GHz respectively and CPI of 1.5, 1.0 and 2.2 respectively. Which processor has the highest performance expressed in instructions per second?(Nov 2018)**
27.	**Classify the instruction based on the operations they perform and give one example to each category.(Nov 2018)**
28.	**Define Amdahl's law(May 2019)**
29.	**Suppose that we are considering an enhancement to the processor of a server system used for Web Serving. The new CPU is 10 times faster on computation in the Web serving application than the original processor. Assuming that the original CPU is busy with computation 40% of the time and is waiting for I/O 60% of the time, what is the overall speedup gained by incorporating the enhancement?(May 2019)**
	PART *B
1	**Explain in detail the various components of computer system with neat diagram.** **(13M)(Nov/Dec 2014, Nov/Dec 2015,May/June2016)** BTL2 **Answer page : 11 – Patterson.** **Definition**: Computer architecture is a set of rules and methods that describe the functionality, organization, and implementation of computer systems. Some definitions of architecture define it as describing the capabilities and programming model of a computer but not a particular implementation. **Five basic components of computer system** • Input Unit.(1M) • Output Unit.(1M) • Storage Unit.(2M) • Central Processing Unit (CPU)(2M) • Arithmetic and Logic Unit (ALU)(2M) • Control Unit.(2M) • Diagram(3M)

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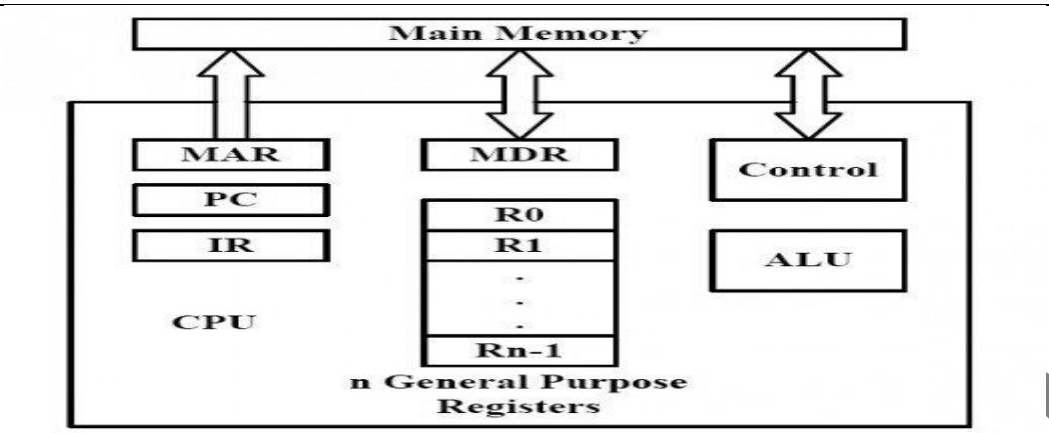
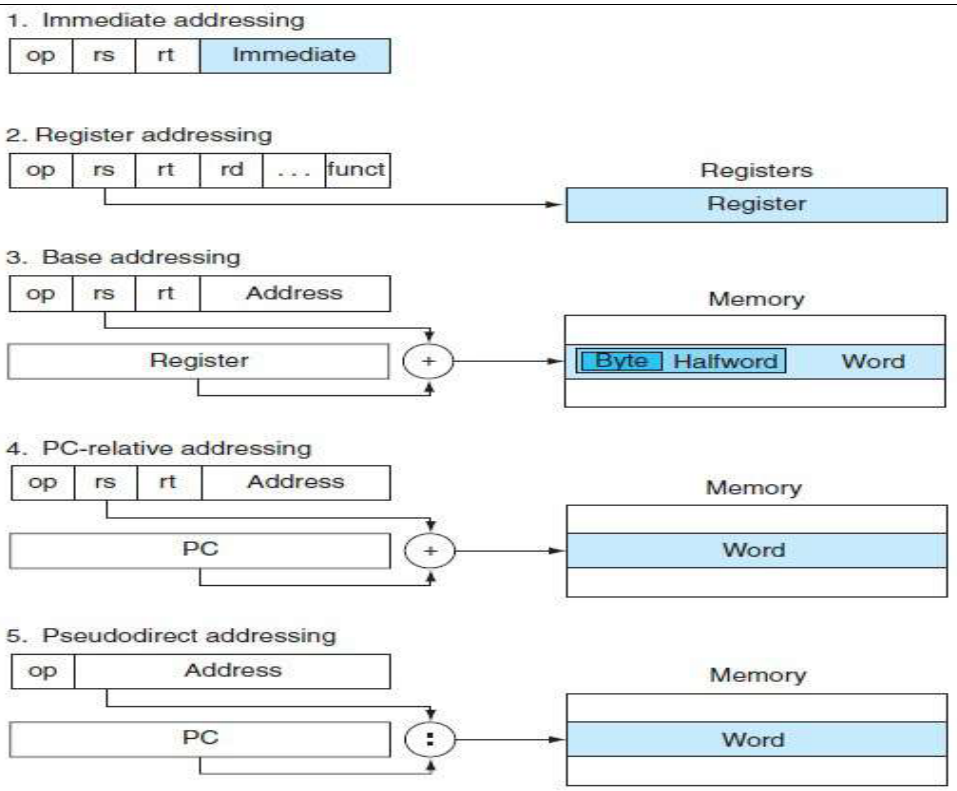
	
2	**What is an addressing mode? What is the need for addressing in a computer system? Explain the various addressing modes with suitable examples. (May/June 2015, Nov/Dec 2015,May/June 2016)**BTL2 **Answer page : 13 - Patterson** **Definition: (3M)** The term addressing modes refers to the way in which the operand of an instruction is specified. Information contained in the instruction code is the value of the operand or the address of the result/operand. Following are the main addressing modes that are used on various platforms and architectures. **Immediate Mode:** (2M) The operand is an immediate value is stored explicitly in the instruction. **Eg: move #200, R0** **Index Mode:**(2M) The address of the operand is obtained by adding to the contents of the general register (called index register) a constant value. The number of the index register and the constant value are included in the instruction code. **Eg: sb $0, array1($3)** **Indirect Mode:**(2M) The effective address of the operand is the contents of a register or main memory location, location whose address appears in the instruction. Indirection is noted by placing the name of the register or the memory address given in the instruction in parentheses. **Eg: lw $10,q ; lw $11,alpha ; sw $10,($11)** **Direct Mode:**(2M) The address of the operand is embedded in the instruction code. **Eg: lw $11, beta** **Register Mode:**(2M) The name (the number) of the CPU register is embedded in the instruction. The register contains the value of the operand. The number of bits used to specify the register depends on the total number of registers from the processor set. **Eg: add $14,$14,$13**
3	**Discuss about the various techniques to represent instructions in a computer system (13M)(April/May 2017,May/June 2015)** BTL2 **Answer : Page:15 - Patterson**



- Immediate Addressing(3M)
- Base Addressing(3M)
- Register Addressing(2M)
- PC Relative(2M)
- Pseudo Direct(3M)

4 **List and explain the eight great ideas in Software architecture.(13M)(April/May 2015,Nov/De 2017)**BTL1

Answer : Page 7 - Patterson

Eight Great Ideas in Computer Architecture

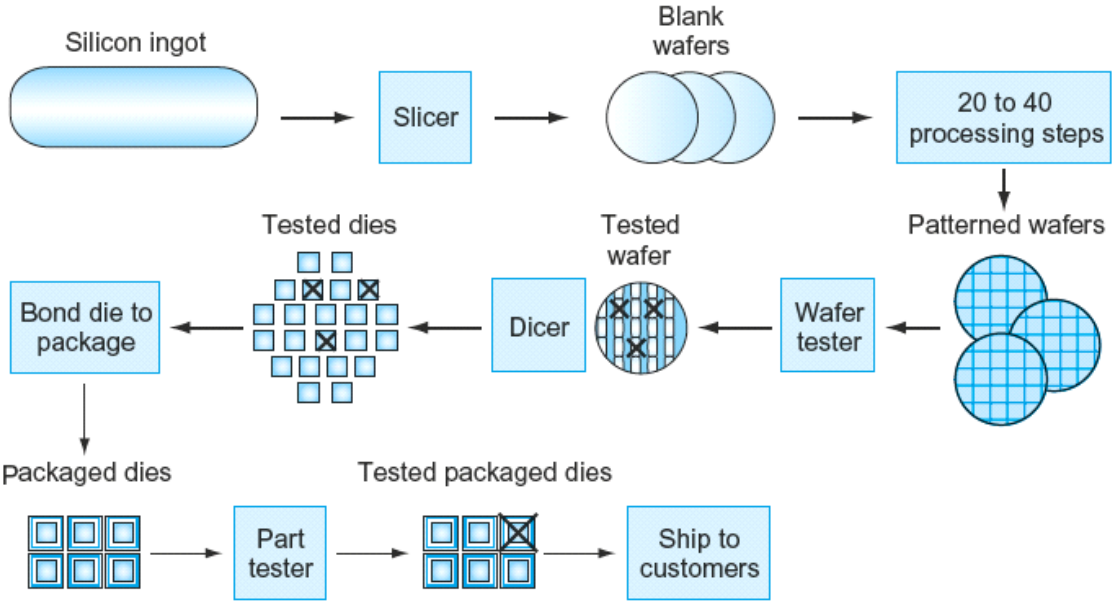
The following are eight great ideas that computer architects have invented in the last 60 years of computer design.

1. Design for Moore's Law. (2M)
2. Use Abstraction to Simplify Design(2M)
3. Make the common case fast(1M)
4. Performance via parallelism(1M)
5. Performance via pipelining(1M)
6. Performance via prediction(2M)
7. Hierarchy of memories(2M)
8. Dependability via redundancy(2M)

5 **State the CPU performance equation and discuss the factors that affect performance?(13M) (Nov/Dec 2014)**BTL2

Answer : Page 49 - Patterson

- Response time (execution time) = the time between the start and the completion of a task(3M)
- performancex = 1 / execution_timex (2M)
- Speedup(1M)
- Throughput – the total amount of work done in a given time(1M)

	• CPU execution time for a program=CPU Clock cycles for a program x clock cycle time CPU execution time for a program(2M) • CPU Clock cycles for a program=Instructions for a program x Average clock cycle of instruction.(2M) • CPU time = Instruction_count x CPI x clock_cycle(2M)
6	**State and explain the technologies involved in building the processor and memory.(13M)(April/May 2016)**BTL2 **Answer Page : 17 – Patterson.** • The IC manufacturing process starts with a silicon crystal ingot. (3M) • The Ingots are 8-12 inches in diameter and about 12 to inches long. • An Ingot is finely sliced into wafers no more than 0.1 inches thick. (2M) • These wafers then go through a series of processing steps, during which patterns of chemicals are placed on each wafer, creating the Transistors, conductors, and insulators . • These good dies are then bonded into packages(connected to the input/output pins of a Package) and tested one more time before shipping the packaged parts to customers. (2M) • As in fig, one bad packaged part was found in the final list. • die : The individual rectangular sections that are cut from a wafer, more informally known as chips. (2M) • yield : The percentage of good dies from the total number of dies on the wafer. • Transistor: An on/ off switch controlled by an electric signal.(2M) • VLSI : A device(IC) containing millions of transistors. • Silicon: A natural element that is a semiconductor. (2M) • Semiconductor: A substance that does not conduct electricity well. 
7.	**(i)Consider two different implementation of the same instruction set architecture. The instructions can be divided into four classes according to their CPI (class A,B,C and D). P1 with a clock rate of 2.5 GHz and CPIs of 1, 2, 3 and 3 respectively, and P2 with a clock rate of 3 GHz and CPIs of 2, 2, 2 and 2 respectively. Given a program with a dynamic instruction count of 1.0 x 10^6 instructions divided into classes as follows: 10% class A, 20% class B, 50% class C and 20% class D, which implementation is faster? What is the global CPI for each implementation? Find the clock cycles required in both cases.(Nov 2018)**

	(ii)Explain the three broad classes of applications of computers.(Nov 2018)
8.	**(i) Assume that the variables f and g are assigned to registers $s0 and $s1 respectively. Assume that the base address of the array A is in register $s2. Assume f is zero initially.** **f = -g – A[4]** **A[5]=f + 100;** **Translate the above C statements into MIPS code. How many MIPS assembly instructions are needed to perform the C statements and how many different registers are needed to carry out the C statements?(Nov 2018)** **(ii) Define addressing mode in a computer. What are the different MIPS addressing modes? Give one example instruction to each category.(Nov 2018)**
9.	**(i) Describe the different types of addressing mode with example.** **(ii) Explain the components of a computer with the block diagram in detail.(May 2019)**
10.	**(i) Explain the eight ideas of the Computer architecture which empowered the computer design over the past decades.(May 2019)** **(ii) Tabulate the difference between the RISC and CISC processor.(May 2019)**
	PART – C
1	**Consider the computer with three instruction classes and CPI measurement as given below and Instruction counts for each instruction class for the same program from two different compilers are given. Assume that the computer's clock rate is 4Ghz. Which code sequence will execute faster according to execution time?(15M) (Nov/Dec 2014)**BTL5 **Answer Page : 48 - Patterson** Code from CPI for this Instruction class A B C CPI 1 2 3 Code from Instruction count for each class A B C Compiler1 2 1 2 Compiler 2 4 1 1 **Answer:** **i. Instructions:(5M)** Instruction executed by Compiler 1 = 2+1+2 = 5 Instruction executed by Compiler 2 = 4+1+1 = 6 **ii. CPU clock cycles:(5M)** CPU clock cycle = IC X CPI CPU clock cycle for Compiler 1 = (2 X 1) + (1 X 2) + (2 X 3) = 2 + 2 + 6 = 10 cycles CPU clock cycle for Compiler 2 = (4 X 1) + (1 X 2) + (1 X 3)= 4 + 2 + 3= 9 cycles **iii. Time for executing the instruction(5M)** ***Given:*** Clock rate = 4GHz = 4 X Hz CPU Execution time for Compiler 1 = = 2.5 X second CPU Execution time for Compiler 2 = = 2.25 X second Execution time for Compiler 1 > Execution time for Compiler 2 ie, Execution time of Compiler 2 is lesser than Compiler 1, So Compiler 2 is faster than Compiler 1
2	**Assume a two address format specified as source, destination. Examine the following sequence of instruction and explain the addressing modes used and the operation done in every instruction?(15M) (Nov/Dec 2014)**BTL5 **Answer : Page 50 – Patterson.** 1. Move (R5) +, R0 2. Add (R5) +, R0.

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	3. Move (R0), (R5) 4. Move 16(R5), R3 5. Add #40, R5 **Answer:** 1. ***Move (R5)+, R0***;(3M) When + comes after register addressing then it has to be auto incremented after the action So move the value from the address pointed by R5 to R0 and then the increment R5 to next address 2. ***Add (R5)+, R0***(3M) Add the value stored at address pointed by R5 with R0 and then increment R5 addressvalue3. 3.***Move (Ro), (R5)***(3M) Move the value from the address R0 to the address pointed in R5 4. ***Move 16(R5), R3*** – Indexed mode(3M) Move the value from the address pointed by 16 bits offset of R5 register 5. ***Add #40, R5***(3M) It will store the value 40 directly to register R5
3	**Suppose we have two implementations of the same instruction set architecture. Computer A has a clock cycle time of 250 ps and a CPI of 2.0 for some program, and computer B has a clock cycle time of 500 ps and a CPI of 1.2 for the same program. Which computer is faster for this program and by how much?(15M)**BTL5 **Answer Page : 51 – Patterson.** **Solution:** We know that each computer executes the same number of instructions for the program; Lets call this number I. First ,find the number of processor clock cycles for each computer. (3M) CPU Clock cycle $_A$ = I * 2.0 CPU clock cycle $_B$ = I*1.2 Now we can compute the CPU time for each computer.(3M) CPU time A = CPU clock cycle A* Clock cycle time =I*2.0*250ps=500 *I ps Likewise for B(3M) CPU time A = CPU clock cycle B* Clock cycle time =I*1.2*500 ps=600 *I ps Clearly ,computer A is faster. The amount faster is given by the ratio of the execution times(3M) CPU Performance A/CPU Performance B = Execution Time of B/Execution Time A(3M) = 600 * I ps / 500 * I ps = 1.2 We can conclude that Computer A is 1.2 times faster than Computer B.(3M)

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UNIT II ARITHEMETIC FOR COMPUTERS

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operation – Subword parallelism.

PART* A

Q.NO	QUESTIONS
1.	**State the rule for floating point addition.**BTL1 • Choose the number with the smaller exponent and shift its mantissa right a number of steps equal to the difference in exponents. • Set the exponent of the result equal to the larger exponent. • Perform the addition on the mantissa and determine the sign of the result.Normalize the resulting value if necessary.
2.	**State the representation of double precision floating point number. (Nov 2015)**BTL1 Double precision representation contains 11 bits, excess -1023 exponent E' which has the range $1 \leq E' \leq 2046$ for normal values. This me that the actual exponent E is in range $-1022 \leq E \leq 1023$. The 53 bit mantissa provides a precision equivalent to about 16 decimal digits.
3.	**What is guard bit ? What are the ways to truncate the guard bits?**BTL2 Although the mantissa of initial operands is limited to 24 bits, it is important to retain extra bits, called as guard bits. There are several ways to truncate the guard bits: Chopping,VonNeumann rounding, Rounding.
4.	**What is overflow and underflow case in single precision?**BTL2 • Underflow-The normalized representation requires an exponent less than -126 • Overflow-The normalized representation requires an exponent greater than -126
5.	**Why floating point number is more difficult to represent and process than integer?BTL2** In floating point numbers we have to represent any number in three fields sign, exponent and mantissa. The IEEE 754 standard gibes the format for these fields and according to format the numbers are to be represented. In case of any process the mantissa and exponent are considered separately.
6.	**When can you say that a number is normalized?**BTL2 When the decimal point is placed to the right of the first (nonzero) significant digit the number is said to be normalized.
7.	**Define Little Endian arrangements? (Nov/Dec2014)**BTL1 • Little-endian describes the order in which a sequence of bytes is stored in computer memory. • Little endian is an order in which the "little end" (least significant value in the sequence)is stored first. • For example, in a little-endian computer, the two bytes required for the hexadecimal number 4F52 would be stored as 524F (52 at address 1000, 4F at 1001).
8.	**What is arithmetic overflow?**BTL2 In a computer, the condition that occurs when a calculation produces a result that is greater in magnitude than which a given register or storage location can store or represent. In a computer, the amount by which a calculated value is greater in magnitude than that which a given register or storage location can store or represent.
9.	**Define Booth Algorithm.**BTL1 Booth's multiplication algorithm is a multiplication algorithm that multiplies two signed binary numbers in two's complement notation. Booth's algorithm can be implemented by repeatedly adding (with ordinary unsigned binary addition) one of two predetermined values A and S to a product P, then performing a rightward arithmetic shift on P
10.	**What is Carry Save addition?**BTL2 Using carry save addition, the delay can be reduced further still. The idea is to take 3 numbers that we want to add together, x+y+z, and convert it into 2 numbers c+s such that x+y+z=c+s, and do this in O (1)

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	time. The reason why addition cannot be performed in O (1) time is because the carry information must be propagated. In carry save addition, we refrain from directly passing on the carry information until the very last step.
11.	**Define Integer Division and give its rule.**BTL1 Integers are the set of whole numbers and their opposites. The sign of an integer is positive if the number is greater than zero, and the sign is negative if the number is less than zero. The set of all integers represented by the set {... -4, -3, -2, -1, 0, 1, 2, 3, 4...}Negative integers: {. . . -4, -3, -2, -1}Positive integers: {1, 2, 3, 4 ...}{0} is neither positive nor negative, neutral. DIVISION RULE: The quotient of two integers with same sign is positive. The quotient of two integers with opposite signs is negative.
12	**Write Restoring and Non-Restoring division algorithm?**BTL1 **Restoring Division Algorithm:** **Step 1:**Shift A and Q left one binary position. Subtract M from A, and place the answer back in A. **Step 2:**If the sign of A is 1, set q0 to 0 and add M back to A (that is, restore A); otherwise, set q0 to 1. **Non- Restoring Division Algorithm** **Step 1:** Do the following n times: If the sign of A is 0, shift A and Q left one bit position and subtract M from A; otherwise, shift A and Q left and add M to A. Now, if the sign of A is 0, set q0 to 1; otherwise, set q0 to 0. **Step 2:** If the Sign of A is 1, add M to A.
13	**Write the rules for add/sub operation on floating point numbers?**BTL1 • Choose the number with the smaller exponent and shift its mantissa right a number of steps equal to the difference in exponents. • Set the exponent of the result equal to the larger exponent • Perform addition / subtraction on the mantissa and determine the sign of the result • Normalize the resulting value, if necessary
14	**Write the rules for multiply operation on floating point numbers?**BTL1 • Add the exponents and subtract 127. • Multiply the mantissa and determine the sign of the result. • Normalize the resulting value, if necessary. • Write the rules for divide operation on floating point numbers • Subtract the exponents and subtract 127. • Divide the mantissa and determine the sign of the result. • Normalize the resulting value, if necessary.
15	**Define Truncation.**BTL1 • To retain maximum accuracy, all extra bits during operation (called *guard bits*) are kept (e.g., multiplication). • If we assume n=3 bits are used in final representation of a number, n=3extra guard bits are kept during operation. • By the end of the operation, the resulting 2n=6 bits need to be truncated to n=3 bits by one of the three methods.
16	**How is Boolean subtraction is performed?**BTL1 • Negate the subtrahend (i.e. in a-b, the subtrahend is b) • perform addition(2's complement).
17	**Define Chopping.**BTL1 There are several ways to truncate. The simplest way is to remove the guard bits and make no changes in the retained bits. This is called Chopping. Chopping discards the least significant bits and retains the 24 most significant digits. This is easy to implement, and biased, since all values are rounded to-wards a lower mantissa value. The maximum rounding error is $0 \leq e < +1$ LSB.
18.	**Define Von Neumann Rounding.**BTL1 • If at least one of the guard bits is 1, the least significant bit of the retained bits is set to 1

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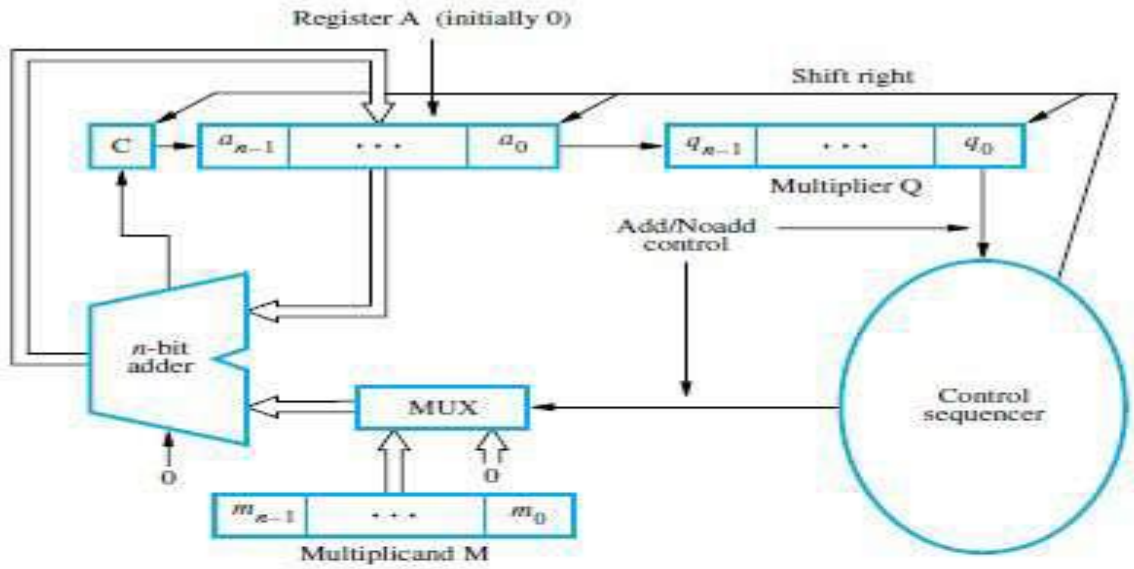
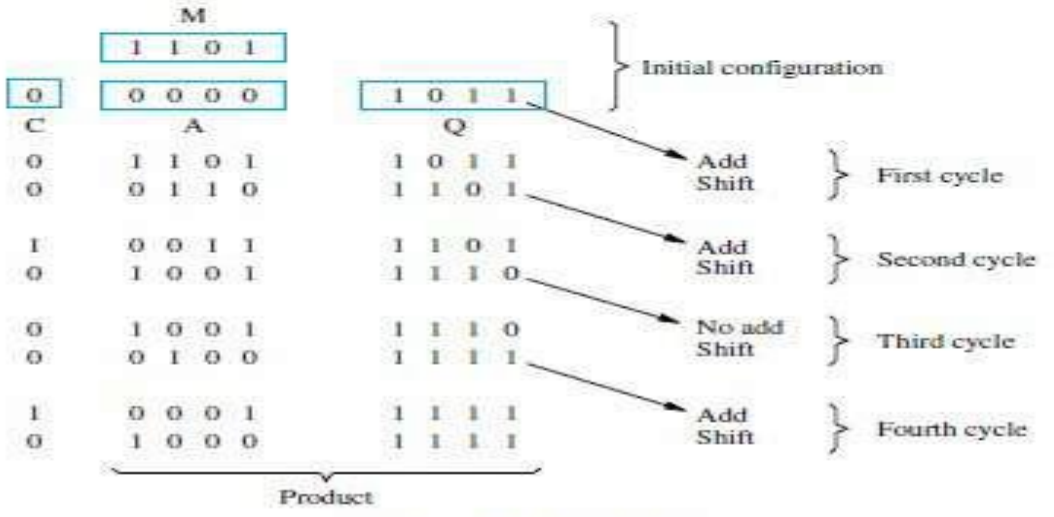
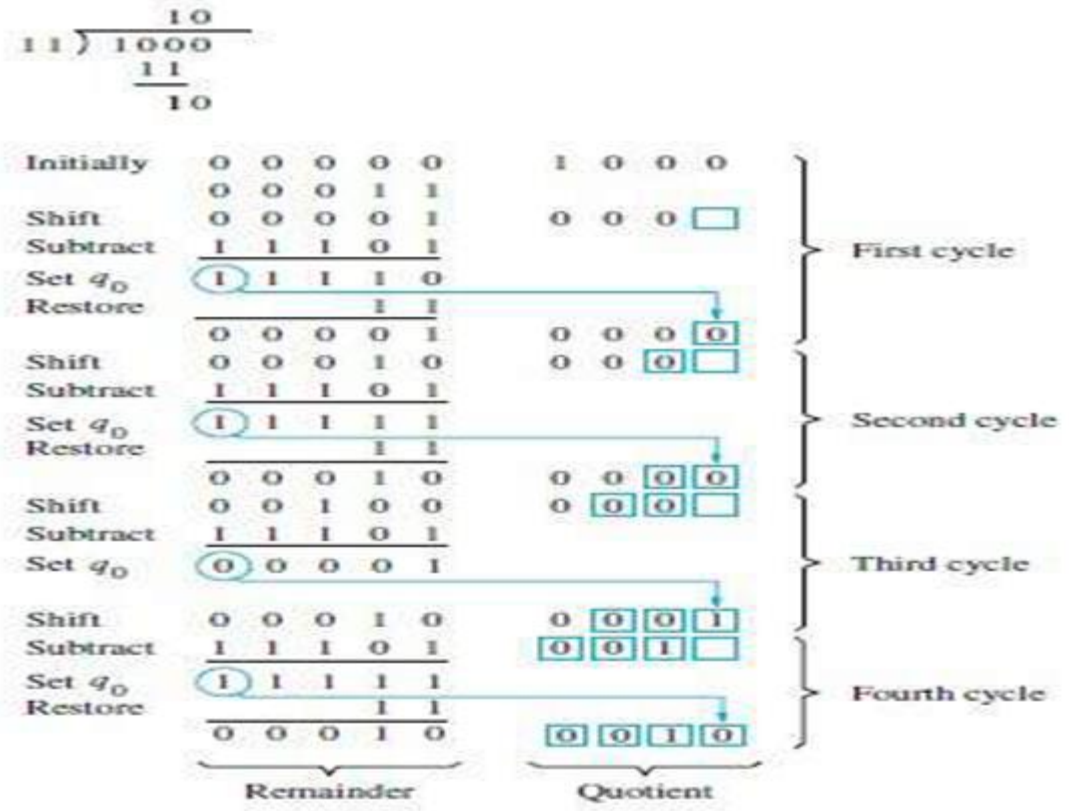
	otherwise nothing is changed in retained bits and simply guard bits are dropped. • Architectural choices may also come from an architect's education and training, exposure to successful architectural patterns, or exposure to systems that have worked particularly poorly or particularly well.
19.	**What do mean by Subword Parallelism?(May 2015) (May 2016)**BTL1 Subword parallelism is a technique that enables the full use of word-oriented data paths when dealing with lower precision data. It is a form of low-cost, small-scale SIMD parallelism.
20.	**How overflow occur in subtraction? (May 2015)**BTL1 When overflow occurs on integer addition and subtraction, contemporary machines invariably discard the high-order bit of the result and store the low-order bits that the adder naturally produces. Signed integer overflow of addition occurs if and only if the operands have the same sign and the sum has a sign opposite to that of the operands.
21.	**What are generate and propagate function?**BTL1 The generate function is given by $G_i=x_iy_i$ and The propagate function is given as $P_i=x_i+y_i$
22.	**What is excess-127 format?**BTL2 Instead of the signed exponent E, the value actually stored in the exponent field is and unsigned integer $E^{¢}=E+127$ This format is called excess-127.
23.	**What is floating point number?**BTL1 **Ans:** In some cases, the binary point is variable and is automatically adjusted as computation proceeds. In such case, the binary point is said to float and the numbers are called floating point numbers.
24.	**Write the IEEE 754 floating point format?**BTL1 The IEEE 754 standard floating point representation is almost always an approximation of the real number. The format is: $(-1)^s(1+\text{Fraction})x2^{(\text{Exponent-Bias})}$
25.	**What are the overflow/underflow conditions for addition and subtraction? (Nov 2015)**BTL1 When result can not be represented in the allocated number of bits. Overflow occurs if the the Result > Max value. Underflow occurs if the Result < Min value. Overflow can occur when two positive numbers are added and result is out of range. After addition, the result will become negative. Underflow can occur when two negative numbers are added and result is out of range. After addition, the result will become positive. While adding a positive number with a negative number. No overflow or underflow can occur. **Unsigned number representation using n-bits** • Overflow when result > 2^n-1. • Underflow when result < 0. **Signed number representation using n-bits** • Overflow when result > $2^{n-1}-1$. • Underflow when result < -2^{n-1}.
26.	**Perform X-Y using 2's complement arithmetic for the given two 16-bit binary numbers X = 0000 1011 1110 1111 and Y = 1111 0010 1001 1101.(Nov 2018)**
27.	**Define sub-word parallelism.(Nov 2018)**

28.	**Convert $(1.00101)_2$ to decimal.(May 2019)**
29.	**Perform subtraction by two's complement method : 100 – 110000.(May 2019)**
	PART *B
1	**Explain the sequential version of multiplication algorithm and its hardware?(13M) (Apr/May2015)**BTL5 **Answer Page : 2.28 – Kanimozhi.** Steps: Set B= Multiplicand, Q= Multiplier, A=0, N=Count(4M) If Q_0=1 then A=A+B(2M) Shift A,Q right(3M) N=N-1 (until N=0)(2M) A,Q is the product.(2M)  (a) Register configuration  (b) Multiplication example
	Discuss in detail about Restoring Division algorithm in detail with diagram and example? (13M)(Nov/Dec 2015)BTL5

2	**Answer Page : 2.34 - kanimozhi** **Steps:** 1. Set A=0, B=Divisor, Q=Dividend, Count=n;(1M) 2. Shift left A,Q;(2M) 3. A=A-B;(2M) 4. If A<0?(2M) a. If NO i. Q_0=1; b. If YES i. Q_0=0; ii. A=A+B; 5. Count = Count -1(2M) 6. If Count ≠0(2M) a. Go to Step 2 7. Q = Quotient(2M) A=Remainder 
3	**Discuss in detail about NON Restoring Division algorithm in detail with diagram and example?(13M)(Nov/Dec 2015,April/May 2017).**BTL5 **Answer Page: 2.34 - Kanimozhi** **Steps:** 1. Set A=0, B=Divisor, Q=Dividend, Count=n;(1M) 2. Shift left A,Q(2M) 3. If A<0?(2M) a. If YES i. A=A+B b. If NO

	i. A=A-B 4. If A<0?(2M) a. If YES i. Q_0=0; b. If No i. Q_0=1; 5. Count=Count-1(2M) 6. If Count =0(2M) a. If NO i. Go To Step 2 b. If YES i. If A<0? 1. If YES a. A=A+B 2. If NO a. END 7. Q=Quotient(2M) A=Remainder
4	**Explain briefly about the floating point addition and subtraction in detail?(13M)**BTL2 **Answer Page : 2.42 – Kanmozhi.** $X = 0.3 * 10^2 = 30$(3M) $Y = 0.2 * 10^3 = 200$(2M) $X+Y = (0.3 * 10^{2-3} + 0.2) * 10^3 = 0.23 * 10^3 = 230$(2M) $X-Y=(0.3 * 10^{2-3} - 0.2) * 10^3 = (-0.17) * 10^3 = -170$(2M) $X*Y =(0.3*0.2)*10^{2+3}= 0.06*10^5 =6000$(2M) $X/Y=(0.3*0.2)*10^{2-3}=1.5*10^{-1}=0.15$(2M)
5	**Multiply the following pair of signed nos. using Booth's bit – pair recoding of the multiplier. A =+13(Multiplicand) and B = -6 (Multiplier)? (13M)(Nov/Dec 2014)**BTL2 **Answer page : 2.30 – Kanimozhi.** + = 0 1 1 0 ← Multiplicand - = 1 1 1 ← Multiplicand ↓ 1 0 1 0 ← 2's Complement(3M) Recode the multiplier using bit pair recoding method(3M) Implied Zero 1 0 1 1 0 Multiplier(7M) -1 -2 0 1 1 0 1 -1 -2 1 1 1 0 0 1 1 0 1 1 0 0 1 1 1 1 0 1 1 0 0 1 0
6	**Show the IEEE 754 binary representation of the number _0.75ten in single and double precision.(13M)(Nov/Dec 2014)**BTL6 **Answer Page : 2.45 - Kanimozhi**

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	The number _0.75ten is also_3/4ten or _ 3/22ten(2M) It is also represented by the binary fraction_11two /22ten or _ 0.11two In scientifi c notation, the value is_ 0.11two _ 20and in normalized scientifi c notation, it is_1.1two _ 2_1 The general representation for a single precision number is(2M) (_1)S _ (1 _ Fraction) _ 2(Exponent_127) Subtracting the bias 127 from the exponent of _1.1two _ 2_1 yields (_1)1 _ (1 _ .1000 0000 0000 0000 0000 000two) _ 2(126_127) The **single precision binary representation** of _0.75ten is then(4M) 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 0 1 1 1 1 1 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 bit 8 bits 23 bits The **double precision representation** is(5M) 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 1 0 1 1 1 1 1 1 1 1 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 bit 11 bits 20 bits 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 32 bits
7.	**(i) Multiply the following signed numbers using Booth algorithm. A = $(-34)_{10}$ =$(1011110)_2$ and B = $(22)_{10}$ =$(0010110)_2$ where B is multiplicand and A is multiplier.** **(ii) Draw the block diagram of integer divider and explain the division algorithm(Nov 2018)**
8.	**(i) How IEEE 752 32-bit single precision floating print numbers represented? Example. How are print numbers represented?(Nov 2018)** **(ii) Explain floating point addition algorithm with a neat block diagram?**
9.	**Calculate the following problems using BOOTH's ALGORITHM(May 2019)** **(i) (+13)x(-6)** **(ii) (+13)x(+6)** **(iii) (-13)x(-6)** **(iv) (-13)x(+6)**
10.	**Calculate 10011 (-13) x 01011 (+11) using Signed-Operand Multiplication.(May 2019)**
	PART – C
1	**Multiply 0.510 and -0.437510 using floating point multiplication algorithm.(15M)(Nov/Dec 2017)**BTL5 **Answer Page : 2.32 – kanimozhi.** **0.510** = 1/2 10 = 00012 / 00102 = 0.12 x 20 = **1.0002 x 2-1** **-0.437510 = -7/ 1610 =-7/24** **10 = -0.01112 =**-0.01112 x 20 **=-1.110 x 2-2** **Step: 1** Adding the Exponent without bias 3(6M) **Step 2:** Multiplication of significands Product is 1.1100002 x 2-3(6M) Keep it to four bits 1.1102 x 2-3 **Step 3:** Check the product whether normalized & Check the exponent for overflow or

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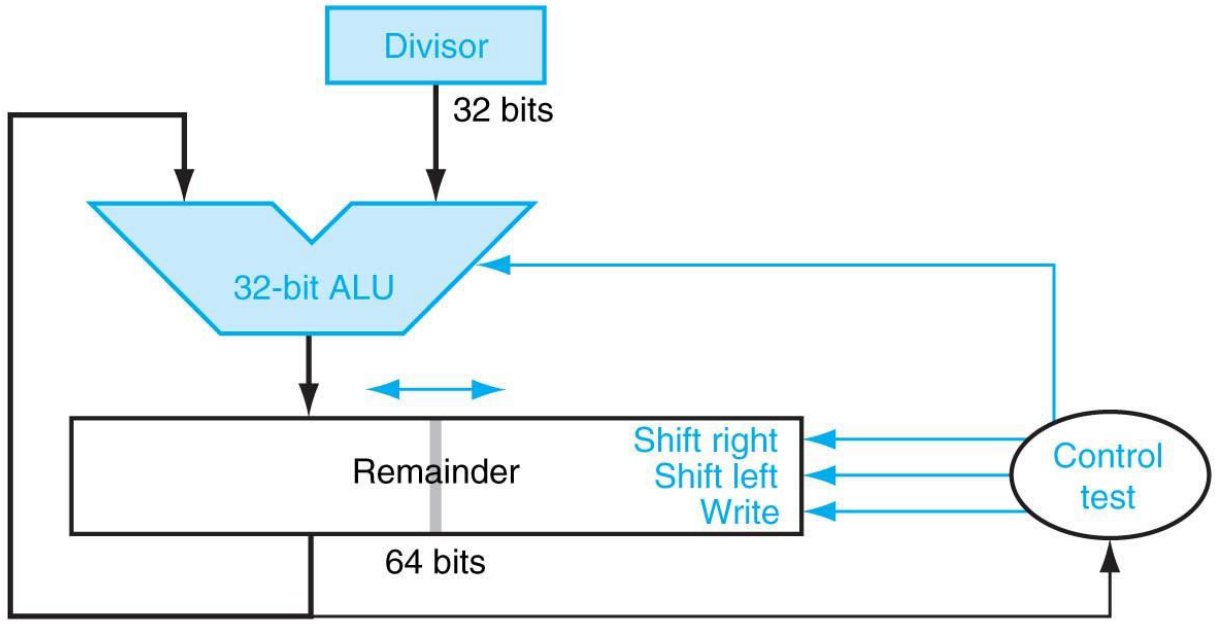
underflow
Already normalized, No overflow and underflow(1M)
Step 4: Rounding the product no change(1M)
Step 5: Sign of the original operands differ , make sign of the product negative - 1.1102 x 2-3(1M)
Convert to decimal to check the results: - 1.1102 x 2-3 = -0.0011102 = -0.001112 = -7/25
10=-7/3210=-0.2187510

2 **Explain with example the conditions of overflow for addition and subtraction?(13M) (Nov/Dec 2014)**BTL2
Answer Page : 2.17 – Kanimozhi

OPERATION	OPERAND A	OPERAND B	RESULT INDICATING OVERFLOW	
A+B	>=0	>=0	<0	(4M)
A+B	<0	<0	>=0	(4M)
A-B	>=0	<0	<0	(3M)
A-B	<0	>=0	>=0	(4M)

3 **With a neat sketch Explain the improved version of division algorithm.(15M)**BTL2
Answer Page : 2.40 - Kanimozhi
• Algorithm and hardware refined to be faster and cheaper(2M)
• Divisor register, ALU, and Quotient register are all 32 bits wide(2M)
• Remainder register left at 64 bits(2M)
• ALU and Divisor registers are halved and the remainder is shifted left.(2M)
• Combines the Quotient register with the right half of the Remainder register.(2M)
Diagram(5M)



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UNIT III PROCESSOR AND CONTROL UNIT	
A Basic MIPS implementation – Building a Datapath – Control Implementation Scheme – Pipelining Pipelined datapath and control – Handling Data Hazards & Control Hazards – Exceptions.	
PART* A	
Q.NO	**QUESTIONS**
1.	**What is pipelining?**BTL2 The technique of overlapping the execution of successive instruction for substantial improvement in performance is called pipelining.
2.	**What is precise exception?**BTL2 A precise exception is one in which all instructions prior to the faulting instruction are complete and instruction following the faulting instruction, including the faulty instruction; do not change the state of the machine.
3.	**Define processor cycle in pipelining.**BTL1 The time required between moving an instruction one step down the pipeline is a processor cycle.
4.	**What is meant by pipeline bubble?**BTL2 To resolve the hazard the pipeline is stall for 1 clock cycle. A stall is commonly called a pipeline bubble, since it floats through the pipeline taking space but carrying no useful work.
5.	**What is pipeline register delay?**BTL2 Adding registers between pipeline stages me adding logic between stages and setup and hold times for proper operations. This delay is known as pipeline register delay.
6.	**List the major characteristics of a pipeline?**BTL2 The major characteristics of a pipeline are: 1. Pipelining cannot be implemented on a single task, as it works by splitting multiple tasks into a number of subtasks and operating on them simultaneously. 2. The speedup or efficiency achieved by suing a pipeline depends on the number of pipe stages and the number of available tasks that can be subdivided.

7.	**How do you define the terms data path?**BTL2 As instruction execution progress data are transferred from one instruction to another, often passing through the ALU to perform some arithmetic or logical operations. The registers, ALU, and the interconnecting bus are collectively referred as the data path.
8.	**What is meant by data hazard in pipelining?** BTL2 Any condition in which either the source or the destination operands of an instruction are not available at the time expected in the pipeline is called data hazard.
9.	**What is Instruction or control hazard?**BTL2 The pipeline may be stalled because of a delay in the availability of an instruction. For example, this may be a result of a miss in the cache, requiring the instruction to be fetched from the main memory. Such hazards are often called control hazards or instruction hazard.
10.	**Define structural hazards.**BTL1 This is the situation when two instruction require the use of a given hardware resource at the same time. The most common case in which this hazard may arise is in access to memory.
11.	**What is side effect?**BTL2 When a location other than one explicitly named in an instruction as a destination operand is affected, the instruction is said to have a side effect.
12	**What do you mean by branch penalty?**BTL2 **Step 1:**The time lost as a result of a branch instruction is often referred to as branch penalty. **Step 2:**If the sign of A is 1, set q0 to 0 and add M back to A (that is, restore A); otherwise, set q0 to 1.
13	**What is branch folding?**BTL2 When the instruction fetch unit executes the branch instruction concurrently with the execution of the other instruction, then this technique is called branch folding.
14	**What do you mean by delayed branching?**BTL2 Delayed branching is used to minimize the penalty incurred as a result of conditional branch instruction. The location following the branch instruction is called delay slot. The instructions in the delay slots are always fetched and they are arranged such that they are fully executed whether or not branch is taken. That is branching takes place one instruction later than where the branch instruction appears in the instruction sequence in the memory hence the name delayed branching.
15	**What are the two types of branch prediction techniques available?**BTL2 The two types of branch prediction techniques are static branch prediction and dynamic branch prediction.
16	**What is a hazard? What are its types? (Nov 2015)**BTL2 Any condition that causes the pipeline to stall is called hazard. They are also called as stalls or bubbles. The various pipeline hazards are: • Data hazard • Structural Hazard • Control Hazard..
17	**Why is branch prediction algorithm needed?** BTL3 The branch instruction will introduce branch penalty which would reduce the gain in performance expected from pipelining. Branch instructions can be handled in several ways to reduce their negative impact on the rate of execution of instructions. Thus the branch prediction algorithm is needed.
18.	**What is branch Target Address?**BTL2 The address specified in a branch, which becomes the new program counter, if the branch is taken. In MIPS the branch target address is given by the sum of the offset field of the instruction and the address of the instruction following the branch.

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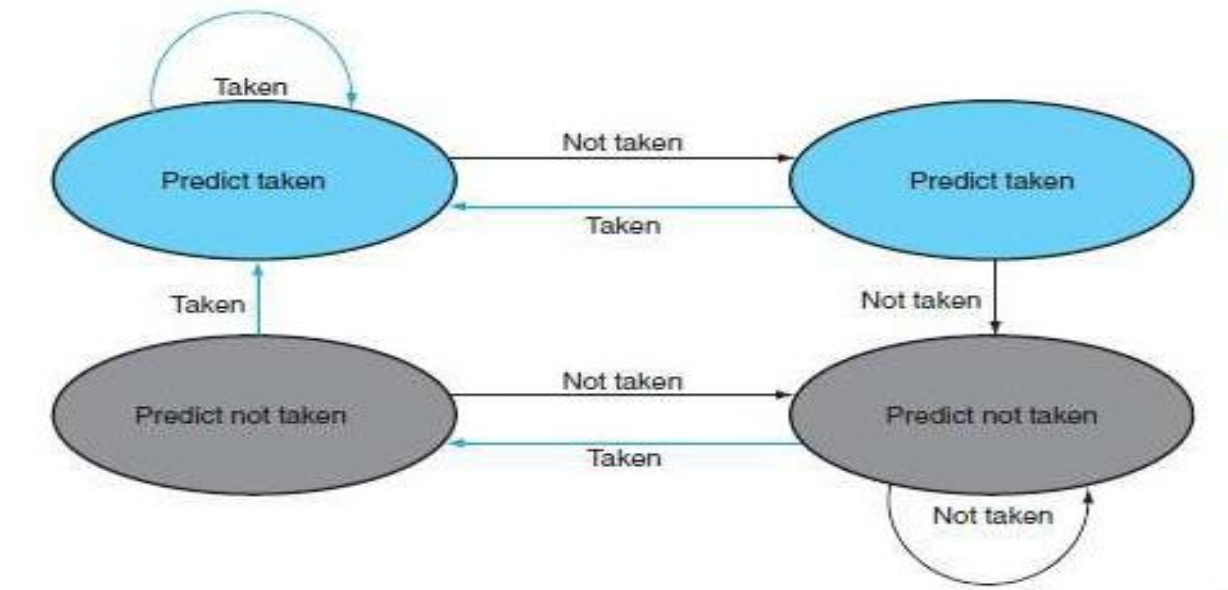
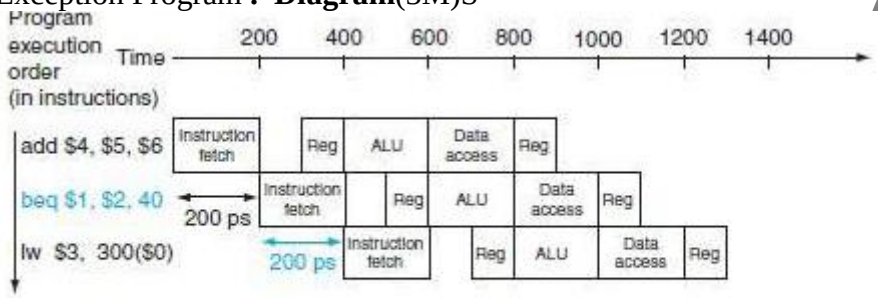
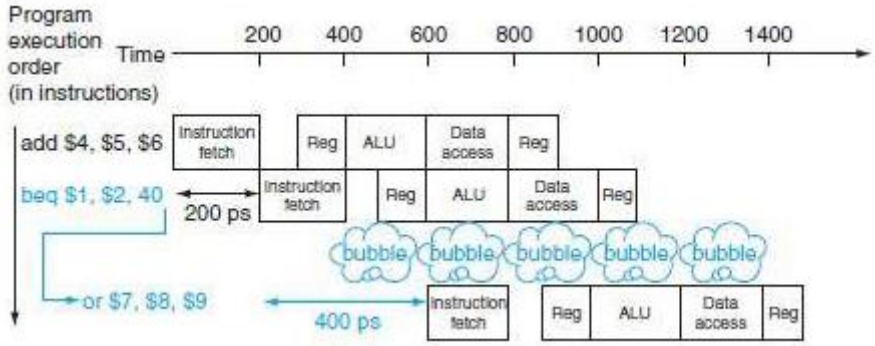
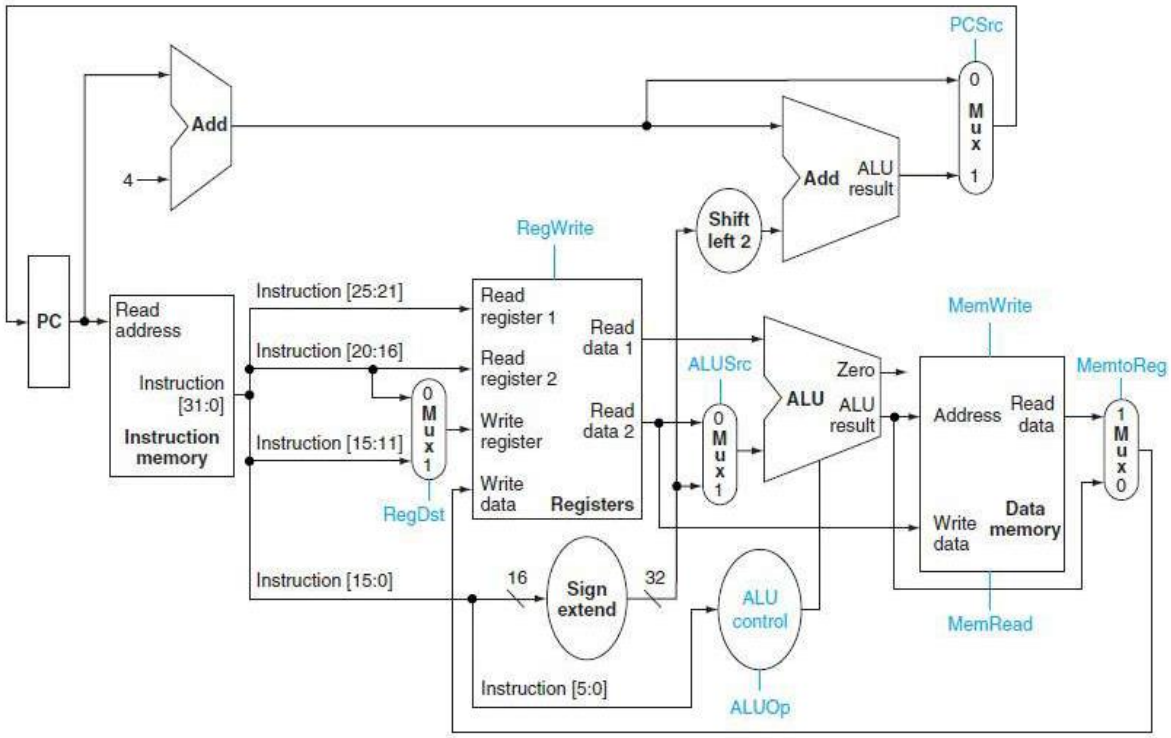
19.	**What is an interrupt?**BTL2 An exception is the one that comes from outside of the processor. There are two types of interrupt. They are imprecise interrupt and precise interrupt.
20.	**Define Pipeline speedup.**BTL1 The ideal speedup from a pipeline is equal to the number of stages in the pipeline. Speedup= Time per instruction on un pipelined machine/Number of pipe stages .
21.	**What is meant by vectored interrupt?** BTL2 An interrupt for which the address to which control is transferred is determined by the cause of the exception.
22.	**Define exception. (Nov 2014) (May 2016)**BTL1 The term exception is used to refer to any event that causes an interruption otherwise an unexpected change in the control flow. When an exception or interrupt occurs, the hardware begins executing code that performs an action in response to the exception. This action may involve killing a process, outputting a error message, communicating with an external device
23.	**What are R-type instructions? (May 2015)**BTL2 R instructions are used when all the data values used by the instruction are located in registers. All R-type instructions have the following format: OP rd, rs,rt. Where "OP" is the mnemonic for the particular instruction. *rs*, and *rt* are the source registers, and *rd* is the destination register.
24.	**What is a branch prediction buffer? (May 2015)**BTL2 The simplest thing to do with a branch is to predict whether or not it is taken. This helps in pipelines where the branch delay is longer than the time it takes to compute the possible target PCs .
25.	**What is meant by branch prediction? (Nov 2015)**BTL2 Branch Instructions may introduce branch penalty. To avoid it, branch prediction is done by two ways. **Static Branch prediction** The static branch prediction, assumes that the branch will not take place and to continue to fetch instructions in sequential address order. **Dynamic Branch prediction** The idea is that the processor hardware assesses the likelihood of a given branch being taken by keeping track of branch decisions every time that instruction is executed. The execution history used in predicting the outcome of a given branch instruction is the result of the most recent execution of that instruction.
26.	**Write the two steps that are common to implement any type of instruction.(Nov 2018)**
27.	**What is an exception? Give one example for MIPS exception.(Nov 2018)**
28.	**Convert the following code segment in C to MIPS instructions, assuming all variables are in memory and are addressable as offsets from $t0** **a=b + e; c= b + f; (May 2019)**
29.	**Write down the five stages of instruction executions.(May 2019)**
	PART *B

1	**Explain different type of pipeline hazards with suitable example?(13M)(Nov/Dec 2014)**BTL2 **Answer Page : 3.39 – Kanimozhi.** There are situations in pipelining when the next instruction cannot execute in the following clock cycle. These events are called hazards, and there are three different types. **Structural Hazards**(3M) The first hazard is called a structural hazard. It means that the hardware cannot support the combination of instructions that we want to execute in the same clock cycle. The MIPS instruction set was designed to be pipelined, making it fairly easy for designers to avoid structural hazards when designing a pipeline. **Data Hazards**(3M) Data hazards occur when the pipeline must be stalled because one step must wait for another to complete. In a computer pipeline, data hazards arise from the dependence of one instruction on an earlier one that is still in the pipeline. The primary solution is based on the observation that we don't need to wait for the instruction to complete before trying to resolve the data hazard. Adding extra hardware to retrieve the missing item early from the internal resources is called forwarding or bypassing. **Control Hazards**(3M) The third type of hazard is called a control hazard, arising from the need to make a decision based on the results of one instruction while others are executing. Computers use *prediction* to handle branches. **Diagram(**4M) 
2	**Explain in detail how exception are handled n MIPS Architecture?(13M)(April/May 2015)**BTL3 **Answer Page : 3.80 – Kanimozhi.** • Another form of control hazard involves exceptions. For example, suppose the following instruction add $1,$2,$1 has an arithmetic overflow.(2M) • We need to transfer control to the exception routine immediately after this instruction because we wouldn't want this invalid value to contaminate other registers or memory locations.(2M)

	• We must flush the instructions that follow the add instruction from the pipeline and begin fetching instructions from the new address.(2M) • Flush signal is used to prevent the instruction in the EX stage from writing its result in the WB stage.(2M) • We eventually have to complete the instruction that caused the exception as if it executed normally.(2M) • To do this flush the instruction and restart it from the beginning after the exception is handled. The final step is to save the address of the offending instruction in the Exception Program **. Diagram**(3M)S  
3	**Explain data path and its control line in detail with a neat sketch?(13M)(April/May 2017).**BTL2 **Answer Page : 3.9 – Kanimozhi.** • Implementation of instructions (Arithmetic & logic, Memory reference, Branch Instruction)(2M) • Program Counter- It holds the address of the current instruction(2M) • Instruction Memory- It store the instructions of a program • Adders- Used to add 32 bit inputs(2M) • Register File: The processors 32 General Purpose Registers are stored here. • Diagram(7M)



4 **What is pipelining? Discuss about pipeline data path control?(13M)(Nov/Dec2015, April/May 2017)**BTL2

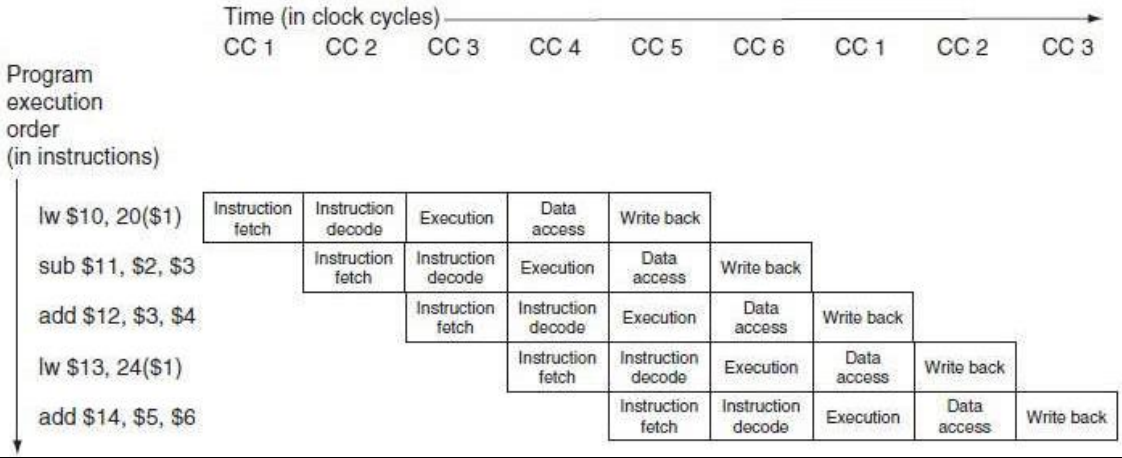
Answer Page: 3.34 – Kanimozhi.

The division of an instruction into five stages means a five-stage pipeline, which in turn means that up to five instructions will be in execution during any single clock cycle.(3M)

We can separate the data path into five pieces, with each piece named corresponding to a stage of instruction execution(5M)

1. IF: Instruction fetch.
2. ID: Instruction decode and register file read
3. EX: Execution or address calculation
4. MEM: Data memory access
5. WB: Write back

Many instructions are simultaneously executing in a single data path in every clock cycle Diagram(5M)



5	**i)Explain the hazards caused by unconditional branching statements.(7M)(April/May 2017)**BTL2 **Answer Page : 3.39 – Kanimozhi.** • Control Hazard occurs when we execute the branch instruction in pipeline process.(1M) • Control Hazards are relatively simple to understand and it occurs less frequently.(1M) • To avoid control hazard in pipeline process, we can use simple method and no need to go for any special technique like data hazard.(2M) • Diagram(3M) **ii)Describe operand forwarding in a pipeline processor with a diagram.(6M))(April/May 2017)**BTL3 • Forwarding is a method used to avoid data hazards in pipelined process.(1M) • Normally the desired result is available at the end of the EX stage or clock cycle 3.(1M) • To perform AND and OR instructions we need the result value at the beginning of the EX stage.(1M) • We can execute this segment without stalls if forwarding the data as soon as it is available to read from the register file.(1M) • Diagram(2M)
6	**List and explain the factors that impacts the designing of Instruction sets for pipelining.(13M)**BTL2 **Answer : Page : 3.34 – Kanimozhi.** • **Length of the Instruction.**(3M) ✓ To perform pipelining in X86 instructions we need to perform following tasks. ✓ X86 architecture translate X86 instructions into simple operations like MIPS instructions. ✓ Then pipeline the simple operations rather than native X86 instructions. • **Instruction Format.(**3M) ✓ If instruction format is symmetry then the second stage can begin reading the file at the same time the hardware is determining what type of instruction was fetched. ✓ If instruction format is asymmetry then we have to split the second stage into two parts. • **Memory Operands.**(3M) ✓ MIPS instruction set has only two memory operand (lw and sw) ✓ It can use the execute stage to calculate the memory address and then access memory in following stage. • **Operand Alignment.**(4M) ✓ Operand must be aligned in memory. ✓ So, we need not worry about a single data transfer instruction requiring two data memory access. ✓ The requested data can be transferred between processor memory in a single pipeline stage.
7.	**Draw a simple MIPS datapath with the control unit and explain the execution of ALU instructions.(Nov 2018)**
8.	**(i) A processor has five individual stages namely, IF, ID, EX, MEM and WB and their latencies are 250ps, 350ps, 150ps, 300ps and 200ps respectively. The frequency of the instructions executed by the processor are as follows ; ALU : 40%, Branch : 25%, load : 20% and store : 15%. What is the clock cycle time in a pipelined and non-pipelined**

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	processor? If you can split one stage of the pipelined datapath into two new stages, each with half the latency of the original stage, which stage would you split and what is the new clock cycle time of the processor? Assuming there are no stalls or hazards, what is the utilization of the data memory? Assuming there are no stalls or hazards, what is the utilization of the write-register port of the "Registers" unit? **(ii) List the hazards in pipelining a processor and give one example for each.(Nov 2018)**
9.	**Explain the basic MIP's implementation with necessary multiplexers and control lines.(May 2019)**
10.	**Explain how the instruction pipeline works? What are the various situation where an instruction pipeline stalls? Illustrate with an example.(May 2019)**
	PART – C
1	**A pipelined processor used delayed branch technique, Recommended any one of the following possibility for the design of the design of the processor. In the first possibility ,the processor has a 4 stage pipeline and one delay slot. In the second possibility it has a 6 stage pipeline and two delay slots. Compare the performance of two alternatives,taking only the branch penalty into account. Assume that 20% of the instructions are branch instructions and that an optimizing compiler has an 80% success rate in filling in the single delay slot. For the second alternative, the compiler is able to fill the second slot 25% of the time.(15M)(April/May 2017)**BTL6 **Answer Page : 3.37 – Kanimozhi.** The instructions and the clock cycles are given below.(8M) • beq $s1.$s2,L1 • add $s4,$s5,$s6 • lw $s3,300($s0) • lw $s7,400($s0) • lw $s8,500($s0) • There is a branch delay slot in the second instruction. Diagram(7M)
2	**Consider the following code segment in C:A=B+E;C=B+F (15M)**BTL6 **Answer Page : 3.42 – Kanimozhi.** Here is the generated MIPS code for this segment,assuming all variables are in memory and are addressable as offsets from $t0: Lw $t1,0($t0) Lw $t2,4($t0) Add$t3,$t1,$t2 Sw$t3,12($t0) Lw$t4,8($t0) Add$t5,$t1,$t4 Sw$t5,16($t0) Find the hazard in the preceding code segment and reorder the instructions to avoid any pipeline stalls. **Answer:** In that code we have two add instructions.(8M) • Both add instructions have a hazard because of their respective dependence on the

IF	ID	EX	ME	WB			
	IF	ID	EX	ME	WB		
		IF	ID	EX	ME	WB	
			IF	ID	EX	ME	WB

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	immediately preceding lw instruction. • Bypassing eliminates several other hazards ,including the dependence of the first add on the first lw and any hazard for store instructions. • Moving up the third lw instruction to become the third instruction eliminates both hazards. Lw $t1,0($t0)(7M) Lw $t2,4($t0) Lw$t4,8($t0) Add$t3,$t1,$t2 Sw$t3,12($t0) Add$t5,$t1,$t4 Sw$t5,16($t0)
3	**Consider the following sequence of instruction and shows what happens when the branch is taken, assuming the pipeline is optimized for branches that are not taken and that we moved the branch execution to the ID stage.(15M)** **Answer Page : 3.76 – Kanimozhi.** 36 sub $s10,$s4,$s8 40 beq $s1,$s3,7# PC – Relative branch to 40+4+7*4=72 44 and $s12,$s2,$s5 48 or $s13,$s2,$s6 52 add $s14,$s4,$s2 56 slt $s15,$s6,$s7 72 lw$s4,50($s7) **Answer:** • The ID stage of clock cycle 3 determines that a branch must be taken.(3M) • So it selects 72 as the next PC address and zeros the instruction fetched for the next clock cycle.(2M) • Clock cycle 4 shows the instruction at location 72 being fetched and single bubble or nop instruction in the pipeline as a result of the taken branch.(3M) • NOP is an instruction that has no action and changes no state.(3M) • To flush instructions in the IF stage IF. Flush control lines are used.(2M) • This control lines zeros the instruction field of the IF/ID pipeline register.(2M)

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UNIT IV PARALLELISM	
Parallel processing challenges – Flynn's classification – SISD, MIMD, SIMD, SPMD, and Vec Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocess - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Messa Passing Multiprocessors.	
PART* A	
Q.NO	**QUESTIONS**
1.	**What is Instruction level parallelism? (Nov 2015) (May 2016)**BTL1 ILP is a measure of how many of the operations in a computer program can be performed simultaneously. The potential overlap among instructions is called instruction level parallelism. There are two primary methods for increasing the potential amount of instruction-level parallelism. 1. Increasing the depth of the pipeline to overlap more instructions. 2. Multiple issue.
2.	**Define Static multiple issue.**BTL1 It is an approach to implementation multiple-issue processor where many decisions are made by the compiler before execution.
3.	**Define Dynamic multiple issue.**BTL1 It is an approach to implementation multiple-issue processor where many decisions are made during execution by the processor.
4.	**What is Speculation?**BTL2 One of the most important methods for finding and exploiting more ILP is speculation. It is an approach whereby the compiler or processor guesses the outcome of an instruction to remove it as dependence in executing other instructions. For example, we might speculate on the outcome of a branch, so that instructions after the branch could be executed earlier.
5.	**What is Loop unrolling?**BTL2 It is a technique to get more performance from loops that helps in accessing the arrays, in which multiple copies of the loop body are made and instructions from different iterations are scheduled together.
6.	**Define Register renaming.**BTL1 The renaming of registers is done by the compiler or hardware to remove anti-dependences. renaming removes WAW/WAR hazard.

7.	**Define a superscalar processor. (Nov 2015)**BTL1 Superscalar is an advanced pipelining technique that enables the processor to execute more than one instruction per clock cycle by selecting them during execution. Dynamic multiple-issue processors are also known as superscalar processors, or simply superscalars.
8.	**Define Commit unit.**BTL1 It is a unit in a dynamic or out-of-order execution pipeline that decides when it is safe to release the result of an operation to programmer visible registers and memory.
9.	**Define Reorder buffer.**BTL1 The buffer that holds results in a dynamically scheduled processor until it is safe to store the results to memory or a register.
10.	**Define Out of order execution.**BTL1 A situation in pipelined execution when an instruction blocked from executing does not cause the following instructions to wait.
11.	**What is In order commit?**BTL2 It is a commit in which the results of pipelined execution are written to the programmer visible state in the same order that instructions are fetched.
12	**Differentiate between Strong scaling and weak scaling.(May 2015)**BTL4 **Strong scaling:** Speed-up is achieved on a multi-processor without increasing the size of the problem. **sWeak scaling:** Speed-up is achieved on a multi-processor while increasing the size of the problem proportionally to the increase in the number of processors.
13	**Define Single Instruction, Single Data stream (SISD).**BTL1 A sequential computer which exploits no parallelism in either the instruction or data streams. Single control unit (CU) fetches single Instruction Stream (IS) from memory. The CU then generates appropriate control signals to direct single processing element (PE) to operate on single Data Stream (DS) i.e. one operation at a time. Examples of SISD architecture are the traditional uniprocessor machines like a PC
14	**Define Single Instruction, Multiple Data streams (SIMD).**BTL1 A computer which exploits multiple data streams against a single instruction stream to perform operations which may be naturally parallelized. For example, an array processor.
15	**Define Multiple Instruction, Single Data stream (MISD).**BTL1 Multiple instructions operate on a single data stream. It is uncommon architecture which is generally used for fault tolerance. Heterogeneous systems operate on the same data stream and must agree on the result. Examples include the Space Shuttle flight control computer.
16	**Define Multiple Instruction, Multiple Data streams (MIMD).**BTL1 Multiple autonomous processors are simultaneously executing different instructions on different data. Distributed systems are generally recognized to be MIMD architectures; either exploiting a single shared memory space or a distributed memory space. A multi-core superscalar processor is an MIMD processor.
17	**What is Fine grained multithreading? (May 2016)**BTL2 Switches between threads on each instruction, causing the execution of multiples threads to be interleaved, Usually done in a round-robin fashion, skipping any stalled threads CPU must be able to switch threads every clock
18.	**What is Coarse grained multithreading?**BTL2 In coarse grained multithreading superscalar ,the long stalls are partially hidden by switching to another thread that uses the resources of the processor. Switches threads only on costly stalls, such as L2 cache misses.
19.	**Define Multi core processors.**BTL1 A multi-core processor is a processing system composed of two or more independent cores. The cores are typically integrated onto a single integrated circuit die or they may be integrated onto multiple dies in a single chip package.

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20.	**What is symmetric multi-core processor?**BTL2 A symmetric multi-core processor is one that has multiple cores on a single chip, and all of those cores are identical. Example: Intel Core 2.
21.	**What is asymmetric multi-core processor?**BTL2 In an asymmetric multi-core processor, the chip has multiple cores onboard, but the cores might have different designs. Each core will have different capabilities
22.	**Define multithreading. (Nov 2014)**BTL1 Multiple threads to share the functional units of 1 processor via overlapping processor must duplicate independent state of each thread e.g., a separate copy of register file, a separate PC, and for running independent programs, a separate page table memory shared through the virtual memory mechanisms, which already support multiple processes
23.	**What is the need for Speculation? (Nov 2014)**BTL2 It is one of the most important methods for finding and exploiting more ILP. It is an approach that allows the compiler or the process to guess about the properties of an instruction, so as to enable execution to begin for other instructions that may depend on the speculated instruction.
24.	**What is Flynn's Classification? (Nov 2014)**BTL2 Michael Flynn uses the stream concept for describing a machine's structure. A stream is nothing but a sequence of items (data or instruction). The parallelism in the instruction and data stream called for by the instruction at the most constrained of the multiprocessor and placed all computers into one to four categories. • Single Instruction, Single Data stream (SISD) • Single Instruction, Multiple Data streams (SIMD) • Multiple Instruction, Single Data stream (MISD) • Multiple Instruction, Multiple Data streams (MIMD)
25.	**Compare UMA and NUMA multiprocessors.(May 2015)**BTL4 The main difference between the NUMA and UMA memory architecture is the location of the Memory. The UMA architecture nodes have first and second cache memory levels joint with the processor, next levels of the memory hierarchy are "in the other side" of the interconnection network.
26.	**Web server is to be enhanced with a new CPU which is 10 times faster on computation than old CPU. The original CPU spent 40% of its time processing and 60% of its time waiting for I/O. What will be the overall speedup?(Nov 2018)**
27.	**Classify shared memory multiprocessor based on the memory access latency.(Nov 2018)**
28.	**List the four multicore systems.(May 2019)**
29.	**What is shared memory multiprocessor?(May 2019)**
	PART *B

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1	**Explain Instruction level parallel processing? State the challenges of Parallel processing?(13M)(April/May 2017,Nov/Dec 2014)**BTL2 **Answer page : 148 – Patterson.** • Pipelining exploits the potential parallelism among instructions. This parallelism is called **instruction-level parallelism** (ILP). There are two primary methods for increasing the potential amount of instruction-level parallelism.(2M) • The first is increasing the depth of the pipeline to overlap more instructions.(2M) • We would then move from a four-stage to a six stage pipeline. The amount of parallelism being exploited is higher, since there are more operations being overlapped. Performance is potentially greater since the clock cycle can be shorter.(2M) • Another approach is to replicate the internal components of the computer so that it can launch multiple instructions in every pipeline stage. The general name for this technique is **multiple issue**. • There are two primary and distinct responsibilities that must be dealt with in a multiple-issue pipeline.(2M) • Packaging instructions into **issue slots** • Dealing with data and control hazards: • **Speculation** is an approach that allows the compiler or the processor to "guess" about the properties of an instruction, so as to enable execution to begin for other instructions that may depend on the speculated instruction(2M) • Static Multiple Issue-Static multiple-issue processors all use the compiler to assist with packaging instructions and handling hazards. In a static issue processor, you can think of the set of instructions that issue in a given clock cycle, which is called an **issue packet**, as one large instruction with multiple operations.(3M)
2	**Explain Flynn's classification in detail? Or Discuss about SISD, SIMD, MISD, MIMD ?(13M)(April/May 2017)**BTL2 **Answer Page 262 - Patterson** **SISD (Single Instruction, Single Data stream)**(4M) • It is an Instruction Set Architecture in which a single processor (one CPU) executes exactly one instruction stream at a time. • It also fetches or stores one item of data at a time to operate on data stored in a single memory unit. **SIMD (Single Instruction, Multiple Data streams)**(5M) • It is an Instruction Set Architecture that have a single control unit (CU) and more than one processing unit(PU). • It operates by executing a single instruction stream over multiple PU's. • The CU generates the control signals for all of the PUs and by which executes the same operation on different data streams. **MIMD(Multiple Instruction, Multiple Data streams)**(4M) • It is an Instruction Set Architecture for parallel computing usually used in computers with multiprocessors. • Here, each processor in a multiprocessor system can execute asynchronously different set of the instructions independently on the different set of data units. • The MIMD based computer systems can used the shared memory in a memory pool or work using distributed system.

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3	**What is Hardware multithreading? Explain its type in detail?(13M)(April/May 2017, Nov/Dec 2014)**BTL2 **Answer Page : 167 – Patterson.** **Multi-threading (MT)**(1M) Multithreading allows overlap of memory access of one thread/process with computation by another thread / process. It improve utilization by multiplexing multiple threads on single core. If one thread cannot fully utilize core we can have more than one thread. Three designs • Coarse-grain multithreading (CGMT) • Fine-grain multithreading (FGMT) • Simultaneous multithreading (SMT) **Coarse-Grain Multi-Threading (CGMT)**(4M) • It follows Priority thread scheduling policy • It designates a "preferred" thread (e.g., thread A) and then switch to thread B on thread A cache miss again switch back to A when A cache miss returns. • Example: IBM Northstar/Pulsar **Fine-Grain Multithreading (FGMT)**(4M) • If we have so many threads that never stall on cache misses then we have to apply Thread scheduling policy • Here we Switch threads every cycle (round-robin). Here we need a lot of threads • Extreme example: Denelcor HEP, Tera MTA **Simultaneous Multithreading (SMT)**(4M) • Here we can issue instructions from multiple threads in one cycle. • It needs more hardware support. • It maximizes utilization of execution units. • IBM Power5: 4-way issue, 2 threads
4	**Explain multi core processors.(13M) (Nov/Dec 2014)**BTL2 **Answer Page : 264 – Patterson.** • Processors communicate through shared variables in memory, with all processors capable of accessing any memory location via loads and stores.(3M) • **Uniform Memory Access (UMA)** A multiprocessor in which latency to any word in main memory is about the same no matter which processor requests the access.(2M) • **Non uniform Memory Access (NUMA)** A type of single address space multiprocessor in which some memory accesses are much faster than others depending on which processor asks for which word.(2M) • **Synchronization** The process of coordinating the behavior of two or more processes, which may be running on different processors.(3M) • **Lock** A synchronization device that allows access to data to only one processor at a time.(3M)
5	**Explain in detail about graphics processing Unit and compare CPU with GPU.(13M)**BTL4 **Answer Page : 288 – Patterson.** **GPU**(8M) • A graphics processing unit (GPU) is a computer chip that performs rapid mathematical calculations, primarily for the purpose of rendering images. • In the early days of computing, the control processing unit (CPU) performed these calculations. • As more graphics-intensive applications such as AutoCAD were developed; however,

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	their demands put strain on the CPU and degraded performance. GPUs came about as a way to offload those tasks from CPUs, freeing up their processing power. • A GPU may be found integrated with a CPU on the same circuit, on a graphics card or in the motherboard of a personal computer or server. • NVIDIA, AMD, Intel and ARM are some of the major players in the GPU market. **GPU vs. CPU**(7M) • A graphics processing unit is able to render images more quickly than a central processing unit because of its parallel processing architecture, which allows it to perform multiple calculations at the same time. • A single CPU does not have this capability, although multi core processors can perform calculations in parallel by combining more than one CPU onto the same chip. A CPU also has a higher clock speed, meaning it can perform an individual calculation faster than a GPU. Therefore, a CPU is often better equipped to handle basic computing tasks.
6	**Explain about warehouse scale computers in detail.(13M)**BTL2 **Answer page : 138 - Notes** • A cluster is a collection of desktop computers or servers connected together by a local area network to act as a single larger computer.(2M) • A warehouse-scale computer (WSC) is a cluster comprised of tens of thousands of servers.(1M) • The cost may be on the order of $150M for the building, electrical and cooling infrastructure, the servers, and the networking equipment that houses 50,000 to 100,000 servers.(1M) • A WSC can be used to provide internet services search – Google social networking – Face book video sharing – You Tube online sales – Amazon cloud computing services – Rack space and many more applications(2M) • WSC goals and requirements in common with servers.(1M) • cost- performance - work done per dollar energy efficiency - work done per joule dependability via redundancy network I/O interactive and batch processing workloads. • WSC aspects that are distinct from servers.(2M) • Ample parallelism is always available in a WSC.(1M) • Operational costs represent a greater fraction of the cost of a WSC.(1M) • Customization is easier for the scale of an WSC.(2M)
7.	**(i) List the software and hardware techniques to achieve Instruction Level Parallelism(ILP)** **(ii) Discuss the challenges in parallel processing in enhancing computer architecture.(Nov 2018)**
8.	**(i) Explain any three types of hardware multithreading.** **(ii) Define the classes in Flynn's Taxonomy of computer architectures. Give one example for each class. (Nov 2018)**
9.	**Explain in detail Flynn's classification of parallel hardware.(May 2019)**
10.	**Discuss the principle of hardware multithreading and elaborate its types.(May 2019)**
	PART – C
1	**Suppose you want to achieve a speed up to 90 times faster with 100 processors. What percentage of the original computation can be sequential?(15M)**BTL6 **Answer Page : 4.14 – Kanimozhi.** **Solution:**

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	• Amdahl's law says that(3M) Execution time after improvement = [Execution time affected by improvement/Amount of improvement] + Amount of Improvement. • We can reformulate Amdahl's Law in terms of speed up versus the original execution time.(3M) Speedup = [Execution time before/(Execution Time before – Execution time(affected)]+[Execution time affected/Amount of improvement]=1 (4M) $90 = \frac{1}{(1-\text{Fraction time affected})+\frac{\text{Fraction Time Affected}}{\text{Amt of improvement}}}$ (3M) 90-1 = 90 * 0.99 * fraction time affected Fraction Time Affected= 89/89.1 = 0.999(2M) Thus, to achieve a speed up of 90 from 100 processors , the sequential percentage can be 0.1%
2	**Suppose we want to perform two sums : one is a sum of 10 scalar variables and one is a matrix sum of a pair of two dimensional arrays, with dimensions 10 by 10. For now let's assume only the matrix sum is parallelizable. What speed up do you get with 10 versus 40 processors? Next calculate the speed ups assuming the matrices grow to 20 by 20.(15M)**BTL6 **Answer Page : 4.15 – Kanimozhi.** **Solution:** • If we assume performance is a function of the time for an addition , t ,then there are 10 additions that do not benefit from parallel processors and 100 additions that do.(3M) • If the time for a single processor is 110t,the execution time for 10 processor is (2M) Execution time after improvement = [Execution Time affected by improvement/Amount of improvement]+Amount of improvement Execution time after improvement =100t/10 +10t=20t So the speed up with 10 processors is 110t/20t=5.5. The Execution time for 40 processors is 110t/12.5t=8.8t.(4M) • Thus for this problem size , we get about 55% of the potential speedup with 10 processors, but only 225 with 40.(2M) • If we increase the matrix then the sequential program now takes 10t + 400 t=410t. • The execution time for 10 processors = 400t (2M) ------ + 10t = 50t 10 • So, the speed up with 10 processors is 410 t / 20 t = 20.5. • Thus ,for this larger problem size, we get 82% of the potential speed up with 10 processors and 51% with 40processors.(2M)
3	**To achieve the speedup of 20.5 on the previous larger problem with 40 processors, we assumed the load was perfectly balanced. That is , each of the 40 processors, we assumed the load was perfectly balanced. That is , each of the 40 processors had 2.5% of the work to do. Instead show the impact on speed up if one processor load is higher than all the rest. Calculate at twice the load (5%) and five times the load (12.5) for the hardest working processor. How well utilized are the rest of the processors?(15M)**BTL6 **Answer Page : 4.16 - Kanimozhi** **Solution:** • If one processor has 5% of the parallel load , then it must do 5% * 400 or 20 additions and the other 39 will share the remaining 380. Since thy are operating simultaneously, we can

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	just calculate the execution time as a maximum.(4M) • Execution time after improvement = Max(380t/39, 20t/l)+10t = 30t • The speed up drops from 20.5 to 410 t/30t = 14. The remaining 39 processors are utilized less than half the time. • While waiting 20t for hardest working processor to finish , they only compute for 380 t / 39 = 9.7 t.(4M) • If one processor has 12.5 % of the load , it must perform 50 addition. • The formula is Execution utilized less than 20 % of time after improvement = Max (350t/39,50t/l)+10t = 60t(4M) • The speed up drops even further to 410 t/60 t = 7. • The rest of the processors are utilized less than 20% of the time (9 t / 50 t).(3M) • This example demonstrates the importance of load balancing. • For a single processor, with twice the load of other cuts speed up by a third and five times the load on just one processor reduces speed by almost a factor of three.

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UNIT V MEMORY AND I/O SYSTEMS	
Memory Hierarchy - memory technologies – cache memory – measuring and improving cache performanc virtual memory, TLB's – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – E operation – Arbitration – Interface circuits - USB.	
PART* A	
Q.NO	**QUESTIONS**
1.	**State is principle of locality?**BTL1 The principle of locality states that programs access a relatively small portion of their address space at any instant of time. Two different types of locality have been observed: **Temporal locality**: states that recently accessed items are likely to be accessed in the near future. **Spatial locality:** says that items whose addresses are near one another tend to be referenced close together in time.
2.	**Define temporal locality.**BTL1 The principle stating that a data location is referenced then it will tend to be referenced again soon. Temporal locality is found in instruction loops, data stacks and variable accesses
3.	**Define spatial locality.**BTL1 The locality principle states that if a data location is referenced, data locations with nearby addresses will tend to be referenced soon.
4.	**What is the need to implement Memory as Hierarchy?(April/May 2015)**BTL3 • It is a structure that uses multiple levels of memory with different speeds and sizes. • The memory unit is a essential component in a digital computer since it is needed for storing program and data. • They are used for storing system programs, large data files, and other backup information. Only programs and data currently needed by the processor reside in main memory.
5.	**Define Hit and Miss.**BTL1 The performance of cache memory is frequently measured in terms of a quantity called hit ratio. When the CPU refers to memory and finds the word in cache, it is said to produce a hit. If the word is not found in cache, then it is in main memory and it counts as a miss.
6.	**What is cache memory?**BTL2 It is a fast memory that is inserted between the larger slower main memory and the processor. It holds the currently active segments of a program and their data.
7.	**What is Direct mapped cache?**BTL2 Direct-mapped cache is a cache structure in which each memory location is mapped to exactly one location in the cache. For example, almost all direct mapped caches use this mapping to find a block, (Block address) modulo (Number of blocks in the cache)
8.	**Define write through.**BTL1 It is a scheme in which writes always update both the cache and the next lower level of the memory hierarchy, ensuring the data is always consistent between the two.
9.	**Define write buffer.**BTL1 It is a queue t\hat holds data while the data is waiting to be written to memory.
10.	**What is write-back?**BTL2 It is a scheme that handles writes by updating values only to the block in the cache, then writing the modified block to the lower level of the hierarchy when the block is replaced.

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11.	**Define virtual memory.**BTL1 The data is to be stored in physical memory locations that have addresses different from those specified by the program. The memory control circuitry translates the address specified by the program into an address that can be used to access the physical memory
12	**Distinguish between memory mapped I/O and I/O mapped I/O.**BTL4 **Memory mapped I/O:** When I/O devices and the memory share the same address space, the arrangement is called memory mapped I/O. The machine instructions that can access memory is used to transfer data to or from an I/O device. **I/O mapped I/O:** Here the I/O devices the memories have different address space. It has special I/O instructions. The advantage of a separate I/O address space is that I/O devices deals with fewer address lines.
13	**How does a processor handle an interrupt?**BTL2 Assume that an interrupt request arises during execution of instruction i. steps to handle interrupt by the processor is as follow: 1. Processor completes execution of instruction i 2. Processor saves the PC value, program status on to stack. 3. It loads the PC with starting address of ISR 4. After ISR is executed, the processor resumes the main program execution by reloading PC with (i+1) th instruction address.
14	**What is SCSI?**BTL2 Small Computer System Interface, a parallel interface standard. SCSI interfaces provide for faster data transmission rates (up to 80 megabytes per second) than standard serial and parallel ports. In addition, you can attach many devices to a single SCSI port, so that SCSI is really an I/O bus rather than simply an interface.
15	**Define USB.**BTL1 Universal Serial Bus, an external bus standard that supports data transfer rates of 12 Mbps. A single USB port can be used to connect up to 127 peripheral devices, such as mice, modems, and keyboards. USB also supports Plug-and-Play installation and hot plugging.
16	**Distinguish between isolated and memory mapped I/O.**BTL4 The **isolated I/O** method isolates memory and I/O addresses so that memory address values are not affected by interface address assignment since each has its own address space. In **memory mapped I/O**, there are no specific input or output instructions. The CPU can manipulate I/O data residing in interface registers with the same instructions that are used to manipulate memory words.
17	**What is meant by vectored interrupt?** BTL2 Vectored Interrupts are type of I/O interrupts in which the device that generates the interrupt request (also called IRQ in some text books) identifies itself directly to the processor.
18.	**Compare Static RAM and Dynamic RAM.**BTL4 **Static RAM** is more expensive, requires four times the amount of space for a given amount of data than dynamic RAM, but, unlike dynamic RAM, does not need to be power-refreshed and is therefore faster to access. One source gives a typical access time as 25 nanoseconds in contrast to a typical access time of 60 nanoseconds for dynamic RAM. (More recent advances in dynamic RAM have improved access time.) Static RAM is used mainly for the level-1 and level-2 caches that the microprocessor looks in first before looking in dynamic RAM. **Dynamic RAM** uses a kind of capacitor that needs frequent power refreshing to retain its charge. Because reading a DRAM discharges its contents, a power refresh is required after each read. Apart from reading, just to maintain the charge that holds its content in place, DRAM must be refreshed about every 15 microseconds. DRAM is the least expensive kind of RAM.
19.	**What is DMA? (Nov 2014)**BTL2 DMA (Direct Memory Access) provides I/O transfer of data directly to and from the memory unit and the peripheral. The following DMA transfer combinations are possible: • Memory to memory • Memory to peripheral

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	• Peripheral to memory • Peripheral to peripheral
20.	**Differentiate Programmed I/O and Interrupt I/O. (Nov/Dec 2014)**BTL4 In programmed I/O all data transfers between the computer system and external devices are completely controlled by the computer program. Part of the program will check to see if any external devices require attention and act accordingly. Interrupt I/O is a way of controlling input/output activity in which a peripheral or terminal that needs to make or receive a data transfer sends a signal that causes a program interrupt to be set.
21.	**What is the purpose of Dirty/Modified bit in Cache memory? (Nov /Dec 2014)**BTL2 During Write back the information is written only to the block in the cache. The modified cache block is written to main memory only when it is replaced. To reduce the frequency of writing back blocks on replacement, a dirty bit is commonly used. This status bit indicates whether the block is dirty (modified while in the cache) or clean (not modified). If it is clean the block is not written on a miss.
22.	**Point out how DMA can improve I/O speed?(May /June 2015)**BTL2 Direct memory access (DMA) is a feature of computer systems that allows certain hardware subsystems to access main system memory (RAM) independently of the central processing unit (CPU).
23.	**Differentiate physical address from logical address.**BTL4 Physical address is an address in main memory. Logical address (or) virtual address is the CPU generated addresses that corresponds to a location in virtual space and is translated by address mapping to a physical address when memory is accessed.
24.	**What are the various memory technologies? (Nov /Dec 2015)**BTL2 • SRAM, • DRAM, • Magnetic Disks
25.	**Define Hit ratio. (Nov/Dec 2015)**BTL1 The **hit rate**, or hit ratio, is the fraction of memory accesses found in the upper level; it is often used as a measure of the performance of the memory hierarchy.
26.	**Draw the memory hierarchy in a typical computer system.(Nov 2018)**
27.	**What is meant by memory-mapped I/O?(Nov 2018)**
28.	**Draw the basic structure of a memory hierarchy.(May 2019)**
29.	**How many total bits are required for a direct-mapped cache with 16KB of data and 4-word blocks, assuming a 32-bit address?(May 2019)**
	PART *B
1	**Explain mapping function in cache memory to determine how memory blocks are placed in cache?(13M)(Nov /Dec 2016)**BTL2 **Answer Page : 5.17 – Kanimozhi.** **Cache Memories**(3M) The cache is a small and very fast memory, interposed between the processor and the main memory. Its purpose is to make the main memory appear to the processor to be much faster than it actually is. There are several possible methods for determining where memory blocks are placed in the cache. **Direct Mapping**(3M) In this technique, block *j* of the main memory maps onto block *j* modulo 128 of the cache, as depicted in Thus, whenever one of the main memory blocks 0, 128, 256, . . . is loaded into the cache, it is

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	stored in cache block 0. Blocks 1, 129, 257, . . . are stored in cache block 1, and so on. **Associative-mapping**(3M) It is the most flexible mapping method, in which a main memory block can be placed into any cache block position. Here, 12 tag bits are required to identify a memory block when it is resident in the cache. It gives complete freedom in choosing the cache location in which to place the memory block, resulting in a more efficient use of the space in the cache **Set-Associative Mapping**(4M) Here we use a combination of the direct- and associative-mapping techniques. The blocks of the cache are grouped into sets, and the mapping allows a block of the main memory to reside in any block of a specific set.
2	**Explain in detail about bus Arbitration techniques in DMA?(13M)(April /May 2016)**BTL2 **Answer Page :5.70 – Kanimozhi.** • Trying to get access to a bus at the same time, but access can be given to only one of these. • Only one processor or controller can be **bus master.** • The bus master— it is the controller that has access to a bus at an instance. • Any one controller or processor can be the bus master at the given instance • Bus arbitration process refers to a process by which the current bus master accesses and then leaves the control of the bus and passes it to another bus-requesting processor unit. **Three bus arbitration processes**(4M) • Daisy Chain • Independent Bus Requests and Grant • Polling **Daisy Chain Method**(3M) • A method for a centralized bus arbitration process • The bus control passes from one bus master to the next one, then to the next and so on **Independent bus request method**(3M) • Controller separate BR signals, BR0, BR1,…, BRn. • Separate BG signals, BG0, BG1, …, BGn for the controllers. • Any controller, which finds active BUSY, does not send BR from it. **Bus polling method**(3M) • The bus control passes from one processor (bus controller) to another only through the centralized bus controller, but only when the controller sends poll count bits, which correspond to the unit number.
3	**Elaborate on the various memory technologies and its relevance?(13M)(April /May 2017)**BTL2 **Answer Page : 5.11 - Kanimozhi** **Static Memories**(3M) • Static RAMs can be accessed very quickly. Continuous power is needed for the cell to retain its state. • If power is interrupted, the cell's contents are lost. **Dynamic RAMs**(3M) • DRAM cells do not retain their state for a long period, unless they are accessed frequently for • Read or Write operations. Memories that use such cells are called dynamic RAMs

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	(DRAMs) **Synchronous DRAMs**(3M) • DRAMs operation is synchronized with a clock signal. Such memories are known as synchronous DRAMs (SDRAMs). **DDR SDRAMs**(2M) • To make the best use of the available clock speed, data are transferred externally on both the rising and falling edges of the clock. For this reason, memories that use this technique are called double-data-rate SDRAMs (DDR SDRAMs). **Rambus Memory**(2M) • Rambus is a memory technology that achieves a high data transfer rate by providing a high-speedinterface between the memory and the processor. • One way for increasing the bandwidth of this connectionis to use a wider data path. However, this requires more space and more pins, increasing system cost. The alternative is to use fewer wires with a higher clock speed. This is the approach taken by Rambus.
4	**What is Virtual memory? Explains the steps involved in virtual memory address translation?(13M)(April/May2017),**BTL2 **Answer Page : 5.43 - Kanimozhi** **Explanation:** (7M) • Virtual memory as an alternate set of memory addresses. • Programs use these virtual addresses rather than real addresses to store instructions and data. • When the program is actually executed, the virtual addresses are converted into real memory addresses. • When a computer is executing many programs at the same time, Virtual memory make the computer to share memory efficiently. • To facilitate copying virtual memory into real memory, the operating system divides virtual memory into pages, each of which contains a fixed number of addresses. • Each page is stored on a disk until it is needed. • When the page is needed, the operating system copies it from disk to main memory, translating the virtual addresses into real addresses. • MMU is the hardware base that makes a virtual memory system possible. • MMU allows software to reference physical memory by virtual addresses, quite often more than one. It accomplishes this through the use of page and page tables. • Paging is a technique used by virtual memory operating systems to help ensure that the data you need is available as quickly as possible. • In paging the operating system copies a certain number of pages from your storage device to main memory. • When a program needs a page that is not in maim memory, the operating system copies the required page into memory and copies another page back to the disk. **TLBs:** (6M) • A way to speed up translation is to use a special cache of recently used page table entries this has many names, but the most frequently used is Translation Look aside Buffer or TLB.
5	**Explain about DMA controller with the help of neat diagram?(13M)(Nov/Dec2016)**BTL2 **Answer page : 5.70 – Kanimozhi.** **Explanation:**(8M) • DMA based method useful, when a block of bytes are transferred, for example, from disk

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	to the RAM or RAM to the disk. • Repeatedly interrupting the processor for transfer of every byte during bulk transfer of data will waste too much of processor time in context switching. • System performance improves by separate processing of the transfers from and to the peripherals. • DMA controller operates under the control of an operating system routine. To initiate the transfer of a block of words, the processor sends to the DMA controller the starting address, the number of words in the block, and the direction of the transfer. • The DMA controller then proceeds to perform the requested operation. When the entire block has been transferred, it informs the processor by raising an interrupt. • **Example** : (5M) • The DMA controller registers that are accessed by the processor to initiate data transfer operations. • A graphics processing unit is able to render images more quickly than a central processing unit because of its parallel processing architecture, which allows it to perform multiple calculations at the same time. • A single CPU does not have this capability, although multi core processors can perform calculations in parallel by combining more than one CPU onto the same chip. • A CPU also has a higher clock speed, meaning it can perform an individual calculation faster than a GPU. Therefore, a CPU is often better equipped to handle basic computing tasks.
6	**Explain in detail about any two standard input and output interfaces required to connect the I/O device to the bus.(13M)(Nov/Dec 2017)**BTL2 **Answer Page : 5.60 - Kanimozhi** • The main data processing functions of a computer involve its CPU and external memory M. • The CPU fetches instructions and data from memory M, Processes them and eventually stores the results back in M. • The other system components like secondary memory, user interface devices etc constitute the Input – Output (IO) system. **IO CONTROL METHODS:** (4M) • Input – output operations are distinguished based on the involvement of CPU in its execution.IO operations refers to data transfer between an IO device and M or between an IO device and the CPU. **PROGRAMMED IO:** (3M) • IO operations are completely controlled by the CPU then the CPU executes programs that initiates, direct and terminate the IO operations , the computer is said to be using programmed IO. **DIRECT MEMORY ACCESS:** (3M) • A modern hardware design enables an IO device to transfer a block of information to or from M without CPU intervention. • This task requires the IO device to generate memory addresses and transfer data to or from the bus connecting it to M via its interface controller. **DMA Controller:** (3M) • DMA controller also provides service from the CPU that is execution of a specific program to service an IO device. • This type of request is called an interrupt and it frees the CPU from the task of periodically testing the status of IO devices.

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7.	**(i) Discuss the three mapping techniques in memory hierarchy. Explain with examples.** **(ii) Define Translation Lookaside Buffer(TLB). What is its use?(Nov 2018)**
8.	**Explain mechanisms Direct Memory Access and Interrupt handling.(Nov 2018)**
9.	**Explain the various mapping functions that can be applied on cache memories in detail.(May 2019)**
10.	**(i) With a neat sketch explain the working principle of DMA.(May 2019)** **(ii) Explain about input-output processor(IOP).**

PART – C

1	**Assume the miss rate of n instruction cache is 2% and the miss rate of the data cache is 4%. If a processor has a CPI of 2 without any memory stalls and the miss penalty is 100 cycles for all misses, determine how much faster a processor would run with a perfect cache that never missed. Assume the frequency of all loads and stores is 36%.(15M)(April /Dec 2015),**BTL6 **Answer Page :5.31 – Kanimozhi.** Miss rate of an instruction cache is 2% (3M) Miss rate of the data cache is 4% Processor – CPI without any memory stall is 2 Frequency of loads and stores is 36%(3M) The number of memory miss cycles for instructions in terms of the instruction count (I) is Instruction miss cycles = 2% * 100 = 2.00 I As the frequency of all loads and stores is 36% we can find the number of memory miss cycles for data references. Data Miss Cycles , I = 36%*4%*100 = 1.44 I The total number of memory stall is 2.00 I + 1.44 I = 3.44 I(3M) This is more than three cycles of memory stall per instruction.(3M) The total CPI including memory stall is 2+3.44 = 5. 44 I Since there is no change in instruction count or clock rate , the ratio of the CPU execution time is(3M) $\frac{\text{CPU Times with stalls}}{\text{CPU time with perfect cache}} = \frac{I * CPI_{stalls} * \text{Clock Cycles}}{I * CPI_{perfect} * \text{Clock Cycle}}$ $= \frac{CPI_{stall}}{CPI_{perfect}} = 5.44/2 = 2.72$
2	**Find the AMAT for a processor with a 1 ns clock cycle time, a miss penalty of 20 clock cycle, a miss rate of 0.05 misses per instruction and a cache access time (including hit detection) of 1 clock cycle. Assume that the read and write miss penalties are the same and ignore other write stalls.(15M)(April/May 2016)**BTL6 **Answer page : 5.33 – Kanimozhi.** The average memory access time per instruction is AMAT = Time for hit + miss rate * miss penalty(8M) = 1+0.05 * 20(4M) = 2 clock cycles or 2 ns(3M)
3	**To achieve the speedup of 20.5 on the previous larger problem with 40 processors, we assumed the load was perfectly balanced. That is , each of the 40 processors, we assumed the lload was perfectly balanced. That is , each of the 40 processors had 2.5% of the work to do. Instead show the impact on speed up if one processor load is higher than all the rest. Calculate at**

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	twice the load (5%) and five times the load (12.5) for the hardest working processor. How well utilized are the rest of the processors?(15M)(BTL6)S **Answer Page : 5.5 – Kanimozhi.** **Solution:** • If one processor has 5% of the parallel load , then it must do 5% * 400 or 20 additions and the other 39 will share the remaining 380. Since thEy are operating simultaneously, we can just calculate the execution time as a maximum.(4M) • Execution time after improvement = Max(380t/39, 20t/l)+10t = 30t(2M) • The speed up drops from 20.5 to 410 t/30t = 14. The remaining 39 processors are utilized less than half the time.(2M) • While waiting 20t for hardest working processor to finish , they only compute for 380 t / 39 = 9.7 t.(2M) • If one processor has 12.5 % of the load , it must perform 50 addition. • The formula is Execution utilized less than 20 % of time after improvement = Max (350t/39,50t/l)+10t = 60t • The speed up drops even further to 410 t/60 t = 7.(3M) • The rest of the processors are utilized less than 20% of the time (9 t / 50 t). • This example demonstrates the importance of load balancing.(2M) • For a single processor, with twice the load of other cuts speed up by a third and five times the load on just one processor reduces speed by almost a factor of three.
	(i) Consider web browsing application. Assuming both client and server are involved in the process of web browsing application, where can caches be placed to speed up the process? Design a memory hierarchy for the system. Show the typical size and latency at various levels of the hierarchy. What is the relationship between cache size and its access latency? What are the units of data transfer between hierarchies? What is the relationship between the data location, data size and transfer latency? **(ii) The following sequence of instructions are executed in the basic 5-stage pipelined processor:** **1w $1, 40($6)** **add $6, $2, $2** **sw $6, 50($1)** **Indicate dependences and their type. Assuming there is no forwarding in this pipelined processor, indicate hazards and add NOP instructions to eliminate them.(Nov 2018)**
	Compare hardwired and microprogrammed control unit designs in terms of their mechanism of generating control signals with diagram(Nov 2018)
	In a small town, there are three temples in a row and a well in front of each temple. A pilgrim came to the town with certain number of flowers. Before entering the first temple, he washed all the flowers he had with the water of well. To his surprise, flowers doubled. He offered few flowers to the God in the first temple and moved to the second temple. Here also, before entering the temple he washed the remaining flowers with the water of well. And again his flowers doubled. He offered few flowers to the God in second temple and moved to the third temple. Here also, his flowers doubled after washing them with water. He offered few flowers to the God in third temple. **There were no flowers left when pilgrim came out of third temple and he offered same number of flowers to the God in all three temples. What is the minimum number of flowers the pilgrim had initially(X)? And find the value of (X/3) using Restoring Division method? How many flower did he offer to each God(Y)? And find the value of (Y/3) using Non-Restoring Division method?(May 2019)**

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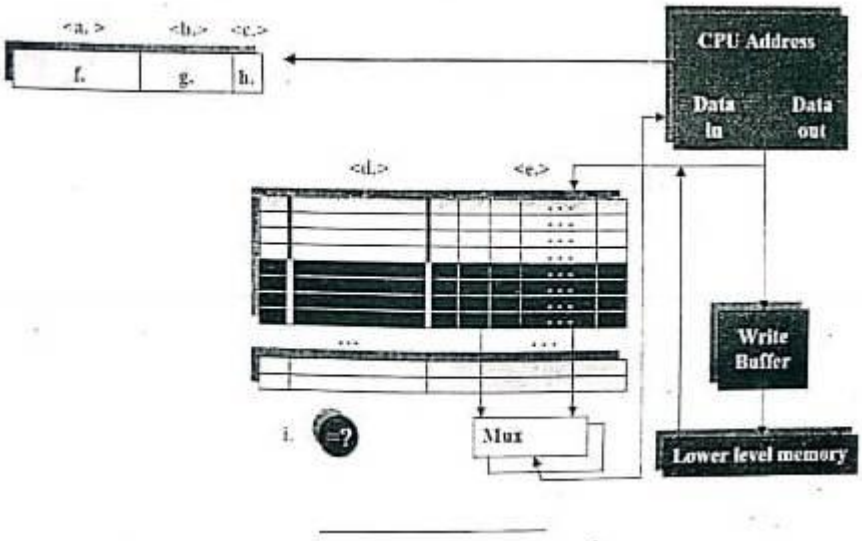
(i) You have been asked to design a cache with the following properties:
(1) Data words are 32 bits each
(2) A cache block will contain 2048 bits of data
(3) The cache is direct mapped
(4) The address supplied from the CPU is 32 bits long
(5) There are 2048 blocks in the cache
(6) Addresses are to the word.
(ii) In the below picture, there are 8 fields(labeled a,b,c,d,e,f,g and h), you will need to indicate the proper name or number of bits for a particular portion of this cache configuration. Explain the process of accessing data using this design.(May 2019)



JIT - 2016

CS8492 DATABASE MANAGEMENT SYSTEM LTPC
3 0 03

OBJECTIVES

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study SQL and relational database design.
- To understand the internal storage structures using different file and indexing techniques which will help in physical DB design.
- To understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.
- To have an introductory knowledge about the Storage and Query processing Techniques

UNITI RELATIONAL DATABASES 10

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL

UNIT II DATABASE DESIGN 8

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

UNITIII TRANSACTIONS 9

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery - Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

UNIT IV IMPLEMENTATION TECHNIQUES 9

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.

UNIT V ADVANCED TOPICS 9

Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL - XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- Classify the modern and futuristic database applications based on size and complexity
- Map ER model to Relational model to perform database design effectively
- Write queries using normalization criteria and optimize queries
- Compare and contrast various indexing strategies in different database systems
- Appraise how advanced databases differ from traditional databases.

TEXT BOOKS:

1. 3, Henry F. Korth, S. Sudharshan, -Database System Concepts‖, Sixth Edition, Tata McGraw Hill,2011.
2. Ramez Elmasri, Shamkant .Navathe,-Fundamentals of Database Systems‖, Sixth Edition, Pearson Education,2011.

REFERENCES:

1. C.J.Date,A.Kannan,S.Swamynathan,-An Introduction to Database Systems‖, Eighth Edition, Pearson Education,2006.
2. RaghuRamakrishnan,―DatabaseManagementSystems‖,FourthEdition,McGraw-Hill College Publications,2015.
3. G.K.Gupta, "Database Management Systems‖, Tata McGraw Hill,2011.

JIT-2106

Subject Code: CS8492 **Year/Semester: II/04**
Subject Name: DATABASE MANAGEMENT SYSTEM **Subject Handler: DAYA MARY MATHEW**

UNIT-I RELATIONAL DATABASES	
Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL	
PART * A	
Q.No.	Questions
1.	**What is database?** BTL 2 A database is logically coherent collection of data with some inherent meaning, representing some aspect of real world and which is designed, built and populated with data for a specific purpose.
2	**Define DBMS.** BTL 1 A Database-management system consists of a collection of interrelated data and a set of programs to access those data. The collection of data, usually referred to as the database, contains information about one particular enterprise. The primary goal of a DBMS is to provide an environment that is both convenient and efficient to use in retrieving and storing database information.
3	**List the purpose of Database System** BTL 2 Problems with File Processing System: 1. Data redundancy and inconsistency 2. Difficulty in accessing data 3. Difficulty in data isolation 4. Integrity problems 5. Atomicity problems 6. Concurrent-access anomalies 7. Security problems
4	**What are the disadvantages of file processing system?** BTL 2 Data redundancy & inconsistency 1. Difficult in accessing data 2. Data isolation 3. Data integrity 4. Concurrent access is not possible. 5. Security problem
5	**Who is a DBA? What are the responsibilities of a DBA? April/May-2011** BTL 2 A database administrator (short form DBA) is a person responsible for the design, implementation, maintenance and repair of an organization's database. They are also known by the titles Database Coordinator or Database Programmer, and is closely related to the Database Analyst, Database Modeler, Programmer Analyst, and Systems Manager.

6	**What is data model? April/May-2011** BTL 2 A database model is the theoretical foundation of a database and fundamentally determines in which manner data can be stored, organized, and manipulated in a database system. It thereby defines the infrastructure offered by a particular database system. The most popular example of a database model is the relational model.
7	**List the types of data model used.** BTL 2 Types of data model used 1. Hierarchical model 2. Network model 3. Relational model 4. Entity-relationship 5. Object-relational model 6. Object model
8	**List any eight applications of DBMS.** BTL 2 1. Banking 2. Airlines 3. Universities 4. Credit card transactions 5. Tele communication 6. Finance g) Sales 7. Manufacturing 8. Human resources
9	**Write the levels of data abstraction.**BTL 2 1. Physical level 2. Logical level 3. View level
10	**Define instance and schema?** BTL1 Instance: Collection of data stored in the data base at a particular moment is called an Instance of the database. The overall design of the data base is called the data base schema.
11	**What is storage manager?** BTL 2 A storage manager is a program module that provides the interface between the low level datastored in a database and the application programs and queries submitted to the system.
12	**What are the components of storage manager?** BTL 2 The storage manager components include 1. Authorization and integrity manager 2. Transaction manager 3. File manager 4. Buffer manager
13	**What are the purpose of storage manager?** BTL 2 The storage manager is responsible for the following 1. Interaction with the file manager 2. Translation of DML commands in to low level file system commands 3. Storing, retrieving and updating data in the database

14	**What is data dictionary?** BTL 2 A data dictionary is a data structure which stores meta data about the structure of the databaseie. the schema of the database traversal
15	**What is an entity relationship model?** BTL 2 The entity relationship model is a collection of basic objects called entities and relationship among those objects. An entity is a thing or object in the real world that is distinguishable fromother objects.
16	**What are attributes? Give examples.** BTL 2 An entity is represented by a set of attributes. Attributes are descriptive properties possessed byeach member of an entity set. Example: possible attributes of customer entity are customer name, customer id, Customer Street, customer city.
17	**What is relationship? Give examples.**BTL 2 A relationship is an association among several entities. Example: A depositor relationship associates a customer with each account that he/she has.
18	**Define the terms relationship set.**BTL 1 The set of all relationships of the same type is termed as a relationship set.
19	**Define single valued and multivalued attributes.** BTL 1 Single valued attributes: attributes with a single value for a particular entity are called singlevalued attributes. Multivalued attributes: Attributes with a set of value for a particular entity are calledmultivalued attributes.
20	**What are stored and derived attributes?** BTL 2 Stored attributes: The attributes stored in a data base are called stored attributes. Derived attributes: The attributes that are derived from the stored attributes are called derived attributes.
21	**Define the terms i) Entity type ii) Entity set** BTL 1 Entity type: An entity type defines a collection of entities that have the same attributes. Entity set: The set of all entities of the same type is termed as an entity set.
22	**Define weak and strong entity sets.** BTL 1 Weak entity set: entity set that do not have key attribute of their own are called weak entity sets. Strong entity set: Entity set that has a primary key is termed a strong entity set.
23	**What does the cardinality ratio specify?** BTL 2 Mapping cardinalities or cardinality ratios express the number of entities to which another entitycan be associated. Mapping cardinalities must be one of the following: 1. One to one 2. One to many 3. Many to one
24	**What is meant by lossless-join decomposition? APRIL/MAY-2011** BTL 2 1. Let R be a relation schema. 2. Let F be a set of functional dependencies on R. 3. Let R1and R2 form a decomposition of R. 4. The decomposition is a lossless-join decomposition of R if at least one of the following functional dependencies are in : a. $R1 \cap R2 \rightarrow R1$ b. $R1 \cap R2 \rightarrow R2$

25	**What are the uses of functional dependencies?** BTL 2 To test relations to see whether they are legal under a given set of functional dependencies. To specify constraints on the set of legal relations.
26	**Define Relational Algebra.** BTL 1 A general expression in the relational algebra is constructed out of smaller sub expressions. Let E1 and E2 be relational algebra expressions. Then, the following are all relational algebra expressions: • E1 U E2 • E1 – E2 • E1 * E2 • (E1), where P is a predicate on attribute in E1. • (E1), where S is a list consisting of some of the attributes in E1 • (E1), where x is the new name for the result of E1.
27	**Define Data Independence.** BTL 1 The ability to modify a schema definition in one level without affecting a schema definition in the next higher level is called data independence. There are two levels of data independence: Physical data independence, and Logical data independence.
28	**What is embedded SQL? What are its advantages? April/May-2011** BTL 2 Embedded SQL is a method of combining the computing power of a programming language and the database manipulation capabilities of SQL. Embedded SQL statements are SQL statements written in line with the program source code of the host language. The embedded SQL statements are parsed by an embedded SQL preprocessor and replaced by host-language calls toa code library. The output from the preprocessor is then compiled by the host compiler. This allows programmers to embed SQL statements in programs written in any number of languages such as: C/C++, COBOL and Fortran.
	PART * B
1	**What is file processing system? What are the disadvantages of a file-processing system that led to the development of the database system? (13M)** BTL 2 **Answer: Page 10 - 16 -** Abraham Silberschatz • File processing system (4M) • Data redundancy (3M) • Data consistency (3M) • Example (3M)
2	**Discuss the advantages of database system. Explain the various cost and risk factors involved in implementing a database system. (13M)** BTL 4 **Answer: Page 10 - 16 -** Abraham Silberschatz • Controlled data redundancy (3M) • Enforcing data integrity (2M) • Data sharing (2M) • Data security (2M) • Multiple user interface (2M) • Backup and recovery (2M)

3	**Explain the different criteria on the basics of which DBMS is classified into different categories. (13M) BTL3** **Answer: Page 04 - 06 -** Abraham Silberschatz • Based on data model (4M) • Based on number of errors (3M) • Based on number of sites (3M) • Based on the purpose (3M)
4	**What is the goal of designing a database? Explain the overall database(13M) (May 2015) BTL2** **Answer: Page 50 - 56 -** Abraham Silberschatz • Requirement collection and analysis (2M) • Conceptual database design (2M) • Choice of a DBMS (2M) • Logical database design (2M) • Physical database design (2M) • Database system architecture (2M) • Testing and evaluation (1M)
5	**Explain with neat diagram about database system architecture. (13M) (Dec'2016) BTL3** **Answer: Page 18 - 20 -** Abraham Silberschatz • Diagram (2M) • Data definition (2M) • DDL compiler (2M) • Data manipulation (2M) • DML compiler (2M) • Data security and integrity (1M) • Concurrency and data recovery (1M) • Performance optimization (1M)
6	**What is entity-relationship? Explain with an example about major components of entity-relationship diagrams (13M) BTL2** **Answer: Page 10 - 16 -** Abraham Silberschatz • Entity: concrete entity, abstract entity (5M) • Attributes: Simple, Composite, derived (4M) • Relationship: Unary, Binary, Ternary (4M)

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7	**Explain different data models.(13M)** BTL 3 **Answer: Page 10 - 16 -** Abraham Silberschatz • Data model (2M) • Conceptual data model (2M) • Representation data model (2M) • Hierarchical data model (2M) • Network data model (2M) • Relational data model (2M) • Example for online book database (1M)
	PART – C
1	**Draw ER diagram for Online Book database. (15M) BTL** 4 **Answer: Page 25 - 26 -** Abraham Silberschatz • Entity: Book Edition, Author, Publisher, Reviews, Feedback (8M) • Relationship: Published by, Has, Writes (7M)
2	**Explain about three-schema architecture and schemas, mapping and instances. (15M) BTL** 3 **Answer: Page 30 - 36 -** Abraham Silberschatz • Internal level (4M) • Conceptual level (4M) • External level (4M) • Mapping (3M)
3	**What do you understand by an embedded SQL? How are variables declared and used in an embedded SQL? Explain with examples.(15M)**BTL 2 **Answer: Page 37 - 39 -** Abraham Silberschatz • Embedded SQL: SQL statements, application program, host language. (5M) • Variables: Host variables, commands (5M) • Application programs (5M)

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UNIT II DATABASE DESIGN	
Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form	
PART * A	
Q.No.	Questions
1	**What are the parts of SQL language?** BTL 2 1. The SQL language has several parts: 2. data - definition language 3. Data manipulation language 4. View definition 5. Transaction control 6. Embedded SQL 7. Integrity 8. Authorization
2	**What are the categories of SQL command?** BTL 2 1. SQL commands are divided in to the following categories: 2. Data - Definition Language 3. Data Manipulation language 4. Data Query Language 5. Data Control Language 6. Data Administration Statements 7. Transaction Control Statements
4	**What are the three classes of SQL expression?** BTL 2 SQL expression consists of three clauses: 1. Select 2. From 3. Where
5	**Give the general form of SQL query.**BTL 1 Select A1, A2…..... , An From R1, R2,… ....., Rm Where P
6	**What is the use of rename operation?** BTL 2 Rename operation is used to rename both relations and attributes. It uses the as clause, taking the form: Old-name as new-name
7	**List the string operations supported by SQL.** BTL 2 1. Pattern matching Operation 2. Concatenation 3. Extracting character strings 4. Converting between uppercase and lower case letters.
	List the set operations of SQL.BTL 2

8	1. Union 2. Intersect operation 3. The except operation
9	**What is the use of Union and intersection operation?**BTL 2 Union: The result of this operation includes all tuples that are either in r1 or in r2 or in both r1 and r2.Duplicate tuples are automatically eliminated. Intersection: The result of this relation includes all tuples that are in both r1 andr2
10	**What is the use of Union and intersection operation?** BTL 1 Union: The result of this operation includes all tuples that are either in r1 or in r2 or in both r1 and r2.Duplicate tuples are automatically eliminated. Intersection: The result of this relation includes all tuples that are in both r1 andr2
11	**What is the use of group by clause?** BTL 2 Group by clause is used to apply aggregate functions to a set of tuples. The attributes given in the group by clause are used to form groups. Tuples with the same value on all attributes in the group by clause are placed in one group.
12	**What is view in SQL? How is it defined?** BTL 2 Any relation that is not part of the logical model, but is made visible to a user as a virtual relation is called a view. We define view in SQL by using the create view command. The form of the create view command is Create view v as
13	**What is the use of with clause in SQL?** BTL 2 The 'with' clause provides a way of defining a temporary view whose definition is available only to the query in which the 'with' clause occurs.
14	**List the table modification commands in SQL. BTL 2** 1. Deletion 2. Insertion 3. Updates 4. Update of a view
15	**List the SQL domain types. BTL 2** SQL supports the following domain types. 1. Char(n) 2. varchar(n) 3. int 4. numeric(p,d) 5. float(n) 6. date
16	**What is the use of integrity constraints?** BTL 2 Integrity constraints ensure that changes made to the database by authorized users do not result in a loss of data consistency. Thus integrity constraints guard against accidental damage to the database.
17	**Mention the 2 forms of integrity constraints in ER model.**BTL 4 1. Key declarations 2. Form of a relationship
18	**What is trigger?** BTL 2 Triggers are statements that are executed automatically by the system as the side effect of a modification to the database.
19	**What are domain constraints?** BTL 2 A domain is a set of values that may be assigned to an attribute .all values that appear in a column of a relation must be taken from the same domain.

20	**What are referential integrity constraints?** BTL 2 A value that appears in one relation for a given set of attributes also appears for a certain set of attributes in another relation.
21	**What is assertion? Mention the forms available.** BTL 2 An assertion is a predicate expressing a condition that we wish the database always to satisfy.
22	**What is the need for triggers?** BTL 2 Triggers are useful mechanisms for alerting humans or for starting certain tasks automatically when certain conditions are met.
23	**List the requirements needed to design a trigger.** BTL 2 The requirements are 1. Specifying when a trigger is to be executed. 2. Specify the actions to be taken when the trigger executes.
24	**Give the forms of triggers.**BTL 1 1. The triggering event can be insert or delete. 2. For updated the trigger can specify columns. 3. The referencing old row as clause 4. The referencing new row as 5. The triggers can be initiated before the event or after the event.
25	**What does database security refer to?** BTL 2 Database security refers to the protection from unauthorized access and malicious destruction or alteration.
26	**List some security violations (or) name any forms of malicious access.** BTL 2 1. Unauthorized reading of data 2. Unauthorized modification of data 3. Unauthorized destruction of data.
27	**Give the limitations of SQL authorization.** BTL 2 The code for checking authorization becomes intermixed with the rest of the application code. Implementing authorization through application code rather than specifying it declaratively in SQL makes it hard to ensure the absence of loopholes
28	**What do you mean by "Query Optimization"?** BTL 2 Improving of the strategy for processing a query is called "Query Optimization". It is the responsibility of the system to transform the query as entered by the user into an equivalent query which can be computed more efficiently.
29	**What are the steps involved in query processing?** BTL 2 The basic steps are: 1. parsing and translation 2. optimization 3. Evaluation
30	**What is called a query –execution engine?** BTL 2 The query execution engine takes a query evaluation plan, executes that plan, and returns the answers to the query.

31	**What is called a query evaluation plan?** BTL 2 A sequence of primitive operations that can be used to evaluate a query is a query evaluation plan or a query execution plan.
	PART -B
1	**What are the various operation in relation algebra? Explain with examples. (13M)** BTL 2 **Answer: Page 113 - 116 -** Abraham Silberschatz • Union operation (4M) • Interaction operation (3M) • Difference operation (3M) • Cartesian product operation (3M)
2	**What is the use of constraint? Explain the different type of constraint that can be specified.(13M)** BTL 2 **Answer: Page 160 - 165 -** Abraham Silberschatz 1. Primary key (3M) 2. Unique constraint (3M) 3. Check constraint (3M) 4. NOT null constraint (2M) 5. Foreign key constraint (2M)
3	**Explain Normalization with the help of an example. (13M)** BTL 3 **Answer: Page 157 - 159 -** Abraham Silberschatz 1. Insert anomaly (2M) 2. Deletion anomaly (2M) 3. Update anomaly (2M) 4. First normal form(1NF) (1M) 5. Second normal form(1NF) (1M) 6. Third normal form(1NF) (1M) 7. Fourth normal form(1NF) (1M) 8. Fifth normal form(1NF) (1M) 9. Example (2M)
4	**Write the inference rules for multi-valued dependencies (13M)** BTL 2 **Answer: Page 148 - 149 -** Abraham Silberschatz 1. Complementation rule (3M) 2. Augmentation rule (3M) 3. Transitive rule (3M) 4. Replication rule (2M) 5. Coalescence rule (2M)

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5	**Explain inference rules for functional dependencies. (13M)** BTL 3 **Answer: Page 145 - 146 - C** Abraham Silberschatz • Reflexivity rule (3M) • Augmentation rule (2M) • Transitivity rule (2M) • Decomposition rule (2M) • Union rule (2M) • Pseudo transitivity rule (2M)
6	**What are the role of join operations in relational algebra(13M)**BTL 2 **Answer: Page 130 - 136 -** Abraham Silberschatz • Equijoin operation (3M) • Natural join operation (3M) • Left outer join operation (3M) • Right outer join operation (2M) • Full outer join operation (2M)
	PART - C
1	**Discuss the various update operations that can be performed on a relation and its integrity (15M)**BTL 4 **Answer: Page 210 - 216 -** Abraham Silberschatz • Insert operation (3M) • Delete operation (2M) • Update operation (2M) • Domain integrity (2M) • Entity integrity (2M) • Referential integrity (2M) • Semantic integrity (2M)
2	**Explain the characteristics of relations and mapping relation scheme.(15M)**BTL 3 **Answer: Page 220 -226 -** Abraham Silberschatz • Ordering of tuples in a relation (3M) • Ordering of values within a tuple (2M) • Values and nulls in the tuples (2M) • Interpretation of a relation (2M) • Many-to- many (2M) • One-to-many (2M) • Many-to-One (2M)

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UNIT-III TRANSACTIONS	
Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery - Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.	
PART * A	
Q.No.	Questions
1	**What are the ACID properties? APRIL/MAY-2011** BTL 2 ACID properties is a set of properties that guarantee database transactions are processed reliably. In the context of databases, a single logical operation on the data is called a transaction. For example, a transfer of funds from one bank account to another, even though that might involve multiple changes (such as debiting one account and crediting another), is a single transaction.
2	**What is transaction?** BTL 2 Collections of operations that form a single logical unit of work are called transactions.
4	**What are the two statements regarding transaction?** BTL 2 The two statements regarding transaction of the form: 1. Begin transaction 2. End transaction
5	**What are the properties of transaction?** BTL 2 The properties of transactions are: 1. Atomicity 2. Consistency 3. Isolation 4. Durability
6	**What is recovery management component?** BTL 2 Ensuring durability is the responsibility of a software component of the base system called as recovery management component.
7	**When is a transaction rolled back?** BTL 2 Any changes that the aborted transaction made to the database must be undone. Once the changes caused by an aborted transaction have been undone, then the transaction has been rolled.
8	**What are the states of transaction?** BTL 2 The states of transaction are 1. Active 2. Partially committed 3. Failed 4. Aborted 5. Committed 6. Terminated
9	**List out the statements associated with a database transaction.**BTL 2 1. Commit work 2. Rollback work
	Give the reasons for allowing concurrency.BTL 3

10	The reasons for allowing concurrency is if the transactions run serially, a short transaction may have to wait for a preceding long transaction to complete, which can lead to unpredictable delays in running a transaction. So concurrent execution reduces the unpredictable delays in running transactions.
11	**What is average response time?** BTL 2 The average response time is that the average time for a transaction to be completed after it hasbeen submitted.
12	**What are the two types of Serializability?** BTL 2 The two types of Serializability is 1. Conflict serializability 2. View serializability
13	**Define lock.**BTL 1 Lock is the most common used to implement the requirement is to allow a transaction to access a data item only if it is currently holding a lock on that item.
14	**Define the phases of two phase locking protocol.**BTL 1 Growing phase: a transaction may obtain locks but not release any lock. Shrinking phase: a transaction may release locks but may not obtain any new locks.
15	**Define upgrade and downgrade.**BTL 1 It provides a mechanism for conversion from shared lock to exclusive lock is known as upgrade. It provides a mechanism for conversion from exclusive lock to shared lock is known as downgrade.
16	**What are the two methods for dealing deadlock problem?** BTL 2 The two methods for dealing deadlock problem is deadlock detection and deadlock recovery.
17	**What is a recovery scheme?** BTL 2 An integral part of a database system is a recovery scheme that can restore the database to the consistent state that existed before the failure.
18	**When is a transaction rolled back?** BTL 2 Any changes that the aborted transaction made to the database must be undone. Once the changes caused by an aborted transaction have been undone, then the transaction has been rolled back.
19	**Give the reasons for allowing concurrency.**BTL 3 The reasons for allowing concurrency is if the transactions run serially, a short transaction may have to wait for a preceding long transaction to complete, which can lead to unpredictable delays in running a transaction. So concurrent execution reduces the unpredictable delays in running transactions.
20	**Define upgrade and downgrade.**BTL 1 1. It provides a mechanism for conversion from shared lock to exclusive lock is known as upgrade. 2. It provides a mechanism for conversion from exclusive lock to shared lock is known as downgrade
21	**What is a database graph?** BTL 2 The partial ordering implies that the set D may now be viewed as a directed acyclic graph, called a database graph.
22	**What are the two methods for dealing deadlock problem?** BTL 2 The two methods for dealing deadlock problem is deadlock detection and deadlock recovery.
23	**What is meant by log-based recovery?** BTL 2 The most widely used structures for recording database modifications is the log. The log is a sequence of log records, recording all the update activities in the database. There are several types of log records

24	**What are uncommitted modifications?** BTL 2 The immediate-modification technique allows database modifications to be output to the database while the transaction is still in the active state. Data modifications written by active transactions are called uncommitted modifications.
25	**Differentiate strict two phase locking protocol and rigorous two phase locking protocol.** BTL 3 1. Strict two phase locking protocol all exclusive mode locks taken by a transaction is held until that transaction commits. 2. Rigorous two phase locking protocol requires that all locks be held until the transaction commits.
26	**How the time stamps are implemented?** BTL 4 1. Use the value of the system clock as the time stamp. That is a transaction's time stamp is equal to the value of the clock when the transaction enters the system. 2. Use a logical counter that is incremented after a new timestamp has been assigned; that is the time stamp is equal to the value of the counter.
27	**What are the time stamps associated with each data item?** BTL 2 1. W-timestamp (Q) denotes the largest time stamp if any transaction that executed WRITE (Q) successfully. 2. R-timestamp (Q) denotes the largest time stamp if any transaction that executed READ (Q) successfully.
28	**When is a transaction rolled back?** BTL 2 Any changes that the aborted transaction made to the database must be undone. Once the changes caused by an aborted transaction have been undone, then the transaction has been rolled back.
	PART -B
1	**Explain state transition diagram. Explain when a transaction is said to be failed. (13M)**BTL 3 **Answer: Page 60 - 63 -** Abraham Silberschatz • State transition diagram (3M) • Active (2M) • Partially committed (2M) • Committed (2M) • Failed (2M) • Terminated (2M)
2	**Discuss the two different forms of schedule equivalence. (13M)**BTL 4 **Answer: Page 70 - 76 -** Abraham Silberschatz • Conflict equivalence (4M) • Conflict serializability (3M) • View equivalence (3M) • Conflict serializability (3M)
3	**How is locking implemented? What is the role of the lock table in implementation? How are the requests to lock and unlock a data item handled? (13M)**BTL 3 **Answer: Page 85 - 86 -** Abraham Silberschatz • Lock manager (4M) • Lock table (3M)

	• Lock request (3M) • Unlock request (3M)
4	**What do you understand by lock upgrade and lock downgrade? Explain the graph –based locking technique. (13M)**BTL 2 **Answer: Page 80 - 84 -** Abraham Silberschatz • Lock conversion (3M) • lock upgrade (3M) • lock downgrade (3M) • Database graph (2M) • Tree-locking (2M)
5	**Discuss deadlock prevention and how it is detected. (13M)**BTL 4 **Answer: Page 97 - 98 -** Abraham Silberschatz • Wait-die (3M) • Wound-wait (2M) • Wait – for graph (2M) • Conservation 2PL (2M) • Assigning data item (2M) • Timestamp lock (2M)
6	**Explain two-phase locking protocol. (13M)**BTL 3 **Answer: Page 90- 96 -** Abraham Silberschatz • Growing or expanding phase (3M) • Shrinking phase (3M) • Lock point (3M) • Strict two - phase locking (2M) • Rigorous two- phase locking (2M)
	PART -C
1	**How are optimistic concurrency control technique different from other concurrency control technique? (15M) BTL3** **Answer: Page 100- 106 -** Abraham Silberschatz • Validation (3M) • Read phase (3M) • Write phase (3M) • System clock (2M) • Logical counter (2M) • Blocking (2M)

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2	**What are intension locking? How does it provide a higher degree of concurrency? (15M)**BTL2 **Answer: Page 110 - 116 -** Abraham Silberschatz • Intention lock (3M) • Intension shared (3M) • Intension exclusive mode (3M) • Shared- exclusive mode (3M) • Multiple granularity lock (3M)

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UNIT-IV IMPLEMENTATION TECHNIQUES	
RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.	
PART * A	
Q.No.	Questions
1	**What are the storage types?** BTL 2 The storage types are: 1. Volatile storage 2. Nonvolatile storage
2	**Define blocks.**BTL 1 The database system resides permanently on nonvolatile storage, and is into fixed-length storage units called blocks.
3	**What is meant by Physical blocks?** BTL 2 The input and output operations are done in block units. The blocks residing on the disk are referred to as physical blocks.
4	**What is meant by buffer blocks?** BTL 2 The blocks residing temporarily in main memory are referred to as buffer blocks.
5	**What is meant by disk buffer?** BTL 2 The area of memory where blocks reside temporarily is called the disk buffer.
6	**Define garbage collection.** BTL 1 Garbage may be created also as a side effect of crashes. Periodically, it is necessary to find all the garbage pages and to add them to the list of free pages. This process is called garbage collection.
	What is an index? BTL 2

7	An index is a structure that helps to locate desired records of a relation quickly,without examining all records
8	**Define query optimization.** BTL 1 Query optimization refers to the process of finding the lowest –cost method of evaluating a given query.
9	**What are the types of storage devices?** BTL 2 1. Primary storage 2. Secondary storage 3. Tertiary storage 4. Volatile storage 5. Nonvolatile storage
10	**What is called remapping of bad sectors?** BTL 2 If the controller detects that a sector is damaged when the disk is initially formatted, or when an attempt is made to write the sector, it can logically map the sector to a different physical location.
11	**Define access time.** BTL 1 Access time is the time from when a read or write request is issued to when data transfer begins.
12	**Define seek time.** BTL 1 The time for repositioning the arm is called the seek time and it increases with the distance that the arm is called the seek time.
13	**Define average seek time.** BTL 1 The average seek time is the average of the seek times, measured over a sequence of random requests.
14	**What is meant by data-transfer rate?** BTL 2 The data-transfer rate is the rate at which data can be retrieved from or stored to the disk.
15	**What is meant by mean time to failure?** BTL 2 The mean time to failure is the amount of time that the system could run continuously without failure.
16	**What is a block and a block number?** BTL 2 A block is a contiguous sequence of sectors from a single track of one platter.Each request specifies the address on the disk to be referenced. That address is in the form of a block number.
17	**What are called journaling file systems?** BTL 2 File systems that support log disks are called journaling file systems.
18	**What is the use of RAID?** BTL 2 A variety of disk-organization techniques, collectively called redundant arrays of independent disks are used to improve the performance and reliability

19	**What is called mirroring?** BTL 2 The simplest approach to introducing redundancy is to duplicate every disk. This technique is called mirroring or shadowing.
20	**What is called bit-level striping?** BTL 2 Data striping consists of splitting the bits of each byte across multiple disks. This is called bit-level striping.
21	**What is called block-level striping?** BTL 2 Block level striping stripes blocks across multiple disks. It treats the array of disks as a large disk, and gives blocks logical numbers
22	**What are the two main goals of parallelism?** BTL 2 1. Load –balance multiple small accesses, so that the throughput of such accesses increases. 2. Parallelize large accesses so that the response time of large accesses is reduced
23	**What are the factors to be taken into account when choosing a RAID level?** BTL 2 1. Monetary cost of extra disk storage requirements. 2. Performance requirements in terms of number of I/O operations 3. Performance when a disk has failed. 4. Performances during rebuild.
24	**What is meant by software and hardware RAID systems?** BTL 2 RAID can be implemented with no change at the hardware level, using only software modification. Such RAID implementations are called software RAID systems and the systems with special hardware support are called hardware RAID systems.
25	**What are the ways in which the variable-length records arise in database systems?** BTL 2 1. Storage of multiple record types in a file. 2. Record types that allow variable lengths for one or more fields. 3. Record types that allow repeating fields.
26	**What is the use of a slotted-page structure and what is the information present in the header?** BTL 2 The slotted-page structure is used for organizing records within a single block. The header contains the following information. 1. The number of record entries in the header. 2. The end of free space 3. An array whose entries contain the location and size of each record.
27	**What are the two types of blocks in the fixed –length representation? Define them.** BTL 2 Anchor block: Contains the first record of a chain. Overflow block: Contains the records other than those that are the first record of a chain.
28	**What is hashing file organization?** BTL 2

	In the hashing file organization, a hash function is computed on some attribute of each record. The result of the hash function specifies in which block of the file the record should be placed.
29	**What are called index-sequential files?** BTL 2 The files that are ordered sequentially with a primary index on the search key, are called index-sequential files.
30	**What is a B+-Tree index?** BTL 2 A B+-Tree index takes the form of a balanced tree in which every path from the root of the root of the root of the tree to a leaf of the tree is of the same length
31	**What is a hash index?** BTL 2 A hash index organizes the search keys, with their associated pointers, into a hash file structure.
32	**What is called as recursive partitioning?** BTL 2 The system repeats the splitting of the input until each partition of the build input fits in the memory. Such partitioning is called recursive partitioning.
33	**What is called as an N-way merge?** BTL 2 The merge operation is a generalization of the two-way merge used by the standard in memory sort-merge algorithm. It merges N runs, so it is called an N-way merge.
	PART-B
1	**List the different types of storage media available in the company system. Also explain how they are classified into different categories?** BTL 2 **Answer: Page 312 - 316 -** Abraham Silberschatz • Primary storage: cache memory, main memory, flash memory (5M) • Secondary memory: magnetic disk (4M) • Tertiary memory: optical disc, tape storage (4M)
2	**Give hardware description of magnetic disk and steps involved in accessing data from a magnetic disk.** BTL 2 **Answer: Page 300 - 309 -** Abraham Silberschatz • Single-sided disk (3M) • Double-sided disk (2M) • Head –disk assemblies (2M) • Seek time (2M) • Rotate (2M) • Data transfer (2M)
3	**How can be reliability and performance of disk be improved using RAID? Explain different RAID levels.** (13M) BTL 3

	Answer: Page 330 - 336 - Abraham Silberschatz • Data stripping (3M) • Bit-level data stripping (2M) • Block-level stripping (2M) • Mirroring and shadowing (2M) • RAID level 0 and RAID level 1 (1M) • RAID level 2 and RAID level 3 (1M) • RAID level 4 and RAID level 5 (1M) • RAID level 6 (1M)
4	**Explain the polices used by the buffer manager to replace a page.** (13M) BTL3 **Answer: Page 337 - 338 -** Abraham Silberschatz • Lase Recently Used(LRU) (4M) • Most Recently Used(MRU) (4M) • Clock Replacement (5M)
5	**Discuss the importance of file organization in database and various types of file organization available**. (13M) BTL4 **Answer: Page 340 - 346 -** Abraham Silberschatz • File organization (4M) • Heap file organization (3M) • Sequential file organization (3M) • Hash file organization (3M)
	PART – C
1	**What are the main problem associated with most of the hash function and how can it be resolved?**(15M) BTL2 **Answer: Page 290 - 296 -** Abraham Silberschatz • Cut key hashing (3M) • Folded key (2M) • Division remainder hashing (2M) • Collision (2M) • Open addressing (2M) • Multiple hashing (2M) • Chained overflow (2M)

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2	**Explain the various algorithms for implementing the select operation involving complex condition?** (15M) BTL3 **Answer: Page 300 - 306 -** Abraham Silberschatz • Conjunctive selective using one index (4M) • Conjunctive selection using composite index (4M) • Conjunctive selection by intersection of record pointers (4M) • Conjunctive union of intersection of record pointers (3M)

Subject Code: CS8492 Year/Semester: II/04
Subject Name: DATABASE MANAGEMENT SYSTEM Subject Handler: DAYA MARY MATHEW

UNIT V ADVANCED TOPICS	
Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL - XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.	
PART * A	
Q.No.	Questions
1	**Define Data mining.** BTL 1 Data mining - knowledge discovery in database. Data mining is the process of semi automatically analyzing large databases to find useful patterns.
2	**What is meant by Data warehouse?** BTL 2 A data warehouse is a repository (archive) of information gathered from multiple sources, stored under a unified schema at a single site. ¬ Greatly simplifies querying, permits study of historical trends ¬ Shifts decision support query load away from transaction processing systems
3	**List out the functionalities of Data warehouse.** BTL 2 1. Data cleaning 2. Data transformation 3. Data integration 4. Data loading 5. Periodic data refreshing
4	**List the types of security mechanisms.** BTL 2 1. Discretionary security mechanisms 2. Mandatory security mechanisms
5	**What are the database design issues?** BTL 2 1. Legal and ethical issues 2. Policy issues 3. System related issues

6	**List the actions performed by DBA?** BTL 2 1. Account creation 2. Privilege granting 3. Privilege revocation 4. Security level assignment
7	**What are the steps for designing a warehouse?** BTL 2 1. Choose a business process to model 2. Choose the grain of the business process 3. Choose the dimension that will apply to each fact table record 4. Choose the measures that will populate each fact table record
8	**What are the issues in data warehouse design?** BTL 2 1. When and how to gather data 2. What schema to use 3. Data cleansing 4. How to propagate updates 5. What data to summarize
9	**What are the goals of data mining?** BTL 2 1. Prediction 2. Identification 3. Classification 4. Optimization
10	**List out the types of Discovered knowledge.** BTL 2 1. Association rules 2. Classification Hierarchies 3. Sequential patterns 4. Patterns within time series 5. Clustering
11	**What is meant by Association rule?** BTL 2 An association rule is of the form X→Y, where X={x1, x2,…….xn} and Y={y1, y2,……. yn} are set of items with xi and yi being distinct items of all i and j. It must satisfy a minimum support and confidence.
12	**What is meant by Confidence rule?** BTL 2 Given a rule of the form A→B, rule confidence is the conditional probability that B is true when A is known to be true.
13	**Define Apriori algorithm.** BTL 1 The Apriori algorithm was the first algorithm used to generate association rules. It uses the general algorithm for creating association rules together with downward closure and ant monotonicity

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14	**Define Sampling algorithm.** BTL 1 The Sampling algorithm selects samples from the database of transactions that individually fit into memory. Frequent itemsets are then formed for each sample.
15	**What is meant by frequent pattern tree algorithm?** BTL 2 The Frequent pattern tree algorithm reduces the total number of candidate itemsets by producing a compressed version of the database in terms of an FP-tree. The FP-tree stores relevant information and allows for the efficient description of frequent item sets. The algorithm consists of 2 steps: 1. Build FP-tree 2. Use the tree to find frequent itemsets.
16	**What is meant by Classification?** BTL 2 Classification is the process of learning a model that is able to describe different classes of data.
17	**List the applications of data mining.** BTL 2 1. Marketing 2. Finance 3. Resource optimization 4. Image Analysis 5. Fraud detection
	PART- B
1	**Discuss various security issues and threats.** (13M) BTL 4 **Answer: Page 400 - 406 -** Abraham Silberschatz • Privacy (3M) • Database integrity (2M) • Database availability (2M) • Accidental threats (2M) • Managing user accounts (2M) • Database audit (2M)
2	**What is the role of access matrix? Discuss with the help of an example**. (13M) BTL 2 **Answer: Page 407 - 416 -** Abraham Silberschatz • Authorizer (4M) • Select and modify (3M) • Reference and drop (3M) • Alter and propagate access control (3M)
3	**What are the various technique that can be used to authenticate a user and two approaches for access control in DBMS?** (13M) BTL 2 **Answer: Page 417 - 426 -** Abraham Silberschatz • Password Authentication (3M)

	• Physical characteristics (2M) • Smart card (2M) • Discretionary access control (2M) • Mandatory access control (2M) • Star property (2M)
4	**Discuss various locking technique that can be applied in distributed system along with their advantages and disadvantages.** (13M) BTL 4 **Answer: Page 430 - 436 -** Abraham Silberschatz • Single lock manager (3M) • Distributed lock manager (2M) • Primary copy (2M) • Majority locking (2M) • Advantages (2M) • Disadvantages (2M)
5	**Discuss the three layers of three-tier client/server architecture used in developing distributed system.**(13M) BTL 4 **Answer: Page 450 - 456 -** Abraham Silberschatz • Presentation layer (4M) • Application layer (3M) • Database layer (3M) • Sever layer (3M)
	PART C
1	**Explain various indexing and ranking technique.(15M)** BTL 3 **Answer: Page 490 - 496 -** Abraham Silberschatz • Stemming (3M) • Inverted index (2M) • Posting file (2M) • Signature files (2M) • Signature width (2M) • TF/IDF based ranking (2M) • Similarity based ranking (2M)
2	**Write a on the ODMG object model.(15M)**BTL 2 **Answer: Page 500 - 506 -** Abraham Silberschatz • Objects: state, behavior, identifier, name, lifetime, structure. (3M) • Literals : collection and structural literals (3M) • Atomic objects : atomic objects (3M) • Interface (2M) • Inheritance: interface inheritance (2M) • Extents (2M)

3	**Discuss the spatial database in detail.(15M)**BTL 4 **Answer: Page 510 - 516 -** Abraham Silberschatz • Spatial data model (2M) • Elements (2M) • Geometry (2M) • Layer (2M) • Spatial query (2M) • Range query (2M) • Nearest neighbor query (2M) • Spatial join query (1M)

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CS8451 DESIGN AND ANALYSIS OF ALGORITHMS L T P C
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OBJECTIVES:

- To understand and apply the algorithm analysis techniques.
- To critically analyze the efficiency of alternative algorithmic solutions for the same problem
- To understand different algorithm design techniques.
- To understand the limitations of Algorithmic power.

UNIT I INTRODUCTION 9

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithmic Efficiency –Asymptotic Notations and their properties. Analysis Framework – Empirical analysis – Mathematical analysis for Recursive and Non-recursive algorithms – Visualization

UNIT II BRUTE FORCE AND DIVIDE-AND-CONQUER 9

Brute Force – Computing an – String Matching – Closest-Pair and Convex-Hull Problems – Exhaustive Search – Travelling Salesman Problem – Knapsack Problem – Assignment problem. Divide and Conquer Methodology – Binary Search – Merge sort – Quick sort – Heap Sort – Multiplication of Large Integers – Closest-Pair and Convex – Hull Problems.

UNIT III DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE 9

Dynamic programming – Principle of optimality – Coin changing problem, Computing a Binomial Coefficient – Floyd ‘s algorithm – Multi stage graph – Optimal Binary Search Trees – Knapsack Problem and Memory functions. Greedy Technique – Container loading problem – Prim ‘s algorithm and Kruskal’s Algorithm – 0/1 Knapsack problem, Optimal Merge pattern – Huffman Trees.

UNIT IV ITERATIVE IMPROVEMENT 9

The Simplex Method – The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs, Stable marriage Problem.

UNIT V COPING WITH THE LIMITATIONS OF ALGORITHM POWER 9

Lower – Bound Arguments – P, NP NP- Complete and NP Hard Problems. Backtracking – n-Queen problem– Hamiltonian Circuit Problem – Subset Sum Problem. Branch and Bound – LIFO Search and FIFO search – Assignment problem – Knapsack Problem – Travelling Salesman Problem – Approximation Algorithms for NP-Hard Problems – Travelling Salesman problem – Knapsack problem.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the students should be able to:

- Design algorithms for various computing problems.
- Analyze the time and space complexity of algorithms.
- Critically analyze the different algorithm design techniques for a given problem.
- Modify existing algorithms to improve efficiency.

TEXT BOOKS:

1. Anany Levitin, ―Introduction to the Design and Analysis of Algorithms‖, Third Edition, Pearson Education, 2012.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2007.

REFERENCES:

1. Thomas H. Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, ―Introduction to Algorithms‖, Third Edition, PHI Learning Private Limited, 2012.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, ―Data Structures and Algorithms‖, Pearson Education, Reprint 2006.
3. Harsh Bhasin, ―Algorithms Design and Analysis‖, Oxford university press, 2016.
4. S. Sridhar, ―Design and Analysis of Algorithms‖, Oxford university press, 2014.

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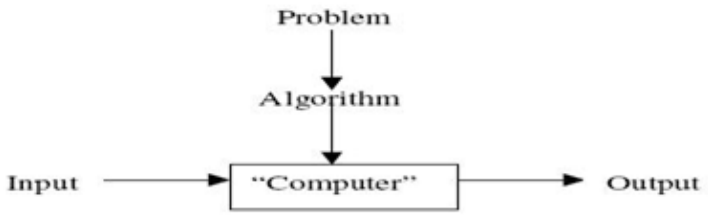
Subject Code: CS8451 **Subject Name – Design and Analysis of Algorithms**

Subject Handler: R.ANNAMALAI **Year/ Sem: II/04**

UNIT I -INTRODUCTION	
Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithmic Efficiency –Asymptotic Notations and their properties. Analysis Framework – Empirical analysis – Mathematical analysis for Recursive and Non-recursive algorithms – Visualization	
Q.NO	**PART* A**
1.	**What is the need for studying algorithms?** BTL1 From a practical standpoint, a standard set of algorithms from different areas of computing must be known, in addition to be able to **design** them and **analyze their efficiencies**. From a theoretical standpoint the study of algorithms is the cornerstone of computer science.
2.	**What is an algorithm? (May/June 2017)** BTL1 An algorithm is a **sequence of unambiguous instructions** for solving a problem, i.e., for obtaining a required output for any legitimate input in finite amount of time. An algorithm is step by step procedure to solve a problem.
3.	**Give the diagrammatic representation of Notion of algorithm.** BTL2 
4.	**What is the formula used in Euclid's algorithm for finding the greatest common divisor of two numbers? (May/June 2016, May/June 2017)** BTL1 Euclid 's algorithm is based on repeatedly applying the equality Gcd(m, n)=gcd (n,m mod n) until m mod n is equal to 0, since gcd(m,0) =m.
5.	**List the three different algorithms used to find the gcd of two numbers.** BTL1 The three algorithms used to find the gcd of two numbers are • Euclid 's algorithm • Consecutive integer checking algorithm • Middle school procedure
6.	**Show the fundamental steps involved in algorithmic problem solving.** BTL2 The fundamental steps are: • Understanding the problem • Ascertain the capabilities of computational device • Choose between exact and approximate problem solving

	• Decide on appropriate data structures • Algorithm design techniques • Methods for specifying the algorithm • Proving an algorithms correctness • Analyzing an algorithm.
7.	**What is an algorithm design technique?** BTL 1 An algorithm design technique is a **general approach to solving problems algorithmically** that is applicable to a variety of problems from different areas of computing.
8.	**What is pseudocode?** BTL1 A pseudocode is a **mixture of a natural language and programming language** constructs to specify an algorithm. A pseudocode is more precise than a natural language and its usage often yields more concise algorithm descriptions.
9.	**List the types of algorithm efficiencies.** BTL1 The algorithm efficiencies: Time efficiency: indicates how fast the algorithm runs Space efficiency: indicates how much extra memory the algorithm needs
10.	**List some of the important problem types.** BTL1 • Sorting • Searching • String processing • Graph problems • Combinatorial problems • Geometric problems • Numerical problems
11.	**What are the classical geometric problems?** BTL1 The closest pair problem: given n points in a plane find the closest pair among them The convex hull problem: find the **smallest convex polygon** that would include all the points of a given set.

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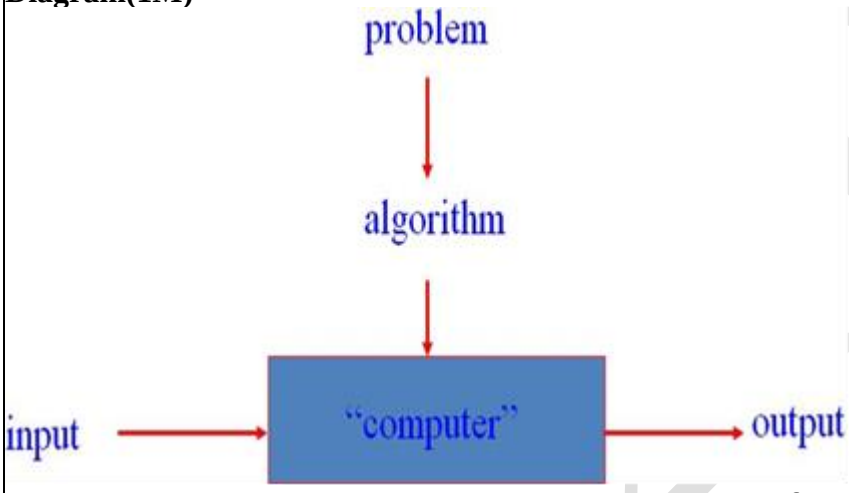
12.	**List the steps involved in the analysis framework?** BTL1 • Measuring the input ‘s size • Units for measuring running time • Orders of growth • Worst case, best case and average case efficiencies
13.	**What do you mean by worst case efficiency of an algorithm? (Nov/Dec 2017)** BTL1 The **worst-case complexity of an algorithm** should be contrasted with its average-**case complexity**, which is an average measure of the amount of resources the **algorithm** uses on a random input.
14.	**Define O-notation, Ω-notation, θ notations. (May/June 2012)** BTL1 A function t(n) is said to be in O(g(n)), denoted by t(n) ε O(g(n)), if t(n) is bounded above by some constant multiple of g(n) for all large n, i.e., if there exists some positive constant c and some non-negative integer n_0 such that T (n) <=cg (n) for all n >= n_0 A function t(n) is said to be in θ (g(n)), denoted by t(n) ε θ (g(n)), if t(n) is bounded both above & below by some constant multiple of g(n) for all large n, i.e., if there exists some positive constants c1 & c2 and some nonnegative integer n0 such that c_2g (n) <= t (n) <= c_1g (n) for all n >= n0 A function t(n) is said to be in Ω (g(n)), denoted by t(n) ε Ω (g(n)), if t(n) is bounded below by some constant multiple of g(n) for all large n, i.e., if there exists some positive constant c and some non-negative integer n_0 such that T (n) >=cg (n) for all n >=n_0
15.	**Mention the useful property, which can be applied to the asymptotic notations and its use?** BTL1 If $t_1(n)$ ε O($g_1(n)$) and $t_2(n)$ ε O($g_2(n)$) then $t_1(n)+t_2(n)$ ε max {$g_1(n)$, $g_2(n)$} this property is also true for Ω and θ notations. This property will be useful in analyzing algorithms that comprise of two consecutive executable parts.
16.	**What is average case efficiency? (May/June 2014)** BTL1 The average case efficiency of an algorithm is its **efficiency** for an **average case input** of size n. It provides information about an algorithm behavior on a ―typical‖ or ―random‖ input.
17.	**What is amortized efficiency?** BTL1 In some situations a single operation can be expensive, but the total time for the entire sequence of n such operations is always significantly better that the worst case efficiency of that single operation multiplied by n. this is called amortized efficiency.
18.	**What are the basic asymptotic efficiency classes?** BTL1 The basic efficiency classes are: Constant: 1 Logarithmic: log n Linear: n N-log-n: nlog n Quadratic: n2 Cubic: n3 Exponential: 2n Factorial : n!
19.	**What is algorithm visualization?** BTL1 Algorithm visualization is a way to study algorithms. It is defined as the use of images to convey some useful information about algorithms. That information can be a **visual illustration** of algorithm‘s operation, of its performance on different kinds of inputs, or of its execution speed versus that of other algorithms for the same problem.

20.	**What are the two variations of algorithm visualization?** BTL1 The two principal variations of algorithm visualization‖. Static algorithm visualization: It shows the algorithm ‘s progress through a **series of still images**. Dynamic algorithm visualization: Algorithm animation shows a **continuous movie like presentation** of algorithms operation,
	PART *B
1	**Explain in detail about notion of algorithm with suitable example. (13M)** BTL4 **Definition (2M)** An algorithm is a sequence of unambiguous instructions for solving a computational problem, i.e., for obtaining a required output for any legitimate input in a finite amount of time. **Diagram(1M)**  **Algorithms – Computing the Greatest Common Divisor of Two Integers (**gcd (m, n): the largest integer that divides both m and n.) **(5M)** **Euclid’s algorithm:** gcd (m, n) = gcd (n, m mod n) Step1: If n = 0, return the value of m as the answer and stop; otherwise, proceed to Step 2. Step2: Divide m by n and assign the value of the remainder to r. Step 3: Assign the value of n to m and the value of r to n. Go to Step 1. **Algorithm** *Euclid (m, n)* //Computes gcd (m, n) by Euclid ‘s algorithm //Input: Two nonnegative, not-both-zero integers m and n //Output: Greatest common divisor of m and n while n ≠ 0 do r ← m mod n m ← n n ← r return m **Consecutive Integer Algorithm (3M)** Step1: Assign the value of min {m, n} to t. Step2: Divide m by t. If the remainder of this division is 0, go to Step3; otherwise, go to Step 4. Step3: Divide n by t. If the remainder of this division is 0, return the value of t as the answer and stop; otherwise, proceed to Step4. **Middle-school procedure (2M)**

	Step1: Find the prime factors of m. Step2: Find the prime factors of n. Step3: Identify all the common factors in the two prime expansions found in Step1 and Step2. (If p is a common factor occurring Pm and Pn times in m and n, respectively, it should be repeated in min {Pm, Pn} times.) Step4: Compute the product of all the common factors and return it as the gcd of the numbers given.
2	**Explain in detail about Fundamentals of Algorithmic Problem Solving. (13M)** BTL3 **Explanation(10M)** • Understanding the problem(1M) • Deciding on Exact vs. approximate problem solving(2M) • Appropriate data structure(1M) • Design an algorithm(2M) • Proving correctness(2M) • Analyzing an algorithm(2M) **Diagram of Fundamentals of Algorithmic Problem Solving (3M)**

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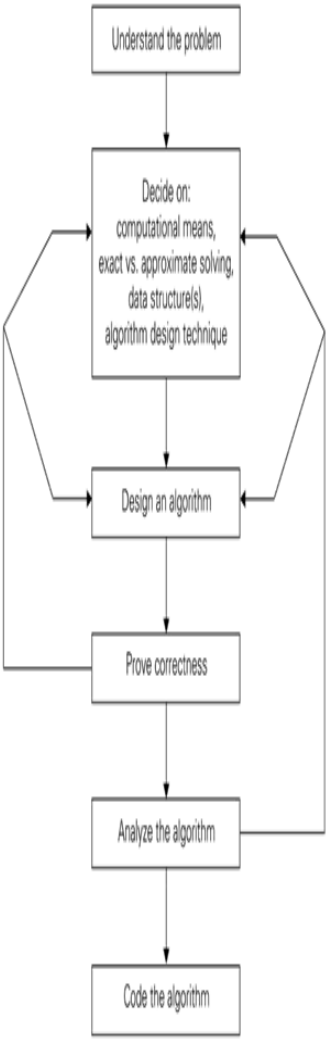

Time efficiency: how fast the algorithm runs
Space efficiency: how much extra memory the algorithm need Coding an algorithm

3 **Discuss the important problem types in Algorithmic Analysis. (13M)** BTL2

Problem Types

- **Sorting**
- **Searching**
- **String Processing**
- **Graph Problems**

SORTING(4M)
Rearrange the items of a given list in ascending order.
Input: A sequence of n numbers <a1, a2, …, an>
Output: A reordering <a′1, a′2, …, a's> of the input sequence such that a′1≤a′2 ≤… ≤a's.
A specially chosen piece of information used to guide sorting. I.e., sort student records by

	names. **Examples of sorting algorithms** Selection sort Bubble sort Insertion sort Merge sort Heap sort. Stability: A sorting algorithm is called stable if it preserves the relative order of any two equal elements in its input. In place: A sorting algorithm is in place if it does not require extra memory, except, possibly for a few memory units. **SEARCHING (3M)** Find a given value, called a search key, in a given set. Examples of searching algorithms Sequential searching Binary searching. **STRING PROCESSING (3M)** A string is a sequence of characters from an alphabet. Text strings: letters, numbers, and special characters. String matching: searching for a given word/pattern in a text. **GRAPH PROBLEMS (3M)** A graph is a collection of points called vertices, some of which are connected by line segments called edges. Modeling real-life problems Modeling WWW communication networks Project scheduling.
4	**Discuss Fundamental analysis of algorithm efficiency elaborately. (13M) (Nov/Dec 2017).** BTL2 **Definition(2m)** Analysis of algorithms means to investigate an algorithm's efficiency with respect to resources: running time and memory space. Time efficiency: how fast an algorithm runs. Space efficiency: the space an algorithm requires. • Measuring an input 's size • Measuring running time • Orders of growth (of the algorithm 's efficiency function) • Worst-base, best-case and average efficiency **Measuring Input Sizes (3M)** Efficiency is defined as a function of input size. Input size depends on the problem. Example 1: what is the input size of the problem of sorting n numbers? Example 2: what is the input size of adding two n by n matrices? **Units for Measuring Running Time(3M)** Measure the running time using standard unit of time measurements, such as seconds, minutes Depends on the speed of the computer. count the number of times each of an algorithm 's operations are executed. count the number of times an algorithm 's basic operation is executed.

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	Basic operation: the most important operation of the algorithm, the operation contributing the most to the total running time. For example, the basic operation is usually the most time-consuming operation in the algorithm ‘s innermost loop. **Orders of Growth(2M)** consider only the leading term of a formula Ignore the constant coefficient. **Worst-Case, Best-Case, and Average-Case Efficiency(3M)** Algorithm efficiency depends on the input size n For some algorithm’s efficiency depends on type of input. **Example: Sequential Search**
5	**Explain Asymptotic Notations in detail. (13M) (May/June 2016 May/June 2017)** BTL3 Three notations used to compare orders of growth of an algorithm ‘s basic operation count: a. O(*g*(*n*)): class of functions *f*(*n*) that grow <u>*no faster*</u> than *g*(*n*) **(4M)** b.Ω(*g*(*n*)): class of functions *f*(*n*) that grow *at least as fast* as *g*(*n*) **(3M)** c.Θ (g(n)): class of functions f(n) that grow at same rate as g(n) **(3M)** **Diagram(3m)**
6	**Explain in detail about Mathematical Analysis of non-recursive Algorithms and recursive algorithms. (13M) (Nov/Dec 2017 May/June 2014).** BTL4 **Non-Recursive Algorithms (6M)** *MaxElement (A [0...n-1])* //Determines the value of the largest element in a given array //Input: An array A[0...n-1] of real numbers //Output: The value of the largest element in A maxvalA [0] for i 1 to n-1 do if A[i] >maxval maxval A[i] return maxval **Recursive Algorithms(7M)** Decide on parameter *n* indicating *input size* Identify algorithm ‘s *basic operation* Determine *worst*, *average*, and *best* case for input of size *n* Set up a recurrence relation and initial condition(s) for *C*(*n*)-the number of times the basic operation will be executed for an input of size *n* (alternatively count recursive calls) Solve the recurrence or estimate the order of magnitude of the solution F(n) = 1 if n = 0 n * (n-1) * (n-2) … 3 * 2 * 1 if n > 0 Recursive definition F(n) = 1 if n = 0 n * F(n-1) if n > 0 **Algorithm(6m)** **Algorithm** *F(n)* if *n*=0

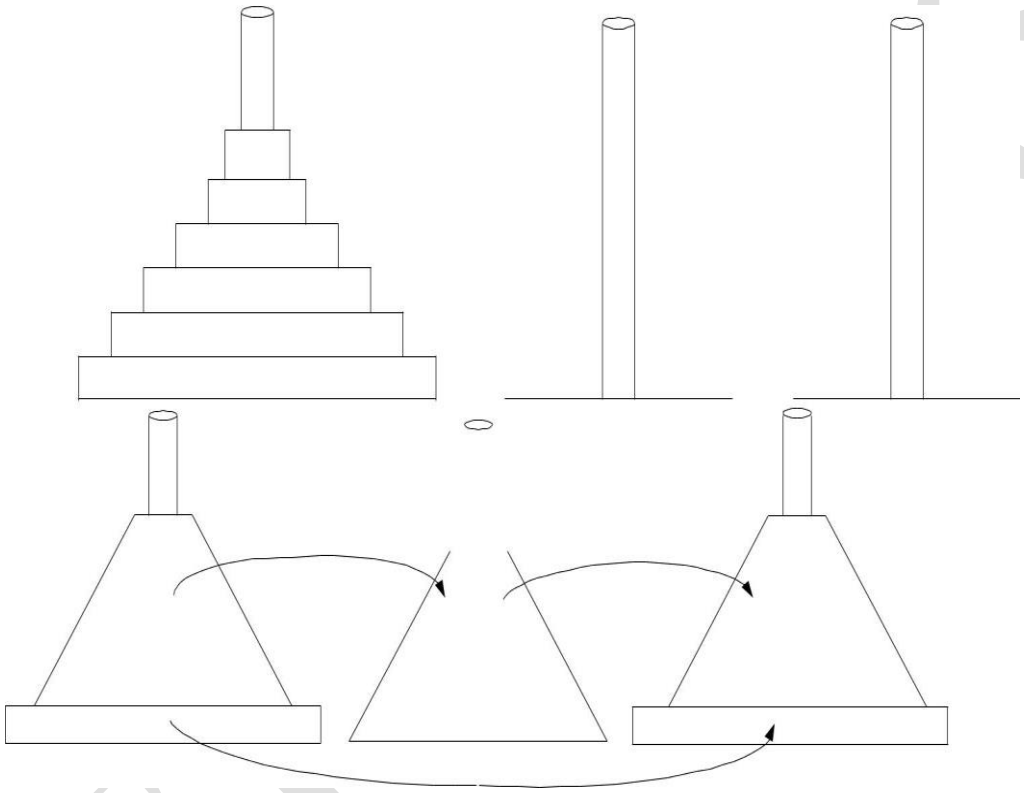
	return 1 else *return F* (*n* -1) * *n*
	PART *C
1	**Describe in detail about linear search. (15M) (Nov/Dec 2013).** BTL3 **Definition(2M)** **Sequential Search** searches for the key value in the given set of items sequentially and returns the position of the key value else returns -1. **Algorithm of linear search(7M)** **Time Complexity analysis(6M)** **Average Case Analysis:** $C_{avg}(n) = [1 \cdot \frac{p}{n} + 2 \cdot \frac{p}{n} + \cdots + i \cdot \frac{p}{n} + \cdots + n \cdot \frac{p}{n}] + n \cdot (1-p)$ $= \frac{p}{n}[1 + 2 + \cdots + i + \cdots + n] + n(1-p)$ $= \frac{p}{n}\frac{n(n+1)}{2} + n(1-p) = \frac{p(n+1)}{2} + n(1-p).$ the average number of key comparisons will be *n* because the algorithm will inspect all *n* elements on all such inputs.

2 **Explain in detail about Tower of Hanoi. (15M) (May/June 2014).** BTL3

Explanation(7M)

In this puzzle, there are *n* disks of different sizes and three pegs. Initially, all the disks are on the first peg in order of size, the largest on the bottom and the smallest on top.
The goal is to move all the disks to the third peg, using the second one as an auxiliary, if necessary.

Diagram(4M)



The number of disks *n* is the obvious choice for the input's size indicator, and so is moving one disk as the algorithm's basic operation. Clearly, the number of moves *M(n)* depends on *n* only, and we get the following recurrence equation for it:

$$M(n) = M(n-1) + 1 + M(n-1)$$

With the obvious initial condition M (1) = 1, the recurrence relation for the number of moves M(n) is:

$$M(n) = 2M(n-1) + 1 \text{ for } n > 1, M(1) = 1.$$

The total number of calls made by the Tower of Hanoi algorithm: ***n-1***

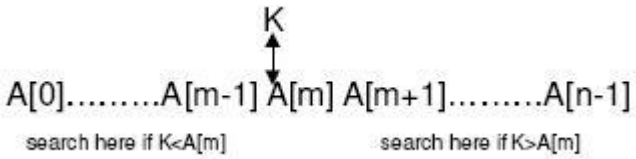
Time Complexity Analysis(4m)

$$C(n) = \sum_{l=0}^{n-1} 2^l$$

= 2n-1

UNIT 2- BRUTE FORCE AND DIVIDE-AND-CONQUER	
Brute Force – Computing an – String Matching – Closest-Pair and Convex-Hull Problems – Exhaustive Search – Travelling Salesman Problem – Knapsack Problem – Assignment problem. Divide and Conquer Methodology – Binary Search – Merge sort – Quick sort – Heap Sort – Multiplication of Large Integers – Closest-Pair and Convex – Hull Problems.	
PART* A	
1	**What is brute force algorithm?** BTL1 A straightforward approach, usually based directly on the problem‘s statement and definitions of the concepts involved.
2	**List the strength and weakness of Brute Force Algorithm.** BTL1 **Strength** • wide applicability, • simplicity • yields reasonable algorithms for some important problems (e.g., matrix multiplication, sorting, searching, string matching) **Weakness:** • rarely yields efficient algorithms • some brute-force algorithms are unacceptably slow not as constructive as some other design techniques
3	**Define exhaustive search.** BTL1 A **brute force solution** to a problem involving search for an element with a special property, usually among combinatorial objects such as permutations, combinations, or subsets of a set.
4	**Give the general plan of exhaustive search Method**. BTL2 • Generate a **list of all potential solutions** to the problem in a systematic manner. • **evaluate potential solutions** one by one, disqualifying infeasible ones. • For an optimization problem, **keeping track of the best one** found so far when search ends, announce the solution(s) found
5	**Give the general plan for divide-and-conquer algorithms. (Nov/Dec 2017 May/June 2016).** BTL2 • A problems instance is divided into **several smaller instances** of the same problem, ideally about the same size • The smaller instances are **solved**, typically **recursively** • If necessary the solutions obtained are combined to get the solution of the original problem Given a function to compute on _inputs the divide-and-conquer strategy suggests splitting the inputs in to ‘k ‘distinct subsets, 1<k <n, yielding _k ‘sub problems. The sub problems must be solved, and then a method must be found to combine sub solutions into a solution of the whole. If the sub problems are still relatively large, then the divide-and conquer strategy can possibly be reapplied.
6	**List the advantages of Divide and Conquer Algorithm. BTL**1 Solving difficult problems, Algorithm efficiency, Parallelism, Memory access, Round off control.
7	**Define of feasibility.** BTL1 A feasible set (of candidates) is promising if it can be extended to produce not merely a

	solution, but an optimal solution to the problem.
8	**Define Hamiltonian circuit.** BTL1 A Hamiltonian circuit is defined as a cycle that passes through all the vertices of the graph exactly once.
9	**State the Master theorem and its use.** BTL2 If $f(n) \in \theta(n^d)$ where $d \geq 0$ in recurrence equation $T(n) = aT(n/b)+f(n)$, then $T(n) \in \theta(n^d)$ if $a<b^d$ $\theta(n^d \log n)$ if $a=b^d$ $\theta(n^{\log_b a})$ if $a>b^d$ The efficiency analysis of many divide-and-conquer algorithms is greatly simplified by the use of Master theorem.
10	**What is the general divide-and-conquer recurrence relation?** BTL1 An instance of size n can be divided into several instances of size n/b, with a of them needing to be solved. Assuming that size n is a power of b, to simplify the analysis, the following recurrence for the running time is obtained: $T(n) = aT(n/b)+f(n)$ Where f(n) is a function that accounts for the time spent on dividing the problem into smaller ones and on combining their solutions.
11	**Define merge sort.** BTL1 Merge sort sorts a given array A[0..n-1] by **dividing it into two halves** a[0..(n/2)-1] and A[n/2..n-1] sorting each of them recursively and then merging the two smaller sorted arrays into a single sorted on
12	**List the Steps in Merge Sort.** BTL1 **a. Divide Step:** If given array A has zero or one element, return S; it is already sorted. Otherwise, divide A into two arrays, A1 and A2, each containing about half of the elements of A. **b. Recursion Step:** Recursively sort array A1 and A2. **Conquer Step:** Combine the elements back in A by merging the sorted arrays A1 and A2
13	**List out Disadvantages of Divide and Conquer Algorithm** BTL1 • Conceptual difficulty • Recursion overhead • Repeated sub problems
14	**Define Quick Sort.** BTL1 Quick sort is an algorithm of choice in many situations because it is not difficult to implement, it is a good "general purpose" sort and it consumes relatively fewer resources during execution.
15	**List out the Advantages in Quick Sort.** BTL1 • It is **in-place** since it uses only a small auxiliary stack. • It requires only **n log(n)** time to sort n items. • It has an extremely short inner loop • This algorithm has been subjected to a thorough mathematical analysis, a very precise statement can be made about performance issues.
16	**List out the Disadvantages in Quick Sort.** BTL1 a. It is **recursive.** Especially if recursion is not available, the

	implementation is extremely complicated. b. It requires **quadratic** (i.e., n2) time in the **worst-case**. c. It is fragile i.e., a simple mistake in the implementation can go unnoticed and cause it to perform badly.
17	**What is the difference between quicksort and merge sort?** BTL1 Both quicksort and merge sort use the divide-and-conquer technique in which the given array is partitioned into subarrays and solved. The difference lies in the technique that the arrays are partitioned. For merge sort the arrays are partitioned according to their position and in quicksort they are partitioned according to the element values.
18	**What is binary search?** BTL1 Binary search is a remarkably efficient algorithm for **searching in a sorted array**. It works by comparing a search key K with the arrays middle element A[m]. If they match the algorithm stops; otherwise the same operation is **repeated recursively for the first half of the array if K < A[m] and the second half if K > A[m].** 
19	**List out the 4 steps in Strassen's Method.** BTL1 • Divide the input matrices A and B into n/2 * n/2 submatrices, as in equation (1). • Using Θ(n2) scalar additions and subtractions, compute 14 n/2 * n/2 matrices A1, B1, A2, B2, …, A7, B7. • Recursively compute the seven matrix products Pi =AiBi for i =1, 2, 7. • Compute the desired submatrices r, s, t, u of the result matrix C by adding and/or subtracting various combinations of the Pi matrices, using only Θ(n2) scalar additions and subtractions
20.	**Define Travelling Salesman Problem.**BTL1 The traveling salesman problem consists of a salesman and a set of cities. The salesman has to visit each one of the cities starting from a certain one (e.g. the hometown) and returning to the same city. The challenge of the problem is that the traveling salesman wants to **minimize the total length of the trip.**
	PART B
1	**Explain Divide and Conquer Method in detail. (13M)** BTL3 **Definition(2M)** • The most well-known algorithm design strategy is Divide and Conquer Method. It • Divide the problem into two or more smaller sub problems. • Conquer the sub problems by solving them recursively. • Combine the solutions to the sub problems into the solutions for the original problem. **Explanation(11M)** **Divide and Conquer Examples** Sorting: merge sort and quicksort**(4M)** binary search**(4M)**

	Matrix Multiplication-Strassen ‘s algorithm **(3M)**
3	**Discuss Quick Sort algorithm with suitable example. (13M).** BTL2 **Quick Sort definition(2M)** Quick sort is an algorithm of choice in many situations because it is not difficult to implement, it is a good \"general purpose\" sort and it consumes relatively fewer resources during execution. **Explanation with Algorithm (11m)** **ALGORITHM Quicksort(A[l..r])** //Sorts a subarray by quicksort //Input: A subarray A [l... r] of A [0...n-1], defined by its left and right indices l and r //Output: The subarray A [l... r] sorted in no decreasing order if l <r s <- Partition (A [l... r]) // s is a split position Quicksort (A [l... s-1]) Quicksort (A [s+1...r] **ALGORITHM Partition (A [l ...r])** //Partitions a subarray by using its first element as a pivot //Input: A subarray A [l... r] of A [0...n-1], defined by its left and right indices l and r (l < r) //Output: A partition of A [l... r], with the split position returned as this function ‘s value P <- A[l] i <- l; j <- r + 1; Repeat repeat i <- i + 1 until A[i]>=p //left-right scan repeat j <- j – 1 until A[j] <= p//right-left scan if (i< j) //need to continue with the scan swap(A[i], a[j]) until i>= j //no need to scan swap(A[l], A[j]) return j
5	**Explain Binary Search in detail with suitable example. (13M) (Nov/Dec 2016).** BTL3 **Definition(2M)** **Definition:** Search a *sorted array* by repeatedly dividing the search interval in half. Begin with an interval covering the whole array. If the value of the search *key* is less than the item in the middle of the interval, narrow the interval to the lower half. Otherwise narrow it to the upper half. Repeatedly check until the value is found or the interval is empty. **Algorithm with example(9M)** **Algorithm:** **function** binary search (A, n, T):

```
L: = 0
R: = n − 1
while L <= R:
   m: = floor ((L + R) / 2)
   if A[m] < T:
      L: = m + 1
   else if A[m] > T:
      R: = m - 1
   else:
      return m
return unsuccessful
```

Time complexity(2m)

Time complexity:

T(N) = O(log(N))

6 **Explain Strassen's Algorithm in detail with suitable example. (13M) (May/June 2016).** BTL3

Definition(2M)

Definition:

Strassen's Matrix multiplication can be performed only on **square matrices** where **n** is a **power of 2**. Order of both of the matrices are **n × n**.

Algorithm Explanation with example(9M)

Strassen's Algorithm:

M1: =(A+C) ×(E+F) M1: =(A+C) ×(E+F)
M2: =(B+D) ×(G+H) M2: =(B+D) ×(G+H)
M3: =(A−D) ×(E+H) M3: =(A−D) ×(E+H)
M4: =A×(F−H) M4: =A×(F−H)
M5: =(C+D) ×(E)M5: =(C+D) ×(E)
M6: =(A+B) ×(H)M6: =(A+B) ×(H)
M7: =D×(G−E) M7: =D×(G−E)

Then,

I: =M2+M3−M6−M7I: =M2+M3−M6−M7
J: =M4+M6J: =M4+M6
K: =M5+M7K: =M5+M7
L: =M1−M3−M4−M5L: =M1−M3−M4−M5

Time complexity analysis(2M)

PART *C

1 **Explain in detail about Travelling Salesman Problem using exhaustive search. (15M)** BTL2.

Traveling Salesman Problem (TSP)2M

	• Find the shortest tour through a given set of n cities that visits each city exactly once before returning to the city where it started • Can be conveniently modeled by a weighted graph; vertices are cities and edge weights are distances **Algorithm Explanation with example(8m)** **Algorithm: Traveling-Salesman-Problem** C ({1}, 1) = 0 for s = 2 to n do for all subsets S Є {1, 2, 3, …, n} of size s and containing 1 C (S, 1) = ∞ for all j Є S and j ≠ 1 C (S, j) = min {C (S – {j}, i) + d (i, j) for i Є S and i ≠ j} Return min C ({1, 2, 3, …, n}, j) + d (j, i) **Time complexity analysis(3M)** **Time complexity Analysis:** There are at the most 2^n. n sub-problems and each one takes linear time to solve. Therefore, the total running time is O (2^n. n^2) O (2^n. n^2).
2	**Explain in detail about Knapsack problem with example. (15M) (May/June 2014).** BTL3 **Knapsack Problem (2M)** Given a set of items, each with a weight and a value, determine a subset of items to include in a collection so that the total weight is less than or equal to a given limit and the total value is as large as possible. **Algorithm Explanation with example(10M)** **Algorithm: Greedy-Fractional-Knapsack (w [1...n], p [1...n], W)** for i = 1 to n do x[i] = 0 weight = 0 for i = 1 to n if weight + w[i] ≤ W then x[i] = 1 weight = weight + w[i] else x[i] = (W - weight) / w[i] weight = W break return x **Time complexity analysis (3M)**

	Efficiency: Ω(2^n)
3	**Explain in detail about closest pair problem. (15M) (Nov/Dec 2017).** BTL3 **Definition(2m)** The brute force algorithm checks the distance between every pair of points and keep track of the min. The cost is O(n(n-1)/2), quadratic. **Algorithm Explanation with example(10M)** **Algorithm** Closest Pair • Initially sort the n points, $P_i = (x_i, y_i)$ by their x dimensions. • Then recursively divide the n points, $S_1 = \{P_1...,P_{n/2}\}$ and $S_2 = \{P_{n/2+1}...,P_n\}$ • so that S_1 points are two the left of $x = x_{n/2}$ and S_2 are to the right of $x = x_{n/2}$. • Recursively find the closest pair in each set, d_1 of S_1 and d_2 for S_2, $d = \min(d_1, d_2)$. • We must check all the S_1 points lying in this strip to every S_2 points in the strip, and get closest distance $d_{between}$ • To efficiently do the above, need to sort the points along the y dimensions, using a merge sort approach. • Then the minimum distance is minimum distance is min(d, $d_{between}$) **Time complexity analysis (3M)** **Efficiency: Θ(n^2)**

JIT-2106

UNIT 3 DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE
Dynamic programming – Principle of optimality – Coin changing problem, Computing a Binomial Coefficient – Floyd 's algorithm – Multi stage graph – Optimal Binary Search Trees – Knapsack Problem and Memory functions. Greedy Technique – Container loading problem – Prim 's algorithm and Kruskal's Algorithm – 0/1 Knapsack problem, Optimal

Merge pattern – Huffman Trees.	
	PART *A
1	**Define dynamic programming (May/June 2017).** BTL1 Dynamic programming is an algorithm design method that can be used when a solution to the problem is viewed as the **result of sequence of decisions.** Dynamic programming is a technique for solving problems with overlapping sub problems. These sub problems arise from a recurrence relating a solution to a given problem with solutions to its smaller sub problems only once and recording the results in a table from which the solution to the original problem is obtained. It was invented by a prominent U.S Mathematician, Richard Bellman in the 1950s.
2	**What are the features of dynamic programming? (May/June 2014).** BTL1 • Optimal solutions to sub problems are retained so as to avoid re computing their values. • Decision sequences containing subsequences that are sub optimal are not considered. • It definitely gives the optimal solution always.
3	**What are the drawbacks of dynamic programming?** BTL1 • Time and space requirements are high, since storage is needed for all level. • Optimality should be checked at all levels.
4	**Write the general procedure of dynamic programming.** BTL2 The development of dynamic programming algorithm can be broken into a sequence of 4 steps. They are: • **Characterize** the structure of an optimal solution. • **Recursively define** the value of the optimal solution. • **Compute** the value of an optimal solution in the **bottom-up fashion.** • **Construct an optimal solution** from the computed information.
5	**Define principle of optimality. (Nov/Dec 2017 May/June 2014).** BTL1 It states that an optimal sequence of decisions has the property that whenever the initial stage or decisions must constitute an optimal sequence with regard to stage resulting from the first decision.
6	**Differentiate the Greedy method and Dynamic programming. (May/June 2012).** BTL2 • Greedy method Only one sequence of decision is generated. It does not guarantee to give an optimal solution always. • Dynamic programming Many numbers of decisions are generated. It definitely gives an optimal solution always
7	**What is greedy technique?** BTL1 Greedy technique suggests a greedy grab of the best alternative available in the hope that a sequence of locally optimal choices will yield a globally optimal solution to the entire problem. The choice must be made as follows Feasible: It has to satisfy the problem's constraints Locally optimal: It has to be the best local choice among all feasible choices available on that step. Irrevocable: Once made, it cannot be changed on a subsequent step of the algorithm

8	**What is the Greedy choice property?** BTL1 • The first component is greedy choice property (i.e.) a globally optimal solution can arrive at by making a locally optimal choice. • The choice made by greedy algorithm depends on choices made so far but it cannot depend on any future choices or on solution to the sub problem. • It progresses in top down fashion.
9	**List the steps required to develop a greedy algorithm. (May/June 2017).** BTL1 • Determine the **optimal substructure** of the problem. • Develop a **recursive solution**. • Prove that at any stage of recursion one of the optimal choices is greedy choice. Thus it is always safe to make greedy choice. • Show that all but one of the sub problems induced by having made the greedy choice are empty. • Develop a recursive algorithm and **convert into iterative algorithm.**
10	**11. What are the labels in Prim's algorithm used for?** BTL1 Prim 's algorithm makes it necessary to provide each vertex not in the current tree with the information about the shortest edge connecting the vertex to a tree vertex. The information is provided by attaching two labels to a vertex. • The name of the nearest tree vertex. • The length of the corresponding edge
12	**How are the vertices not in the tree are split into?** BTL2 The vertices that are not in the tree are split into two sets: • Fringe: It contains the vertices that are not in the tree but are adjacent to at least one tree vertex. • Unseen: All other vertices of the graph are called unseen because they are yet to be affected by the algorithm.
13	**What are the operations to be done after identifying a vertex u* to be added to the tree?** BTL1 After identifying a vertex u* to be added to the tree, the following two operations need to be performed: • Move u* from the set $V-V_T$ to the set of tree vertices V_T. • For each remaining vertex u in $V-V_T$ that is connected to u* by a shorter edge than the u 's current distance label, update its labels by u* and the weight of the edge between u* and u, respectively.
14	**Give the use of Dijkstra's algorithm.** BTL2 Dijkstra 's algorithm is used to solve the **single-source shortest-paths problem**: for a given vertex called the source in a weighted connected graph, find the shortest path to all its other vertices. The single-source shortest-paths problem asks for a family of paths, each leading from the source to a different vertex in the graph, though some paths may have edges in common.
15	**Define Spanning tree.** BTL1 Spanning trees defined as a connected graph *G*: a connected acyclic subgraph of *G* that includes all of *G*'s vertices

16	**What is minimum spanning tree?** BTL1 Minimum spanning tree of a weighted, connected graph *G*: a spanning tree of *G* of the minimum total weight
17	**What does a Floyd algorithm do? (Nov/Dec 2017).** BTL1 The Floyd-Warshall algorithm works based on a property of intermediate vertices of a shortest path. An intermediate *vertex* for a path $p = <v_1, v_2, ..., vj>$ is any vertex other than v_1 or v_j.
18	**What is closest pair problem? (May/June 2016 May/june 2017).** BTL1 The closest pair problem is finding the two closest points from the set of n points.
19.	**What is optimal merge pattern?** BTL1 **Optimal merge pattern** is a **pattern** that relates to the **merging** of two or more sorted files in a single sorted file.
20.	**What is Huffman tree?** BTL1 **Huffman coding tree** or **Huffman tree** is a full **binary tree** in which each leaf of the ***tree*** corresponds to a letter in the given alphabet.

PART B

1 **Explain Dijkstra's shortest path algorithm. (13M). (Nov/Dec 2017).** BTL2

Dijkstra's algorithm(2M)

solves the single-source shortest-paths problem on a directed weighted graph $G = (V, E)$, where all the edges are non-negative (i.e., $w(u, v) \geq 0$ for each edge $(u, v) \in E$).

Algorithm: Dijkstra's-Algorithm (G, w, s) (9M)

```
for each vertex v Є G.V
   v.d := ∞
   v.∏ := NIL
s.d := 0
S := Φ
Q:= G.V
while Q ≠ Φ
   u := Extract-Min (Q)
   S := S U {u}
   for each vertex v Є G.adj[u]
      if v.d > u.d + w(u, v)
         v.d := u.d + w(u, v)
         v.∏ := u
```

Time complexity analysis(2M)

Analysis:

The complexity of this algorithm is fully dependent on the implementation of Extract-Min function. If extract min function is implemented using linear search, the complexity of this algorithm is $O(V^2 + E)$

2 **Explain Kruskal's algorithm in detail with appropriate example. (13M) (May/June 2014).** BTL3

	Kruskal's algorithm (2M) It is a minimum spanning tree algorithm that takes a graph as input and finds the subset of the edges of that graph which • form a tree that includes every vertex • It has the minimum sum of weights among all the trees that can be formed from the graph The steps for implementing Kruskal's algorithm are as follows: 1. Sort all the edges from low weight to high 2. Take the edge with the lowest weight and add it to the spanning tree. If adding the edge created a cycle, then reject this edge. 3. Keep adding edges until we reach all vertices. **Algorithm (9M)** KRUSKAL(G): A = ∅ For each vertex v ∈ G.V: MAKE-SET(v) For each edge (u, v) ∈ G.E ordered by increasing order by weight (u, v): if FIND-SET(u) ≠ FIND-SET(v): A = A ∪ {(u, v)} UNION (u, v) return A **Time complexity analysis(2M)** **Time complexity analysis:** **Kruskal's algorithm** can be shown to run in O (E log E) **time**, or equivalently, O (E log V) **time**, where E is the number of edges in the graph and V is the number of vertices,
3	**Discuss Prim's Algorithm in detail with suitable example. (13M) (Nov/Dec 2017).** BTL3 **Definition(2M)** **Prim's algorithm**, in contrast with Kruskal's algorithm, treats the nodes as a single tree and keeps on adding new nodes to the spanning tree from the given graph. **Algorithm Explanation with example(9M)** **Algorithm:**

	T = ∅; U = { 1 }; while (U ≠ V) let (u, v) be the lowest cost edge such that u ∈ U and v ∈ V - U; T = T ∪ {(u, v)} U = U ∪ {v} **Time complexity analysis(2M)** **The time complexity** is O(Vlog + ElogV) = O(ElogV), making it the same as Kruskal's algorithm
4	**Explain Greedy Method in detail with suitable example. (13M)** BTL2 A greedy algorithm makes a locally optimal choice in the hope that this choice will lead to a globally optimal solution. **(2M)** The choice at each step must be: • Feasible (**1M)** Satisfy the problem 's constraints • locally optimal **(1M)** Be the best local choice among all feasible choices • Irrevocable **(1M)** Once made, the choice can 't be changed on subsequent steps. **Applications of the Greedy Strategy** • Optimal solutions **(4M)** change making Minimum Spanning Tree (MST) Single-source shortest paths. Huffman codes • Approximations **(4M)** Traveling Salesman Problem (TSP) Knapsack problem
	PART *C
1	**Discuss Warshall's Algorithm with suitable diagrams. (15M)** BTL3 ***Warshall's Algorithm*** **Definition(2M)** **Warshall's algorithm** uses the adjacency matrix to find the transitive closure of a directed graph. The **transitive closure** of a directed graph with *n* vertices can be defined as the *n*-by-*n* Boolean matrix *T*, in which the element in the *i*th row and *j*th column is 1 if there exist a directed path from the *i*th vertex to the *j*th vertex, otherwise it is zero. **Algorithm Explanation with example(11M)** **Algorithm:** *Warshall* (*A* [1...*n*, 1...*n*]) // A is the adjacency matrix $R^{(0)} \leftarrow A$ **for** *k* ← 1 **to** *n* **do** **for** *i* ← 1 **to** *n* **do**

	for $j \leftarrow$ **to** n **do** $R^{(k)}[i, j] \leftarrow R^{(k-1)}[i, j]$ **or** ($R^{(k-1)}[i, k]$ **and** $R^{(k-1)}[k, j]$) **return** $R^{(n)}$ **Time complexity analysis(2M)** **Time Complexity:** O(V^3)
2	**Explain Floyd's Algorithm in detail with example. (15M).** BTL3 **Definition(2M)** **Floyd-Warshall Algorithm** The Floyd-Warshall algorithm works based on a property of *intermediate* vertices of a shortest path. An *intermediate* vertex for a path $p = <v_1, v_2, ..., vj>$ is any vertex other than v_1 or v_j. **Algorithm(11M)** *Floyd* (W [1...n, 1...n]) // W is the weight distances $D^{(0)} \leftarrow W$ **for** $k \leftarrow 1$ **to** n **do** // iteration through distance matrices **for** $i \leftarrow 1$ **to** n **do** **for** $j \leftarrow$ **to** n **do** $D^{(k)}$ [i, j] $\leftarrow \min(D^{(k-1)}[i, j], (D^{(k-1)}[i, k] + D^{(k-1)}[k, j]))$ **return** $D^{(n)}$ **Time complexity analysis(2M)** **Time complexity** of **Floyd Warshall algorithm**. The Floyd-Warshall all-pairs shortest path runs in $O(n^3)$ time
3	**Explain Memory Function algorithm for the Knapsack problem. (15M).** BTL1 **Definition(2M)** **Memory Function algorithm for the Knapsack problem:** The technique uses a top-down approach, recursive algorithm, with table of sub-problem solution. Before determining the solution recursively, the algorithm checks if the sub problem has already been solved by checking the table. If the table has a valid value, then the algorithm uses the table value else it proceeds with the recursive solution. **Algorithm (13M)** *Knapsack* (i, j) // i, j represents the sub problem **if** $V[i, j] < 0$ // meaning not already calculated **if** $j <$ *Weights*[i] **then** *value* $\leftarrow$ *Knapsack* (i-1, j) **else** *value* $\leftarrow$ max (*Knapsack* (i-1, j), *Values*[i] + *Knapsack* (i-1, j-*Weights*[i])

$V[i, j] \leftarrow value$ // put valid value in the table for both cases
return $V[i, j]$

4 **Explain in detail about Huffman tree. (15M) (May/June 2017).** BTL2

Definition(2m)

Huffman coding tree or **Huffman tree** is a full binary tree in which each leaf of the tree corresponds to a letter in the given alphabet.

Define the weighted path length of a leaf to be its weight times its depth. The Huffman tree is the binary tree with minimum external path weight, i.e., the one with the minimum sum of weighted path lengths for the given set of leaves. So the goal is to build a tree with the minimum external path weight.

Letter frequency table

Letter	Z	K	M	C	U	D	L	E
Frequency	2	7	24	32	37	42	42	120

Huffman code

Letter	Freq	Code	Bits
E	120	0	1
D	42	101	3
L	42	110	3
U	37	100	3
C	32	1110	4
M	24	11111	5
K	7	111101	6
Z	2	111100	6

Algorithm Explanation with example(13M)

Algorithm:

Begin

define a node with character, frequency, left and right child of the node for Huffman tree.

create a list ‘freq’ to store frequency of each character, initially, all are 0

for each character c in the string do

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	increase the frequency for character ch in freq list. done for all type of character ch do if the frequency of ch is non-zero then add ch and its frequency as a node of priority queue Q. done while Q is not empty do remove item from Q and assign it to left child of node remove item from Q and assign to the right child of node traverse the node to find the assigned code done End

UNIT-4 ITERATIVE IMPROVEMENT	
The Simplex Method – The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs, Stable marriage Problem.	
PART *A	
1	**What do you mean by optimal solution?** BTL1 Given a problem with n inputs, we obtain a subset that satisfies come constraints. Any subset that satisfies these constraints is called a feasible solution. A feasible solution, which either **maximizes or minimizes a given objective function** is called optimal solution.

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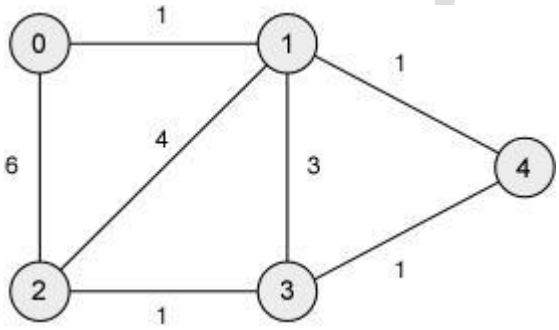
2	**What is feasible solution?** BTL1 It is obtained from given n inputs Subsets that satisfies some constraints are called feasible solution. It is obtained based on some constraints
3	**Compare feasible and optimal solution. (Nov/Dec 2017 May/June 2014).** BTL2 **Feasible solution** A solution (set of values for the decision variables) for which all of the constraints in the Solver model are satisfied is called a feasible solution. In some problems, a feasible solution is already known in others, finding a feasible solution may be the hardest part of the problem. **Optimal solution** An optimal solution is a feasible solution where the objective function reaches its maximum (or minimum) value – for example, the most profit or the least cost. A globally optimal solution is one where there are no other feasible solutions with better objective function values. A locally optimal solution is one where there are no other feasible solutions **"**in the vicinity**"** with better objective function values.
4	**Recall LPP.** BTL1 *Linearprogrammingproblem* (LPP) is to optimize a linear function of several variables subject to linear constraints: Maximize (or minimize) $c_1 x_1 + ... + c_n x_n$ $\leq$ (or $\geq$ or =) b_i , $i = 1,...,$ Subject to $a_{i\ 1}x_1 + ... + a_{in} x_n$ m $x_1 \geq \mathbf{0}, ..., x_n \geq 0$ The function $z = c_1 x_1 + ... + c_n x_n$ is called the objective function; Constraints $x_1 \geq 0, ..., x_n \geq 0$ are called nonnegativity constraints
5	**What is Simplex Method?** BTL1 The classic method for solving Linear programming problem (LPP.One of the most important algorithms ever invented to solve LPP.Invented by George Danzig in 1947.Based on the iterative improvement idea. **Generates a sequence of adjacent points of the problem's feasible region with** improving values of the objective function until no further improvement is possible.
6	**Write the steps to solve LPP problems by Simplex Method / Procedure for Simplex Method.** BTL2 • **Step 0 [Initialization**] Present a given LP problem in standard form and set up initial tableau. • **Step 1** [**Optimality test**] If all entries in the objective row are nonnegative then stop: the tableau represents an optimal solution. • **Step 2 [Find entering variable]** Select the most negative entry in the objective row. Mark its column to indicate the entering variable and the **pivot column**. • **Step 3 [Find departing (leaving) variable]** For each positive entry in the pivot column, calculate the **θ**-ratio by dividing that row's entry in the rightmost column (solution) by its entry in the pivot column. (If there are no positive entries in the pivot column then stops: the problem is unbounded.) Find the row with the smallest **θ**-ratio, mark this row to indicate the departing variable and the **pivot row.** • **Step 4 [Form the next tableau]** Divide all the entries in the pivot row by its entry in the pivot column. Subtract from each of the other rows, including the objective row, the new pivot row multiplied by the entry in the pivot column of the row in

	question. Replace the label of the pivot row by the variable's name of the pivot column and go back to Step 1.
7	**Mention the time complexity of the Simplex Method.** BTL2 • Finding an initial basic feasible solution may pose a problem. • Theoretical possibility of cycling. • Typical number of iterations is between m and 3m, where m is the number of equality constraints in the standard form. Worse-case efficiency is **exponentia**l.
8	**Write the Standard form of LP problem.** BTL2 Must be a **maximization** problem All constraints (except the nonnegativity constraints) must be in the form of linear equations All the variables must be required to be nonnegative Thus, the general linear programming problem in standard form with m constraints and n unknowns ($n \geq m$) is Maximize $c_1 x_1 + ... + c_n x_n$ Subject to $a_{i\ 1}x_1 + ... + a_{in} x_n = b_i$, $i = 1,..., m$, $x_1 \geq \mathbf{0}, ..., x_n \geq$
9	**Give the possible outcomes in solving an LP problem.** BTL2 • has a finite optimal solution, which may not be unique • *unbounded*: the objective function of maximization (minimization) LP problem is unbounded from above (below) on its feasible region • *infeasible*: there are no points satisfying all the constraints, i.e. the constraints are contradictory
10	**Solve the LPP by algebraic geometry technique.** BTL1 Maximize: 60c + 90s Subject to 50c + 100s = 20000 (1) 100c + 40s = 19200 (2) (1)/50 => c + 2s = 400 (2)/20 => 5c + 2s = 960 (2) – (1) => 4c = 560 C= 140 Substitute c = 140 in (1) then s = 130 Profit: p = 60c + 90s = 60(140) + 90(130) = 20,100
11	**How will you calculate new pivot row and remaining rows in new iteration of simplex method?** BTL2 Pivot row: New Pivot Row = Current Pivot Row / Pivot Element All other rows including z: New Row = Current Row – (Its Pivot column coefficient)* New Pivot Row
12	**Convert the given primal problem into dual problem.** BTL3 The Primal problem Minimize $4x_1 + 2x_2 - \mathbf{x}_3$ subject to $x_1 + x_2 + 2x_3 \geq \mathbf{3}$ $2x_1 - \mathbf{2x}_2 + 4x_3 \leq \mathbf{5}$ $x_1, x_2, x_3 \geq \mathbf{0}$. The dual problem

	Maximize $3y_1 + 5y2$ subject to $y_1 + 2y_2 \leq \mathbf{4}$ $y_1 - \mathbf{2}y_2 \leq \mathbf{2}$ $2y_1 + 4y_2 \leq \mathbf{-1}$ $y_1 \geq \mathbf{0}, y_2 \geq \mathbf{0}$
13	**Compare Explicit and Implicit Constraints. (May/June 2014).** BTL2 1) Explicit constraints: Explicit constraints are rules that restrict each Xi to take values only from a given set. Some examples are, Xi >0 or Si = {all non-negative real nos.} Xi =0 or 1 or Si= {0,1}. Li Xi Ui or Si= {a: Li a Ui} All tupules that satisfy the explicit constraint define a possible solution space. 2) Implicit constraints: The implicit constraint determines which of the tuples in the solution space can actually satisfy the criterion functions.
14	**Define weighted graph.** BTL2 A weighted graph is a graph in which a number (the weight) is assigned to each edge. such weights might represent for example costs, lengths or capacities, depending on the problem at hand. Some authors call such a graph a network. 
15	**Define multistage graph.** BTL1 A multistage graph is a graph **G= (V, E)** with **V** partitioned into **K >= 2** disjoint subsets such that if **(a, b)** is in **E**, then **a** is in $\mathbf{V_i}$, and **b** is in $\mathbf{V_{i+1}}$ for some subsets in the partition; and $\mathbf{|V_1| = |V_K| = 1}$. The vertex **s** in $\mathbf{V_1}$ is called the source; the vertex **t** in $\mathbf{V_K}$ is called the sink. **G** is usually assumed to be a **weighted graph**. The cost of a path from node v to node w is sum of the costs of edges in the path. The "multistage graph problem" is to find the minimum cost path from s to t.
17	**Define source and sink node of graph.** BTL1 A Flow graph contains 1 source node and 1 sink node. Source node: Unique vertex with no entering edges. Sink node: Unique vertex with no leaving edges.

18	**What is bipartite graph? (Nov/Dec 2017).** BTL1 A **bipartite graph**, also called a bigraph, is a set of **graph** vertices decomposed into two disjoint sets such that no two **graph** vertices within the same set are adjacent. A **bipartite graph** is a special case of a k-partite **graph**
19	**What is Maximum Flow Problem?** BTL1 • Problem of maximizing the flow of a material through a transportation network (e.g., pipeline system, communications or transportation networks) • Formally represented by a connected weighted digraph with *n* vertices numbered from 1 to *n* with the following properties: • contains exactly one vertex with no entering edges, called the **source (numbered 1)** • contains exactly one vertex with no leaving edges, called the **sink (numbered *n*)** • has positive integer weight u_{ij} on each directed edge (*i.j*), called the **edge capacity,** indicating the upper bound on the amount of the material that can be sent from *i* to *j* through this edge. • A digraph satisfying these properties is called a **flow network** or simply a network.
20.	**What is state space tree? (May/ June 2016).** BTL2 Backtracking and branch bound are based on the construction of a state space tree, whose nodes reflect specific choices made for a solution's component. Its root represents an initial state before the search for a solution begins. The nodes of the first level the tree represent the made for the first component of solution, the nodes of the second level represent the Choices for the second components & so on
	PART * B
1	**Describe stable marriage problem with example. (13M) (Nov/Dec 2017).** BTL3 **Definition(2M)** A ***marriage matching M*** is a set of ***n (m, w)*** pairs whose members are selected from disjoint-element sets ***Y*** and ***X*** in a one-one fashion, i.e., each man ***m*** from is paired with exactly one-woman ***w*** from ***X*** and vice versa. (If we represent and ***X*** as vertices of a complete bipartite graph with edges connecting possible marriage partners, then a marriage matching is a perfect matching in such a graph.) **Algorithm and explanation(11M)** **Algorithm** **function** stable Matching { Initialize all *m* ∈ M and *w* ∈ W to *free* **while** ∃ *free* man *m* who still has a woman w to propose to { w = first woman on m's list to whom m has not yet proposed **if** w is *free* (m, w) become *engaged* **else** some pair (m', w) already exists **if** w prefers m to m'

	m' becomes *free* (m, w) become *engaged* **else** (m', w) remain *engaged* } }
2	**Explain Simplex method with example. (13M) (Nov/Dec 2017 May/June 2016).** BTL3 **Definition(2M)** **Algorithm and explanation(11M)** The classic method for solving LP problems. Invented by George Dantzig in 1947. • Based on the iterative improvement idea. • Generates a sequence of adjacent points of the problem's feasible region with improving • values of the objective function until no further improvement is possible. **Simplex method steps** Step 0 [Initialization] Present a given LP problem in standard form and set up initial tableau. Step 1 [Optimality test] If all entries in the objective row are nonnegative then stop: the tableau represents an optimal solution. Step 2 [Find entering variable] Select the most negative entry in the objective row. Mark its column to indicate the entering variable and the pivot column. Step 3 [Find departing (leaving) variable] For each positive entry in the pivot column, calculate the θ
3.	**Explain Maximum Flow Problem in detail. (13M). (Nov/Dec 2016).** BTL3 **Definition(2M)** Maximum Flow Problem Problem of maximizing the flow of a material through a transportation network (e.g., pipeline system, communications or transportation networks) Formally represented by a connected weighted digraph with n vertices numbered from 1 to n with the following properties: • Contains exactly one vertex with no entering edges, called the source (numbered 1) • Contains exactly one vertex with no leaving edges, called the sink (numbered n) • Has positive integer weight uij on each directed edge (i.j), called the edge capacity, indicating the upper bound on the amount of the material that can be sent from i to j through this edge. • A digraph satisfying these properties is called a flow network or simply a network. **Algorithm and explanation(11M)** **Ford-Fulkerson Algorithm:** It was developed by L. R. Ford, Jr. and D. R. Fulkerson in 1956. A pseudocode for this algorithm is given below,

	Inputs required are network graph G, source node S and sink node T. function: Ford Fulkerson (Graph G, Node S,Node T): Initialise flow in all edges to 0 while (there exists an augmenting path(P) between S and T in residual network graph): Augment flow between S to T along the path P Update residual network graph return
4	**Explain in detail about Maximum Matching Bipartite graph. (13M) (Nov/Dec 2016).** BTL2 **Definition(2M)** A **matching** in a graph is a sub set of edges such that no two edges share a vertex. The **maximum matching** of a graph is a matching with the maximum number of edges. **Algorithm and explanation(11M)** **Algorithm** MaximumBipartiteMatching(G) initialize set *M* of edges // can be the empty set initialize queue *Q* with all the free vertices in *V* **while not** *Empty*(*Q*) **do** *w* ← *Front*(*Q*) **if** *w* ε *V* **then** **for** every vertex *u* adjacent to *w* **do** // *u* must be in *U* **if** *u* is free **then** // augment *M* ← *M* union (*w*, *u*) *v* ← *w* **while** *v* is labeled **do** // follow the augmenting path *u* ← *label* of *v* *M* ← *M* - (*v*, *u*) // (*v*, *u*) was in previous *M* *v* ← label of *u* *M* ← *M* union (*v*, *u*) // add the edge to the path // start over remove all vertex labels reinitialize *Q* with all the free vertices in *V* **break** // exit the for loop **else** // *u* is matched **if** (*w*, *u*) not in *M* **and** *u* is unlabeled **then** label *u* with *w* // represents an edge in *E-M* *Enqueue*(*Q*, *u*) // only way for a *U* vertex to enter the queue

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	else // $w \varepsilon U$ and therefore is matched with v $v \leftarrow w$'s mate // (w, v) is in M label v with w // represents in M *Enqueue*(Q, v) // only way for a mated v to enter Q
	PART C
1.	**Explain 2 colorable graph problem (15M) (May/June 2014 Nov/Dec 2012).** BTL3 **Definition(2M)** A bipartite graph is also called 2 colorable. A bipartite graph is possible if the graph coloring is possible using two colors such that vertices in a set are colored with the same color. Note that it is possible to color a cycle graph with even cycle using two colors. For example, see the following graph. **Algorithm and explanation(11M)** ***Algorithm to check if a graph is Bipartite:*** One approach is to check whether the graph is 2-colorable or not using backtracking algorithm m coloring problem. Following is a simple algorithm to find out whether a given graph is Bipartite or not using Breadth First Search (BFS). 1. Assign RED color to the source vertex (putting into set U). 2. Color all the neighbors with BLUE color (putting into set V). 3. Color all neighbor's neighbor with RED color (putting into set U). 4. This way, assign color to all vertices such that it satisfies all the constraints of m way coloring problem where m = 2. 5. While assigning colors, if we find a neighbor which is colored with same color as current vertex, then the graph cannot be colored with 2 vertices (or graph is not Bipartite)

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UNIT 5- COPING WITH THE LIMITATIONS OF ALGORITHMPOWER	
Lower – Bound Arguments – P, NP NP- Complete and NP Hard Problems. Backtracking – n-Queen problem – Hamiltonian Circuit Problem – Subset Sum Problem. Branch and Bound – LIFO Search and FIFO search – Assignment problem – Knapsack Problem – Travelling Salesman Problem – Approximation Algorithms for NP-Hard Problems – Travelling Salesman problem – Knapsack problem.	
PART *A	
1	**Analyze the limitations of algorithm power.** BTL2 There are many algorithms for solving a variety of different problems. They are very powerful instruments, especially when they are executed by modern computers. The power of algorithms is because of the following reasons: • There are some problems cannot be solved by any algorithm. • There are some problems can be solved algorithmically but not in polynomial time.

	• There are some problems can be solved in polynomial time by some algorithms, but there are usually lower bounds on their efficiency. • Lower-Bound Arguments • Decision Trees • P, NP and NP-Complete Problems
2	**What are lower-bound arguments? May/june 2016.** BTL1 Lower bounds mean estimating the minimum amount of work needed to solve the problem. We present several methods for establishing lower bounds and illustrate them with specific examples. • Trivial Lower Bounds • Information-Theoretic Arguments • Adversary Arguments • Problem Reduction In analyzing the efficiency of specific algorithms in the preceding, we should distinguish between a lower-bound class and a minimum number of times a particular operation needs to be executed.
3	**Define Trivial Lower Bounds.** BTL1 The simplest method of obtaining a lower-bound class is based on counting the **number of items in the problem's input that must be processed and the number of output** items that need to be produced. Since any algorithm must at least **"**read**"** all the items it needs to process and **"**write**"** all its outputs, such a count yields a **trivial lower bound**.
4	**Define Information-Theoretic Arguments.** BTL1 The information-theoretical approach seeks to establish a lower bound based on the amount of information it has to produce by algorithm.
5	**Define Adversary Arguments.** BTL1 Adversary Argument is a method of proving by playing a role of adversary in which algorithm has to work more for adjusting input consistently. Consider the Game of guessing number between positive integer 1 and n by asking a person (Adversary) with yes/no type answers for questions. After each question at least one-half of the numbers reduced. If an algorithm stops before the size of the set is reduced to 1, the adversary can exhibit a number. Any algorithm needs $\log_2 n$ iterations to shrink an n-element set to a one-element set by halving and rounding up the size of the remaining set. Hence, at least $\log_2 n$ questions need to be asked by any algorithm in the worst case. This example illustrates the ***adversary method*** for establishing lower bounds.
6	**Discuss Problem Reduction.** BTL2 Problem reduction is a method in which a difficult unsolvable problem P is reduced to another solvable problem B which can be solved by a known algorithm. A similar reduction idea can be used for finding a lower bound. To show that problem P is at least as hard as another problem Q with a known lower bound, we need to reduce Q to P (not P to Q!). In other words, we should show that an arbitrary instance of problem Q can be transformed to an instance of problem P, so any algorithm solving P would solve Q as well. Then a lower bound for Q will be a lower bound for P.

7	**Define decision trees.** BTL1 Important algorithms like sorting and searching are based on comparing items of their inputs. The study of the performance of such algorithm is called a **decision tree**. As an example, Each internal node of a binary decision tree represents a key comparison indicated in the node.
8	**Define tractable and intractable.** BTL1 Problems that can be solved in polynomial time are called ***tractable***, and problems that cannot be solved in polynomial time are called ***intractable***
9	**Give the importance of Hamiltonian circuit problem. Nov/Dec 2013.** BTL2 Determines whether a given graph has a Hamiltonian circuit—a path that starts and ends at the same vertex and passes through all the other vertices exactly once.
10	**Define Traveling salesman problem.** BTL1 Find the shortest tour through n cities with known positive integer distances between them (find the shortest Hamiltonian circuit in a complete graph with positive integer weights). ***Applications*** Vehicle routing. Discrete optimization Computer network problem Airport tour. Sonnet ring Power cable
11	**What is the use of Knapsack problem?** BTL1 Find the most valuable subset of n items of given positive integer weights and values that fit into a knapsack of a given positive integer capacity.
12	**Write about Partition problem.** BTL1 Given n positive integers, it determines whether it is possible to partition them into two disjoint subsets with the same sum.
13	**Define Bin-packing problem.** BTL1 Given n items whose sizes are positive rational numbers not larger than 1, put them into the smallest number of bins of size 1.
14	**Define Graph-coloring problem.** BTL1 For a given graph, find its chromatic number, which is the smallest number of colors **that need to be assigned to the graph's vertices s**o that no two adjacent vertices are assigned the same color. Every Planner graph is 4 colorable.
15	**Define Integer linear programming problem.** BTL1 Find the maximum (or minimum) value of a linear function of several integer-valued variables subject to a finite set of constraints in the form of linear equalities and inequalities.
16	**Mention the use of deterministic and nondeterministic algorithm.** BTL2 **A nondeterministic algorithm** is a two-stage procedure that takes as its input an instance I of a decision problem and does the following. **Nondeterministic ("guessing") stage:** An arbitrary string S is generated that can be thought of as a candidate solution to the given instance. **Deterministic ("verification") stage:** A deterministic algorithm takes both I and S

	as its input and outputs yes if S represents a solution to instance I. (If S is not a solution to instance I , the algorithm either returns no or is allowed not to halt at all.) Finally, a nondeterministic algorithm is said to be ***nondeterministic polynomial*** if the time efficiency of its verification stage is polynomial.
17	**Define Class P.** BTL1 **Class *P*** is a class of decision problems that can be **solved in polynomial time by deterministic algorithms.** This class of problems is called **polynomial class**. **Examples:** Searching Element uniqueness Graph connectivity Graph a cyclicity Primality testing
18	**Define Class NP.** BTL1 **Class *NP*** is the class of decision problems that can be **solved by nondeterministic polynomial algorithms**. This class of problems is called nondeterministic polynomial. Examples: Integer factorization problem, graph isomorphism problem, All NP-complete problem (travelling salesman problem, Boolean satisfiability problem).
19	**State the use of Class NP-Hard. / List out the properties of NP-Hard Problems. (May/June 2014).** BTL2 A problem is NP-hard if an algorithm for solving it can be translated into one for solving any NP-problem (nondeterministic polynomial time) problem. Therefore, NP-hard means "at least as hard as any NP-problem," although it might, in fact, be harder. There are no polynomial-time algorithms for NP-hard problems. Traveling salesman and knapsack problems are NP-hard problems.
20	**Define NP-complete. (May/June 2014 Nov/Dec 2013). BTL**1 A decision problem *D* is said to be ***NP-complete*** if it is hard as any problem in NP. • It belongs to class *NP* • Every problem in *NP* is polynomial reducible to *D*

	PART *B
1	**Describe Briefly about Np-hard and Np-Completeness (13m) (Nov/Dec 2016).** BTL2 **Definition (3M)** A problem is in the class NPC if it is in NP and is as **hard** as any problem in NP. A problem is **NP-hard** if all problems in NP are polynomial time reducible to it, even though it may not be in NP itself. A language **B** is ***NP-complete*** if it satisfies two conditions • **B** is in NP • Every **A** in NP is polynomial time reducible to **B**. **NP-Complete Problems (5M)** Following are some NP-Complete problems, for which no polynomial time algorithm is

known.

- Determining whether a graph has a Hamiltonian cycle
- Determining whether a Boolean formula is satisfiable, etc.

NP-Hard Problems (5M)

The following problems are NP-Hard

- The circuit-satisfiability problem
- Set Cover
- Vertex Cover
- Travelling Salesman Problem

2 **Describe about Assignment Problem and extend how job assignment problems could be solved. (13M) (Nov/Dec 2017).** BTL2

Definition(3m)

Assignment problem is a special type of linear programming **problem** which deals with the allocation of the various resources to the various activities on one to one basis. It **does** it in such a way that the cost or time involved in the process is minimum and profit or sale is maximum.

	J1	*J2*	*J3*	*J4*
W1	82	83	69	92
W2	77	37	49	92
W3	11	69	5	86
W4	8	9	98	23

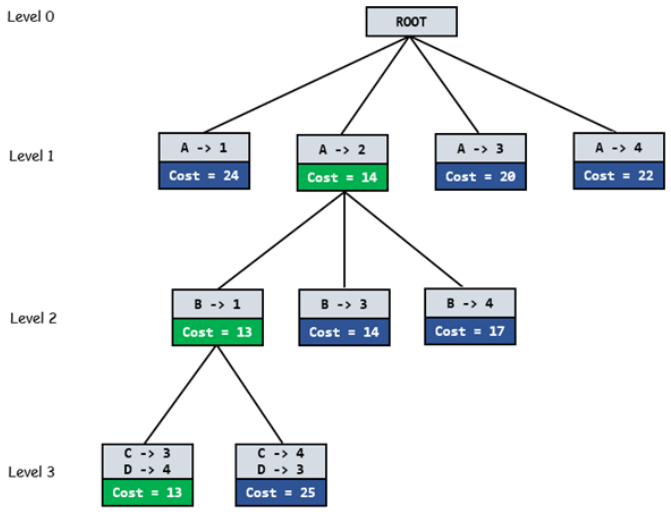
Each worker should perform exactly one job and the objective is to minimize the total time required to perform all jobs.

It turns out to be optimal to assign worker 1 to job 3, worker 2 to job 2, worker 3 to job 1 and worker 4 to job 4. The total time required is then 69 + 37 + 11 + 23 = 140 minutes. All other assignments lead to a larger amount of time required.

Solution 1: Brute Force (2M)

Solution 2: Hungarian Algorithm(3M)

	Solution 3: DFS/BFS on state space tree(2M) **Solution 4: Finding Optimal Solution using Branch and Bound(2M)** 1. .
3	**Discuss the 8-Queens problem & discuss the possible solutions. (13M) (May/June 2014).** BTL3 **Definition (3M)** The eight queen's problem is the problem of placing eight queens on an 8×8 chessboard such that none of them attack one another (no two are in the same row, column, or diagonal). More generally, the n queen's problem places in queens on an n×n chessboard. solutions for the problem Backtracking Algorithm **Algorithm(10M)** The idea is to place queens one by one in different columns, starting from the leftmost column. When we place a queen in a column, we check for clashes with already placed queens. In the current column, if we find a row for which there is no clash, we mark this row and column as part of the solution. If we do not find such a row due to clashes, then we backtrack and return false. 1) Start in the leftmost column 2) If all queens are placed return true 3) Try all rows in the current column. Do following for every tried row. a) If the queen can be placed safely in this row then mark this [row, column] as part of the solution and recursively check if placing queen here leads to a solution. b) If placing the queen in [row, column] leads to a solution then return true. c) If placing queen doesn't lead to a solution then mark this [row, column] (Backtrack) and go to step (a) to try other rows. 4) If all rows have been tried and nothing worked, return false to trigger backtracking.
	PART C
1	**Describe in detail about Branch and Bound Problem (15M) (May/June 2014).** BTL2 **Definition (3M)** The selection rule for the next node in BFS and DFS is "blind". i.e. the selection rule does not give any preference to a node that has a very good chance of getting the search to an answer node quickly. The search for an optimal solution can often be speeded by using an "intelligent" ranking function, also called an approximate cost function to avoid searching in sub-trees that do not contain an optimal solution.

	Finding Optimal Solution using Branch and Bound(7M) It is similar to BFS-like search but with one major optimization. Instead of following FIFO order, we choose a live node with least cost. We may not get optimal solution by following node with least promising cost, but it will provide very good chance of getting the search to an answer node quickly. There are two approaches to calculate the cost function: 1. For each worker, we choose job with minimum cost from list of unassigned jobs (take minimum entry from each row). 2. For each job, we choose a worker with lowest cost for that job from list of unassigned workers (take minimum entry from each column). **Example(5M)** 
2	**Illustrate about Hamiltonian Circuit Problem (15M) (Nov/Dec 2017 May/June 2014 Nov/Dec 2016).** BTL3 **Definition (3M)** **Hamiltonian Path** in an undirected graph is a path that visits each vertex exactly once. A **Hamiltonian cycle** (or Hamiltonian circuit) is a Hamiltonian Path such that there is an edge (in graph) from the last vertex to the first vertex of the Hamiltonian Path. Determine whether a given graph contains Hamiltonian Cycle or not. If it contains, then print the path. **Explanation with example(12M)** Following are the input and output of the required function. A 2D array graph[V][V] where V is the number of vertices in graph and graph[V][V] is adjacency matrix representation of the graph. A value graph[i][j] is 1 if there is a direct edge from i to j, otherwise graph[i][j] is 0. *Output:* An array path[V] that should contain the Hamiltonian Path. path[i] should represent the ith vertex in the Hamiltonian Path. The code should also return false if there is no Hamiltonian Cycle in the graph. For example, a Hamiltonian Cycle in the following graph is {0, 1, 2, 4, 3, 0}.

	(0) --(1) --(2) | /\ | | / \ | |/ | (3) -------(4) And the following graph doesn't contain any Hamiltonian Cycle. (0) --(1) --(2) | /\ | | / \ | |/ | (3) (4)

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CS8493 OPERATING SYSTEMS L T P C

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UNIT I OPERATING SYSTEM OVERVIEW 7

Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System.- Computer System Organization Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.

UNIT II PROCESS MANAGEMENT 11

Processes - Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication; CPU Scheduling - Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling, Real time scheduling; Threads- Overview, Multithreading models, Threading issues; Process Synchronization - The critical-section problem, Synchronization hardware, Mutex locks, Semaphores, Classic problems of synchronization, Critical regions, Monitors; Deadlock - System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

UNIT III STORAGE MANAGEMENT 9

Main Memory – Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, 32 and 64 bit architecture Examples; Virtual Memory – Background, Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.

UNIT IV FILE SYSTEMS AND I/O SYSTEMS 9

Mass Storage system – Overview of Mass Storage Structure, Disk Structure, Disk Scheduling and Management, swap space management; File-System Interface - File concept, Access methods, Directory Structure, Directory organization, File system mounting, File Sharing and Protection; File System Implementation- File System Structure, Directory implementation, Allocation Methods, Free Space Management, Efficiency and Performance, Recovery; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem, Streams, Performance.

UNIT V CASE STUDY 9

Linux System - Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, Input-Output Management, File System, Inter-process Communication; Mobile OS - iOS and Android - Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System.

TOTAL : 45 PERIODS

TEXT BOOK: 1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts",9th Edition, John Wiley and Sons Inc., 2012.

REFERENCES:

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1. Ramaz Elmasri, A. Gil Carrick, David Levine, ―Operating Systems – A Spiral Approach‖, Tata McGraw Hill Edition, 2010.

2. Achyut S.Godbole, Atul Kahate, ―Operating Systems‖, Mc Graw Hill Education, 2016. 3. Andrew S. Tanenbaum, ―Modern Operating Systems‖, Second Edition, Pearson Education, 2004.

4. Gary Nutt, ―Operating Systems‖, Third Edition, Pearson Education, 2004.

5. Harvey M. Deitel, ―Operating Systems‖, Third Edition, Pearson Education, 2004.

6. Daniel P Bovet and Marco Cesati, ―Understanding the Linux kernel‖, 3rd edition, O'Reilly, 2005.

7. Neil Smyth, ―iPhone iOS 4 Development Essentials – Xcode‖, Fourth Edition, Payload media, 2011.

OUTCOMES:

At the end of the course, the students should be able to:

- Analyze various scheduling algorithms.
- Understand deadlock, prevention and avoidance algorithms.
- Compare and contrast various memory management schemes.
- Understand the functionality of file systems.
- Perform administrative tasks on Linux Servers.
- Compare iOS and Android Operating Systems.

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Subject Code: CS8493 **Year/Semester: II /04**
Subject Name: OPERATING SYSTEMS **Subject Handler: S. NEELAKANDAN**

UNIT I – OPERATING SYSTEM OVERVIEW

Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System. - Computer System Organization Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.

PART * A

Q.No.	Questions
1	**What is an Operating system?** BTL2 An operating system is a program that manages the computer hardware. It also provides a basis for application programs and act as an intermediary between a user of a computer and the computer hardware. It controls and coordinates the use of the hardware among the various application programs for the various users.
2	**List the services provided by an Operating System? Program execution.** BTL2 • I/O Operation • File -System manipulation Communications • Error detection
3	**What is the Kernel?** BTL2 A more common definition is that the OS is the one program running at all times on the computer, usually called the kernel, with all else being application programs.
4	**What is meant by Mainframe Systems?** BTL2 Mainframe systems are the first computers developed to tackle many commercial and scientific applications. These systems are developed from the batch systems and then multiprogramming system and finally time sharing systems.
5	**What is meant by Batch Systems?** BTL2 Operators batched together jobs with similar needs and ran through the computer as a group .The operators would sort programs into batches with similar requirements and as system become available, it would run each batch.
6	**Define Multiprogramming**. BTL1 Several users simultaneously compete for system resources (i.e) the job currently waiting for I/O will yield the CPU to another job which is ready to do calculations, if another job is waiting. Thus it increases CPU utilization and system throughput.
7	**What can you say about Time-sharing Systems?** BTL2 Time Sharing is a logical extension of multiprogramming. Here, CPU executes multiple jobs by switching among them, but the switches occur so frequently that the users can interact with each program while it is running.
8	**What are the Components of a Computer System?** BTL2 • Application Programs • System Program

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	• Operating System • Computer Hardware
9	**What are the advantages of Multiprogramming**? BTL2 • Increased System Throughput • Increased CPU utilization
10	**Define Multiprocessor System?** BTL1 Multiprocessor systems have systems more than one processor for communication, sharing the computer bus, the memory, clock & peripheral devices.
11	**What are the advantages of multiprocessors?** BTL2 • Increased throughput • Economy of scale • Increased reliability
12	**What are Multiprocessor Systems & give their advantages?** BTL2 Multiprocessor systems also known as parallel systems or tightly coupled systems are systems that have more than one processor in close communication, sharing the computer bus, the clock and sometimes memory & peripheral devices.
13	**What are the different types of Multiprocessing?** BTL2 Symmetric multiprocessing (SMP): In SMP each processor runs an identical copy of the OS & these copies communicate with one another as needed. Asymmetric multiprocessing: Each processor is assigned a specific task. A master processor controls the system; the other processors look to the master for instructions or predefined tasks. It defines a master-slave relationship.
14	**What is meant by clustered system?** BTL2 Clustered systems are collection of multiple CPUs to accomplish computational work. Those systems share storage and are closely linked via LAN networking.
15	**What are the types of clustering?** BTL2 • Asymmetric Clustering • Symmetric Clustering • Clustering over a WAN
16	**What is meant by Asymmetric Clustering?** BTL2 In this clustering, one machine is in hot standby mode, while the other is running the application. The hot standby machine just monitors the active server. If that server fails, hot standby host become the active server.
17	**Define Symmetric clustering.** BTL1 Two or more hosts are running applications and they are monitoring each other. This clustering requires more than one application be available to run and it uses all of the available hardware.
18	**Define parallel clusters.** BTL1 Parallel clusters allow multiple hosts to access the same data on the shared storage. Each machine has full access to all data in the database.
19	**What is meant by Real time system?** BTL2 Real time systems are systems that have their in-built characteristics as supplying immediate response. In real time system, each process is assigned a certain level of priority according to the relative importance of the events to be processed.
20	**What are the advantages of distributed systems?** BTL2 • Resource sharing • Load balancing • Reliability

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	• Communication link easy
21	**What are the applications of real-time systems?** BTL2 Controlling the machines Instruments Industrial process Landing & tasking off aero planes Real time simulations Military applications.
22	**What are the types of Real time systems?** BTL2 • Hard Real Time System • Soft Real Time System
23	**What is meant by Hard Real time systems?** BTL2 They are generally required to and they guarantee that the critical tasks are completed in given amount of time.
24	**Define soft real time system**. BTL1 It provides priority to the tasks based on their criticality. It does not guarantee completion of critical tasks in time.
25	**What are the disadvantages of distributed systems?** BTL2 • Security weakness Over dependence on performance • Reliability Maintenance • control become complex
	PART - B
1	**What are the different types of Operating System Services? (13M)** BTL2 **Answer Page: 55 - Silberschatz, Galvin** **Definition (2M)** An Operating System provide services to both the users and to the programs. It provides programs an environment to execute. It provides users the services to execute the programs in a convenient manner. Normally, an operating system provides certain services to programs and to the users of those programs. Some of them are: **Operating Services(11M)** i. Program Execution. (3M) ii. I/O operations (2M) iii. File-system manipulation (2M) iv. Communications (2M) v. Error Detection (2M)
2	**Explain different types of System Programs? (13M)** BTL2 **Answer Page:74 - Silberschatz, Galvin** **Definition(2M)** System programs provide a convenient environment for program development and execution. Some of these programs are user interfaces to system calls and others are more complex. Some of them are: **Types of System Programs(11M)** i. File Management (2M) ii. Status Information (1M) iii. File modification (1M) iv. Programming Language support (2M) v. Program loading and Execution (2M) vi. Communication.(1M) vii. Application Programs (2M)

3	**What are System Calls? What are the five major categories of System Calls?(13M)** BTL2 **Answer: Page:62 Silberschatz, Galvin** **Definition (2M)** System calls provide the interface between a process and the operating system. These calls are generally available as assembly-language instructions. i. Process Control (2M) ii. File-management (2M) iii. Device-management (2M) iv. Information maintenance (2M) v. Communications (3M)
4	**Explain different types of Operating System Components ?(13M)** BTL2 **Answer Page:66 - Silberschatz, Galvin.** **Definition (2M)** The parts of an operating system all exist so as to make the various parts of a computer system work together. All user software program has to undergo the operating system in order to utilize any of the hardware, whether it be as basic as a mouse or keyboard or as complicated as an Internet component. i. Process management (1M) ii. I/O-system management (2M) iii. Secondary-storage management (2M) iv. Networking (2M) v. Protection system (2M) vi. Command-interpreter system(2M)
	PART - C
1	**Explain with the features of Operating System Structures(13M)** BTL2 **Answer: Page: 78 Silberschatz, Galvin** **Definition(2M)** A system as large and complex as a modern operating system must be engineered carefully if it is to function properly and be modified easily. A common approach is to partition the task into small components, or modules, rather than have one monolithic system. Each of these modules should be a well-defined portion of the system, with carefully defined inputs, outputs, and functions. Types of Structures • Simple Structure (4M) • Layered Approach (4M) • Microkernel (3M)
2	**Explain basic Elements Operating Systems(15M)** BTL2 **Answer: Page:74 Silberschatz, Galvin.** **Definition (2M)** An operating system is a software that controls your computer. There are a few elements that

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	make up an operating system. The first element of an operating system is the kernel. The kernel ensures that every running process has adequate time to execute. • Instruction Execution (2M) • Interrupts (2M) • Memory Hierarchy (3M) • Cache Memory (2M) • Direct Memory Access (2M) • Multiprocessor and Multicore Organization (2M)

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UNIT II – PROCESS MANAGEMENT

Processes - Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication; CPU Scheduling - Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling, Real time scheduling; Threads- Overview, Multithreading models, Threading issues; Process Synchronization - The critical-section problem, Synchronization hardware, Mutex locks, Semaphores, Classic problems of synchronization, Critical regions, Monitors; Deadlock - System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

PART * A

Q.No.	Questions
1	**Define process.** BTL1 A process is more than a program code, which is sometime known as the text section. IT also includes the current activity, as represented by the value of the program counter and the processor's registers.
2	**What is meant by the state of the process?** BTL2 The state of the process is defined in part by the current activity of that process. Each process may be in one of the following states. x New: The process is being created. x Running: Instruction are being executed x Waiting: The process is waiting for some event to occur. x Ready: The process is waiting to be assigned to a processor x Terminated: The process has finished execution
3	**Define process control block.** BTL1 Each process is represented in the operating system by a process control block (PCB) – also called as task control block. The PCB simply serves as the repository for any information that may vary from process to process.
4	**What does PCB contain?** BTL2 • Process state • Program counter • CPU registers • CPU scheduling information • Memory management information • Accounting information
5	**What are the three different types of scheduling queues?** BTL2 **i). Job Queue:** As process enters the system they are put into job queue. **ii). Ready Queue:** The processes that are residing in the main memory and are ready and waiting to execute are kept in the queue **iii). Device Queue**: The list of processes waiting for particular I/O device is called a device queue.
6	**Define schedulers.** BTL1 A process migrates between the various scheduling throughout its lifetime. The operating system must select, for scheduling purposes, processes from these queues in some fashion. The selection process is carried out by the appropriate scheduler.

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7	**What are the types of scheduler?** BTL2 Long term scheduler or job scheduler selects processes from the pool and load them into the memory for execution. Short term scheduler or CPU scheduler, select among the processes that are ready to execute and allocates the CPU to one of them.
8	**Define critical section.** BTL1 If a system consist on n processes {P0, P1,……., Pn-1}.Each process has a segment of code called a critical section, in which the process may be changing common variables, updating a table , writing a file. The important feature of this system is that, when one process is in its critical section, no other process is to be allowed to execute in its critical section.
9	**What requirement is to be satisfied for a solution of a critical section problem?** BTL2 A solution to the critical section problem must satisfy the following 3 requirements. • Mutual exclusion • Progress • Bounded waiting
10	**Define semaphores.** BTL1 Semaphore is a synchronization toll. A semaphore S is an integer variable that apart from initialization is accessed only through 2 standard atomic operations. x Wait x Signal
11	**Define Starvation in deadlock.** BTL1 A problem related to deadlock is indefinite blocking or starvation, a situation where processes wait indefinitely within a semaphore. Indefinite blocking may occur if we add and remove processes from the list associated with a semaphore in LIFO order.
12	**List out the classic problem of synchronization?** BTL1 • The Bounded – Buffer Problem • The Reader – Writer Problem • The Dining –Philosophers Problem
13	**Define deadlock.** BTL1 A process request resources; if the resource are not available at that time, the process enters a wait state. Waiting processes may never change state, because the resources they are requested are held by other waiting processes. This situation is called deadlock.
14	**What is the sequence of operation by which a process utilizes a resource?** BTL2 Under the normal mode of operation, a process may utilize a resource in only the following sequence: x Request: If the request cannot be granted immediately, then the requesting process must wait until it can acquire the response. x Use: The process can operate on the resource. x Release: The process releases the resource
15	**Give the condition necessary for a deadlock situation to arise?** BTL3 A deadlock situation can arise if the following 4 condition hold simultaneously in a system. • Mutual Exclusion • Hold and Wait • No preemption • Circular Wait
16	**Define 'Safe State".** BTL1 A state is safe if the system allocates resources to each process in some order and still avoid deadlock.
17	**Define deadlock-avoidance algorithm.** BTL1 A deadlock-avoidance algorithm dynamically examines the resource allocation state to ensure that a circular wait condition can never exist. The resource allocation state is defined by the number of available and allocated resources, and the maximum demand of the processes.

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18	**What are the benefits of multithreaded programming?** BTL2 • Responsiveness • Resource sharing • Economy • Utilization of multiprocessor architecture
19	**Define deadlock detection diction.** BTL1 If a system does not employ either a deadlock-prevention or a deadlock avoidance algorithm, then a deadlock situation may occur. In this environment, the system must provide: • An algorithm that examines the state of the system to determine whether a deadlock has occurred. • An algorithm to recover from the deadlock.
20	**Define race condition.** BTL1 When several process access and manipulate same data concurrently, then the outcome of the execution depends on particular order in which the access takes place is called race condition. To avoid race condition, only one process at a time can manipulate the shared variable
21	**What is critical section problem?** BTL2 Consider a system consists of 'n' processes. Each process has segment of Code called a critical section, in which the process may be changing common variables, updating a table, writing a file. When one process is executing in its critical section, no other process can allowed to execute in its critical section.
22	**Define busy waiting and spinlock.** BTL1 When a process is in its critical section, any other process that tries to enter its critical section must loop continuously in the entry code. This is called as busy waiting and this type of semaphore is also called a spinlock, because the process while waiting for the lock.
23	**What are the requirements that a solution to the critical section problem must satisfy?** BTL2 The three requirements are • Mutual Exclusion • Progress • Bounded waiting
24	**Define entry section and exit section.** BTL1 The critical section problem is to design a protocol that the processes can use to cooperate. Each process must request permission to enter its critical section. The section of the code implementing this request is the entry section. The critical section is followed by an exit section. The remaining code is the remainder section.
25	**What are conditions under which a deadlock situation may arise?** BTL2 A deadlock situation can arise if the following four conditions hold Simultaneously in a system: • Mutual exclusion • Hold and wait • No pre-emption • Circular wait
26	**What is a resource-allocation graph?** BTL2 Deadlocks can be described more precisely in terms of a directed graph called a system resource allocation graph. This graph consists of a set of vertices V and a set of edges E. The set of vertices V is partitioned into two different types of nodes; P the set consisting of all active processes in the system and R the set consisting of all resource types in the system.

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	PART - B
1	**Explain different types of scheduler ?(13M)** BTL2 **Answer Page:206 - Silberschatz, Galvin.** **Definition (2M)** The process scheduling is the activity of the process manager that handles the removal of the running process from the CPU and the selection of another process on the basis of a particular strategy. Process scheduling is an essential part of a Multiprogramming operating systems. The objective of multiprogramming is to have some process running at all times, so as to maximize CPU utilization. **Types of Schedulers (11M)** • Long-term scheduler(4M) • Medium-term scheduler(4M) • Short-term scheduler(3M)
2	**Explain about process operation in detail ?(13M)** BTL1 **Answer Page: 115 - Silberschatz, Galvin.** **Definition (2M)** In computing, a process is an instance of a computer program that is being executed. It contains the program code and its activity. Depending on the operating system (OS), a process may be made up of multiple threads of execution that execute instructions concurrently. Each CPU (core) executes a single task at a time. **Process operation (11M)** • Process Creation (4M) • Process Termination(4M) • Cooperating Process(3M)
3	**Explain interprocess communication (IPC)with example ?(13M)** BTL1 **Answer Page: 122 - Silberschatz, Galvin.** **Definition (2M)** Operating systems provide the means for cooperating processes to communicate with each other via an inter process communication (PC) facility. IPC provides a mechanism to allow processes to communicate and to synchronize their actions. IPC is best provided by a message passing system. **IPC Operation (10M)** • Direct communication (2M) • Indirect communication (2M) • Shared Memory systems(2M) • Message Passing systems(2M) • Buffering (2M) • Synchronization (1M)
4	**What is critical section problem? Can you explain the solution to solve it ?(13M) BTL1** **Answer Page:206 - Silberschatz, Galvin.**

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	Definition (2M) Only one process in the group can be allowed to execute in their critical section at any one time. If one process is already executing their critical section and another process wishes to do so, then the second process must be made to wait until the first process has completed their critical section work. Solution (5M) • Mutual Exclusion • Progress • Bounded waiting Example (6M)
5	**Briefly describe the deadlock operation with example ?(13M)** BTL2 **Answer Page: 317 - Silberschatz, Galvin.** **Definition (2M)** A process requests resources. If the resources are not available at that time ,the process enters a wait state. Waiting processes may never change state again because the resources they have requested are held by other waiting processes. This situation is called a deadlock. **Deadlock Operation (11M)** • Deadlock Characterization(3M) • Methods for handling Deadlocks(3M) • Deadlock Avoidance(3M) • Deadlock Prevention(3M)
6	**What are the different types of scheduling algorithms used in Operating System?(13M)** BTL2 **Answer Page: 266 - Silberschatz, Galvin.** **Definition (2M)** A scheduling system allows one process to use the CPU while another is waiting for I/O, thereby making full use of otherwise lost CPU cycles. The challenge is to make the overall system as "efficient" and "fair" as possible, subject to varying and often dynamic conditions, and where "efficient" and "fair" are somewhat subjective terms, often subject to shifting priority policies. **Types of Scheduling Algorithms (11M)** • First-Come, First-Served Scheduling (3M) • Shortest Job First Scheduling (3M) • Priority Scheduling (3M) • Round Robin Scheduling (3M)
	PART *C
1	**Consider the following set of processes, with the length of the CPU-burst time given in milliseconds:** Process Burst Time Priority *P*1 10 3 *P*2 1 1 *P*3 2 3 *P*4 1 4

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	*P*5 5 2 The processes are assumed to have arrived in the order P1, P2, P3, P4, P5, all at time 0. **a. Draw four Gantt charts illustrating the execution of these processes using FCFS,SJF,A non pre-emptive priority (a smaller priority number implies a higher priority), and RR (quantum = 1) scheduling. (10M)** BTL4 b. What is the turnaround time of each process for each of the scheduling algorithms in part a? (5M). BTL2 **Answer: Page:301 - Silberschatz, Galvin.** • FCFS – 13.4 TAT and 9.6 WT • SJF - 7 TAT and 3.2 WT • A non pre-emptive priority – 13.4 TAT and 8.2 WT • Round Robin – 9.2 TAT and 5.4 WT
2	**Consider the following snapshot of a system:** **Process** **Allocation** **Max** **Available** A B C D A B C D A B C D P0 0 0 1 2 0 0 1 2 1 5 2 0 P1 1 0 0 0 1 7 5 0 P2 1 3 5 4 2 3 5 6 P3 0 6 3 2 0 6 5 2 P4 0 0 1 4 0 6 5 6 **Answer the following questions using the banker's algorithm: a. What is the content of the matrix Need? Is the system in a safe state? (10M)** BTL4 **If a request from process P1 arrives for (0, 4, 2, 0), can the request be granted immediately?(5M)** BTL4 **Answer Page: 333 - Silberschatz, Galvin.** a) What is the content of the matrix *Need* ? **Answer** *Need = Max – Allocation* **Need** **A B C D** **P0** 0 0 0 0 **P1** 0 7 5 0 **P2** 1 0 0 2 **P3** 0 0 2 0 **P4** 0 6 4 2

b) Is the system in a safe state? Explain why?

Answer

Work = Available = 1 5 2 0, then if Need ≤ Work, then Work = Work + Allocation.

	Work			
	A	B	C	D
P0	1	5	3	2
P2	2	8	8	6
P3	2	14	11	8
P4	2	14	12	12
P1	3	14	12	12

The system is in a safe state since the sequence < P0, P2, P3, P4, P1> satisfies safety criteria.

c) If a request from P1 arrives for (0,4,2,0), can the request be granted immediately? Explain why?

Answer

Check Request ≤ Available → (0,4,2,0) ≤ (1,5,2,0) , then

	Allocation				Need				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	0	0	1	2	0	0	0	0	1	1	0	0
P1	1	4	2	0	0	3	3	0				
P2	1	3	5	4	1	0	0	2				
P3	0	6	3	2	0	0	2	0				
P4	0	0	1	4	0	6	4	2				

Now, check if the system is in a safe state.

Work = Available = 1 1 0 0, then if Need ≤ Work, then Work = Work + Allocation.

	Work			
	A	B	C	D
P0	1	1	1	2
P2	2	4	6	6
P3	2	10	9	8
P4	2	10	10	12
P1	3	14	12	12

The system is in a safe state since the sequence < P0, P2, P3, P4, P1> satisfies safety criteria. . So the request can be granted immediately.

UNIT III – STORAGE MANAGEMENT	
Main Memory – Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, 32- and 64-bit architecture Examples; Virtual Memory – Background, Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.	
PART * A	
Q.No.	**Questions**
1	**Define Dynamic Loading.** BTL1 To obtain better memory-space utilization dynamic loading is used. With dynamic loading, a routine is not loaded until it is called. All routines are kept on disk in a relocatable load format. The main program is loaded into memory and executed. If the routine needs another routine, the calling routine checks whether the routine has been loaded. If not, the relocatable linking loader is called to load the desired program into memory.
2	**Define Dynamic Linking.** BTL1 Dynamic linking is similar to dynamic loading, rather that loading being postponed until execution time, linking is postponed. This feature is usually used with system libraries, such as language subroutine libraries. A stub is included in the image for each library-routine reference. The stub is a small piece of code that indicates how to locate the appropriate memory-resident library routine, or how to load the library if the routine is not already present.
3	**What are Overlays?** BTL2 To enable a process to be larger than the amount of memory allocated to it, overlays are used. The idea of overlays is to keep in memory only those instructions and data that are needed at a given time. When other instructions are needed, they are loaded into space occupied previously by instructions that are no longer needed.
4	**Define Swapping.** BTL2 A process needs to be in memory to be executed. However a process can be swapped temporarily out of memory to a backing store and then brought back into memory for continued execution. This process is called swapping.
5	**What do you mean by Best Fit?** BTL2 Best fit allocates the smallest hole that is big enough. The entire list has to be searched, unless it is sorted by size. This strategy produces the smallest leftover hole.
6	**What do you mean by First Fit?** BTL2 First fit allocates the first hole that is big enough. Searching can either start at the beginning of the set of holes or where the previous first-fit search ended. Searching can be stopped as soon as a free hole that is big enough is found.
7	**How is memory protected in a paged environment?** BTL2 Protection bits that are associated with each frame accomplish memory protection in a paged environment. The protection bits can be checked to verify that no writes are being made to a read-only page.

8	**What is External Fragmentation?** BTL2 External fragmentation exists when enough total memory space exists to satisfy a request, but it is not contiguous; storage is fragmented into a large number of small holes.
9	**What is Internal Fragmentation?** BTL2 When the allocated memory may be slightly larger than the requested memory, the difference between these two numbers is internal fragmentation.
10	**Define Compaction.** BTL1 Compaction is a solution to external fragmentation. The memory contents are shuffled to place al free memory together in one large block. It is possible only i f relocation is dynamic, and is done a execution time.
11	**What are Pages and Frames?** BTL2 Paging is a memory management scheme that permits the physical -address space of a process to be non-contiguous. In the case of paging, physical memory is broken into fixed-sized blocks called frames and logical memory is broken into blocks of the same size called pages.
12	**State the use of Valid-Invalid Bits in Paging?** BTL2 When the bit is set to valid, this value indicates that the associated page is in the process's logical address space, and is thus a legal page. If the bit is said to invalid, this value indicates that the page is not in the process's logical address space. Using the valid-invalid bit traps illegal addresses.
13	**What is the basic method of Segmentation?** BTL1 Segmentation is a memory management scheme that supports the user view of memory. A logical address space is a collection of segments. The logical address consists of segment number and offset. If the offset is legal, it is added to the segment base to produce the address in physical memory of the desired byte.
14	**How Virtual Memory is used in Operating systems?** BTL4 Virtual memory is a technique that allows the execution of processes that may not be completely in memory. It is the separation of user logical memory from physical memory. This separation provides an extremely large virtual memory, when only a smaller physical memory is available.
15	**Why Demand Paging is needed?** BTL4 Virtual memory is commonly implemented by demand paging. In demand paging, the pager brings only those necessary pages into memory instead of swapping in a whole process. Thus it avoids reading into memory pages that will not be used anyway, decreasing the swap time and the amount of physical memory needed.
16	**Define Lazy Swapper.** BTL1 Rather than swapping the entire process into main memory, a lazy swapper is used. A lazy swapper never swaps a page into memory unless that page will be needed.
17	**What is a Pure Demand Paging?** BTL2 When starting execution of a process with no pages in memory, the operating system sets the instruction pointer to the first instruction of the process, which is on a non-memory resident page, the process immediately faults for the page. After this page is brought into memory, the process continues to execute, faulting as necessary until every page that it needs is in memory. At that point, it can execute with no more faults. This schema is pure demand paging.
18	**Define Effective Access Time.** BTL1 Let p be the probability of a page fault close to 0; that is, there will be only a few page faults. The effective access time is, Effective access time = (1-p)*ma+p*page fault time ma: memory access time
19	**Define Secondary Memory.** BTL1

	This memory holds those pages that are not present in main memory. The secondary memory is usually a high speed disk. It is known as the swap device, and the section of the disk used for this purpose is known as swap space
20	**What is the basic approach of Page Replacement?** BTL2 If no frame is free is available, find one that is not currently being used and free it. A frame can be freed by writing its contents to swap space, and changing the page table to indicate that the page is no longer in memory. Now the freed frame can be used to hold the page for which the process faulted.
21	**What is the various Page Replacement Algorithms used for Page Replacement?** BTL2 • FIFO page replacement • Optimal page replacement • LRU page replacement • LRU approximation page replacement • Counting based page replacement
22	**What are the major problems to implement Demand Paging?** BTL2 The two major problems to implement demand paging is developing, Frame allocation algorithm Page replacement algorithm
23	**Define Reference String.** BTL1 An algorithm is evaluated by running it on a particular string of memory references and computing the number of page faults. The string of memory reference is called a reference string.
25	**Define secondary memory.** BTL1 This memory holds those pages that are not present in main memory. The secondary memory is usually a high speed disk. It is known as the swap device, and the section of the disk used for this purpose is known as swap space.
	PART - B
1	**Explain contiguous memory allocation detail ?(13M)** BTL2 **Answer Page:360 - Silberschatz, Galvin.** **Definition (2M)** Contiguous memory allocation is a classical memory allocation model that assigns a process consecutive memory blocks (that is, memory blocks having consecutive addresses). Contiguous memory allocation is one of the oldest memory allocation schemes. When a process needs to execute, memory is requested by the process. **Types of Memory Allocation (11M)** • First Fit Allocation (4M) • Best Fit Allocation (4M) • Worst Fit Allocation (3M)
2	**Explain Paging hardware and paging operation concepts with diagram.?(13M)** BTL2 **Answer Page: 367 - Silberschatz, Galvin.** **Definition (2M)** In computer operating systems, paging is a memory management scheme by which a computer stores and retrieves data from secondary storage for use in main memory. In this scheme, the operating system retrieves data from secondary storage in same-size blocks called pages. **Diagram (6M)**

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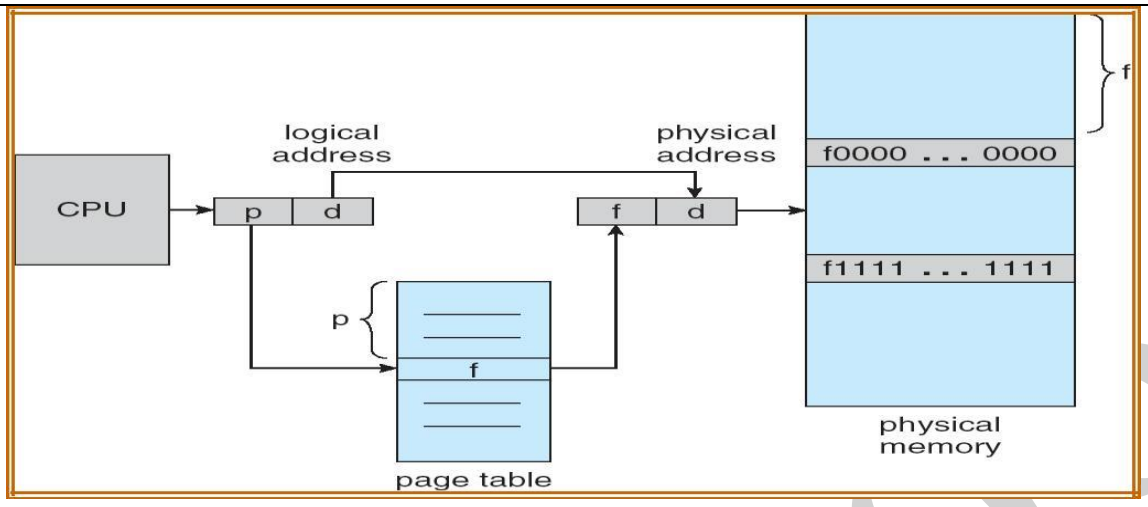
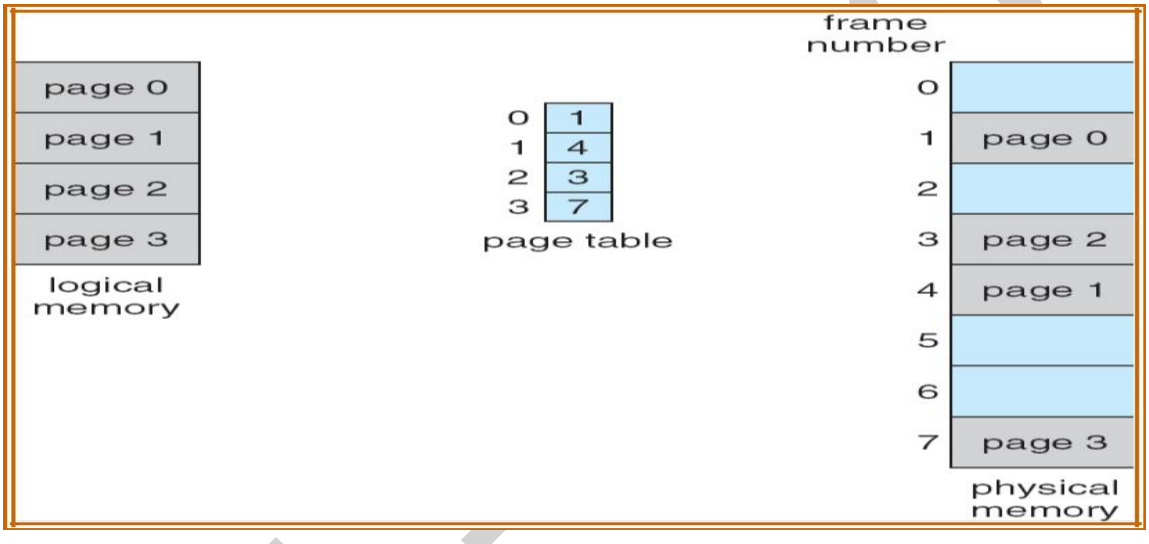




Explanation (5M)

3

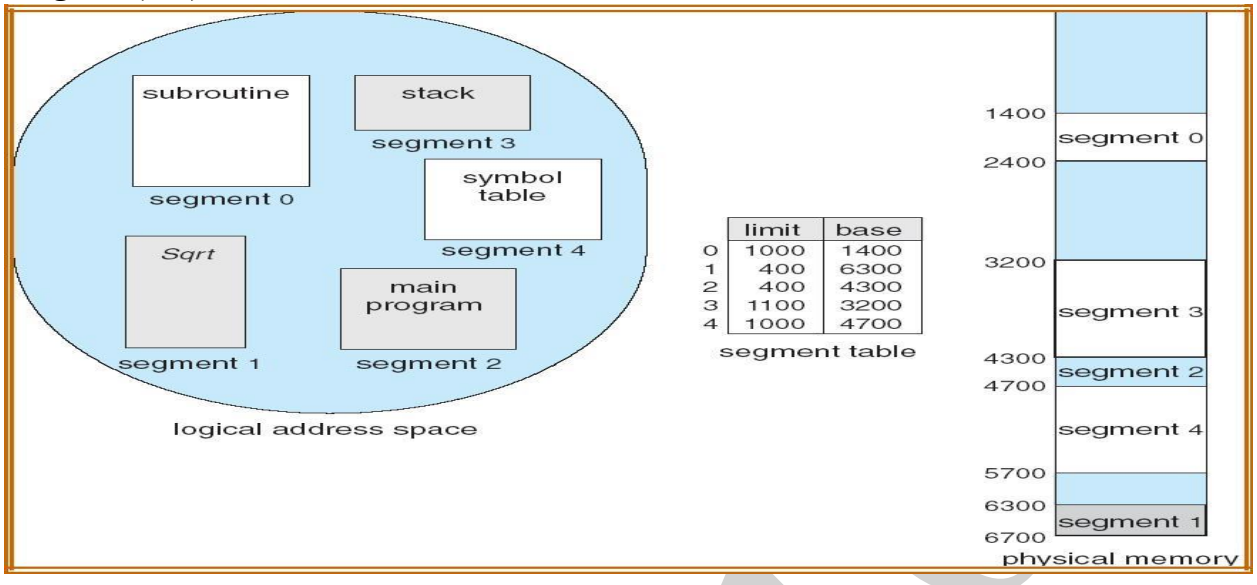
Explain Segmentation hardware and its operation concepts with necessary diagram.?(13M)BTL2

Answer Page: 364 - Silberschatz, Galvin.

Definition (2M)

Segmentation is one of the most common ways to achieve memory protection. In a computer system using segmentation, an instruction operand that refers to a memory location includes a value that identifies a segment and an offset within that segment. A segment has a set of permissions, and a length, associated with it.

Diagram (6M)



Explanation (5M)

4

Explain Thrashing and Demand Paging in detail ?(13M) BTL2

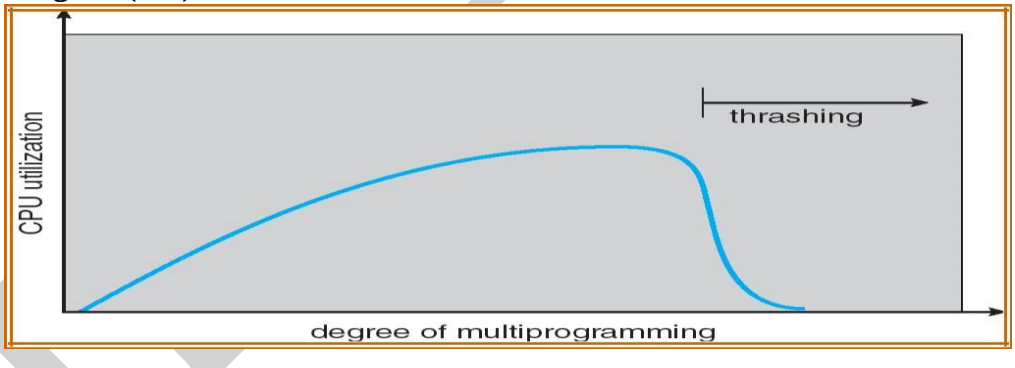
Answer Page: 425 & 401 Silberschatz, Galvin.

Thrashing(7M)

Definition (2M)

In a virtual storage system (an operating system that manages its logical storage or memory in units called pages), thrashing is a condition in which excessive paging operations are taking place. A system that isthrashing can be perceived as either a very slow system or one that has come to a halt.

Diagram(3M)

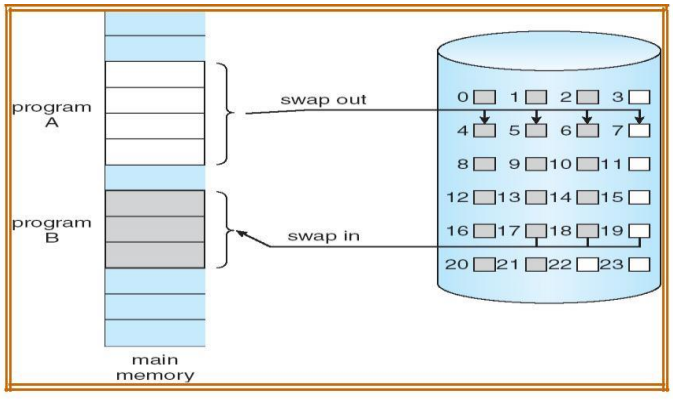


Explanation(2M)

Demand Paging (6M)

Demand Paging. Demand paging is a type of swapping done in virtual memory systems. In demand paging, the data is not copied from the disk to the RAM until they are needed or being demanded by some program. The data will not be copied when the data is already available on the memory.

Diagram (3M)



Explanation(3M)

PART *C

1

Consider the following page reference string: 7, 0,1,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1 Calculate the number of page faults would occur for the following page replacement algorithm with frame size of 3 .i)FIFO ii)LRU iii) Optimal (15M) BTL6

Answer Page:409 - Silberschatz, Galvin.

Definition (2M)

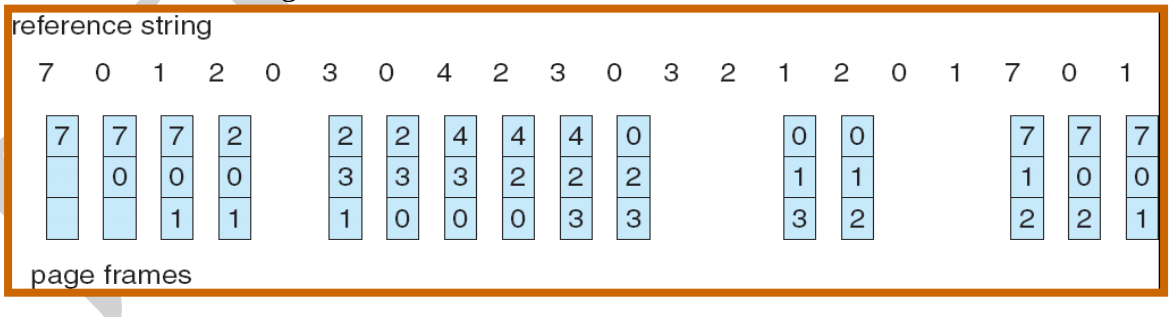
Page replacement algorithm. In a computer operating system that uses paging for virtual memory management, page replacement algorithms decide which memory pages to page out, sometimes called swap out, or write to disk, when a page of memory needs to be allocated.

Page Replacement Algorithms (4M)

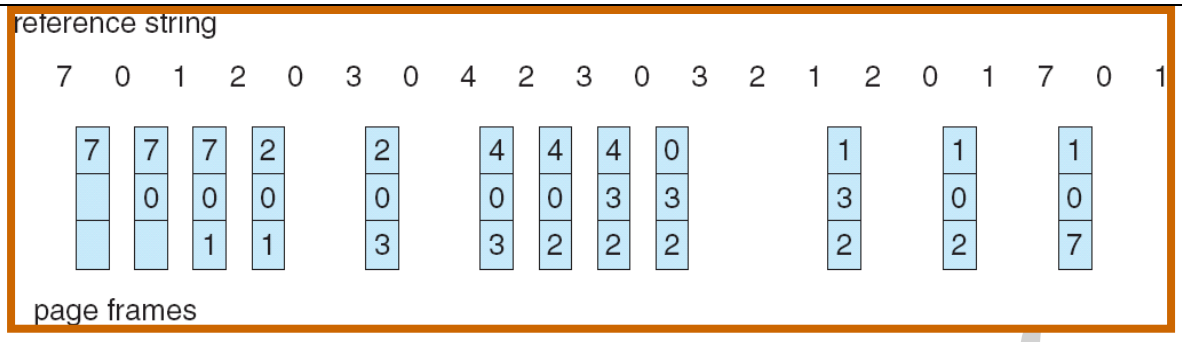
- FIFO – 15 Page Faults
- LRU – 12 Page Faults
- Optimal - 9 Page Faults

Diagram (9M)

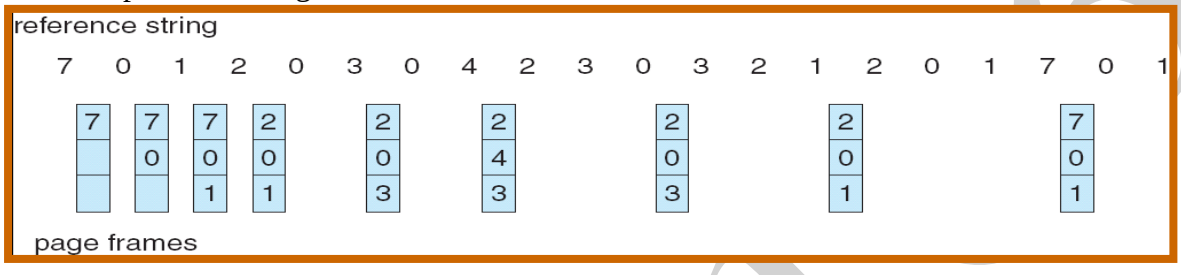
- FIFO – 15 Page Faults



- LRU – 12 Page Faults



- Optimal - 9 Page Faults



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UNIT IV – FILE SYSTEMS AND I/O SYSTEMS

Mass Storage system – Overview of Mass Storage Structure, Disk Structure, Disk Scheduling and Management, swap space management; File-System Interface - File concept, Access methods, Directory Structure, Directory organization, File system mounting, File Sharing and Protection; File System Implementation- File System Structure, Directory implementation, Allocation Methods, Free Space Management, Efficiency and Performance, Recovery; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem, Streams, Performance.

PART * A

Q.No.	Questions
1	**What is a File?** BTL2 A file is a named collection of related information that is recorded on secondary storage. A file contains either programs or data. A file has certain "structure" based on its type. File attributes: Name, identifier, type, size, location, protection, time, date File operations: creation, reading, writing, repositioning, deleting, truncating, appending, renaming File types: executable, object, library, source code etc.
2	**List the various File Attributes.** BTL1 A file has certain other attributes, which vary from one operating system to another, but typically consist of these: Name, identifier, type, location, size, protection, time, date and user identification.
3	**What are the various File Operations?** BTL2 The basic file operations are, Creating a file • Writing a file • Reading a file • Repositioning within a file • Deleting a file • Truncating a file
4	**What is the information associated with an Open File?** BTL2 Several pieces of information are associated with an open file which may be: • File pointer • File open count • Disk location of the file • Access rights
5	**What are the different Accessing Methods of a File?** BTL2 The different types of accessing a file are: Sequential access: Information in the file is accessed sequentially Direct access: Information in the file can be accessed without any particular order.

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	Other access methods: Creating index for the file, indexed sequential access method
6	**Define Directory.**BTL1 The device directory or simply known as directory records information- such as name, location, size, and type for all files on that particular partition. The directory can be viewed as a symbol table that translates file names into their directory entries.
7	**What are the operations that can be performed on a Directory?** BTL2 The operations that can be performed on a directory are, Search for a file • Create a file • Delete a file • Rename a file • List directory • Traverse the file system
8	**How to define the Logical Structure of a Directory?** BTL1 The most common schemes for defining the logical structure of a directory Single -Level Directory Two -level Directory Tree-Structured Directories Acyclic -Graph Directories General Graph Directory
9	**State the use of UFD and MFD.** BTL1 In the two-level directory structure, each user has own user file directory Each UFD has a similar structure, but lists only the files of a single user. When a job starts the system's master file directory(MFD) will monitor the file handling process.
10	**What is a Path Name?** BTL2 A pathname is the path from the root through all subdirectories to a specified file. In a two-leve directory structure a user name and a file name define a path name.
11	**What is Access Control List?** BTL1 The most general scheme to implement identity-dependent access is to associate with each file and directory an access control unit.
12	**Define Equal Allocation.** BTL1 The way to split „m' frames among „n' processes is to give everyone an equal share, m/n frames. For instance, if there are 93 frames and 5 processes, each process will get 18 frames. The leftover 3 frames could be used as a free-frame buffer pool. This scheme is called equal allocation.
13	**How would you solve thrashing problem?** BTL3 Thrashing is caused by under allocation of the minimum number of pages required by a process, forcing it to continuously page fault. The system can detect thrashing by evaluating the level of CPU utilization as compared to the level of multiprogramming. It can be eliminated by reducing the level of multiprogramming.
14	**What is Belady's Anomaly?** BTL2 For some page replacement algorithms, the page fault rate may increase as the number of allocated frames increases.
15	**List out the types of Path Names.** BTL1 Path names can be of two types. Absolute path name: Begins at the root and follows a path down to the specified file, giving the directory names on the path. Relative path name: Defines a path from the current directory.
16	**What is meant by Locality of Reference?** BTL2

	The locality model states that, as a process executes, it moves from locality to locality. Locality is of two types. • Spatial locality • Temporal locality.
17	**Define Seek Time and Latency Time.** BTL1 The time taken by the head to move to the appropriate cylinder or track is called seek time. Once the head is at right track, it must wait until the desired block rotates under the read- write head. This delay is latency time.
18	**What are the Allocation Methods of a Disk Space?** BTL2 Three major methods of allocating disk space which are widely in use are • Contiguous allocation • Linked allocation • Indexed allocation
19	**What are the advantages of Contiguous Allocation?**BTL1 The advantages are, • Supports direct access • Supports sequential access • Number of disk seeks is minimal.
20	**List out the drawbacks of Contiguous Allocation of Disk Space.**BTL1 The disadvantages are, • Suffers from external fragmentation • Suffers from internal fragmentation • Difficulty in finding space for a new file • File cannot be extended • Size of the file is to be declared in advance
21	**What are the advantages of Linked Allocation?** BTL2 The advantages are, • No external fragmentation • Size of the file does not need to be declared
22	**What are the disadvantages of Linked Allocation?** BTL2 The disadvantages are, Used only for sequential access of files. • Direct access is not supported • Memory space required for the pointers. • Reliability is compromised if the pointers are lost or damaged
23	**How many types of Disk-Scheduling Algorithms used in operating systems?** BTL1 The various disk-scheduling algorithms are, • First Come First Served Scheduling • Shortest Seek Time First Scheduling • SCAN Scheduling • C -SCAN Scheduling • LOOK scheduling
24	**What are the techniques used for performing I/O?** BTL2

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	• Programmed I/O • Interrupt driven I/O • Direct Memory Access
25	**Give an example of an application in which data in a file should be accessed in the following order**: BTL3 Sequentially - Print the content of the file. Randomly - Print the content of record i. This record can be found using hashing or index techniques
26	**What problems could occur if a system allowed a file system to be mounted simultaneously at more than one location?** BTL2 There would be multiple paths to the same file, which could confuse users or encourage mistakes. (Deleting a file with one path deletes the file in all the other).
	PART – B
1	**Explain different types of storage media used in operating systems ?(13M).** BTL2 **Answer Page: 467 - Silberschatz, Galvin.** **Definition (3M)** A computer storage device is any type of hardware that stores data. These types of drives are often used for backing up internal hard drives, storing video or photo libraries, or for simply adding extra storage. **Types of Storage Media (10M)** • Primary Storage (2M) • Secondary Storage (3M) • Tertiary Storage (3M) • Off-line Storage (2M)
2	**Explain various Directory Structure management in detail ?(13M).** BTL2 **Answer Page: 515 - Silberschatz, Galvin.** **Definition (3M)** A directory is defined as an organizational unit, or container, used to organize folders and files into a hierarchical structure. You can think of a directory as a file cabinet that contains folders that contain files. **There are five directory structures. (10M)** • Single-level directory (2M) • Two-level directory (2M) • Tree-Structured directory (2M) • Acyclic Graph directory (2M) • General Graph directory (2M)
3	**Explain the different types of File Allocation methods in detail ?(13M).** BTL2 **Answer Page: 553 - Silberschatz, Galvin.** **Definition (3M)** A file allocation table (FAT) is a file system developed for hard drives that originally used 12 or 6 bits for each cluster entry into the file allocation table. It is used by the operating system (OS) to manage files on hard drives and other computer systems.

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	Types of File Allocation (10M) • Contiguous Allocation (4M) • Linked Allocation (3M) • Indexed Allocation (3M)
4	**Explain the FCFS, SSTF, SCAN, C-SCAN disk scheduling algorithms?(13M)** BTL2 **Answer Page: 472 - Silberschatz, Galvin.** **Definition (3M)** Disk scheduling is done by operating systems to schedule I/O requests arriving for disk. Disk scheduling is also known as I/O scheduling. ... Hard drives are one of the slowest parts of computer system and thus need to be accessed in an efficient manner. **Types disk scheduling algorithms (10M)** • FCFS scheduling • SSTF scheduling • SCAN scheduling • C-SCAN scheduling • LOOK scheduling • C-LOOK scheduling
5	**How would you classify the File concepts and Access Methods with an example ?(13M)** BTL2 **Answer Page: 512 - Silberschatz, Galvin.** **Definition (3M)** **File Concepts (5M)** • File Attribute. • File operation. • File Types. • File Sharing & Protection. **File Access Methods (5M)** • Sequential Access. • Direct Access. • Other Access.
6	**Explain Free space Management with example ?(13M)** BTL2 **Answer Page: 561 - Silberschatz, Galvin.** **Definition (2M)** The system keeps tracks of the free disk blocks for allocating space to files when they are created. Also, to reuse the space released from deleting the files, free space management becomes crucial. **Free Space Management (11M)** • Bit Vector (3M) • Linked List (3M) • Grouping (3M) • Counting (2M)

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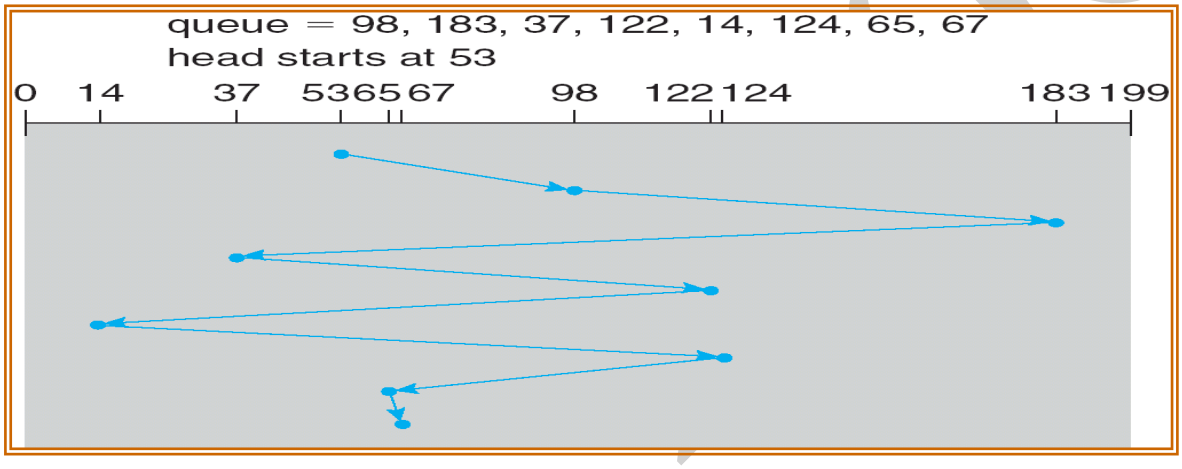
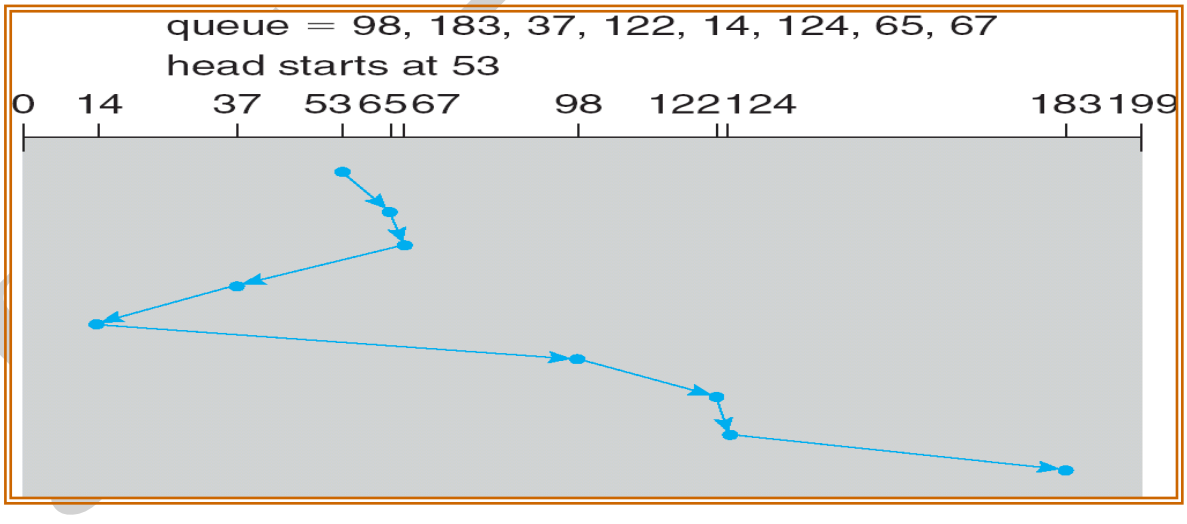
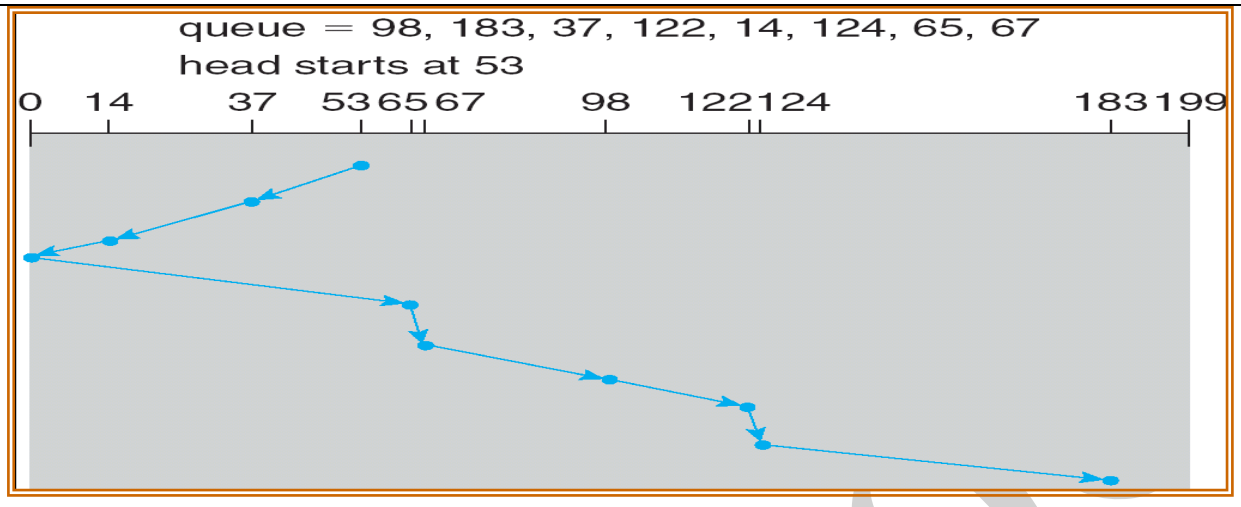
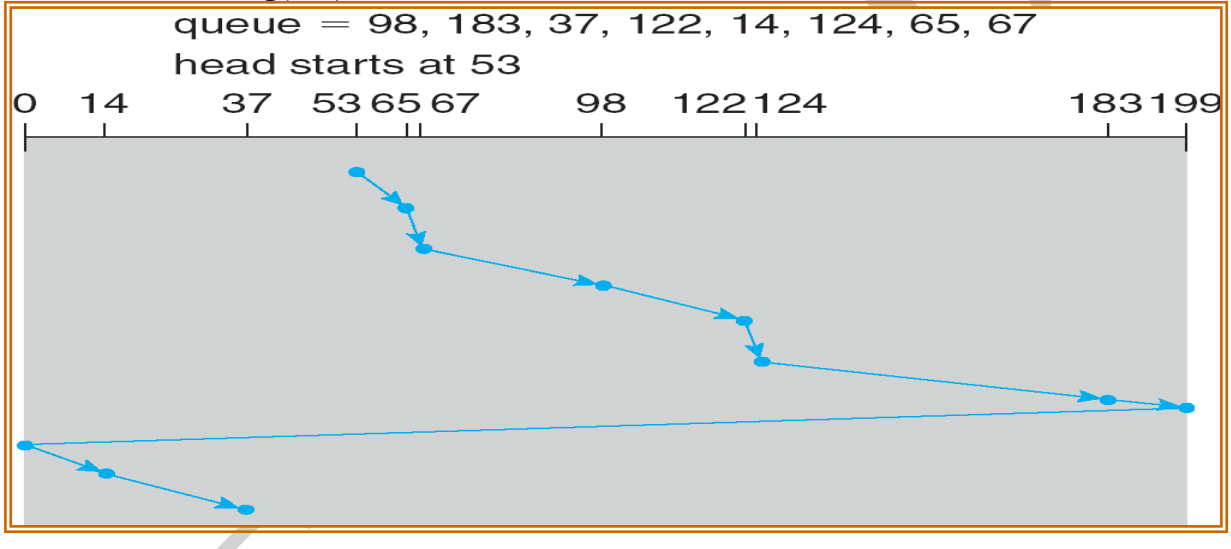
	PART *C
1	**Draw the FCFS, SSTF, SCAN and C-SCAN disk scheduling algorithms graph for the following example. A request queues. 98, 183, 37, 122, 14, 124, 65, 67 , Total tracks (0-199) and Assume that initial position of R/W Head at 53. ? (15M)** BTL4 **Answer Page: 472 - Silberschatz, Galvin.** **Definition (3M)** Disk scheduling is done by operating systems to schedule I/O requests arriving for disk. Disk scheduling is also known as I/O scheduling. Disk scheduling is important because: Multiple I/O requests may arrive by different processes and only one I/O request can be served at a time by disk controller. **FCFS scheduling (3M)**  **SSTF scheduling(3M)**  **SCAN scheduling(3M)**



C-SCAN scheduling(3M)



2

How would you classify the RAID levels with example ?(15M) BTL4

Answer Page: 484 - Silberschatz, Galvin.

Definition (3M)

RAID (Redundant Array of Independent Disks, originally Redundant Array of Inexpensive Disks) is a data storage virtualization technology that combines multiple physical disk drive components into one or more logical units for the purposes of data redundancy, performance improvement, or both.

RAID Levels (12M)

- RAID Level 0 (2M)
- RAID Level 1 (2M)
- RAID Level 2 (2M)
- RAID Level 3 (2M)
- RAID Level 4 (2M)
- RAID Level 5 (2M)

Subject Code: CS8493 **Year/Semester: II /04**
Subject Name: OPERATING SYSTEMS **Subject Handler: S. NEELAKANDAN**

UNIT V Case Study	
Linux System - Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, Input-Output Management, File System, Inter-process Communication; Mobile OS - iOS and Android - Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System.	
PART * A	
Q.No.	**Questions**
1	**What are the Components of a Linux System?** BTL2 Linux System composed of three main modules. They are: • Kernel • System libraries • System utilities
2	**What are the main supports for the Linux modules?** BTL2 The Module support under Linux has three components. They are: • Module Management • Driver Registration. • Conflict Resolution mechanism.
3	**What is meant by Process Personality?** BTL2 Process Personalities are primarily used by emulation libraries to request that system call be compatible with certain versions of UNIX.
4	**Define Buffer cache.**BTL1 It is the kernel's main cache for block-oriented devices such as disk drives and is the main mechanism through which I/O to these devices is performed.
5	**What is the Disadvantage of Static Linking?** BTL2 The main disadvantage of static linking is that every program generated must contain copies o exactly the same common system library functions.
6	**What is meant by Kernel in Linux system?** BTL2 Kernel is responsible for maintaining all the important abstractions of the operating system including such things as virtual memory and processes.
7	**Define System Libraries.**BTL1 System Libraries define a standard set of functions through which applications can interact with the kernel and that implement much of the operating -system functionality that doesn‟t need the full privileges of kernel code.
8	**Define System Utilities.**BTL1 System Utilities are system programs that perform individual, specialized management tasks. Some of the System utilities may be invoked just to initialize and configure some aspect of the system and others may run permanently, handling such tasks as responding to incoming network connections, accepting logon requests from terminals or updating log files.
9	**State the Role of Module management.**BTL1

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	The module management allows modules to be loaded into memory and to talk to the rest of the kernel.
10	**What is the function of Driver registration?** BTL2 Driver Registration allows modules to tell the rest of the kernel that a new driver has become available.
11	**What is the function of Conflict Resolution mechanism?** BTL2 This mechanism allows different device drivers to reserve hardware resources and to protect those resources from accidental use by another driver.
12	**Can you list out some functions of Device drivers?** BTL2 Device drivers include • Character devices such as printers, terminals • Block devices including all disk drives • Network interface devices.
13	**What is Linux distribution?** BTL2 A Linux distribution includes all the standard components of the Linux system, plus a set of administrative tools to simplify the initial installation and subsequent upgrading of Linux and manage installation and removal of other packages on the system.
14	**What is the use of User mode?** BTL2 Under Linux, no user code is built into the kernel. Any operating-system-support code that does not need to run in kernel mode is placed into the system libraries and runs in user mode.
15	**Define process Identity.** BTL1 Each process has a unique identifier. The PID is used to specify the process to the operating system when an application makes a system call to signal, modify, or wait for the process. Additional identifiers associate the process with a process group (typically, a tree of processes forked by a single user command and login session.
16	**Define DNS.** BTL1 The domain name system(DNS) provides host-name-to-network-address translations for the entire Internet. Before DNS became widespread, files containing the same information were sent via e-mail or ftp between all networked hosts.
17	**What is virtualization?** BTL2 Virtualization, in computing, refers to the act of creating a virtual (rather than actual) version of something, including but not limited to a virtual computer hardware platform, operating system (OS), storage device, or computer network resources.
18	**What is meant by Mobile Operating System?** BTL2 A mobile operating system, also called a mobile OS, is software that is specifically designed to run on mobile devices such as mobile phones, smartphones, PDAs, tablet computers and other handheld devices. Much like the Linux or Windows operating system controls your desktop or laptop computer, a mobile operating system is the software platform on top of which other programs can run on mobile devices.
19	**List out various Mobile Operating Systems**. BTL1 • There are many mobile operating systems. The followings demonstrate the most important ones: • Java ME Platform • Palm OS • Symbian OS • Linux OS • Windows Mobile OS • BlackBerry OS

	• iPhone OS • Google Android Platform
20	**Do FAT file system is advantageous? Why?** BTL3 FAT File System is best for cross-compatibility with other platforms. There are NTFS file system drivers for Linux, but not really for Windows. FAT, however, can be read more or less transparently by both operating systems. There is also a slight speed gain in FAT.
21	**What is the responsibility of kernel in Linux operating system?** BTL2 Kernel is the core part of Linux. It is responsible for all major activities of this operating system. It is consisting of various modules and it interacts directly with the underlying hardware. Kernel provides the required abstraction to hide low level hardware details to system or application programs.
22	**Why Virtualization is required?** BTL3 Virtualization reduces the number of physical servers, reducing the energy required to power and cool them. Save time. With fewer servers, you can spend less time on the manual tasks required for server maintenance. It's also much faster to deploy a virtual machine than it is to deploy a new physical server.
23	**Define Android SDK.** BTL1 Android SDK is a software development kit that enables developers to create applications for the Android platform. The Android SDK includes sample projects with source code, development tools, an emulator, and required libraries to build Android applications.
	PART - B
1	**Explain Linux operating systems and its operations?(13M)** BTL2 **Answer Page: 781 - Silberschatz, Galvin.** **Definition (3M)** Linux looks and feels much like any other UNIX system; indeed, UNIX compatibility has been a major design goal of the Linux project. However, Linux is much younger than most UNIX systems. Its development began in 1991, when a Finnish university student, Linus Torvalds, began developing a small but self-contained kernel for the 80386 processor, the first true 32-bit processor in Intel's range of PC-compatible CPUs. **Operations (10M)** • Linux Systems. (2M) • Linux Distributions (3M) • Linux Licensing(2M) • Linux Modules (3M)
2	**Describe Process management systems in Linux OS ?(13M)** BTL2 **Answer Page: 792 - Silberschatz, Galvin.** **Definition (3M)** A process is the basic context in which all user-requested activity is serviced with in the operating system. To be compatible with other UNIX systems, Linux must use a process model similar to those of other versions of UNIX. Linux operates differently from UNIX in a few key places.They are • Process Models (3M) • Processes and Threads(3M) • Process Environment(2M)

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	• Process Identity (2M)
3	**How to manage the Memory system in Linux and explain its components ?(13M)** BTL2 **Answer Page: 801 - Silberschatz, Galvin.** **Definition (3M)** Memory management under Linux has two components. The first deals with allocating and freeing physical memory—pages, groups of pages, and small blocks of RAM. The second handles virtual memory, which is memory-mapped into the address space of running processes. **Components (10M)** • Management of Physical Memory • Virtual Memory • Swapping and Paging • Kernel Virtual Memory • Execution and Loading of user programs
4	**Explain different types of File systems used in Linux operating systems ?(13M)** BTL2 **Answer Page: 809 - Silberschatz, Galvin.** **Definition (3M)** Linux retains UNIX's standard file-system model. In UNIX, a file does not have to be an object stored on disk or fetched over a network from a remote file server. Rather, UNIX files can be anything capable of handling the input or output of a stream of data. Device drivers can appear as files and inter process communication channels or network connections also look like files to the user. • Virtual File Systems (3M) • Linux ext3 File systems (3M) • Journaling(2M) • Linux Process File systems(2M)
5	**What are the advantages and disadvantages of Android Mobile OS? (13M)** BTL2 **Answer Page: 902 - Silberschatz, Galvin.** **Definition (3M)** Android is a mobile operating system developed by Google, based on a modified version of the Linux kernel and other open source software and designed primarily for the touchscreen mobile devices such as smartphones and tablets. **Advantages(5M)** • Large number of devices using Android • Frequent Enhancement • Larger number of applications availability • Excellent UI • Multi-tasking • Free developer tools • No restrictions on applications • Phones are available from every service **Disadvantages (5M)**

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	• Some device manufacturers add alternative UI front-ends which reduces OS consistency • Updates are controlled by device manufacturers and may be slow or nonexistent • Applications are not validated
	PART *C
1	**What are the advantages and disadvantages of Apple iOS and BlackBerry OS? (15M)** BTL2 **Answer Page: 903 - Silberschatz, Galvin.** **Definition (3M)** Apple iOS is a proprietary mobile operating system that runs on the iPhone, iPad and iPod Touch. Apple iOS is based on the Mac OS X operating system for desktop and laptop computers. The iOS developer kit provides tools that allow for iOS app development. **Apple iOS Advantages & Disadvantages(5M)** Advantages • Excellent UI • Larger number of applications availability • Apple validates applications • Consistent UI across devices • Frequent free OS updates Disadvantages • Closed Architecture • Limited number of devices to choose from – all from apple • No multi-tasking for applications • Applications must be approved by Apple before being made available via the Marketplace • Can't be unlocked **BlackBerry OS(2M)** BlackBerry OS is a proprietary mobile operating system developed by Research In Motion (RIM) for its BlackBerry line of smartphones. BlackBerry 10 OS is a QNX-based operating system, similar to the one found on RIM's Playbook tablet. It will replace the BlackBerry OS on smartphones and tablets in 2013. **Blackberry OS Advantages & Disadvantages(5M)** **Advantages** • Secure send and receive email using proprietary encryption • Multi-tasking • Phones available form most service providers **Disadvantages** • Closed Architecture • Limited number of devices to choose from – all from Research In Motion • Limited number of applications available • Application development is more complex and difficult than other Operating Systems • Applications tend to be more costly

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GE8291 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
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OBJECTIVES:

- ✓ To the study of nature and the facts about environment.
- ✓ To find and implement scientific, technological, economic and political solutions to environmental problems.
- ✓ To study the interrelationship between living organism and environment.
- ✓ To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- ✓ To study the dynamic processes and understand the features of the earth‘s interior and surface.
- ✓ To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, Scope and Importance of Environment – Need for Public Awareness - Concept of an Ecosystem – Structure and Function of an Ecosystem – Producers, Consumers and Decomposers – Energy Flow in the Ecosystem – Ecological Succession – Food Chains, Food Webs and Ecological Pyramids – Introduction, Types, Characteristic Features, Structure and Function of the (A) Forest Ecosystem (B) Grassland Ecosystem (C) Desert Ecosystem (D) Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans, Estuaries) – Introduction to Biodiversity Definition: Genetic, Species and Ecosystem Diversity – Bio geographical Classification of India – Value of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values – Biodiversity at Global, National and Local Levels – India as a Mega-Diversity Nation – Hot-Spots of Biodiversity – Threats to Biodiversity: Habitat Loss, Poaching of Wildlife, Man-Wildlife Conflicts – Endangered and Endemic Species of India – Conservation of Biodiversity: In-Situ and Ex-Situ Conservation of Biodiversity. Field Study of Common Plants, Insects, Birds Field Study of Simple Ecosystems – Pond, River, Hill Slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – Causes, Effects and Control Measures of: (A) Air Pollution (B) Water Pollution (C)Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards – Soil Waste Management: Causes, Effects and Control Measures of Municipal Solid Wastes – Role of an Individual in Prevention of Pollution – Pollution Case Studies – Disaster Management: Floods, Earthquake, Cyclone and Landslides. Field Study of Local Polluted Site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest Resources: Use and Over-Exploitation, Deforestation, Case Studies - Timber Extraction, Mining, Dams and Their Effects on Forests and Tribal People – Water Resources: Use and Over-Utilization of Surface and Ground Water, Floods, Drought, Conflicts Over Water, Dams-Benefits

and Problems – Mineral Resources: Use and Exploitation, Environmental Effects of Extracting and Using Mineral Resources, Case Studies – Food Resources: World Food Problems, Changes Caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer-Pesticide Problems, Water Logging, Salinity, Case Studies – Energy Resources: Growing Energy Needs, Renewable and Non Renewable Energy Sources, Use of Alternate Energy Sources. Case Studies – Land Resources: Land as a Resource, Land Degradation, Man Induced Landslides, Soil Erosion and Desertification – Role of an Individual in Conservation of Natural Resources – Equitable Use of Resources for Sustainable Lifestyles. Field Study of Local Area to Document Environmental Assets – River / Forest / Grassland / Hill / Mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From Unsustainable to Sustainable Development – Urban Problems Related to Energy – Water Conservation, Rain Water Harvesting, Watershed Management – Resettlement and Rehabilitation of People; its Problems and Concerns, Case Studies – Role of Non-Governmental Organization- Environmental Ethics: Issues and Possible Solutions – Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies. – Wasteland Reclamation – Consumerism and Waste Products – Environment Production Act– Air (Prevention And Control Of Pollution) Act – Water (Prevention And Control Of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Enforcement Machinery Involved in Environmental Legislation- Central and State Pollution Control Boards- Public Awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population Growth, Variation Among Nations – Population Explosion – Family Welfare Programme – Environment and Human Health – Human Rights – Value Education – HIV / AIDS – Women and Child Welfare – Role of Information Technology in Environment and Human Health – Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the

- ✓ Public awareness of environmental is at infant stage.
- ✓ Ignorance and incomplete knowledge has lead to misconceptions
- ✓ Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS:

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press 2005.

JIT-2106

Subject Code: GE8291 **Year/Semester: II / 04**
Subject Name: ENVIRONMENTAL SCIENCE AND ENGINEERING
Subject Handler: Dr. N. BHUVANA

UNIT I - ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

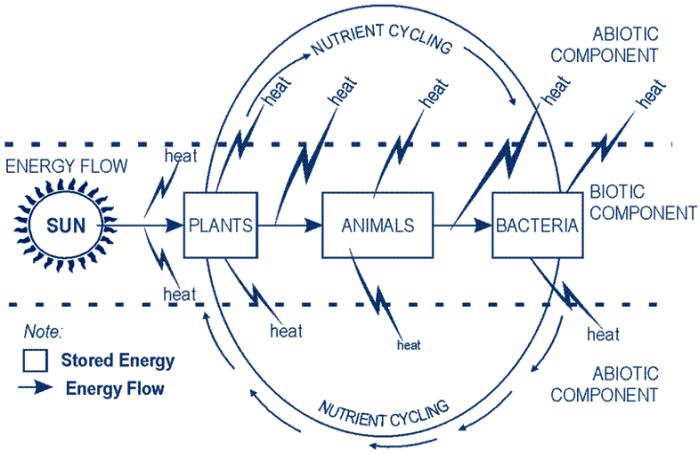
Q. No.	PART – A
1.	**State the significance and scope of environmental education. May 2011** BTL1 • People will understand the concept of need of development without destruction of environment. • Motivate the active participants in environmental protection and improvement. • Develop a concern and respect for the environment.
2	**Give some important physical hazards and their health effects.** BTL2 • The substance (or) activities that threaten your physical safety. **E.g**. Heat, Cold, Radiation, noise. • **Health effects** – Damage of cells, Skin cancer, Damage of ear drum etc.
3	**Define environment and ecosystem. April 2011, April 2019** BTL1 • **Environment**: The sum of total of all the living and non-living things around us influencing one another. • **Ecosystem**: A group of organisms interacting among themselves and with environment for exchanging energy and matter.
4	**Explain the concept of an ecosystem. (Chen AU Jun 2007, Apr 2011, Dec2013)** BTL2 A group of organism interacting among themselves and with the environment. May be natural like a pond, a lake, a river, an ocean, or a forest or may be manmade like an aquarium, cropland, garden, dam etc.
5	**What are the components of ecosystem?** BTL1 i) Abiotic or Non-living component - Physical components and Chemical components **ii)** Biotic or Living component – Autotrophs (Producers), Heterotrophs (Consumers), Saprotrophs (Decomposers-Microconsumers)
6	**Define Ecological succession. (NOV/DEC 2013, April 2019)** BTL1

	The progressive replacement of one community by another till the development of stable community in a particular area.
7	**Name the types of consumers.** BTL4 • Herbivores (or) Primary Consumers (plant eater) • Carnivores (or) Secondary Consumers (meat eater) • Omnivores (or) Tertiary Consumers (meat + plant eater)
8	**What are Decomposers?** BTL1 Organisms which feed on dead organisms, plants and animals and decompose them into simpler compounds. Examples – Bacteria, fungi etc.
9	**What are autotrophic and heterotrophic components of an ecosystem? Give examples (Coim. A.U. Dec 2009)** BTL1 • **Autotrophic components** Self-nourishing organisms. The members of autotrophic components are producers. They derive energy from sunlight and make organic compounds from inorganic substances. Examples: Green plants, algae, bacteria, etc., • **Heterotrophic components** Components that dependent on others for food. The members of heterotrophic components are consumers and decomposers. Herbivores, carnivores (or) omnivores. • **Saprotrops:** They are decomposers - bacteria, fungi, etc.
10	**Define the terms producers and consumers. (A.U. May 2008, Dec 2011)** BTL1 • **Producers**-Synthesize their food themselves through photosynthesis. • **Consumers**-Organisms which cannot prepare their own food and depends directly or indirectly on the producers.
11	**Define primary production and secondary production. (Chen A.U. Dec 2008)** BTL1 • **Primary production** - The conversion of radiant energy into organic substances by photosynthesis by producers (Plants). • **Secondary production**- Distribution of energy in the form of food to the consumer (or) the energy stored by the consumer.
12	**What is Ecological pyramids?** BTL1 Graphical representation of structures and function of tropic levels of an ecosystem, starting with producers at the bottom and each successive tropic level forming the apex is known as ecological pyramids.
13	**Name different types of ecosystems**. **(Chen AU Jan 2006)** BTL1 • Natural ecosystem: 1) Terrestrial ecosystem 2) Aquatic ecosystem a. Forest ecosystems b. Grassland ecosystems c. Desert ecosystems d. Pond ecosystem. e. Lake ecosystem f. River ecosystem g. Marine ecosystem • Man-made ecosystem
14	**What are the characteristics of desert ecosystem? (Chen A.U. Dec 2008, June 2018)** BTL1 • The desert air is dry and the climate is hot. • Annual rainfall is less that 25cm. • The soil is very poor in nutrients and organic matter. • Vegetation is poor
15	**What is meant by keystone species? (Chen A.U. Dec 2008, June 2018)** BTL1 Within a habitat each species connects and depends on other species. But, while each species

	contribute to habitat functioning, some species do more than others in the overall scheme of things. Without the work of these key species, the habitat changes significantly. These species are called keystone species. When a keystone species disappears from its habitat, that habitat changes drastically.
16	**What are the types of grassland ecosystem? (Chen A.U. Dec 2010)** BTL1 There are three types of grassland ecosystem based on the climate condition. i) Tropical grassland ii)Temperate grassland iii) Polar grassland
17	**What are food chains? Mention their type**. **(Chen A.U. Dec 2010)** BTL1 **Food chain-**The sequence of eating and being eaten in an ecosystem. **Types :** i) Grazing food chain (from the living green plants goes to grazing herbivores, and on to carnivores) **ii)** Detritus food chain (Primary source of energy is dead organic matter called 'detritus' which are fallen leaves, plant parts or dead animal bodies)
18	**Define Biodiversity (or) What is biodiversity and its significance? (Chen AU Dec 2005, Jun 2006,Apr 2011,Apr 2015)** BTL1 • The variety and variability among all groups of living organisms and the ecosystem in which they occur. **Significance:** • Very important for human life, as we depend on plants, micro-organisms, earth's animals for our food, medicine and industrial products. • Also important for forestry, fisheries and agriculture, which depend on rich variety of various biological resources available in nature. • Protects the fresh air, clean water and productive land. • Loss of biodiversity has serious economic and social costs for any country
19	**Define genetic diversity, species diversity and ecosystem diversity. (TNV AU Dec 2008, Chen AU Dec 2007, May 2008, Dec2010, 2011)** BTL1 • **Genetic diversity**-Diversity of genes within a species. • **Species diversity**–Diversity among species in an ecosystem. • **Ecosystem diversity**-Diversity at the ecological or habitat level.
20	**What are biodiversity hot-spots? (Chen AU Apr 2011)** BTL1 The geographic areas which possess the high endemic species. The two important biodiversity hot spots in India- 1. Eastern Himalayas 2. Western Ghats.
21	**What are the criteria for recognizing hot spots? (Chen AU Dec 2011)** BTL1 • The Richness of the endemic species is the primary criterion for recognizing hot spots • The hot spots should have a significant percentage of specialized species. • The site is under threat. • It should contain important gene pools of plants of potentially useful plants.
22	**India is a mega diversity nation–Account. (Chen A.U. Dec 2008, Dec 2009)** BTL4 India is one among the 12 mega diversity countries in the world. It has 89,450 animal species accounting for 7.31% of the global faunal species and 47,000 plant species which accounts for 10.8% of the world floral species. The loss of biodiversity or endemism is about 33%.
23	**Give few examples for endangered and endemic species of India. (Chen A.U. Dec 2008)** BTL3 **Endangered species**

	i) **Reptiles:** Tortoise, python; ii) **Mammals:** Indian wolf, Red fox, Tiger; iii) **Primates:** Hoolock gibbon, Golden monkey; iv) **Plants :** Rauvol serpentina, Santalum **Endemic Species** i) **Flora:** Sapria Himalayan, Ovaria lurida ; **ii) Fauna:** Monitor lizards, Indian salamander
24	**Define endangered and endemic species. (Chen A.U. Dec 2006, Apr 2011, Dec 2014)** BTL2 **Endangered Species**-Species which number has been reduced to a critical level. Unless protected and conserved, it becomes immediate danger of extinction. **Endemic species**-The species which found only in a particular region.
25	**Define in-situ conservation and ex-situ conservation** BTL1 **In-situ conservation** - Protection of fauna and flora within their natural habitat, where the species normally occurs is called in-situ conservation. **Ex-situ conservation** - Protection of fauna and flora outside their natural habitats
26	**Enumerate the human activities which destroy the biodiversity**. **(Chen AU Jan 2006)** BTL2 • The farmers prefer hybrid seeds; as a result many plant species become extinct. • For the production of drugs the pharmaceutical companies collect wild plants, so several medicinal plants now become extinct. • Tropical forest is the main sources of world's medicine. Every year these forests are disappearing due to agriculture, mining and logging
27	**Define food web.** BTL1 A network of food chains where different types of organisms are connected at different tropic levels.
28	**Write the food chain in forest ecosystem.** BTL4 Grasshopper→ Woodpecker →Snake → Owl
29	**Write the food chain in lake ecosystem.** BTL4 Algae → Ciliates →Small fish → Large fish
30	**What is biome?** BTL1 Set of ecosystems which are exposed to same climatic conditions and having dominant species with similar life cyclic, climatic adoptions and physical structure.
31	**What is photosynthesis? (or) How the carbohydrates are produced by plants?** BTL1 Chlorophyll present in the leaves of plants converts CO_2 and H_2O in the presence of sunlight into carbohydrates. $$6CO_2 + 12H_2O \overset{hr}{\rightarrow} C_6H_{12}O_6 + 6O_2 + 6H_2O$$
32	**List the different processes of ecological succession.** BTL1 i) Nudation ii) Invasion iii) Competition iii) Reaction iv) Stabilizations
33	**Define extinct, threatened and vulnerable species. (Chen A.U. Dec 2006, Apr 2011, Dec 2014)** BTL2 • **Extinct species –** The species no longer found in the world. • **Threatened Species** Becoming rare and that may become in danger of extinction if current trends continue. • **Vulnerable Species**- Species which population facing continuous decline due to habitat destruction or over exploitation.
34	**Mention the types of lakes.** BTL4 • **Oligotrophic lakes:** Have low nutrient concentrations. • **Eutrophic lakes**: Over nourished by nutrients like N and P. • **Dystrophic lakes**: Have low pH, high humic acid content and brown waters.

	• **Volcanic lakes**: Receive water from magma after volcanic eruptions. • **Meromictic lakes**: Rich in salts. • **Artificial lakes:** Created due to construction of dams
35	**List the different zones of oceans.** BTL4 • **Coastal zone:** Relatively warm, nutrient rich shallow water, High primary productivity. • **Open sea**: Deeper part of the ocean. Vertically divided into three regions. i) **Euphotic zone:** Receives abundant light and shows high photosynthetic activity ii) **Bathyal zone:** Receives dim light and is usually geologically active. iii) **Abyssal zone:** Dark zone and is very deep (2000 to 5000 meters)
36.	**How do the desert plants adopt to the climate? (MAY 2018)** BTL4 Most of the plants have the ability to lack of rainfall. They have widespread roots which are close to the surface. This enables the roots to absorb water quickly, before it evaporates. Plants like cactus survives because of their thick waxy layer on the outside of its stems and leaves. This helps to retain water and protect tissues severe sunlight.
37.	**Define nitrogen cycle and oxygen cycle.** BTL1 **Nitrogen cycle**-Exchange of nitrogen between the lithosphere and atmosphere in cyclic manner. **Oxygen cycle**-Exchange of O_2 between the lithosphere and atmosphere and hydrosphere in a cyclic manner. Cyclic process of Photosynthesis and respiration.
38.	**What is an indicator species? (MAY 2018)** BTL1 An indicator species is an organism whose presence, absence or abundance reflects a specific environmental condition. Indicator species can signal a change in the biological condition of a particular ecosystem, and thus may be used as a proxy to diagnose the health of an ecosystem**.** Example: Plants or lichens sensitive to heavy metals or acids in precipitation may be indicators of air pollution**.**
	PART – B
1.	
	What is environment? List its types. Explain its scope and significance of environment studies. (13M) BTL2 **Answer: Page: 1.2–1.4-A. Ravikrishnan** **Definition-** The sum of all living and non-living things around us influence one another. (2 M) **Types-** i) Natural environment – naturally created all biotic and non-biotic components. ii) Man-made environment- Created by man. (2 M) **Scope of environmental studies** i) Awareness and sensitivity + related problems. ii) Motivate active participation. iii) Identification and solving environmental problems. iv) Awareness on conservation of natural resources. (4 M) **Significance or importance** i) Environment issues being of internal importance. ii) Problems cropped in the wake of development. iii) Explosively increase in pollution. iv) Need for an alternative solution.

	v) Need to save Humanity from extinction. vi) Need for Wise planning of development. (5 M)
2.	
	Explain the flow of energy through the atmosphere and its utilities in an ecosystem. (8M)(AU Dec. 2008) BTL2 **Answer: Page:** 2.10–2.11-**A. Ravikrishnan** Atmosphere → Sunlight major source of energy → Plants (Photosynthesis) Primary Consumer → Secondary consumer → Decomposer First law of thermodynamics. Plants (Photosynthesis) Second law of thermodynamics. Primary Consumer → Secondary consumer → Decomposer • Loss of energy takes place through respiration, running, hunting etc • Biotic components and abiotic components are linked together through energy flow and nutrient cycling. (5 M)  (3 M)
3.	
	Explain abiotic and various biotic components of an Ecosystem with neat sketch. (13M) (A.U. Dec 2007, Jan 2018) BTL2 **Answer: Page:**2.6–2.8-**A. Ravikrishnan** **Abiotic**-Nonliving components-Physical and chemical components. (2 M) **Biotic components-**Living organisms. i) **Autotrophs-Producers (Plants)**–Self nourishing Organisms. (3 M) ii) **Consumers (Animals)** (**Heterotrophs**)–Cannot make their own food. Herbivores-Carnivores-Omnivores. (3 M) iii) **Decomposers (Micro-Organisms) (Saprotrops)-** Feed on dead organisms. (3 M)

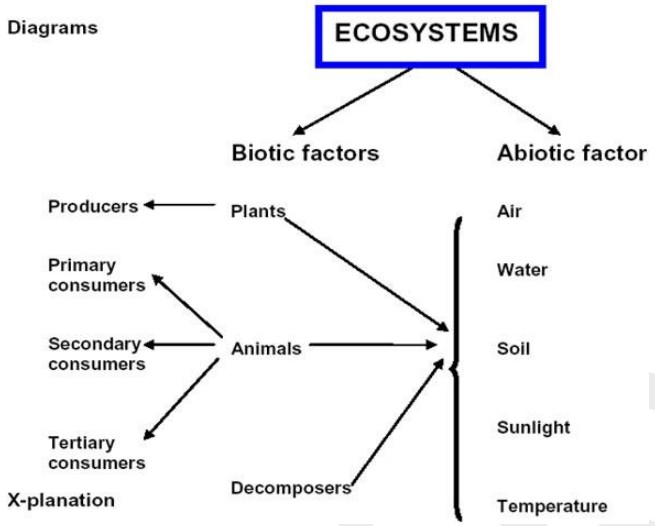


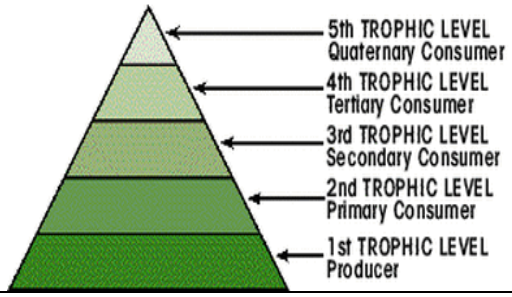
Diagram – (2M)

4.

Write down the ecological succession and ecological pyramid. (13M) (A.U. Dec 2010, Apr 2015, May 2006, Dec 2019) BTL1

Answer: Page: 2.16 – 2.17-A. Ravikrishnan

- **Ecological succession-** The progressive replacement of one community by another till the development of stable community in a particular area. (1 M)
- **Stages of ecological succession** (1 M)
- (i) Pioneer community – First group of organism established their community in the area.
- Seral or seres stage- Variuos developmental stages of a community.
- **Types of ecological succession:** (4M)
- **Primary succession**– Gradual establishment of biotic communities on a lifeless ground
- (a) Hydrarch (or) Hydrosere: Establishment starts in a watery area like pond and lake.
- (b) Xerarch or Xerosere: Establishment starts in a dry area like, desert and rock.
- **Secondary succession**: Establishment of biotic communities in an area, where some type of biotic community is already present.
- **Process of Ecological Succession:** i) Nudation ii) Invasion–migration and establishment iii) competition iv) Reaction and v) Stabilization. (4 M)
- **Ecological Pyramids-**Graphic representation of tropic structure and function of an ecosystem



	(3 M)
5.	
	Explain the structure and function of the following. (i) Forest ecosystem (ii) Grassland ecosystem (iii) Desert ecosystem (iv) Aquatic ecosystem (13M) (A.U. May2011, May 2006) BTL2 **Answer: Page: 2.30 – 2.31, 2.33 – 2.34, 2.36 – 2.37, 2.38 – 2.40, 2.43 – 2.44-A. Ravikrishnan** **(i) Structure and Function of forest ecosystem:** • **Abiotic components** - Physical components found in the soil and atmosphere. Exs: Climatic factors (temperature, light, rainfall) and minerals. • **Biotic components-Producers**-Plants-Photosynthesis-Trees, shrubs and ground vegetation. • **Consumers**-Primary consumers (herbivores)-Ants, flies, insects, mice, deer, squirrels. • **Secondary consumers** (primary carnivores)- Snakes, birds, fox. • **Tertiary consumers**-Tigre, lion, etc. • **Decomposers**–Bacteria and fungi. (3M) **(ii) Structure and Function of Grassland Ecosystem**.- • **Abiotic**–C, H, O, N, P, S etc.–Supplied by rates, nitrates, phosphates and sulphates. • **Biotic**–Producers–Grasses, forbs and shrubs • **Consumers**–Cows, cows, buffaloes, deer, sheep • **Decomposers**–Fungi and bacteria. (3M) **(iii) Structure & Function of Desert Ecosystem-** • **Abiotic**–temperature, rainfall, sunlight, water, • **Biotic** – Producers – shrubs, bushes, grasses, • **Consumers**–Squirrels, mice, foxes; • **Decomposers** – fungi and bacteria. (3M) **(iv) Structure and Function of Aquatic Ecosystem-Pond**–Temporary-Fresh water body. • **Abiotic**– Temperature, light, water, organic and inorganic compounds. • **Biotic**–Producers–green photosynthetic organisms, • **Consumers**–Protozoa, small fish, ciliates, flagellates • **Decomposers**–Fungi, bacteria and flagellates. (2M) **Structure and Function of Aquatic Ecosystem-Lakes**–Natural shallow water bodies • **Abiotic**–Temperature, light, proteins and lipids, turbidity, oxygen and carbon dioxide. • **Biotic–Producers**–Phytoplanktons, algae, flagellates, • **Consumers**–Protozoans, insects, small fishes, large fish; • **Decomposers**–Bacteria, fungi and actinomycetes. (2M)
6.	
	Classify and explain the values of biodiversity. (13M) (A.U. Dec 2010, May 11, Jan 2018) BTL2 **Answer: Page: 3.5 – 3.9-A. Ravikrishnan**

	Classify values biodiversity – Consumptive use values; Productive use values; Social values; Ethical values; Optional values. (1M) **Consumptive use values**–Direct use values; products are harvested and consumed directly. Food, Drugs, Fuel. (2 M) **Productive use values**–Products derived from the animals and plants-commercial value. (2M) **Social values**–Bio-resources used to the society. Associated with the social life, religion and spiritual aspects of the people. (2M) **Ethical values**–"All life must be preserved". In India biodiversity have great value on religious and cultural basis. (2M) **Optional values**–Any species may be proved to be a valuable species after someday. (2M) **Aesthetic values-** Beautiful nature of plants and animals insist us to protect the biodiversity. "Eco-tourism" (2M)
7.	
	Explain the role of biodiversity at global, national and local levels. (13M) (A.U. May 07, Apr 10, May 11, June 2019) BTL2 **Answer: Page: 3.9 – 3.14-A. Ravikrishnan** **Role of Global biodiversity**- Total number of living species in the world are about 20 million. But, of which only about 1.5 million species are found and given scientific names. Tropical deforestation alone is reducing the biodiversity by 0.5% every year. **Terrestrial biodiversity or biomass** i) Largest ecological units present in different geographic areas named in different ways ii) Tropical rain forests –About 50 to 75% of global biodiversity lies in these tropical rain forest. iii) More than 25% of the world's prescription drugs are extracted from plants in tropical rain forest iv) Nearly 1,30,000 flowering plants are found available v) Temperate rain forests - Have much less biodiversity. 1,70,000 flowering plants, 30, 000 vertebrates, 2,50,000 other group of species are found. (3M) **Marine diversity** i) Much higher than terrestrial biodiversity ii) Estuaries coastal waters and oceans are biologically diverse but the diversity is very low iii) Out of 35 existing phyla of multicellular animals, 34 are marine iv) List of few living species (2M) **National level biodiversity**: i) India is second largest nation containing 5% of world's biodiversity and 2% of the earth surface. The second largest nation containing 50% of world's biodiversity and 2% of earth surface. ii) 10^{th} rank among the plant rich countries of the world. iii) 11^{th} rank among the endemic species of higher vertebrates. iv) 6^{th} rank among the centers of diversity and origin of agricultural crops. v) An agricultural country and its economic growth depend on the production of many crops. vi) India "mega - diversity" nation because it is rich in both fauna and flora.

	vii) Many species in India has Medicinal value and Commercial value (5M) **Biodiversity at local level** -1. Point richness 2. Alpha richness 3. Beta richness 4. Gamma richness. (3M)
8.	
	(i) Give the various hot spots of biodiversity.(ii) Explain the various threats to biodiversity along with the means to conserve them. (13M) (May 2008, MAY/JUNE 2013, Dec 2019) BTL4 **Answer: Page: 3.18 – 3.25-A. Ravikrishnan** (i) **Biodiversity hotspot-**The geographic areas which possess high endemic species. Eastern Himalayas, Western Ghats. (2M) **(ii)Threats to biodiversity** • **Habitat loss-**The loss of populations of interbreeding organisms. Threatened a wide range of animals and plants. Factors influencing habitat loss and any two remedies. (3M) • **Poaching-**Killing of animals (or) commercial hunting. Leads to loss of animal biodiversity. Factors influencing poaching loss and any two remedies to overcome. (3M) • **Man-Wild life conflict-** Arise when wildlife starts causing immense damage and danger to the man. Factor influencing man-wild life conflict and two conserve methods. (3M) • **Over exploitation of natural resources** i) Serious threat to the wildlife. ii) Disturbance in migratory routes of animals. iii) Cause of destruction of many species. (2M)
9.	
	Explain in-situ and ex-situ conservation along with their merits and limitations. (A.U. May 2008, Dec 2010, May 11, Dec 11) (13M) BTL2 **Answer: Page: 3.34 – 3.40-A. Ravikrishnan** **Conservation of Biodiversity:** management of biosphere so that it will yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs of future generation. (1M) **In-Situ Conservation (within habitat)** - Protection of wild flora and fauna within their habitat nature. (1 M) Biosphere reserves, National Parks, Sanctuaries, Reserve forests etc. (Each 1 M = 4M) **Advantages:** Cheap and convenient method. Species gets adjusted the natural disasters like drought, floods, forest fires. (1 M) **Limitations:** Large surface area of the earth required – shortage of staff and pollution may lead to improper maintenance of the habitat. (1 M) **Ex-Situ Conservation (outside habitat)** – Protection of flora and fauna outside their habitat nature. (1 M) Gene banks, seed banks, zoos, botanical gardens, culture collections. (2 M) **Advantages:** Special care and attention lead, Assured food, water, shelter and security, Longer

life span. (1 M)

Limitations: Expensive method- Loss of freedom of wild life – Animals cannot survive in such environments. (1 M)

10.

Write a note on endangered and endemic species of India. (13M) (A.U. Dec 2009) BTL2

Answer: Page: 3.28 – 3.33-A. Ravikrishnan

Endangered Species – Species number has been reduced to a critical level. Unless it is protected and conserved, it is in immediate danger of extinction.

i) In India 450 plant species identified as endangered species.
ii) About 100 mammals and 150 birds are endangered species.
iii) India biodiversity threatened due to habitat destruction, degradation and over exploitation.
iv) No. of endangered species in India

Group of Threatened species	Number of Threatened species
Plants	250
Birds	70
Mammals	86
Reptiles	25
Amphibians	3
Fishes	3
Molluscs	2

(6M)

Factors affecting endangered species

- Pollution
- Over exploitation
- Climate change

Remedial measures

- International Treaties on Endangered Species (ITES) (1M)

Endemic Species-Species found only in a particular region

i) In India, Out of 47,000 species 7,000 plants are endemic.
ii) About 62% endemic flora found in Himalayas, Khasi Hills and Western Ghats.
iii) **Fauna-**Animals present in particular region or period. E.g. Sapriya Himalayan, Ovaria lurida, Nepenthes Khasiana, Pedicularis parroter, Pitcher plants and Orchids etc.
iv) Out of 81,000 animal species–Large number of species are described to be endemic
v) 62% amphibians, 50% Lizards are endemic to Western Ghats
vi) No. of endemic species in India
vii)

Group	No. of Species
Land	878
Freshwater	89
Insecta	16214
Amphibia	110
Reptilia	214
Aves	69

	Nannakua 38

viii) **Flora–**Plants present in a particular region or period. Friendly bacteria which helps to protect the human body against invasion by pathogens. E.g. Monitor lizards, reticulated python, Indian Salamander, Viviparous toad

Group	No. of Species
Pteridophyta	200
Angiosperms	4950

(5M)

Factor affecting endemic species

- Habitat loss and fragmentation
- Pollution (1M)

11.

What are the major causes of Man- wild life conflict? Discuss the remedial steps that can curb the conflict. (13M) (A.U. Dec 2011, Apr 2015) BTL4

Answer: Page: 3.26–3.28-A. Ravikrishnan

Man-Wildlife Conflicts-Causes:

i) Shrinking of forest
ii) Human encroachment into forest areas
iii) Animals suffering from illness, weak and injured take humans
iv) Lack of alternate cultivation practices by forest department
v) Electric fencing causes injury to animals, which in return turn violent
vi) Poor cash compensation by govt. to farmers
vii) Food crops near forest areas attract wild animals. (10 M)

Remedies to curb the conflict

i) Adequate crop and cattle compensation schemes must be started.
ii) Solar powered fencing must be provided along with electric current proof trenches.
iii) Cropping pattern should be changed near the forest borders.
iv) Adequate food and water should be made available within the forest areas.
v) The development and constructional work near the forest area must be avoided. (3 M)

PART – C

1.

(i) Elaborate about the different biological zones of India. (5M) BTL6

(ii) Discuss a case study on (a) Man and wild life conflicts (b) Productive use of biodiversity. (10M) BTL6

Answer: Page: 3.4 – 3.5, 3.26–3.28, 3.8-3.9 A. Ravikrishnan

(i) Biogeographically Classification of India:

i) Division of India according to biogeographic characteristics. The study of the distribution of species, organisms, and ecosystems in geographic space and through geological time. The biogeographic zones of India are as follows:
ii) Himalayan zone; Desert zone; Semiarid zone; Western Ghats zone; Deccan plateau zone; Gangetic plain zone; North east zone; Coastal zone; Islands present near the shore line; Trans Himalayan zone. (5 M)

(ii) Case study on Man-Wildlife Conflicts:

i) Wildlife causing damage and danger to humans and properties – crops/houses
ii) In Samalpur (Orissa) 195 humans were killed in the last 5 years by elephants.
iii) Humans responded by killing 98 elephants and injuring 30 elephants.
iv) In Nepal, 17 peoples were killed in the Royal Chitwan National Park by a man-eating tiger.
v) Electrical fencing, explosives were some of the methods adopted by villages to kill wild animals.

Causes:

i) Shrinking of forest
ii) Human encroachment into forest areas
iii) Animals suffering from illness, weak and injured take humans
iv) Lack of alternate cultivation practices by forest department.
v) Electric fencing causes injury to animals, which in return turn violent
vi) Poor cash compensation by govt. to farmers
vii) Garbage near human settlements or food crops near forest areas. (7 M)

Productive use of biodiversity

Products derived from the animals and plants have obtained a commercial value.

Plant product	Industry
Wood	Paper and pulp industry, plywood industry Railway sleeper industry.
Cotton	Textile industry
Fruits, vegetables	Food industry
Leather	Leather industry
Ivory	Ivory - works
Pearl	Pearls industry

(3M)

2.

Inspect about the characteristic features of a pond, river and marine ecosystem and also quote a typical food chain based on that respective ecosystem. (15M) BTL4

Answer: Page: 2.27 – 2.29, 2.33 – 2.36-A. Ravikrishnan

Pond Ecosystem

i) Small bodies of freshwater with shallow and still water, marsh, and aquatic plants.
i) Temporary, only seasonal.
ii) Stagnant fresh water body.
iii) Get polluted easily due to limited amount of water
iv) The size and depth of ponds often varies greatly
v) Diverse array of aquatic life
vi) Top predators may include large fish, herons, or alligators. (3 M)

Food Chain–Producers- Green plants, phytoplanktons like hydrilla, vallisneria, pistia, sagittaria →**Primary consumers**- Zooplanktons like insects, dragon fly larvae, crustaceans, Larvae of insects, beetles, fishes, molluscs → **Secondary consumers**- Insects like water beetles, frogs, fishes → **Tertiary Consumers**-Big fishes, kingfisher, water birds → **Decomposers**–Fungi, bacteria.

(2M)

River Ecosystem:

	i) River viewed as a system operating in its natural environment includes biotic as well as abiotic. i) Fresh water and free flowing water systems. ii) Due to mixing of water, dissolved oxygen content is more. iii) River deposits large amount of nutrients iv) Unidirectional flow. v) State of continuous physical change. High degree of spatial and temporal heterogeneity at all scales. (3M) **Food Chain**–**Producers**-Phytoplankton, algae, water grasses, aquatic masses, amphibious plants →**Primary consumers**-Water insects, snails, fishes → **Secondary consumers**-Birds and mammals → **Decomposers**–Fungi, bacteria. (2M) **Ocean Ecosystem:** i) Largest of Earth's aquatic ecosystems. ii) Include oceans, salt marsh and intertidal ecology estuaries and lagoons, mangroves and coral reefs, the deep sea and the sea floor. iii) Since ship, submarines can sail in ocean, commercial activities may be carried out. iv) Rich in biodiversity. v) Moderates the temperature of the earth vi) Contrasted with freshwater ecosystems. vii) Very important for the overall health of both marine and terrestrial environments. (3M) **Food Chain**–**Producers**-Phytoplanktons, marine plants → **Consumers-Primary consumers**-Crustaceans, moiluscs, fish → **Secondary consumers**-Herring sahd, mackerel→**Tertiary Consumers**-Cod, Haddock → Decomposers–Fungi, bacteria and flagellates. (2M)
3.	
	What is forest ecosystem? List the types of forest ecosystem. Explain the features, characteristics, structure and function forest ecosystem. (15M) BTL1 **Answer: Page: 2.17–2.21-A. Ravikrishnan** **Definition -** Contains tall and dense trees grow that support many animals and birds. (2M) **Types of Forest ecosystem** i) Tropical rain forests. ii) Tropical deciduous forests. iii) Tropical scrub forests. iv) Temperate rain forests. v) Temperate deciduous forests. (2M) **Features of Forest ecosystems** i) **Tropical rain forests:** Found near the equator. High temperature. Broad leaf trees and lion, tiger and monkey are present. ii) **Tropical deciduous forests:** Found little away from the equator. Warm climate and rain only during monsoon. Have deciduous trees and deer, fox, rabbit and rat. iii) **Tropical scrub forests:** Dry climate for longer time. Have small deciduous trees and shrubs and deer, fox, etc., iv) **Temperate rain forests:** Found in temperate areas with adequate rainfall. Coniferous trees and squirrels, fox, cats, bear etc., v) **Temperate deciduous forests:** Found in areas with moderate temperatures. Broad leaf deciduous trees and deer, fox, bear, etc (4M)

Characteristics of forest ecosystem:

i) Warm temperature and adequate rainfall →Generation of number of ponds, lakes etc.,
ii) Maintains climate and rainfall.
iii) Supports many wild animals and protects biodiversity.
iv) The soil is rich in organic matter and nutrients, which support the growth of trees.
v) The conversion of organic matter into nutrients is very fast. (2M)

Structure and Function of forest ecosystem:

i) **Abiotic components** - Physical components found in the soil and atmosphere. E.g. Climatic factors and minerals.
ii) **Biotic components-Producers**-The plants absorb sunlight and produce food through photosynthesis–E.g. Trees, shrubs and ground vegetation.
iii) **Consumers**-Herbivores-E.g. Ants, flies, insects, mice, deer, squirrels. Secondary consumers -primary carnivores-E.g. Snakes, birds, fox. Tertiary consumers- Tiger, lion, etc.
iv) **Decomposers**–E.g. Bacteria and fungi. (5M)

4.

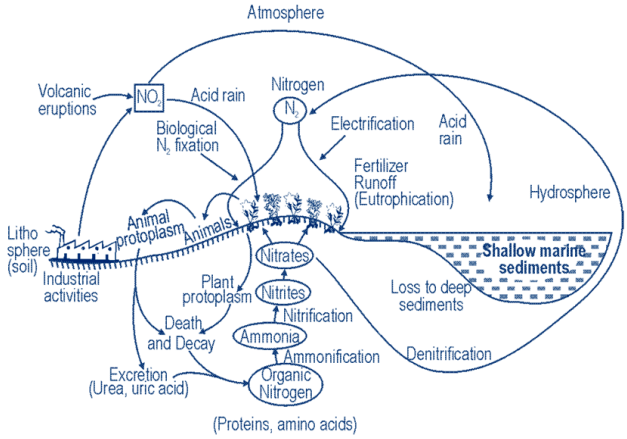
(i) Survey the following topics with a neat diagram. (a) Nitrogen cycle b) Oxygen cycle c) Energy flow in the ecosystem. (12M) BTL4

(ii) Analyze in detail about hydrosere and xerosere (3M) BTL4

Answer: Page: 2.13 - 2.15 and 2.9 – 2.11 and 2.16-A. Ravikrishnan

(i)(a) Nitrogen cycle-Exchange of nitrogen between the lithosphere and atmosphere in cyclic manner.

Atmosphere nitrogen → Plants (protein, vitamin, amino acids) → Consumer → Decomposer
Nitrates→ammonia by anaerobic bacteria → nitrites by Nitrosomonas → nitrates by Nitrobacter - → Rhizobium fixing N_2 in the roots. (3M)

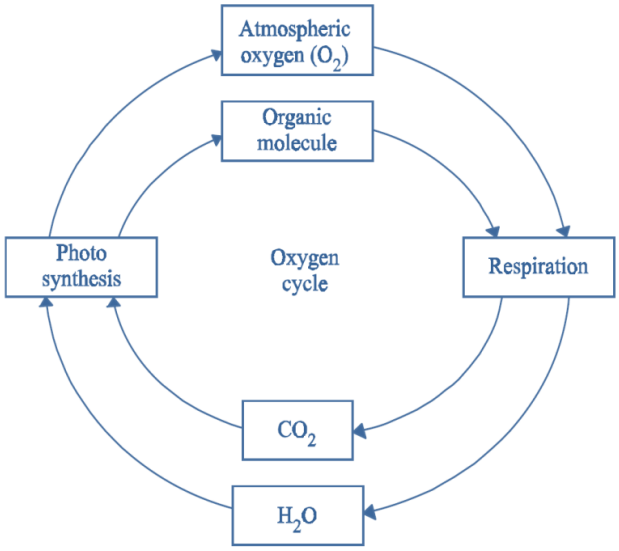


(2 M)

(i)(b) Oxygen cycle – Exchange of O_2 between the lithosphere and atmosphere and hydrosphere in a cyclic manner. Cyclic process of Photosynthesis and respiration. (4M)

$$6CO_2 + 6H_2O + Energy \rightarrow C_6H_{12}O_6 + 6O_2 \ (Photosynthesis)$$

$$6O_2 + C_6H_{12}O_6 \rightarrow 6O_2 + 6H_2O + Energy \ \ (Respiration)$$



(1 M)

(i)(c)Energy Flow In The Ecosystem

Sunlight → Plants (photosynthesis) → Primary Consumer → Secondary consumer → decomposer

- Loss of energy takes place through respiration, running, hunting etc
- Biotic components and abiotic components are linked together through energy flow and nutrient cycling. (2 M)

(ii) **Hydrosere**–Establishment starting in a watery area; **Xerarch**–Establishment starting in a dry area like, desert and rock. (3 M)

5. **Compare the physical and chemical characteristics of Marine water with terrestrial water. (15 M) (Dec 2018)** BTL4

Answer: Page: 2.37 - 2. and 2.9 – 2.11 and 2.16-A. Ravikrishnan

Marine Ecosystem:

i) Largest of Earth's aquatic ecosystems.
ii) Include oceans, salt marsh and intertidal ecology estuaries and lagoons, mangroves and coral reefs, the deep sea and the sea floor.
iii) Since ship, submarines can sail in ocean, commercial activities may be carried out.
iv) Rich in biodiversity.
v) Moderates the temperature of the earth
vi) Contrasted with freshwater ecosystems.
vii) Very important for the overall health of both marine and terrestrial environments.

Food Chain–**Producers**-Phytoplanktons, marine plants → **Consumers-Primary consumers**-Crustaceans, moiluscs, fish → **Secondary consumers**-Herring sahd, mackerel→**Tertiary Consumers**-Cod, Haddock → Decomposers–Fungi, bacteria and flagellates.

Terrestrial Ecosystem

Characteristics of Forest ecosystem:

vi) Warm temperature and adequate rainfall →Generation of number of ponds, lakes etc.,
vii) Maintains climate and rainfall.
viii) Supports many wild animals and protects biodiversity.
ix) The soil is rich in organic matter and nutrients, which support the growth of trees.
x) The conversion of organic matter into nutrients is very fast.

Structure and Function of forest ecosystem:

	v) **Abiotic components** - Physical components found in the soil and atmosphere. E.g. Climatic factors and minerals. vi) **Biotic components-Producers**-The plants absorb sunlight and produce food through photosynthesis–E.g. Trees, shrubs and ground vegetation. vii) **Consumers**-Herbivores-E.g. Ants, flies, insects, mice, deer, squirrels. Secondary consumers -primary carnivores-E.g. Snakes, birds, fox. Tertiary consumers- Tiger, lion, etc. **Decomposers–**E.g. Bacteria and fungi.

JIT-2106

UNIT – II ENVIRONMENTAL POLLUTION

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

PART * A

1. **Define the term pollution. List its types**. BTL1

Pollution-The unfavorable alteration of our surroundings

Types of Pollution-

- Air Pollution
- Water Pollution
- Soil Pollution
- Marine Pollution
- Noise Pollution
- Thermal Pollution and
- Nuclear hazards

2. **What is air pollution?** BTL1

The presence of one or more contaminants like dust, smoke, mist and odour in the atmosphere which are injurious to human beings, plants and animals.

3. **Define bio-degradable pollutant and non-biodegradable pollutant.** BTL1

Bio-degradable pollutant - Decompose rapidly by natural processes

Non-biodegradable pollutant - Do not decompose or decompose slowly in the environment

4. **State the composition of atmospheric air.** BTL1

Constituents	%
Nitrogen	78
Oxygen	21
Argon (Ar)	< 1
CO_2	0.037
Water vapour	Remaining
O_2, He, NH_3	Trace amount

5. **State the Indian ambient air quality standards.** BTL1

Category	Area	Concentration in µg/m3			
		SPM	SO_2	NO_X	CO
A	Industrial and mixed use	500	120	120	5,000
B	Residential and rural	200	80	80	2,000
C	Sensitive (hill stations, tourist resorts, monuments	100	30	30	1,000

6. **Outline the causes of air pollution?** BTL2

- Incomplete burning of fossil fuels, liberate CO, NO_2, Suspended Particulate Matter (SPM) etc.
- Coal burning in power plants, liberate SO_2

<table>
<tr><td></td><td>

- Ozone
- Agriculture, decay of plants, liberate hydrocarbons.

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<tr><td>7.</td><td>

Define photochemical smog. (NOV/DEC 2006) BTL2

It is not related to smoke (or) fog. It is formed by the combination of NO, NO_2, CO_2, H_2O, CO, SO_2 and unburnt hydrocarbon particles. The important reaction is dissociation of NO_2 in sunlight. It is also named as los Angeles smog.

</td></tr>
<tr><td>8.</td><td>

What are the effects of various air pollutants on human health? BTL1

<table>
<tr><td>Name of the Pollutant</td><td>Name of the Diseases</td></tr>
<tr><td>NO_2</td><td>Lung irritation and damage</td></tr>
<tr><td>CO</td><td>Reacts with hemoglobin in red blood cells and reduces the ability of blood to bring oxygen to body cells and tissues, which causes headaches and anemia. At high levels it causes coma, irreversible brain cell damage and death.</td></tr>
<tr><td>SO_2</td><td>Breathing problems for healthy people.</td></tr>
<tr><td>SPM</td><td>Nose and throat irritation, lung damage, bronchitis, asthma, reproductive problems and cancer</td></tr>
<tr><td>Hydrocarbon</td><td>Carcinogenic</td></tr>
</table>

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<tr><td>9.</td><td>

What are oxygen demanding wastes? (APR/MAY 2011) BTL1

Oxygen demanding wastes is the one to reduce amount of oxygen water in water is known as oxygen demanding wastes. The oxygen demanding wastes are BOD and COD

BOD is the amount of oxygen required for the biological decomposition of organic matter present in the water.

COD is the amount of oxygen required for chemical oxidation of organic matter using some oxidizing agent like $K_2Cr_2O_7$ and $KMnO_4$

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<tr><td>10.</td><td>

What Is PAN? Give Its Detrimental Effects. BTL1

PAN

- Peroxy Acetyl Nitrates - Secondary Pollutant Present In Photochemical Smog.
- It is a lachrymatory substance.
- It is thermally unstable and decomposes into peroxy ethanol radicals and nitrogen dioxide gas.
- It is an oxidant and more stable than ozone

Detrimental Effects

- It is a powerful respiratory and eye irritants, toxic in nature.
- Cause extensive damage to vegetation, causing skin cancer
- Damages plants and art.
- React explosively.
- Plays a very large role in photochemical smog

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<tr><td>11.</td><td>

How CFC's are accumulated in atmosphere. (MAY/JUNE 2006) BTL1

CFC's are accumulated in atmosphere through

- Propellant in Aerosol spray cans
- Cleaning solvents
- Refrigerants (Freon) in refrigerators, air conditioners
- Foam plastic blowing agent
- Blowing agent

</td></tr>
</table>

12. **Define primary air pollutant and secondary air pollutant.** BTL1

Primary air pollutants - Those emitted directly in the atmosphere in harmful form. E.g. CO, NO, SO_2,

Secondary air pollutant – New pollutants formed by the reaction of some of the primary air pollutants with one another or with the basic components of air.

E.g. NO /NO_2→ HNO_3 / NO_3

13. **State the composition of soil.** BTL1

Components	%
Mineral matter (inorganic)	45
Organic matter	5
Soil water	25
Soil air	25

14. **State the water quality standards.** BTL1

S. No.	Parameter	WHO standard in mgs/litre	ISI standard in mgs/litre.
1.	Colour, odour and taste	Colourless, odourless and tasteless	Colourless, odourless and tasteless
2.	p^H	6.9	6.9
3.	Total dissolved solids	1500	-
4.	Dissolved oxygen	-	3.0
5.	Chloride	250	600
6.	Sulphate	400	1000
7.	Nitrate	45	-
8.	Cyanide	0.2	0.01
9.	Fluoride	1.5	3.0
10.	Chromium	0.05	0.05
11.	Lead	0.05	0.1
12.	Arsenic	0.05	0.2

15. **List the self-cleaning processes of atmosphere.** BTL4

- Dispersion
- Gravitational settling
- Flocculation
- Absorption
- Rain washout and so on

16. **What are point and non-point sources of water pollution?** BTL1

Point sources are discharged pollutants at specific location through pipes, ditches or sewers into bodies of surface water.

Non-point sources: They cannot be traced at any single site of discharge. They are usually large land areas or air sheds that pollute water by runoff, subsurface flow or deposition from the atmosphere.

17. **Write any four major water pollutants. (MAY/JUNE 2006)** BTL1

- Infectious agents
- Oxygen demanding wastes
- Inorganic chemicals

	• Organic chemicals • Plant nutrients • Sediments • Radioactive materials • Heat (any four)
18.	**What is marine pollution? Name the sources and effects of marine pollution. (MAY/JUNE 2005, NOV/DEC 2014)** BTL1 The discharge of waste substances into the sea resulting in harm to living resources, hazards to human health, hindrance to fishery and impairment of quality for use of sea water. • Dumping the wastes - Marine birds ingest plastic which causes gastrointestinal disorders • Oil - Damage to marine fauna and flora, retard the rate of O_2 uptake by water.
19.	**Define noise pollution. When a sound does cause noise pollution? (NOV/DEC 2013, APR/MAY 2015)** BTL1 • Noise pollution is defined as the unwanted, unpleasant or disagreeable sound that causes discomfort for all living beings. • The sound intensity is measured in decibel (dB), which is tenth part of the longest unit Bel. One dB is equal to the faintest sound, a human ear can hear. If the intensity of the sound exceeds 80 dB, noise pollution occurs. Noise above 140 dB becomes painful.
20.	**Give any four methods to control noise pollution. (MAY/JUNE 2007)** BTL1 • Source Control • Transmission Path Intervention • Receptor control • Oiling
21.	**Define thermal pollution. (NOV/DEC 2005, NOV/DEC 2008)** BTL1 The addition of excess of undesirable heat to water that makes it harmful to man, animal or aquatic life or otherwise causes significant departures from the normal activities of aquatic communities in water.
22.	**What are the causes of thermal pollutions?** BTL 1 • Nuclear power plants • Coal-fired power plants • Industrial effluents • Domestic sewage • Hydro-electric power
23.	**Define hazardous wastes. Why nuclear hazards are so dangerous? (NOV/DEC 2006)** BTL1 • Wastes like toxic chemicals, radioactive or biological substances which contribute to an increase in mortality or in serious irreversible illness to human health and environment are called hazardous wastes. • Radioactive radiation, liberated by nuclear hazards, affects the cells in the body and the function of glands and organs. People suffer from blood cancer and bone cancer if exposed to doses around 100 to 1000 roentgens. Unlike the other pollution, radioactive pollution can cause genetic disorders even in the subsequent generations.
24.	**What are the various sources of radioactive pollution? (NOV/DEC 2008, APR/MAY 2015)** BTL1 • Natural sources.

	The very important natural source is space, which emit cosmic rays. Soil, rocks, air, water, food, radioactive radon-222 etc. also contain one or more radioactive substances. • Man-made sources Man-made sources are nuclear power plants, X-rays, nuclear accidents, nuclear bombs, diagnostic kits, etc., where radioactive substances are used.
25.	**List any four causes of floods. (NOV/DEC 2010)** BTL4 • Heavy rain, rainfall during cyclone causes flood. • Sudden snow melt also raises the quantity of water in streams and causes flood. • Clearing of forests for agriculture has also increased severity of floods. • Reduction in the carrying capacity of the channel, due to accumulation of Sediments cause floods
26.	**What are the types of solid wastes? (NOV/DEC 2006, MAY/JUNE 2007)** BTL2 a. Municipal wastes ; b. Industrial wastes ; c. Hazardous wastes
27.	**Mention the sources of solid wastes. (NOV/DEC 2009)** BTL1 • Domestic wastes – cloth, waste papers • Commercial wastes – cans, bottle, polythene bags • Construction wastes – Wood, Concrete • Biomedical wastes – Infectious wastes • Industrial wastes – Nuclear and thermal power plants • Hazardous wastes – Toxic wastes, chronic toxicity
28.	**Differentiate between recycling and reuse. (NOV/DEC 2007, APR/MAY 2011)** BTL4 • Reuse The refillable containers, which discarded after use can be reused. Rubber rings can be made from the discarded cycle tubes which reduces the waste generation during manufacturing of rubber bands. • Recycling Recycling is the reprocessing of the discarded materials into new useful products Example • Old aluminum cans and glass bottles are melted and recast into new cans and bottles • Preparation of cellulose insulation from paper.
29.	**What are the roles of women in environmental pollution? (NOV/DEC 2008)** BTL1 In rural areas women plant trees and grass, grow vegetables with the drip-irrigation method on order to save water. b. In urban areas they go shopping using cloth bags to reduce white pollution.
30.	**What are the effects of thermal pollution? (APR/MAY 2011)** BTL1 • Reduction in dissolved oxygen • Increase in toxicity • Interference with biological activity • Interference with reproduction • Direct mortality • Food storage for fish
31.	**What do you meant by soil pollution? Or Define soil pollution. (NOV/DEC 2010) Write the causes of soil pollution.** BTL1 The pollution affects and alter the chemical and biological properties of soil. As a result, hazardous

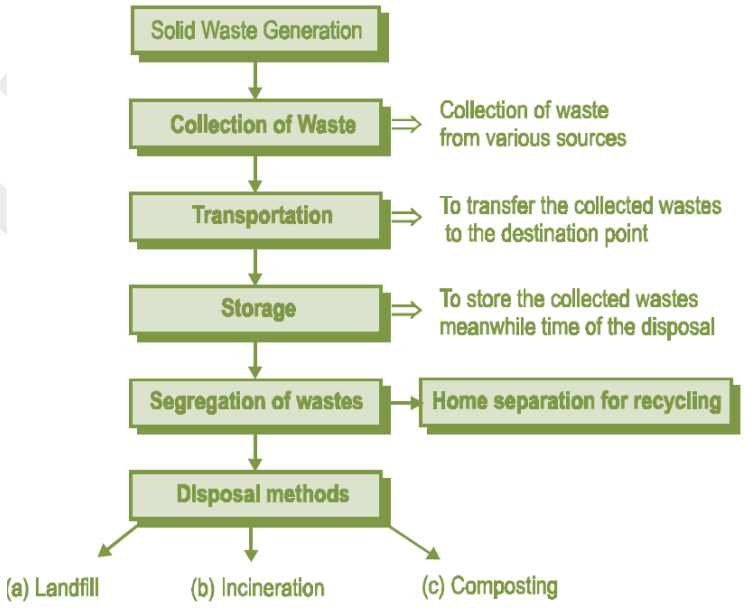
	chemical can enter into human food chain from the soil or water disturbs the biochemical process and finally lead to serious effects on living organism.
32.	**What are causes of noise pollution? (NOV/DEC 2010)** BTL1 • By machine like mechanical saws and pneumatic drill. • From transport, rail, air craft, road vehicles like scooters, cars, motorcycles, buses. • Common noise makers are musical instruments, TV, VCR, radios, transistors, • Telephone and loudspeakers.
33.	**What is a Dobson unit? (MAY/JUNE 2007)** BTL1 The amount of atmospheric ozone is measured by "Dobson spectrometer" and is expressed in Dobson units (DU). 1 DU is equivalent to a 0.01 mm thickness of pure ozone at the density it possesses if it is brought to the ground level (1atm) pressure • In temperate latitude its concentration is 350 DU • In tropics its concentration is 250 DU • In sub polar region its concentration is 450 DU
34.	**What are the harmful effects of landslides?** BTL1 • Landslides block the roads and diverts the passage • Erosion of soil increases. • Sudden landslides damage the houses, crop yield, live stock etc.
35.	**What do you know about particulate? (MAY/JUNE 2018)** BTL1 Particulate refers to all atmospheric substances that are not gases. They can be suspended droplets or solid particles or mixtures of the two. Particulates can be composed of materials ranging in size from 100mm to 0.1mm and less. The chemical composition of particulate pollutants is very much dependent upon the origin of the particulate.
36.	**What are landslides? (MAY/JUNE 2018)** BTL1 The movement of earthy materials like coherent rock, mud, soil and debris from higher region to lower region due to gravitational pull is called landslides.
37.	**Define the term Tsunami.** BTL2 A tsunami is a large wave that is generated in a water body when the sea floor is deformed by seismic activity. This activity displaces the overlying water in the ocean.
	PART * B
1	**Discuss the causes, effects and control of marine pollution. (7 M) (NOV/DEC 2009, APR/MAY 2010, NOV/DEC 2011)** BTL6 **Answer : Page: 4.32 - 4.34- A. Ravikrishnan** • Definition- The discharge of waste substances into the sea resulting in harm to living organisms, hazards to human health, hindrance to fishery and impairment of quality for use of sea water. (1 M) • Sources (Causes) of marine pollution Dumping the wastes-large amount of sewage, garbage, agricultural discharge, pesticides and huge amount of plastics. (1 M) Oil pollution of marine water-Imposed by petroleum and its products. (1 M) • Effects of marine pollution on human health and environment – Oil spilling in sea inhibit the photosynthesis-damage to marine fauna and flora including algae, fish, birds, invertebrates-hydrocarbons and benzpyrene accumulate in food chain and consumption of fish by man cause cancer. (2 M) • Control measures – Plans for conserving marine biodiversity-education about marine

	ecosystems-industrial units on the coastal lines equipped with pollution control instruments-urban growth should be regulated-fisherman needs should be accommodated. (2 M)
2	**What is an earthquake? Write about its causes, effects and measures to face the earthquake. (8 M) (APR/MAY 2008, NOV/DEC 2008, NOV/DEC 13, NOV/DEC 2014)** BTL4 **Answer : Refer : 4.78 – 4.80 - A. Ravikrishnan** • Definition: An earthquake is a sudden vibration caused on the earth's surface due to the sudden release of tremendous amount of energy stored in the rocks under the earth's crust. (2 M) • Causes- disequilibrium in any part of the earth crust-volcanic eruption, hydrostatic pressure and manmade activities-underground nuclear testing-decrease of groundwater level. (2M) • Effects- hilly and mountains cause landslides-collapses houses due to poor construction, peoples die increases depending on the severity-seismic waves caused by earth quakes under the sea. (2 M) • Preventive measures-constructing earthquake resistant buildings, wooden houses are preferred – information about magnitude of intensity should give by seismic hazard map by Seismologist. (2 M)
3	**Describe the sources, effects and various measures to control of noise pollution. (7 M) (NOV/DEC 2009, MAY/JUNE 11, NOV/DEC 2014)** BTL4 **Answer : Page: 4.37 to 4.40 - A. Ravikrishnan** • **Definition** – The unwanted , unpleasant or disagreeable sound that causes discomfort for all the living beings (1 M) • **Types and sources** Industrial noise-by machines, particularly mechanical saws and pneumatic drill is unbearable and is a nuisance to public. (1 M) Transport noise-road traffic noise, rail traffic noise and craft noise. (1M) Neighborhood noise-household gadgets and community like musical instruments, transistors, telephones, TV, VCR, radios, etc. (1M) • **Effects** (2M) Interferes communication Hearing damage (90 dB) Physiological and Psychological disorders • **Control and preventive measures** (1M) Reduction in source of noise Noise making machines should be kept in containers with sound absorbing media Proper oiling will reduce noise from machinery Using silencers – fibrous material Planting trees Legislation can prevent excess sound production, unnecessary horn blowing etc.
4	**What are types, sources and the effects of improper municipal solid waste management? State the measures recommended for proper management for the solid wastes. (7M + 6M)**

(MAY/JUNE 2005, APR/MAY 2010, NOV/DEC 2010, MAY/JUNE 2011, NOV/DEC 2011, NOV/DEC 2013, APR/MAY 2015) BTL1

Answer : Page: 4.61 to 4.70 - A. Ravikrishnan

- Effects of solid wastes (2 M)
- Types
  Urban or municipal wastes
  Industrial wastes
  Hazardous wastes (1 M)
- Sources
  Urban or municipal wastes
  Domestic wastes
  Commercial wastes
  Construction wastes
  Biomedical wastes (1 M)
  Industrial wastes
  Nuclear power plants
  Chemical industries
  Other industries (1 M)
  Hazardous wastes
  Toxic wastes
  Reactive wastes
  Corrosive wastes
  Radioactive wastes
  Infectious wastes
  Heavy metals (2 M)
- Process of solid waste management
  Flow chart



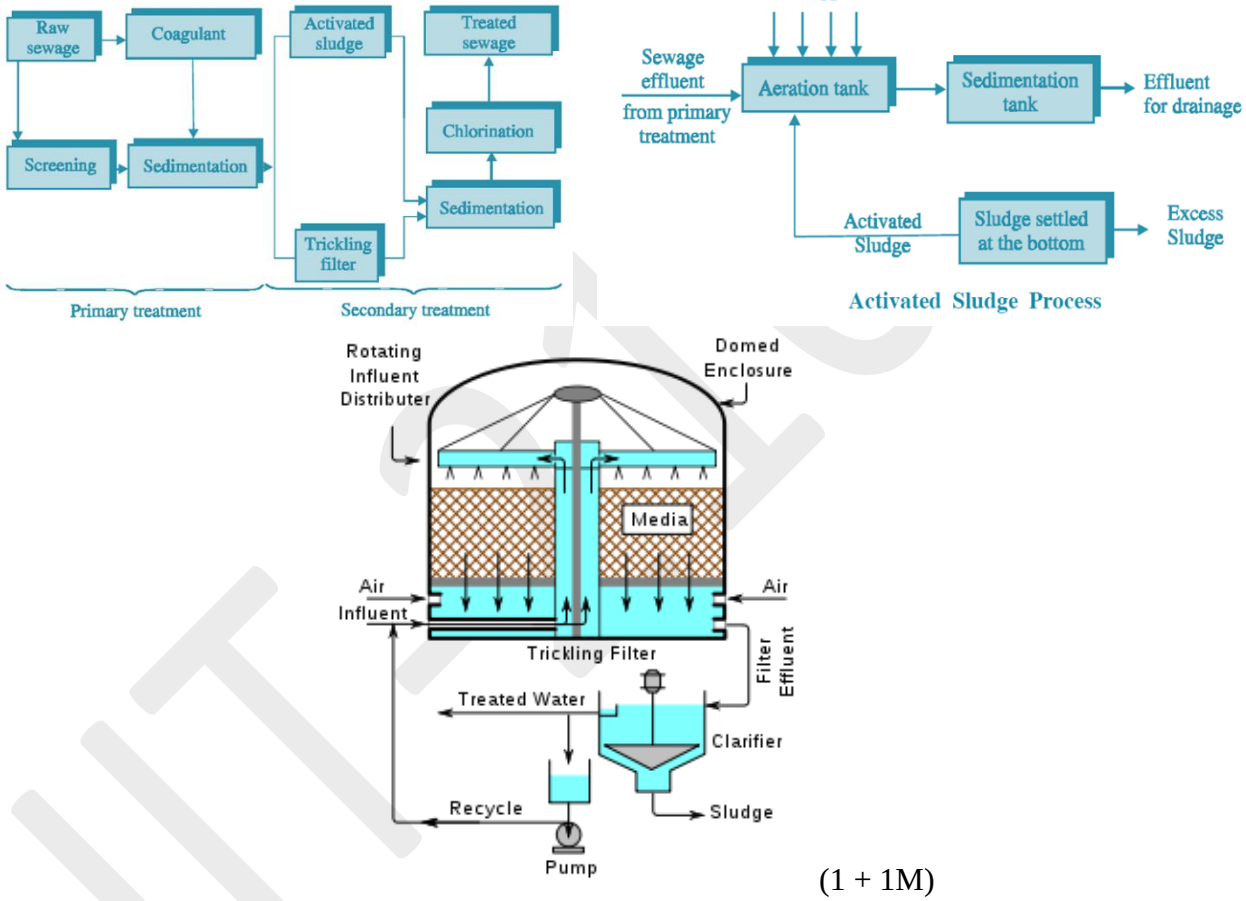
(2 M)

Reduce the usage of raw materials

	Reuse of waste materials Recycling of material (1 M) • Discarding wastes Landfill – Advantages - Disadvantages (1 M) Incineration - Advantages - Disadvantages (1 M) Composting - Advantages - Disadvantages (1 M)
5	**Mention any five air pollutants with their source, effects and control measures. (7 M) (NOV/DEC 2005, APR/MAY 2006, NOV/DEC2005, MAY/JUNE 2013)** BTL1 **Answer : Page: 4.4 to 4.11 - A. Ravikrishnan** • Any five air pollutants (1 M) • Sources, health effects, environmental effects and control measures Carbon monoxide (CO) (1 M) Nitrogen dioxide (NO_2) (1 M) Sulphur dioxide (SO_2) (1 M) Suspended Particulate Matter (SPM) (1 M) Ozone (1 M) Hydrocarbons (Aromatic and aliphatic) (1 M) Any five (5 M) • Control measures (1 M)
6	**How can you, as an individual, prevent environmental pollution? Why such an effort at an individual level is important. (6 M) (NOV/DEC 2009, NOV/DEC 2010,MAY/JUNE 2014, NOV/DEC 2014, APR/MAY 2015)** BTL4 **Answer : Page: 4.61 to 4.62 - A. Ravikrishnan** **Role and responsibility of individual participation:** Use stairs instead of elevators Use public transportation walk or ride a bicycle Plant trees around building Turn off lights, television sets and computer when not in use. Pay immediate attention to leaks in pipes. Install waste saving equipments. Recycle glass metal and paper. Compost garden waste Segregate waste and recycle Buy locally made long losing material Buy environmentally degradable products. Take some bag from home to market to purchase.
7	**Explain the causes, effects and control measure of water pollution. (13 M) (MAY/JUNE 2013) (NOV/DEC 2013)** BTL42 **Answer : Page: 4.12 to 4.24 A. Ravikrishnan** • **Definition** – The alteration and physical, chemical and biological characteristics of water which may cause harmful effects on humans and aquatic life (1 M) • **Causes:** (4M) Infectious agents Oxygen demanding wastes Inorganic chemicals Organic chemicals

	Plant nutrients Sediments Radioactive materials Heat Point and non-point sources **Effects of water pollution** (4M) 1. Objectionable colour and odour is unacceptable and unsuitable for drinking and other purposes. 2. highly turbid and very hard water is unpleasant to drink, food processing 3. acid and alkaline water cause serious health problem 4. water borne infectious enteric disease like typhoid, cholera, dysentery, are the predominant health hazard arising from drinking contaminated water 5. radioactive pollution enter human body through food and get accumulated in thyroid gland, liver, bones and muscles 6. biodegradable waster deplete D O in the receiving stream, affect the flora cause creates anaerobic conditions 7. non biodegradable waste and pesticides travel the food chain and ultimately reach human where they accumulate in fatty tissues 8. thermal discharge in stream depletes D O 9. phosphate, nitrate, promote the growth of algae and encourage eutrophication 10. Industrial effluents result in addition of poisonous chemicals such as arsenic, mercury, lead may reach human body through contaminated food. **Control measures of water pollution** (4M) a) lay down standard for a. drinking water b. disposal of waste water into water course/sewer/land monitoring b) Waste water treatment • preliminary treatment • primary treatment • secondary treatment • advanced treatment
8	**Explain the sources, effects and various measures to control of thermal pollution. (13 M) (MAY/JUNE 2013, NOV/DEC 2013)** BTL4 **Answer : Page: 4.40 to 4.46 - A. Ravikrishnan** • Definition The addition of excess of undesirable heat to water that makes it harmful to man, animal or aquatic life of otherwise causes significant departures from the normal activities of aquatic communities in water (1 M) • Sources of thermal pollution Nuclear power plants Coal-fired power plants Industrial effluents

	Domestic sewage Hydro-electric power (5 M) • Effects of thermal pollution on human health Reduction in dissolved oxygen Increase in Toxicity Interference with biological activities Interference with reproduction Direct mortality Food storage for fish (3 M) • Control measures Cooling towers Cooling ponds Spray ponds Artificial lakes (4 M)
9.	**Give a note on** **(a) Floods** **(b) Cyclone** **(c) Landslides** **(13M)** BTL2 **Answer : Refer : 4.72 – 4.77 - A. Ravikrishnan** • Definition of flood: Whenever the magnitude of water flow exceeds the carrying capacity of the channel within its banks, the excess of water over flows on the surroundings causes floods (1 M) • Causes and effects (2 M) • Preventive measures of floods (1 M) • Definition: Cyclone is a meteorological phenomenon, intense depressions forming over the open oceans and moving towards the land. On reaching the shores, it move into the interior of the land or along the shore lines. (1 M) • Causes and effects (2 M) • Preventive measures of cyclone (1 M) • Definition: The movement of earthy materials like coherent rock, mud, soil and debris from higher region to lower region due to gravitational pull is called landslides. (1 M) • Causes and effects (2 M) Preventive measures of landslides (2 M)
10.	**Discuss the significance of parameters of drinking water quality standards. (7 M) (Dec. 2008)** BTL2 **Answer : Page: 4.22 to 4.23 - A. Ravikrishnan** • Physical parameters Colour Tastes and Odours Turbidity and Sediments (2 M) • Chemical parameters P^H Acidity Alkalinity Flouride

	Nitrogen Chlorides Sulphates Nitrates Arsenic (6 M)
11.	**With a flow diagram explain the waste water treatment. (7 M) (Dec. 2007)** BTL2 **Answer : Page: 4.20 to 4.22 - A. Ravikrishnan** Flow charts and Diagrams  (1 + 1M) Step-I Preliminary treatment (1 M) Step-II Primary Treatment or Settling Process (1 M) Step-III Secondary or Biological Treatment Trickling Filter Process (1 M) Activated Sludge Process (1 M) Step-IV Tertiary Treatment (1 M) Step-V Disposal of Sludge (1 M)
12.	**Write a note on nuclear hazards (Nuclear pollution). (or) Explain the sources, effects and control measures of radioactive pollution. (7 M) (Dec. 2006)** BTL2 **Answer : Page: 4.48 to 4.50 - A. Ravikrishnan** Definition – The presence of radioactive elements in the environment (1M) **Causes**:- (2M)

	a)Natural Sources: Solar rays Radio nuclides in earth‟s crust Environmental radiation b)Manmade Sourse: Medical X-rays Radio isotopes Nuclear test Nuclear installations Nuclear reactor **Effects:-** (2M) Causes skin burns, loss of teeth, vomiting anemia Blood cancer Brain damage **Control measures:-** (2M) Radiation exposure protection Radiation contamination protection Controlled area Disposal of radioactive waste
13.	**Explain the sources, effects and control measures of soil pollution. (8 M)** BTL2 **Answer : Page: 4.54 - A. Ravikrishnan** Definition- The contamination of soil which may cause harmful to environment (1 M) Sources and effects Industrial wastes (1 M) Urban wastes (1 M) Agricultural practices (1 M) Radioactive pollutants (1 M) Biological agents (1 M) Control Measures Control of soil erosion Proper dumping of unwanted materials Production of natural fertilizers Proper hygienic conditions Public awareness Recycling and reuse of wastes Ban on toxic chemicals (2M)
	PART – C
1	**Discuss about the following case study (a) Bhopal gas tragedy (b) Gulf War (c) Mercury wastes (15 M)** BTL6 **Answer : Page: 4.65,4.68 to 4.69 - A. Ravikrishnan** • **Causes and effects of Bhopal gas tragedy:** (5M) Pesticide factory-Union Carbide- corporation leak large volume of methyl iso cyanate – atmosphere Bhopal- India-midnight on December 3,1984-city- change- gas chamber-within a week 10,000 people died – 1000 people turned blind-lakhs of people still continue to

	suffer various diseases • **Causes and effects of Gullf War**: (5 M) Gulf war was fought between Iraq and US-Period of 6 weeks in 1991-American fighters dropped a lakh of bombs-force the Iraq army to withdraw from Kuwait- retreat of Iraq-burning of 700 oil wells-near sea shore –oil from well spills out into the sea-the floating oil oversea water nearly 80 km long-burning of oil wells nearly 10 months-released huge amounts of pollutants likeCO_2 and SO_2 into the atmosphere-1 million birds killed. • **Causes and effects of mercury wastes**: (5 M) Minamata- Small hostel village in Japan –Chicago-chemical company produces Venyl polymer plastics-industry release its effluent into Minamata sea-Effluents by fishes – affect human being through food chain-damage central nervous system-loss of vision and hearing-loss of muscular coordination and severe headache- nervous disorders.
2	**Discuss about the following case study (a) Palar river pollution (b) Textile and dye industries (c) Chernobyl nuclear disaster. (15 M)** BTL4 **Answer : Page: 4.66, 4.69 - A. Ravikrishnan** **Explanation of Palar river pollution** (5 M) Palar river originates in Nandidurgam of Karnataka state and flows for about 350 km through Karnataka, Andra Pradesh and Tamil Nadu.Palar supply drinking water for several municipalities, towns and villages in Vellore district, Tamil Nadu**.** The effluent from the above industries affect the surface and underground water and make the water unfit for domestic work. The effluent also increase the pH of the soil and affect the cultivation. The rivers like Bhavani, Noyyal and Cauvery get polluted due to mixing of effluent from the above industries. Tamil Nadu Pollution Control Board (TNPCB) has directed all textile printers and dyers of Thirupur to not allow the effluent to mix in the river systems. **Explanation of Textile and dye industries** (5 M) There are nearly 500 dying units and 195 bleaching units operating in and around Tirupur. They consume large quantity of water for processing and later discharge waste water. The effluent from the above industries affect the surface and underground water and make the water unfit for domestic work. The effluent also increase the pH of the soil and affect the cultivation. The rivers like Bhavani, Noyyal and Cauvery get polluted due to mixing of effluent from the above industries. Tamil Nadu Pollution Control Board (TNPCB) has directed all textile printers and dyers of Thirupur to not allow the effluent to mix in the river systems. **Explanation of Chernobyl nuclear disaster** (5 M) Occur at Chernobyl in USSR 28 th April,1986-the reactor exploded- result of uncontrolled nuclear reactions-radioactive fuel spread out in to the surrounding areas –killed at least 20,000 people-damage to soil, water and vegetation around 60 km.
3.	**Compare the physical and chemical characteristics of Marine water with terrestrial water. (15 M) (May 2018)** BTL4 **Answer : Page: 4.23 to 4.25 and 2.44 to2.46 - A. Ravikrishnan** **Physical and Chemical Characteristics of terrestrial water: (8M)** **The common specifications recommended by the U.S Public Health for Drinking Water are**

given below.

1.

S. No.	Parameter	WHO standard in mgs/litre	ISI standard in mgs/litre.
1.	Colour, odour and taste	Colourless, odourless and tasteless	Colourless, odourless and tasteless
2.	p^H	6.9	6.9
3.	Total dissolved solids	1500	-
4.	Dissolved oxygen	-	3.0
5.	Chloride	250	600
6.	Sulphate	400	1000
7.	Nitrate	45	-
8.	Cyanide	0.2	0.01
9.	Fluoride	1.5	3.0
10.	Chromium	0.05	0.05

Water should be clear and odourless.

2. It should be cool.
3. It should be pleasant to taste.
4. Turbidity of the water should not exceed 10 ppm.
5. pH of the water should be in the range of 7.0 - 8.5.
6. Chloride and sulphate contents should be less than 250 ppm.
7. Total hardness of the water should be less than 500 ppm.
8. Total dissolved solids should be less than 500 ppm.
9. Fluoride content of the water should be less than 1.5 ppm.
10. The water must be free from disease-producing bacteria.
11. Water should be free from objectionable dissolved gases like H_2S.
12. Water should be free from objectionable minerals such as lead, chromium, manganese and arsenic salts.

11.	Lead	0.05	0.1
12.	Arsenic	0.05	0.2

JIT-2106

UNIT III – NATURAL RESOURCES

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins –Biochemical 39 degradation of pollutants, Bioconversion of pollutants. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

Q.No.	PART * A
1.	**How are forest classified?** BTL2 1. Evergreen forests; 2. Deciduous forests; 3. Coniferous forests
2	**What are the preventive measures of deforestation?** BTL1 • Steps should be taken by the government to discourage the migration of people into the islands from mainland. • To counter the depletion of forest areas, tree plantation programs have been started. • Education and awareness programmes must be conducted. • Strict implementation of law of Forest Conservation Act • Forest fire must be controlled by modern techniques • Use of wood for fuel should be discouraged
3	**Define sustainable forestry (Chen AU Dec 2005)** BTL1 Sustainable forestry is the optimum use of forest resources, which meet the needs of the present without compromising the ability of future generations to meet their own needs.
4.	**Write the functions of forests**. **(Chen A.U. Jun 2006)** BTL2 • Forests perform very important functions both to humans and nature. • They are habitats to millions of plants, animals and wildlife. • They recycle rainwater and remove pollutants from air. They control water quality and quantity • They moderate temperature and weather and help to maintain humidity. • They influence soil Conditions and prevent soil erosion and perform watershed functions. • They promote tourism and contribute aesthetic beauty
5	**Define deforestation. What are the causes of deforestation? (Chen A.U. Jun 2006, Dec 2010)** BTL1 **Deforestation:** The process of destruction of forest (or) process of removal of or elimination of forest resources due to many natural or man-made activities. The process of removal

<table>
<tr><td></td><td>Causes of deforestation: 1. Developmental projects. 2. Mining operations. 3. Raw-materials for industries. 4. Fuel requirements. 5. Shifting cultivation. 6. Forest fires</td></tr>
<tr><td>6</td><td>Differentiate between deforestation and forest degradation. (Chen A.U. Dec 2007, Dec2010) BTL4
<table>
<tr><th>Forest Degradation</th><th>Deforestation</th></tr>
<tr><td>It is the process of deterioration forest materials.</td><td>It is the process of destruction of forest materials.</td></tr>
<tr><td>Slow process</td><td>Rapid process.</td></tr>
<tr><td>Can be removed.</td><td>Cannot be recovered.</td></tr>
</table></td></tr>
<tr><td>7.</td><td>What are the consequences of timber extraction? BTL1
• Large scale timber extraction causes deforestation.
• Timber extraction leads to soil erosion, loss of fertility, landslides and loss of biodiversity.
• Timber extraction also leads to loss of tribal culture and extinction of tribal people.
• Timber extraction reduces thickness of the forest</td></tr>
<tr><td>8.</td><td>List the adverse effects of mining. (TNV A.U. Dec 2009, 2013) BTL1
• During mining operations, the vibrations are developed, which leads to earthquake.
• When materials are disturbed in significant quantities during mining process, large
• quantities of sediments are transported by water erosion
• Noise pollution is another major problem from mining operations.
• Mining reduces the shape and size of the forest areas.
• Destruction of natural habitat at the mine and waste disposal sites.</td></tr>
<tr><td>9</td><td>State the problems caused by the construction of Dam. (Chen AU Jan 2006) BTL3
▪ Displacement of tribal people.
▪ Loss of non-forest land.
▪ Loss of forests, flora and fauna.
▪ Landslips, sedimentation and siltation occur.
▪ Stagnation and water logging around reservoirs retards plant growth.
▪ Breeding of vectors and spread of vector-borne diseases.
▪ Reservoir induced seismicity (RIC) causes earthquakes.
▪ Navigation and aquaculture activities can be developed in the dam area.</td></tr>
<tr><td>10</td><td>What are the effects of dams on tribal? BTL1
• The greatest social cost of big dam is the widespread displacement of tribal people, such a biodiversity cannot be tolerated.
• Displacement and cultural change affects the tribal people both mentally and physically. They do not accommodate the modem food habits and life styles
• Tribal people are ill-treated by the modem society.
• Many of the displaced people were not recognized and resettled or compensated.
• Tribal people and their culture cannot be questioned and destroyed.
• Generally, the body conditions of tribal people (lived in forest) will not suit with the new areas and hence they will be affected by many diseases.</td></tr>
<tr><td>11.</td><td>Compare merits and problems of dams. (Chen A.U. Jun 2007) BTL4
<table>
<tr><th>Merits of dams</th><th>Problems of dams</th></tr>
<tr><td>Dams are built to control flood and store flood water.</td><td>Displacement of tribal people.</td></tr>
</table></td></tr>
</table>

	Sometimes dams are used for diverting part or all of the water from river into	Loss of non-forest land.
	Dams are used mainly for drinking and agricultural purposes.	Loss of forests, flora and Fauna.
	Dams are built for generating electricity.	Water logging and salinity due to over irrigation.
	Dams are used for recreational purposes.	Reduced water flow and silt deposition in rivers.
	Navigation and fishery can be developed in the dam areas.	Salt water intrusion at river mouth.

12. **Explain flood management**. BTL2

- Floods can be controlled by constructing dams or reservoirs.
- Channel management and embankments also control the floods.
- Encroachment of flood ways should be banned.
- Flood hazard may also be reduced by forecasting or flood warning.

13. **Write short note on mineral resources of India**. **(Coim A.U. Dec 2009)** BTL3

India has the following mineral resources

S. No.	Mineral	Place
1.	Iron	Bihar, Orissa, Tamil Nadu, Goa
2.	Coal	A.P, Bihar, MP, West Bengal
3.	Manganese	MP, Orissa, A.P, Rajasthan
4.	Copper	Bihar, A.P, MP, Orissa
5.	Gold	Karnataka, A.P
6.	Aluminum	MP, TN, Bihar, Orissa
7.	Tin	Bihar, Orissa and Rajasthan
8.	Chromium	Bihar, Orissa, MP, TN

14. **State the environmental effects of (mining) extracting and using mineral resources. (Chen AU Jun 2005)** BTL1

- Devegetation and defacing of landscape
- Ground water contamination
- Surface water pollution
- Air pollution
- Subsidence of land
- During mining operations, the vibrations are developed, which leads to earthquake.
- When materials are disturbed in significant quantities during mining process, large
- quantities of sediments are transported by water erosion
- Noise pollution is another major problem from mining operations.
- Mining reduces the shape and size of the forest areas.
- Destruction of natural habitat at the mine and waste disposal sites.

15 **What do you mean by environmental impact? (Chen A.U. Dec 2006) (or) Define environmental impact statement. (Coim. A.U. Dec 2009)** BTL1

Environmental impact is nothing but the effect on the natural environment caused by various human actions. It includes two types

(j) Indirect effects. Example: Pollution.

<table>
<tr><td></td><td>(ii) Direct effects. Example: Cutting down trees</td></tr>
<tr><td>16</td><td>Define overgrazing. Write the adverse effects caused by overgrazing. (TNV A.U. Dec 2008, A.U. May 2008 ,Dec 2013, Chen AU Dec 2006) BTL1, BTL3
Overgrazing: Process of “eating away the forest vegetation without giving it a chance to regenerate”.
Effects of overgrazing: (i) Land degradation (ii) Soil erosion (iii) Loss of useful species</td></tr>
<tr><td>17</td><td>What is water logging? List the effects of water logging. (Coim A.U. Dec 2009, Chen AU Dec 2006, Apr 11) BTL1
Water logging is the land where water stand for most of the year or time.
Problems in water logging:
During water-logged conditions, pore-voids in the soil get filled with water and the soil-air gets depleted. In such a condition the roots of the plants do not get adequate air for respiration. So, mechanical strength of the soil decreases and crop yield falls.</td></tr>
<tr><td>18.</td><td>Enumerate the desired qualities of an ideal pesticide. (A.U. Dec 2007) BTL3
• An ideal pesticide must kill only the target species.
• It must be a biodegradable.
• It should not produce new pests.
• It should not produce any toxic pesticide vapour. Excessive synthetic pesticide should not be used.
• Chlorinated pesticides and organophosphate pesticides are hazardous, so they should be used.</td></tr>
<tr><td>19</td><td>Define desertification, land degradation and land slide. BTL1
Desertification: A progressive destruction or degradation of arid or semiarid lands to desert
Land degradation or Soil degradation: The process of deterioration of soil or loss of fertility of the soil
Land slide: Landslides are the downward and outward movement of a slope composed of earth materials such as rock, soil, artificial fills.</td></tr>
<tr><td>20</td><td>What are the advantages in conjunctive use of water? (Chen A.U. Dec 2006) BTL3
• Control of water logging.
• Use of saline water, especially for cooling purposed.
• Control of salt intrusion in coastal aquifers.
• Controlled withdrawal of water from ground water aquifer</td></tr>
<tr><td>21</td><td>What are renewable and non-renewable energy resources? (Chen. A.U. Dec 2009, TCY A.U. Dec 2008, Dec 2009,Apr 2015) BTL1
Renewable energy resources are natural resources which can be regenerated continuously by the ecological process within a reasonable time period and are inexhaustible. They can be used again and again in an endless manner. Examples: solar energy, wind energy, tidal energy, ocean thermal energy
Non-Renewable energy resources are natural resources which cannot be regenerated. E.g. coal, petroleum, minerals, oils, ground water</td></tr>
<tr><td>22</td><td>Differentiate renewable and non-renewable sources of energy. (TNV A.U. Dec 2008, 11) BTL4
<table>
<tr><th>Renewable energy</th><th>Non-renewable energy</th></tr>
<tr><td>It is regenerated continuously</td><td>Cannot be regenerated.</td></tr>
<tr><td>In exhaustible</td><td>Exhaustible</td></tr>
</table>
</td></tr>
</table>

	It can be used again and again	Cannot be used again
	It is pollution free	It pollutes the atmosphere
	Available in unlimited amount in nature	Available in limited amount
	It is developed in a short period	It is developed in a long period It is developed in a long period
23	**What are the conventional sources of energy for the mankind? (Chen AU Jan 2006)** BTL1 Non-renewable energy resources are natural resources, which cannot be regenerated once they are exhausted. They cannot be used again.	
24	**What is geothermal energy? (Coim A.U. Dec 2009)** BTL1 The energy harnessed form the high temperature present inside the earth is called geothermal energy	
25	**What is meant by soil erosion? List its types. (Chen A.U. Jun 2007)** BTL1 Soil erosion is the process of removal of superficial layer of the soil from one place to another. Soil erosion also removes the soil components and surface litter. 1. Normal erosion 2. Accelerated erosion	
26	**Explain soil leaching**. **(Chen A.U. Dec 2006)** BTL2 1. It removes valuable nutrients from the soil. 2. It may catty buried wastes into ground water and contaminates it.	
27	**Mention the factors causing soil erosion**. (**TCY A.U. Dec2008**) BTL4 1. Water 2. Wind 3. Biotic agents 4. Landslides 5. Construction	
28.	**What are the present food problems of the world? (Chen A.U. Dec 2010)** BTL4 We know that 79% of the area is covered with water and rest is land, of which most of the areas are forest, desert, mountain, barren area only less percentage of land is cultivated. So the food supplied from the rest of the land is not enough to feed all the people. The problem of population explosion has made it worse. The world population increases and cultivable land area decreases therefore the world food problem arises. Urbanization is another problem in developing countries which deteriorates the agricultural lands.	
29.	**What are the effects of over utilization of groundwater? (Chen A.U. Dec 2010)** BTL1 1. Decrease ground water 2. Ground subsidence 3. Lowering of water table 4. Intrusion of salt water 5. Earthquake and landslides 6. Drying up of wells 7. Pollution of water	
30.	**Define the term Nuclear energy. (A.U DEC2014, A.U.Apr.2018)** BTL1 Energy released during a nuclear reaction is called nuclear energy. Nuclear reactors produce the nuclear energy either by nuclear fission (or) nuclear fusion. The nuclear power (or) nuclear energy is clean and safe	
31.	**Define sustainable life style and bio gas.** BTL1 **Sustainable life style:** Sustainable development is the development of healthy environment without damaging the natural resources. In other words, all the natural resources must be used in such a way that it must be available for the future generation also. **Bio gas:** Mixture of various gases formed by anaerobic degradation of biological matter in the absence of oxygen	
	PART * B	
1	**Discuss the causes, ill effects and preventive measures of deforestation. (13M) (A.U. Dec 2005, Dec 2014, Apr 2015, A.U. Jan 2006, Dec 09, Apr 2015, A.U. Dec 2006, June 2007, A.U. May 2008)** BTL2	

Answer :Page : 5.7 – 5.9 - A. Ravikrishnan

Causes (Sources) of Deforestation

Developmental Projects:

Development projects cause deforestation in two ways.
(i) Through submergence of forest area underwater.
(ii) Destruction of forest area.
Examples. Big dams, hydroelectric projects, construction (1 M)

Mining operations

Mining have a serious impact on forest areas. Mining operation reduces the forest area. Examples Mica, coal, manganese, limestone, etc. (1 M)

Raw materials for industries

Wood is the important raw material for so many purposes.
Example - For making boxes, furniture, match-boxes, pulp, etc., (1 M)

Fuel requirements

In India both rural and tribal population depend on the forest for meeting their daily need of fuel wood, which leads to the pressure on forest, ultimately to deforestation. (1 M)

Shifting cultivation: Replacement of forest ecosystem for monospecific tree plantation can lead to disappearance of number of plant and animal species.
Examples: India is the richest nation with more than 15,000 species of plants, many of which is endangered due to deforestation (1M)

Forest fires: Forest fire is one of the major causes for deforestation. Due to human interruption and rise in ambient temperature, forest fire is happened often nowadays. Thus, due to forest fire thousands of forest area gets destructed. (1 M)

Ill effects of deforestation on the environment

Global warming: Cutting and burning of forest trees increases the CO_2 content in the atmosphere, which in turn changes the global climatic pattern, rising sea levels and depletion of the protective ozone layer.

Loss of genetic diversity: Destruction of our forest destroys the greatest storehouse of genetic diversity on earth, which provides new food and medicines for the entire world

Soil erosion: Deforestation also causes soil erosion, landslides, floods and drought. Natural vegetation acts as a natural barrier to reduce the wind velocity, this in turn reduces soil erosion. 6000 million tons of soil gets eroded every year in India

Loss of biodiversity: Most of the species are very sensitive to any disturbance and changes. When the plants no longer exist, animals that depend on them for food and habitat become extinct.

Loss of food grains: As a result of soil erosion, the countries lose the food grains

Unemployment problems: The people living around forest areas lose their livelihood

Flood and Landslides: Frequent floods, landslides in hilly areas and wind speed are heavy. (Any five Each 1 M = 5 M)

Preventive measures (or) avoid of deforestation (or) methods of conservation of forest

- New plants of more or less the same variety should be planted to replace the trees cut down for timber.
- Use of wood for fuel should be discouraged.
- Forest pests can be controlled by spraying pesticides by using aeroplanes.
- Forest fire must be controlled by modem techniques.
- Over grazing by cattle must be controlled.
- Steps should be taken by the government to discourage the migration of people into the

	islands from mainland. • Education and awareness programmes must be conducted. • Strict implementation of law of Forest Conservation Act (2 M)
2	**What are the measures recommended for conservation of natural resources? (7 M) (A.U. June 2005, Jan 2006, A.U. Apr 2010, Dec 2013)** BTL2 **Answer : Page : 5.76 – 5.80 - A. Ravikrishnan** **Measures recommended for (Role of Individual)conservation of natural resource** **Conservation of Energy** • Switch off lights, fans and other appliances when not in use. • Use solar heater for cooking your food on sunny . days, which will cut down your LPG expenses. • Dry the clothes in sunlight instead of driers. • Grow trees near the houses and get a cool breeze and shade. This will cut off your electricity charges on AC and coolers. • Use always pressure cooker. • Ride bicycle or just walk instead of using car and scoot (2 M) **Conservation of water** • Use minimum water for all domestic purposes. • Check for water leaks in pipes and toilets and repair them promptly. • Reuse the soapy water, after washing clothes, for washing off the courtyards, drive ways, etc., • Use drip irrigation to improve irrigation efficiency and reduce evaporation. • The wasted water, coming out from kitchen, bath tub, can be used for watering the plants. • Build rainwater harvesting system in your house (2 M) **Conservation of soil** • Grow different types of plants, herbs, trees and grass in your garden and open areas, which bind the soil and prevent its erosion. • While constructing the house don't uproot the trees as far as possible. • Don't irrigate the plants using a strong flow of water, as it will wash off the top soil. • Soil erosion can be prevented by the use of sprinkling irrigation. • Use green manure in the garden, which will protect the soil. • Use mixed cropping, so that some specific soil nutrients will not get depleted (1 M) **Conservation of Food Resources** • Eat only minimum amount of food. A void over eating. • Don't wastes the food instead gives it to someone before getting spoiled. • Cook only required amount of the food. • Don't cook food unnecessarily. • Don't store large amounts of food grains and protect them from damaging insects (1 M) **Conservation of Forest** • Use non-timber products. • Plant more trees and protect them. • Grassing, fishing must be controlled. • Minimise the use of papers and fuel wood. • Avoid of executing developmental work like dam, road, construction in forest areas (1 M)

3	**What are the effects, causes of soil erosion and the methods of preventing it? (7 M) (A.U. Dec 2005,11)** BTL3 **Answer : Page : 5.70 – 5.73 - A. Ravikrishnan** **Soil erosion-** Damage or removal of top soil renders the soil infertile. Erosion may occur in many ways **Effects of soil erosion** (1M) **Causes of (factors causing) soil erosion** Water ; wind; biotic agents; landslides; construction (1 M) **Control of soil erosion (Soil conservation practices)** • Conservation of till farming or no-till-farming (1 M) • Contour farming (1 M) • Terracing (1 M) • Alley cropping or agro forestry (1 M) • Wind breaks or shelter belts (1 M) Decreasing soil pollution is also a method which helps in soil conservation
5	**Discuss briefly on the consequences of overdrawing of ground water. (13 M) (A.U. Dec 2006)** BTL2 **Answer : Page : 5.19 – 5.21 - A. Ravikrishnan** **Decrease of Ground Water :** Due to increased usage of ground water, the ground water level decreases. Reason (a) The erratic and inadequate rainfall results in reduction in storage of water in reservoirs. (b) The building construction activities are sealing the permeable soil zone, reducing the area for percolation of rain water and increase in surface runoff (2 M) **Ground subsidence** When the ground water withdrawal is more than the recharge rate, the sediments in the aquifer get compacted which results in sinking of over lying land surface. This process is known as ground subsidence. (2M) **Lowering of water table** Over utilization of ground water in arid and semi-arid regions for agriculture disturbs the state of equilibrium of the reservoir (disturb the hydrological cycle) in the region. This causes following problems. (1 M) **Intrusion of salt water** In coastal areas, over exploitation of ground water would lead to rapid intrusion of salt water from sea. (2M) **Earthquake and landslides** Over-utilization of ground leads to decrease in water level, which cause earth quake, landslides and famine (2M) **Drying up of wells** As a result of over utilization of ground water, the level of ground water getting depleted at much faster rates than they can be regenerated. This leads to drying up of dug as well as bore wells. (2M) **Pollution of water** When ground water level near the agricultural land decreases, water, containing the nitrogen as nitrate fertilizer, percolates rapidly into the ground and pollute the ground water (2M)
6	**Write a brief note on changes caused by agricultural and overgrazing. (7 M) (A.U May 2007,**

	Dec 2014) BTL2 **Answer : Page : 5.36 – 5.38 - A. Ravikrishnan** **Overgrazing:** Process of, "eating away the forest vegetation without giving it a chance to regenerate" **Agriculture**: An art, science and industry of managing the growth of plants and animals for human use. (1 M) **Effects (or) impacts of overgrazing** **Land degradation** ✓ Overgrazing removes the cover of vegetation over the soil and the exposed soil gets compacted. ✓ So the roots of plant cannot go much deep into the soil and the adequate soil moisture is not available. ✓ Thus, overgrazing leads to organically poor, dry, compacted soil, this cannot be used for further cultivation. (1 M) **Soil erosion** ✓ Due to overgrazing by livestock, the cover of vegetation gets removed from the soil. ✓ The roots of the grass are very good binders of the soil. ✓ The soil becomes loose by the action of wind and rainfall. (1 M) **Loss of useful species** ✓ Overgrazing also affects the composition of plant population and other regeneration capacity. ✓ When livestock grazes the grasses heavily, the root stocks, which carry the food reserve gets destroyed. (1 M) **Traditional agriculture:** ✓ It involves small plot, simple tools, surface water, organic fertilizers and a mix of crops. ✓ They produce enough and a mix of crops. They produce enough food for their families and to sell it for their income **Effects (or) impacts of Traditional agriculture** **Deforestation:** ✓ Cutting and burning of trees in forests to clear the land for cultivation results in loss of forest cover. **Soil erosion:** ✓ Clearing of forest cover exposes the soil to wind and rainfall, resulting in loss of top fertile soil layer. **Loss of nutrients:** ✓ During cutting and burning of trees, organic matter in the soil gets destroyed and most of the nutrients are taken up by the crops within a short period (each 1M)
7	**Explain how the alternate energy sources play an important role in environmental impact. (8 M) (A.U. May 2007)** BTL4 **Answer : Page : 5.63 – 5.64 - A. Ravikrishnan** **Need of Alternate (Renewable) Energy Sources (or) Role of Alternate (Renewable) Energy sources in environmental impact** 1. The importance of solar energy can be emphasized particularly in view of the fact that fossil fuels and other conventional sources are not free from environmental implications. 2. Energy sources which have least pollution, safety and security snags and are universally available have the best enhance of large scale utilization in future.

	3. Hydro-electric power generation is expected to upset the ecological balance existing on earth. 4. Besides space heating, hydroelectric power plants critically pollute the aquatic and terrestrial biota 5. Radioactive pollutants released from nuclear power plants are chronically hazardous. The commissioning of boiling water power reactors (BWRS) have resulted in the critical accumulation of large number of long lived radionuclides in water. 6. The dangerous radio waste cannot be buried in land without the risk of polluting soil and underground water. Nor the waste can be dumped into the rivers without poisoning aquatic life and human beings as well. 7. The burning of coal, oil, wood, dung cakes and petroleum products have well debated environmental problems. The smoke so produced causes respiratory and digestive problems leading to lungs, stomach and eye diseases. 8. The disposal of fly ash requires large ash ponds and may pose a severe problem considering the limited availability of land. So, the non conventional sources of energy needed (8 M)
8	**Discuss the effects of timber extraction, effects of dams on forests and tribal people. (7 M) (A.U. May 2008, Dec 2013)** BTL2 **Answer : Page : 5.11, 5.13 – 5.15 - A. Ravikrishnan** **Consequences (or) effects of timber extraction** 1. Large scale timber extraction causes deforestation. 2. Timber extraction leads to soil erosion, loss of fertility, landslides and loss of biodiversity. 3. Timber extraction also leads to loss of tribal culture and extinction of tribal people. 4. Timber extraction reduces thickness of forest (1M) **Effects of dam on Forest** 1. Thousands of hectares of forest have been cleared for executing river valley projects. 2. In addition to the dam construction, the forest is also cleared for residential accommodation, office buildings, storing materials, laying roads, etc., 3. Hydroelectric projects also have led to widespread loss of forest in recent years. 4. Construction of darns under these projects led to killing of wild animals and destroying aquatic life. 5. Hydroelectric projects provide opportunities for the spread of water borne diseases. **6.** The big river valley projects also cause water logging which leads to salinity and in tum reduces the fertility of the land. (3M) **Effects of dam on tribal people** 1. The greatest social cost of big dam is the widespread displacement of tribal people, such a biodiversity cannot be tolerated. 2. Displacement and cultural change affects the tribal people both mentally and physically. They do not accommodate the modem food habits and life styles. 3. Tribal people are ill-treated by the modem society. 4. Many of the displaced people were not recognized and resettled or compensated. 5. Tribal people and their culture cannot be questioned and destroyed. **6.** Generally, the body conditions of tribal people (lived in forest) will not suit with the new areas and hence they will be affected by many diseases (3 M)
9	**(i) Discuss the problems of fertilizer and pesticide on modern agriculture. (7 M) (A.U. May 2008, Dec 2010)** BTL2

(ii) List the desired qualities of pesticide. (2M) BTL4

(i) Answer : Page : 5.38 – 5.40 - A. Ravikrishnan

Problems in using fertilizer

(a) Micronutrient imbalance

- ✓ Most of the chemical fertilizers, used in modem agriculture, contain nitrogen, phosphorus and potassium (N, P, K), which are macronutrients.
- ✓ When excess of fertilizers are used in the fields, it causes micronutrient imbalance.
- ✓ Examples: Excessive use of fertilizer in Punjab and Haryana has caused deficiency of the micronutrient zinc in the soil, which affects the productivity of the soil. (1M)

(b) Blue Baby syndrome (Nitrate pollution)

- ✓ When Nitrogenous fertilizers are applied in the fields, they leach deep into the soil and contaminate the ground water.
- ✓ The nitrate concentration in the water gets increased.
- ✓ When the nitrate concentration exceeds 25 mg / lit, they cause serious health problem called "Blue Baby syndrome".
- ✓ This disease affects infants and leads even to death. (1M)

(c) Eutrophication.

- ✓ A large proportion of N and P fertilizers, used In crop field is washed off by the runoff water and reaches the water bodies causing over nourishment of the lake. This process is known as Eutrophication.
- ✓ Due to eutrophication lake gets attacked by algal bloom.
- ✓ These algal species use up the nutrients rapidly and grow very fast.
- ✓ Since the time of algal species is less they die quickly and pollute the water, which in turn affect the aquatic life. (1M)

Problems in using pesticides

In order to improve the crop yield, lot of pesticides are used in the agriculture.

(i) First generation pesticides - Sulphur, arsenic, lead or mercury are used to kill the pests.

(ii) Second generation pesticides - DDT (Dichloro Diphenyl Trichloromethane) kill the pests.

Although these pesticides protect our crops from huge losses due to pests, they produce number of side-effects.

i. Death of non-target organisms

- ✓ Some pest species usually survive even after the pesticide spray, which generates highly resistant generations.
- ✓ They are immune to all type of pesticides and are called super pests. (1 M)

i. Producing new pests

- ✓ Some pest species usually survive even after the pesticide spray, which generates highly resistant generations.
- ✓ They are immune to all type of pesticides (1 M)

(c)Bio-magnification

- ✓ Many of the pesticides are non-biodegradable and keep on concentrating in the food chain.
- ✓ This process is called bio-magnification.

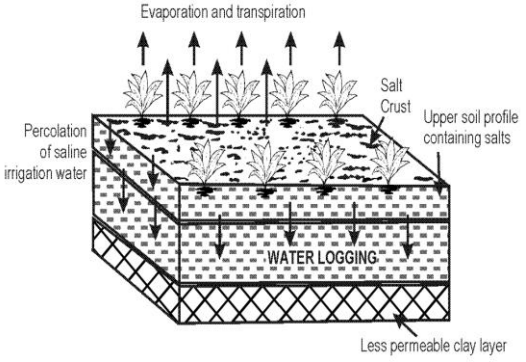
	✓ These pesticides in a bio-magnified form are harmful to the human beings. (1 M) (d)**Risk of cancer** ✓ Pesticides enhance the risks of cancer in two ways. ✓ It directly acts as carcinogens. ✓ It indirectly Suppress the immune system. (1 M) **(ii) Answer : Page : 5.40 - A. Ravikrishnan** **Desired qualities of an ideal pesticide** ✓ An ideal pesticide must kill only the target species. ✓ It must be a biodegradable. ✓ It should not produce new pests. ✓ It should not produce any toxic pesticide vapour. ✓ Excessive synthetic pesticide should not be used. ✓ Chlorinated pesticides and organophosphate pesticides are hazardous, so they should not be used (2 M)
10	**Explain the environmental impacts of mineral extraction (mining) and uses (7 M) (A.U. Dec 2009, Apr 2015)** BTL2 **Answer : Page : 5.29 – 5.31 and 5.24 – 5.26 - A. Ravikrishnan** **Mining:** Mining is the process of extraction of metals from a mineral deposit. **Types of mining** (a) **Surface mining:** Surface mining is the process of extraction of raw materials from the near surface deposits (b) **Underground mining**: The process of extraction of raw materials below the earth's surface. It includes, (c) **Open-pit mining**: Open-pit mining machines dig holes and remove the ores. Example: Iron, copper, limestone, and marble etc **Environmental damage, caused by mining activities** **Devegetation and defacing of landscape:** Topsoil as well as the vegetation are removed from the mining area. Large scale deforestation or devegetation leads to several ecological losses and also landscape gets badly affected**.** (1 M) **Groundwater contamination**: Mining disturbs and also pollutes the ground water. Usually sulphur, present as an impurity in many ores, gets converted into sulphuric acid due to microbial action, which makes the water acidic. Some heavy metals also get leached into groundwater (1 M) **Surface water pollution:** Drainage of acid mines often contaminates the nearby streams and lakes. The acidic water is harmful to many aquatic lives. Radioactive substances like uranium also contaminate the surface water and kill many aquatic animals. (1 M) **Air pollution:** Smelting and roasting are done to purify the metals, which emits enormous amounts of air pollutants damaging the nearby vegetation. The suspended particulate matter (SPM), SOx arsenic particles, cadmium, lead, etc., contaminate the atmosphere and public suffer from several health problems. (1 M) **Subsidence of land:** It is mainly associated with underground mining. Subsidence of mining area results in cracks in houses, tilting of buildings, bending of rail. (1 M) **Effects of over exploitation of Mineral resources** 1. Rapid depletion of mineral deposits. 2. Over exploitation of mineral resources leads to wastage and dissemination of mineral deposits.

	3. Over exploitation of mineral resources causes environmental pollution. 4. Over exploitation needs heavy energy requirement (1 M) **Uses of mining** The extraction of metals and other materials from a mineral deposit by mining has verity of uses. 1. Development of industrial plants and machinery. Examples - Iron, aluminium, copper, etc., 2. Construction, housing, settlements. Example - Iron, aluminium, nickel, etc., 3. Jewellery – Example - Gold, silver, platinum and diamond 4. Generation of energy. Example – Coal, Lignite, Uranium etc 5. Designing of defence equipments, weapons, ornaments **6.** Agriculture purposes, as fertilizers, seed dressings and fungicides. Example Zineb – containing zinc and Maneb - containing manganese. (1 M)
11	**Explain the various food resources. (7 M) (A.U. Apr 2010, Apr 2015, Dec 2010)** BTL2 **Answer : Page : 5.33 – 5.36 - A. Ravikrishnan** **Food Resources** Food is an essential requirement for the human survival. Each person has a minimum food requirement. The main components of food are carbohydrates, fats, proteins, minerals and vitamin (1 M) **Types of Food Supply** Historically humans have dependent on three systems for their food supply. **1. Croplands:** It mostly produces grains and provide about 76% of the world's food. (1 M) Examples: Rice, wheat, maize, barley, sugarcane, potato, etc **2. Rangelands:** It produces food mainly from the grazing livestock and provide about 17% of the world's food. Examples: Meat, milk, fruits, etc., (1 M) **3. Oceans:** Oceanic fisheries supply about 7% of the world's food. Examples: Fish, prawn, crab, etc. (1 M) **Major Food Sources** Earth is provided with more than thousands of edible plants and animals. However only 15 plants and 8 terrestrial animal species supply 90% of our global intake of calories. Examples: Rice, wheat, maize, potato, barley, sugarcane, pulses, fruits, vegetables, milk, meat, fish and sea food. Rice, wheat and maize are the major grains, provide more than 50% of the calories people consume. (2 M) **World food problem** (1 M)
13	**Explain the various conventional (nonrenewable) energy resources. (7 M) (A.U. Dec 2010)** BTL2 **Answer : Page : 5.56 – 5.60 - A. Ravikrishnan** Coal – (1 M), Petroleum – (2 M) LPG - (1 M) Natural gas - (1 M) Nuclear energy - (2 M)
12	**Discuss in detail the over-exploitation of forests. (7 M) (A.U. Dec 2010)** BTL2 **Answer : Page : 5.6 – 5.7 - A. Ravikrishnan** **Over Exploitation of Forest** • Due to overpopulation the materials supplied by the forest like food, medicine, shelter,

	wood and fuel is not sufficient to meet the people's demand. • Hence exploitation of forest materials is going on increasing day by day. • With growing civilization, the demand for raw materials like timber, pulp, minerals, fuel wood, etc., increases resulting in large scale logging, mining, road building and cleaning of forests (3 M) **Reason for over exploitation in India** It has been estimated that in India the minimum area of forests required to maintain good ecological balance is about 33% of total area. But, at present it is only about 22%. So over exploitation of forest materials occur. (2 M) **Causes of over exploitation** (a) Increasing agricultural production. (b) Increasing industrial activities. (c) Increase in demand of wood resources (2 M)
13	**Discuss any four factors responsible for land degradation. (8 M) (A.U. Dec 2010,May 11,Dec 2013, A.U. Dec 2014)** (BTL2 **Answer : Page : 5.69 – 5.70 - A. Ravikrishnan** **Causes of (or factors influencing) land degradation** 1. **Population:** As population increases, more land is needed for producing food, fibre and fuel wood. Hence there is more and more pressure on the limited land resources, which are getting degraded due to over exploitation. (2 M) 2. **Urbanization:** The increased urbanization due to population growth reduce the extent of agricultural land. To compensate the loss of agricultural land, new lands comprising natural ecosystems such as forests are cleared. Thus urbanization leads to deforestation, which intum affects millions of plant and animal species. (2 M) 3. **Fertilizers and pesticides:** Increased applications of fertilizers and pesticides are needed to increase farm output in the new lands, which again leads to pollution of land and water and soil degradation. (1 M) 4. **Damage of top soil:** Increase in food production generally leads to damage of top soil through nutrient depletion. (1 M) 5. Water-logging, soil erosion, salination and contamination of the soil with industrial wastes all cause land degradation. (2 M)
15	**What are the ecological services rendered by forests? Discuss. (7 M) (A.U. Dec 2010)** BTL2 and BTL1 **Answer : Page : 5.2 – 5.5 - A. Ravikrishnan** List the ecological uses of forest (1 M) **Ecological Uses or services rendered by forest** **Production of oxygen:** During photosynthesis trees produce oxygen which is essential for life on earth. (1 M) **Reducing global warming:** The main greenhouse gas carbon dioxide (CO_2) is absorbed by the trees (forests). Trees absorb the main greenhouse gas CO_2 which is a raw material for photosynthesis. Thus the problem of global warming, caused by greenhouse gas CO_2, is reduced. (1 M) **Soil conservation:** Roots of trees (forests) bind the soil tightly and prevent soil erosion. They also act as wind breaks. (1 M) **Regulation of hydrological cycle:** Watersheds in forest act like giant sponges, which absorb rainfall, slow down the runoff and slowly release the water for recharge of springs. (1 M)

	Pollution moderators: Forests can absorb many toxic gases and noises and help in preventing air and noise pollution. (1 M) **Wildlife habitat:** Forests are the homes of millions of wild animals and plants. (1 M)
16.	**What is land degradation? Explain the causes and effects land (soil) degradation. (7 M) (AU A.U. Dec 2010,May 11,Dec 2013, A.U. Dec 2014)** BTL2 **Answer : Page : 5.69 – 5.70 - A. Ravikrishnan** **Land degradation:** The process of deterioration of soil or loss of fertility of the soil (1 M) **Causes of land degradation (or) factors responsible for land degradation** **1. Population:** ✓ As population increases, more land is needed for producing food, fibre and fuel wood. ✓ Hence there is more and more pressure on the limited land resources, which are getting degraded due to over exploitation. (1M) **2. Urbanization:** ✓ The increased urbanization due to population growth reduce the extent of agricultural land. To compensate the loss of agricultural land, new lands comprising natural ecosystems such as forests are cleared. ✓ Thus urbanization leads to deforestation, which in turn affects millions of plant and animal species. (1M) 3. **Fertilizers and pesticides:** ✓ Increased applications of fertilizers and pesticides are needed to increase farm output in the new lands, which again leads to pollution of land and water and soil degradation. (1M) **4. Damage of top soil:** ✓ Increase in food production generally leads to damage of top soil through nutrient depletion. (1M) 5. Water-logging, soil erosion, salination and contamination of the soil with industrial wastes all cause land degradation (1M) **Harmful effects of land (soil) degradation** ✓ The soil texture and structure are deteriorated. ✓ Loss of soil fertility, due to loss of invaluable nutrients. ✓ Increase in water logging, salinity, alkalinity and acidity problems. ✓ Loss of economic social and biodiversity. (1 M)
17.	**What is desertification? Describe the causes and effects of desertification. (7 M) (AU May 2015, Dec. 2016)** BTL2 **Answer : Page : 5.74 – 5.75 - A. Ravikrishnan** **Desertification:** A progressive destruction or degradation of arid or semiarid lands to desert (1M) **Causes of desertification (or) reason for desertification** **1. Deforestation:** ✓ The process of denuding and degrading a forest land initiates a desert. ✓ If there is no vegetation to hold back the rain water, soil cannot soak and groundwater level do not increases. ✓ This also increases, soil erosion, loss of fertility. **2. Over grazing:** ✓ The increase in cattle population heavily graze the grass land or forests and as a

	result denude the land area. ✓ The denuded land becomes dry, loose and more prone to soil erosion and leads to desert. **3. <u>Water Management:</u>** ✓ Over utilization of groundwater, particularly in coastal regions, resulting in saline water intrusion into aquifers, which is unfit for irrigation. **4. <u>Mining and quarrying :</u>** ✓ These activities are also responsible for loss of vegetal cover and denudation of extensive land area leading to desertification. **5. <u>Climate change:</u>** ✓ Formation of deserts may also take place due to climate change, ie., failure of monsoon, frequent droughts. 6. **<u>Pollution:</u>** ✓ Excessive use of fertilizers and pesticides and disposal of toxic water into the land also leads to desertification (Each 1 M; any 5 = 5 M) **<u>Harmful effects of desertification</u>** ✓ Around 80% of the productive land in the arid and semi-arid regions are converted into desert. ✓ Around 600 million people are threatened by desertification. (1 M)
18.	**Describe the following effects and their remedies on modern agriculture. (a) Water logging (b) Salinity. (7 M)** BTL2 **(a) Answer : Page : 5.40 - A. Ravikrishnan** **<u>Water logging:</u>** The land where water stand for most of the year. **<u>Causes of water logging</u>** ✓ Excessive water supply to the croplands. ✓ Heavy rain. ✓ Poor drainage. (1 M) **<u>Problems (or) Effects in water logging</u>** ✓ During water-logged conditions, pore-voids in the soil get filled with' water and the soil-air gets depleted. ✓ In such a condition the roots of the plants do not get adequate air for respiration. So, mechanical strength of the soil decreases and crop yield falls. (1 M) **<u>Remedy for water logging</u>** ✓ Preventing excessive irrigation, sub surface draining technology and bio-drainage by trees like Eucalyptus tree are some method of preventing water logging. (1 M) **(b) Answer : Refer page : 5.41 - A. Ravikrishnan** **<u>Salinity:</u>** The water, not absorbed by the soil, undergo evaporation leaving behind a thin layer of dissolved salts in the topsoil**.** This process of accumulation of salts is called the salinity. (1 M) **<u>Problems in Salinity</u>** ✓ Most of the water, used for irrigation comes only from canal or ground, which unlike rainwater contains dissolved salts. Under dry climates, the water gets evaporated leaving behind the salt in the upper portion of the soil. ✓ Due to salinity, the soil becomes alkaline and crop yield decreases. (1 M)



(1M)

Remedy for salinity

- ✓ The salt deposit is removed by flushing them out by applying more good quality water to such soils.
- ✓ Using sub-surface drainage system the salt water is flushed out slowly (1 M)

PART – C QUESTIONS

1

Discuss the world food problems in detail and how does it affects other resources. (15 M) (A.U. May2011) BTL4

Answer : Page : 5.34 – 5.42 - A. Ravikrishnan

World Food problems

1. We know that 79% of the total area of the earth is covered with water. Only 21% of the earth surface is land, of which most of the areas are forest, desert, mountains, barren areas, only less percentage of the land is cultivated. So the food supplied from the rest of the land is not enough to feed all the people. The problem of population explosion has made it worse. The world population increases and cultivable land area decreases. Therefore world food problem arises.
2. Environmental degradation like soil erosion, water logging, water pollution, salinity, affect agricultural lands.
3. Urbanisation is another problem in developing countries, which deteriorates the agricultural lands.
4. Since the food grains like rice, wheat, com and the vegetable like potato are the major food for the people all over the world, the food problem raises.
5. A key problem is the human activity, which degrade most of the earth's net primary productivity which supports all life (5 M)

Effects (or) impacts of overgrazing

1. Land degradation 2. Soil erosion 3. Loss of useful species (3 M)

Effects (or) impacts of agriculture

Effects (or) impacts of Traditional agriculture

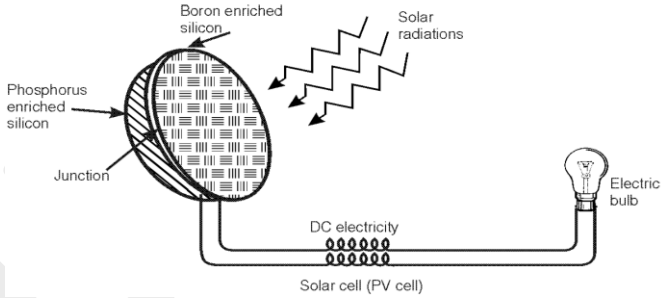
a. Deforestation: Cutting and burning of trees in forests to clear the land for cultivation results in loss of forest cover.

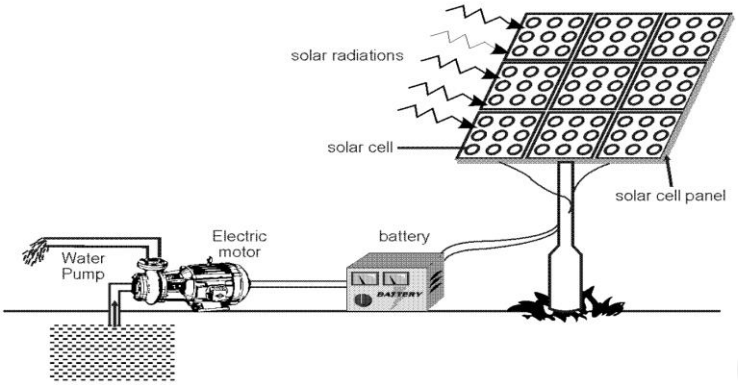
b. Soil erosion: Clearing of forest cover exposes the soil to wind and rainfall, resulting in loss of top fertile soil layer.

c. Loss of nutrients: During cutting and burning of trees, organic matter in the soil gets destroyed and most of the nutrients are taken up by the crops within a short period (2 M)

Effects (or) impacts of modern agriculture (or) adverse effects of agricultural practices (or) Environmental effects of agriculture

(a) Micronutrient imbalance

	(b) Blue Baby syndrome (Nitrate pollution) (c) Eutrophication. d) Water logging e) Salinity (5 M)
2	**What are the natural resources availability in India and discuss any two of them. (15 M) (A.U. May2011)** BTL4 List the natural resources available in India (5M) Any two natural resources available in India (Each 5M)
3.	(i) **Relate the role-play of Environmental Issues in the modern world. (5 M) (ii) Generalize the different methods to propagate environmental awareness. (10 M)** BTL6 **Answer: Page: 5.76 - A. Ravikrishnan** The role-play of environmental issues (5M) Different methods to propagate environmental awareness (10M)
4.	**Discuss the different types of renewable energy resources.(15 M) (A.U. June 2006)** BTL2 **Answer : Page : 5.43 – 5.58 - A. Ravikrishnan** **Renewable energy resources (or) Non-Conventional energy resources** Natural resources which can be regenerated continuously and are inexhaustible. They can be used again and again in an endless manner. Examples: Solar energy, wind energy, tidal energy, etc. (1M) **Renewable energy resources (or) Non-Conventional energy resources** 1. **Solar energy -** The energy that we get directly from the sun is called solar energy. The nuclear fusion reactions occurring inside the sun release enormous amount of energy in the form of heat and light. • **Solar cells** **1. Solar cells (or) photovoltaic cells (or) PV cells**  When solar energy falls on the P-type semiconductor, the electrons in the conduction band transferred to conduction band so that a potential difference is developed across the PN junction. Therefore a current is flowing across the junction. (2M) • **Solar battery** When solar cells are connected in series, a solar battery is formed. Using solar battery we can run electrical machines such as pump, fan, etc.



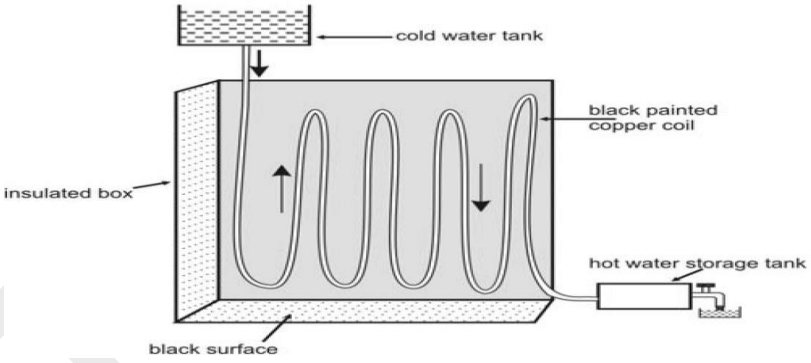
(2 M)

- **Solar Heat Collectors**

Solar heat collectors consist of natural materials like stones, bricks (or) materials like glass, which can absorb heat during the day time and release it slowly at night. (1M)

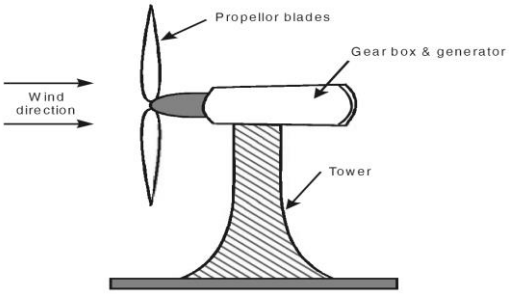
- **Solar water heater**

It consists of an insulated box inside of which is painted with black paint. It is also provided with a glass lid to receive and store solar heat. Inside the box it has black painted copper coil, through which cold water is allowed to flow in, wl1ich gets heated up and flows out into a storage tank. From the storage tank water is then supplied through pipes.



(2M)

2. **Wind energy :** Energy recovered from the force of wind (moving air) is wind energy
   - **Wind mill:** When fast moving air strikes the wind mill blades, it starts to rotate. This rotational motion of the blades derives a number of machines like water pumps, flour mills and electric generators.



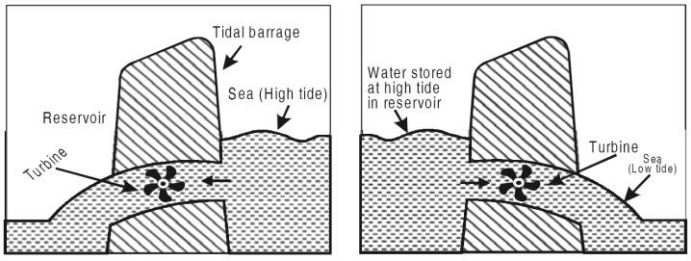
   - **Wind Farms.**

   When a large number of wind mills are installed and joined together in a definite pattern ir forms a wind farm. The wind farms, produce a large amount of electricity (2M)

3. **Ocean energy**

Ocean can also be used for generating energy of the following ways.

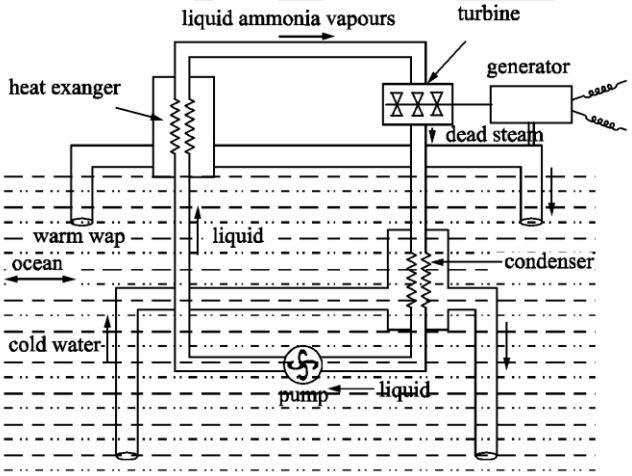
- **Tidal energy (or) Tidal power**
  - ✓ Ocean tides, produced by gravitational forces of sun and moon, contain enormous amount of energy.
  - ✓ The 'high tide' and 'low tide' refer to the rise and fall of water in the oceans.
  - ✓ The tidal energy can be harnessed by constructing a tidal barrage.
  - ✓ During high tide, the sea-water is allowed to flow into the reservoir of the barrage and rotates the turbine, which in turn produces electricity by rotating the generators.
  - ✓ During low tide, when the sea level is low, the sea water stored in the barrage reservoir is allowed to flow into the sea and again rotates the turbine.



(2M)

4. Ocean thermal energy (OTE)

Energy available due to the difference in temperature of water known as ocean thermal energy.



Warm surface water boils the liquid ammonia, thus high pressure steam is produced. This steam rotates the turbine which in turn produces electricity by a generator.

Dead steam passing through condenser condensed by the cold water at deep ocean. This liquid again pumped upwards using a pump. This process is repeated to produce the electricity using OTE. (3 M)

5. **Discuss the different types of nonrenewable energy resources.(15 M) (A.U. June 2006)** BTL2

Answer : Page : 5.43 – 5.58 - A. Ravikrishnan

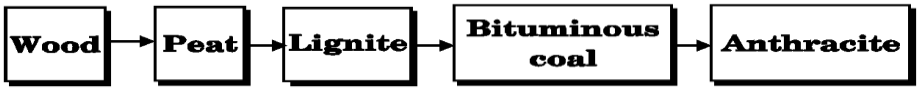
Non-renewable (Conventional) energy resources: Energy resources are natural resources, which cannot be regenerated once they are exhausted. They cannot be used again. Examples: Coal, petroleum, natural gas and nuclear fuels. (1M)

Non-renewable energy resources (or) Conventional energy resources

1. Coal

Coal is a fossil fuel formed as several stages as buried remains of land plants that lived 300-400 million years ago.

Various stages of coal formation



(1M)

The carbon content of Anthracite is 90% and its calorific value is 8700 k.cal. The carbon content of bituminous, lignite and peat are 80, 70 and 60% respectively.

Disadvantages of coal

- ✓ When coal is burnt it produces CO_2, causes global warming.
- ✓ Since it contains S, N, O, produces toxic gases during burning (1M)

2. Petroleum

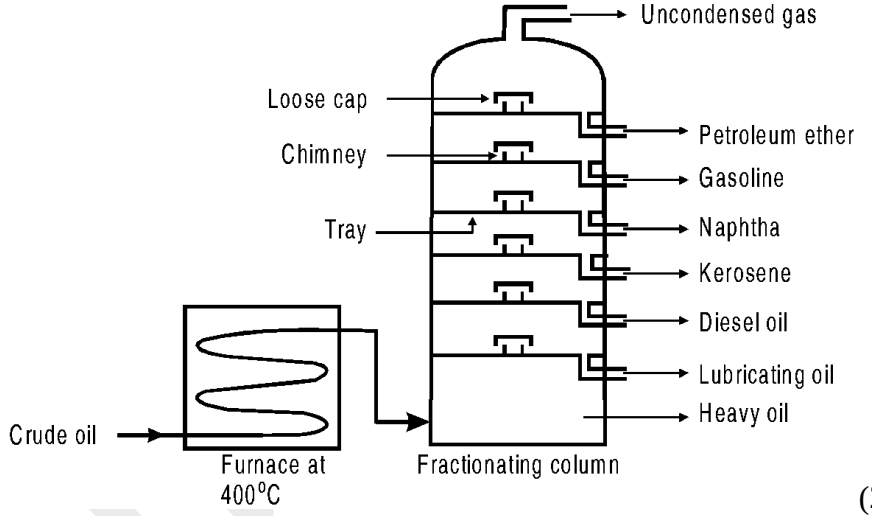
Petroleum or crude oil is a thick liquid contains more than hundreds of hydrocarbons with small amount of S, N, O as impurities.

Occurrence of petroleum

Petroleum or Coal is formed by decomposition of dead animals and plants that were buried under lake and ocean at high temperature and pressure for millions of years. (1M)

Fractional distillation of petroleum

From petroleum various hydrocarbons are separated by purifying and fractionating using fractionating coloumn. (Fig.)



(2 M)

3. LPG

- ✓ Petroleum gas, obtained during cracking and fractional distillation, can be easily converted into liquid under high pressure as LPG.
- ✓ LPG is colourless and odourless gas.
- ✓ But during bottling some mercaptans is added, which produces bad odour, thereby any leakage of LPG from the cylinder can be detected instantaneously. (1M)

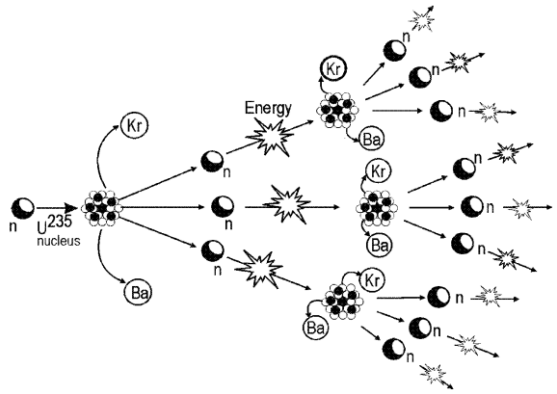
4. Natural gas

- ✓ Natural gas is found above the oil in oil well.
- ✓ It is a mixture of 50-90% methane and small amount of other hydrocarbons.
- ✓ Its calorific value ranges from 12,000-14,000 k . cal/m3 (1M)

5. Nuclear energy

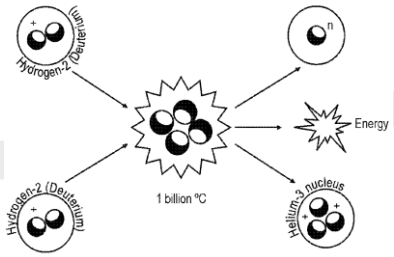
Energy released by nuclear fission or nuclear fusion.

Nuclear Fission: When a heavier nucleus split up in to two lighter nucli by bombardment of a fast moving neutron releases neutrons and tremendous energy.



(1 M)

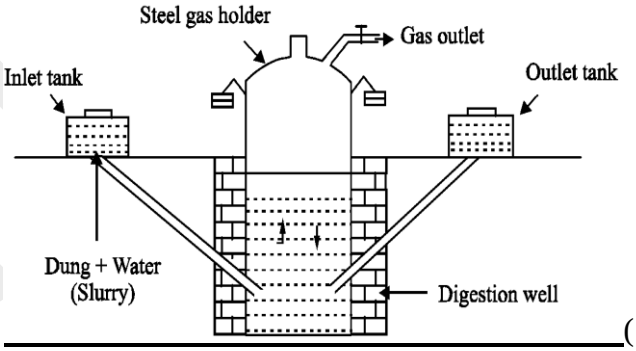
Nuclear Fusion: When two lighter nuclei combined together to form a heavier nucleus at very high temperature releases tremendous energy and neutrons.



Nuclear reactions are effectively used in nuclear power plants. (1M)

6. **Bio gas or Gobar Gas:** Mixture of various gases formed by anaerobic degradation of biological matter in the absence of oxygen. (1 M)

Production of bio gas



(1M)

Bio-gas plant or Gobar gas plant consists of a well like under ground tank (called digester) covered with dome shaped roof with a gas out let pipe. The dome of the digester acts as gas holder. On the left hand side of the digester there is a sloping inlet chamber through which cattle dung + water slurry is introduced. On the right hand side, there is a outlet chamber, through which spent dung slurry gets collected. (1M)

Working

	✓ Slurry (animal dung + water) is fed into the digester through the inlet chamber. The slurry, in the digester, is left for about two months for fermentation. ✓ Anaerobic micro-organisms are responsible for this action. As a result of anaerobic fermentation, bio-gas is collected in the dome. ✓ When sufficient amount of bio-gas is collected in the dome, it exerts a large pressure on the slurry and this in turn forces the spent slurry to the over flow tank through the outlet chamber. (1M) **Uses of Bio Gas** 1. Bio-gas is used for cooking food and heating water. 2. It is used to run engines. 3. It is also used as an illuminant in villages. 4. It is used for running tube-well and water pump-set engines. 5. It is directly used in gas turbines and fuel cells for producing electricity. (1M)
5.	**Discuss the following case studies on** **(a) Deforestation (2 M)** **(b) Mining (8 M)** **(c) Food resources (3 M)** **(d) Renewable and Non-renewable energy resources (2 M)** BTL4 **Answer : Page : 5.10, 5.31, 5.42, 5.64 - A. Ravikrishnan** **(a)** Deforestation (2 M) (b) Mining (8 M) (c) Food resources (3 M) (d) Renewable and Non-renewable energy resources (2 M)

UNIT - IV SOCIAL ISSUES AND THE ENVIRONMENT	
From Unsustainable to Sustainable Development – Urban Problems Related to Energy – Water Conservation, Rain Water Harvesting, Watershed Management – Resettlement and Rehabilitation of People; its Problems and Concerns, Case Studies – Role of Non-Governmental Organization- Environmental Ethics: Issues and Possible Solutions – Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies. – Wasteland Reclamation – Consumerism and Waste Products – Environment Production Act– Air (Prevention And Control Of Pollution) Act – Water (Prevention And Control Of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Enforcement Machinery Involved in Environmental Legislation- Central and State Pollution Control Boards- Public Awareness.	
Q. No.	**PART – A**
1	**Define the term sustainable development. (NOV/DEC 2005, NOV/DEC 2007, NOV/DEC 2009, APR/MAY 2011)** BTL1 Sustainable development is defined as, "meeting the needs of the present without compromising the ability of future generations to meet their own needs".
2	**What are the advantages of rain water harvesting? (MAY/JUNE 2008)** BTL1 Reduction in the use of current for pumping water. • Mitigating the effects of droughts and achieving drought proofing. • Increasing the availability of water from well. • Rise in ground water levels. • Minimizing the soil erosion and flood hazards. • Upgrading the social and environmental status. • Future generation is assured of water.
3	**List the objectives of watershed management. (NOV/DEC 2009)** BTL4 • To minimize the risks, of floods, drought and landslides. • To develop rural areas in the region with clear plan for improving the economy of the region. • To manage the watershed for developmental activities like domestic water supply, irrigation, hydropower generation etc., • To generate huge employment opportunities in the backward rain- fed areas to ensure livelihood security. • 5. To promote social forestry and horticultural activity on all suitable areas of land.
4.	**Define the term environmental ethics. (NOV/DEC 2011, NOV/DEC 2013)** BTL1 Environmental ethics refers to the issues, principles and guidelines relating to human interactions with their environment.
5.	**State a few drawbacks of pollution related acts. (NOV/DEC 2008)** BTL1 • The penalties in the act are very small when compared to the damage caused by the big industries due to pollution. • A person cannot directly file a petition in the court. • Litigation, related to environment is expensive, since it involves technical Knowledge.

	• For small unit it is very expensive to install Effluent Treatment – Plant • The position of chairman of the boards is occupied by political appointee. Hence it is difficult to implement the act without political interference.
6.	**What is meant by ISO 14000? (NOV/DEC 2008)** BTL1 ISO 14000 is the environmental management standards which exist to help Organizations minimize how their operations negatively affect the environment and Comply with applicable laws and regulations.
7	**What are the objectives of public awareness?** BTL1 • To create awareness among people of rural and city about ecological imbalances, local environment, technological development and various development plants. • To organize meetings, group discussion on development, tree plantation programmers, exhibitions. • To focus on current environment problems and situations • To train our planners, decision – makers, politicians and administrators. • To eliminate poverty by providing employment that overcome the basic environmental issues. • To learn to live simple and eco-friendly manner
8.	**What are the objectives of environmental impact assessment (EIA)?** BTL1 EIA is defined as a formal process of predicting the environmental consequences of any Development projects. It is used to identify the environmental, social and economic impacts of the Project prior to decision making. Objectives of EIA • To identify the main issues and problem of the parties. • To identify who is the party. • To identify what are the problems of the parties. • To identify why the problems are arise.
9.	**Define urbanization. (NOV/DEC 2010)** BTL1 Urbanization is the movement of human population from rural area to urban area for the want of better education, communication, health and employment.
10	**How can global warming be controlled? (NOV/DEC 2010, APR/MAY 2011)** BTL2 • By reducing the use of fossil fuels. • Utilize renewable resources such as wind, solar and hydropower. • Plant more trees. • Stabilize population growth. • Remove atmospheric CO_2 by utilizing photo synthetic algae.
11	**Mention any four fundamental rights of the individual. (NOV/DEC 2010)** BTL1 • Human right to freedom. • Human right to property. • Human right to religion. • Human right to culture and education. • Human right to equality.
12.	**What is E-Waste? (NOV/DEC 2011)** BTL2 The waste of electronic equipment like computers, printers and mobile phones, Xerox machines, calculators, etc. are e-waste.

13.	**What do we mean by environment refugees? (NOV/DEC 2011)** BTL2 Environmental refugee is a person displaced due to environment causes, especially land loss, and degradation and natural disaster.
14.	**List the objectives of Forest Conservation act. (NOV/DEC 2013)** BTL1 • To protect and conserve the forest • To ensure judicious use of forest
15.	**What are the objectives of water act? (NOV/DEC 2014)** BTL1 • Prevention and control of water pollution. • Maintaining or restoring the wholesomeness of water. • Establishing central and state boards for the prevention and control of water pollution.
16	**Define consumerism and disaster. (NOV/DEC 2015)** BTL2 Consumerism refers to the interrelationship between sellers and buyer. Disaster is a geological process and is defined as an event concentrated in time and space, in which a society or sub-division of a society undergoes severe danger and causes loss of its members and physical property.
17	**What are landslides? (MAY/JUNE 2008, NV/DEC 2014)** BTL2 The movement of earthy materials like coherent rock, mud, soil and debris from higher region to lower region due to gravitational pull is called landslides.
18	**What are the harmful effects of landslides?** BTL2 • Landslides block the roads and diverts the passage • Erosion of soil increases. • Sudden landslides damage the houses, crop yield, live stock etc.
19.	**Define the term Tsunami.** BTL2 A tsunami is a large wave that is generated in a water body when the sea floor is deformed by seismic activity. This activity displaces the overlying water in the ocean.
20	**Give comprehensive definition for air pollution. (NOV/DEC 2010, APR/MAY 2011)** BTL2 The presences of one are more contaminants like dust, smoke, mist and dour in the atmosphere, which are injurious to human beings, plants and animal.
21	**Mention four causes of floods. (NOV/DEC 2010)** BTL2 • Heavy rain, rainfall during cyclone causes flood. • Sudden snow melt also raises the quantity of water in streams and causes flood. • Clearing of forests for agriculture has also increased severity of floods. • Reduction in the carrying capacity of the channel, due to accumulation of Sediments cause floods.
22	**List the objectives of Forest Conservation Act. (NOV/DEC 2013)** BTL1 • Illegal non-forest activity within a forest area can be immediately stopped under this act. • Provides conservation of all types of forests. Non forest activities include clearing of forest land for cultivation of any types of crops.
23	**What are the important aspects of sustainable development?** BTL2 • Inter – generational equity It states that we should hand over a safe, healthy and resourceful environment to our future generations.

	• Intra – generational equity It states that the technological development of rich countries should support the economic growth of the poor countries and help in narrowing the wealth gap and lead to sustainability
24	**Explain the need for water conservation.** BTL2 • Though the resources of water are more, the quality and reliability are not high due to changes in environmental factors. • Better lifestyles require more fresh water. • As the population increases, the requirement of water is also more. • Due to deforestation, the annual rainfall is also decreasing. • Over exploitation of ground water, lead to drought. • Agricultural and industrial activities require more fresh water.
25	**Define the term environmental ethics. (NOV/DEC 2011, NOV/DEC 2013)** BTL2 "Environmental ethics refers to the issues, principles and guidelines relating to human interactions with their environment".
26	**What is meant by environmental audit? (NOV/DEC 2008)** BTL2 Environmental audits are intended to quantify environmental performance and Environmental position. In this way they perform analogous function to financial Audits. It also aims to define what needs to be done to improve on indicators of such Performance and position.
27.	**What is consumerism? List any two objectives of consumerism.** BTL1 The consumption of resources by the people is known as consumerism. Objectives It improves the rights and powers of the buyer It forces the manufacturer to reuse and recycle the product after usage.
28.	**What is Eco-mark?** BTL1 Environmentally friendly products are generally indicated by the symbol called Eco-mark. Eco-mark is a certification mark issued by the Bureau of Indian Standard (BIS) to the environmental friendly products.
	PART – B
1	**What are the salient features of the Air pollution act, Water pollution act and Environment protection Act? Give the reason for why do we prefer environmental protection act as an Umbrella act. (13 M) (MAY/JUNE 2005, NOV/DEC 2005, JAN 2006, NOV/DEC 2006, NOV/JUNE 2007, NOV/DEC 2009, NOV/DEC 2010, MAY/JUNE 2011, NOV/DEC 2013, DEC 2014)** BTL4 **Answer : Refer : 6.34 – 6.38 - A. Ravikrishnan** • Objectives and features of environment protection act (5 M) • Objectives and features of air pollution act (4 M) • Objectives and features of water pollution act (4 M)
2	**Explain in detail the strategies adopted for conservation of water. (6 M) (NOV/DEC 2009, APR/MAY 2010, NOV/DEC 2010, APR/MAY 2011, NOV/DEC 2014)** BTL2 **Answer : Refer : 6.7 – 6.8 - A. Ravikrishnan** • Reducing evaporation loss (1 M) • Reducing irrigation loss (1 M) • Re-use of water (1 M) • Preventing wastage of water (1 M) • Decreasing run-off losses (1 M)

	• Avoid discharge of sewage (1 M)
3	**Discuss in detail about Wild life protection act 1972 and Forest conservation act 1980. (13 M) (NOV/DEC 2010, NOV/DEC 2014)** BTL4 **Answer : Refer : 6.38 – 6.40 - A. Ravikrishnan** • Objectives of Wildlife protection act (2 M) • features of wildlife protection act (4 M) • Objectives of Forest conservation act (2 M) • Features of Forest conservation act (5 M)
4	**Explain the following** **(a) Sustainable development (6 M)** BTL2 **(b) Urban problems related to energy. (7 M) (NOV/DEC 2005, NOV/DEC 2006, MAY/JUNE 2007, NOV/DEC 2010, NOV/DEC 2011, MAY/JUNE 2013)** BTL2 **i. Answer : Refer : 6.21 – 6.6 - A. Ravikrishnan** Sustainable development : • World summit (Agenda) (2 M) • Aspects (2 M) • Concept and significance (2 M) **ii. Answer : Refer : 6.21 – 6.6 - A. Ravikrishnan** Urban problems related to energy : • Definition of urbanization (2 M) Urbanization is the movement of human population from rural areas to urban areas for the want of better education, communication, health, employment, etc. • Energy demanding activities (3 M) • Solution for urban energy problem (2 M)
5	**Discuss the phenomenon of global warming and the factors contributing to it. (13 M)** BTL4 • Explanation of phenomenon of global warming (7 M) • Contributing factors (6 M)
6	**Give a note on nuclear accidents and holocausts. (6 +7 M) (MAY/JUNE 2013, NOV/DEC 2013)** BTL4 **Answer : Refer : 6.24 – 6.26 - A. Ravikrishnan** • Nuclear energy and nuclear accidents (2 M) • Types of nuclear accidents (4 M) • Effect of nuclear holocaust (4 M) • Control measures of holocausts (3 M)
7.	**State the 12 principles of green chemistry. (7 M)** BTL1 **Answer : Refer : - A. Ravikrishnan** • **Prevention.** It is better to prevent waste than to treat or clean up waste after it is formed. • **Atom Economy.** Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product. • **Less Hazardous Chemical Synthesis.** Whenever practicable, synthetic methodologies should be designed to use and generate substances that possess little or no toxicity to human health and the environment. • **Designing Safer Chemicals**. Chemical products should be designed to preserve

efficacy of the function while reducing toxicity.

- **Safer Solvents and Auxiliaries**. The use of auxiliary substances (solvents, separation agents, etc.) should be made unnecessary whenever possible and, when used, innocuous.
- **Design for Energy Efficiency.** Energy requirements should be recognized for their environmental and economic impacts and should be minimized. Synthetic methods should be conducted at ambient temperature and pressure
- **Use of Renewable Feed stocks.** A raw material or feedstock should be renewable rather than depleting whenever technically and economically practical.
- **Reduce Derivatives.** Unnecessary derivatization (blocking group, protection/deprotection, temporary modification of physical/chemical processes) should be avoided whenever possible .
- **Catalysis**. Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.
- **Design for Degradation**. Chemical products should be designed so that at the end of their function they do not persist in the environment and instead break down into innocuous degradation products.
- **Real-time Analysis for Pollution Prevention**. Analytical methodologies need to be further developed to allow for real-time in-process monitoring and control prior to the formation of hazardous substances.
- **Inherently Safer Chemistry for Accident Prevention**. Substance and the form of a substance used in a chemical process should be chosen so as to minimize the potential for chemical accidents, including releases, explosions, and fires (7 M)

8.

What is rain water harvesting? What are the purposes survived by it? (7 M) BTL2

Answer : Refer : 6.8 - A. Ravikrishnan

Rain water harvesting : A technique of capturing and storing of rain water for further utilization (1 M)

Objective:

- To meet increasing demands of water
- Raise water table by recharging ground water
- Reduce ground water contamination from salt water intrusion
- To reduce the surface run-off losses
- To reduce storm water and soil erosion
- To increase hydrostatic pressure to stop land subsidence
- To reduce water crises and water conflicts (1 M)

Roof top rainwater harvesting

- Involves collecting water that falls on roof of house
- Rainwater from roof top, road surface, playground diverted to surface tank. Explanation (2 M)
- Diagram (2 M)

Advantages of rainwater harvesting

- Increases the well water availability § Raise ground water level
- Minimizes soil erosion and flood hazards
- Upgrading the environmental and social status
- Reduction in the use of current for pupping water

	• Future generation is assured for water (1 M)
9.	**What is wasteland? Mention its types and sources. Explain the objectives and methods of wasteland reclamation. (7 M)** BTL2 **Answer : Refer : 6.28 - A. Ravikrishnan** The land which is not in use is named as wasteland. Types: 1. Uncultivable wasteland 2. Cultivatable wasteland (1 M) Causes of wasteland (1 M) Objectives of wasteland reclamation (1 M) Methods of wasteland reclamation (4 M)
10.	**List the traditional rights of seller and buyer. Describe the objectives of consumerism and factors affecting consumerism. (7 M)** BTL2 **Answer : Refer : 6.31 - A. Ravikrishnan** Traditionally favourable rights of seller (1 M) Traditional buyer rights (1 M) Objectives of consumerism (3 M) Factors affecting comsumerism (2 M)
11.	**What is biomedical waste? Describe types and the various steps involved in management of biomedical waste. (7 M)** BTL2 **Answer : Refer : 6.41 - A. Ravikrishnan** Waste generated from health care activities. (1 M) Types of biomedical waste (3 M) Three steps involved in management of biomedical waste (3 M)
12.	**Define watershed and watershed management? Explain the concept of watershed management in detail. (13 M)** BTL2 **Answer : Refer : 6.11 - A. Ravikrishnan** Watershed – The land area from which water drains under the influence of gravity into a stream, lake, reservoir or other body of surface water, (1 M) Watershed management – The management of rainfall and resultant runoff is called watershed management. (1 M) Factors affecting watershed management (1 M) Objectives of watershed management (2 M) Watershed management techniques (2 M) Components of integrated watershed management (6 M)
	PART–C
1	**What is an earthquake? Write about its causes, effects and measures to face the earthquake. (15 M) (APR/MAY 2008, NOV/DEC 2008, NOV/DEC 13, NOV/DEC 2014)** BTL4 **Answer : Refer : 6.58 – 5.58 - A. Ravikrishnan** • Definition: An earthquake is a sudden vibration caused on the earth's surface due to the sudden release of tremendous amount of energy stored in the rocks under the earth's crust. (2 M) • Causes (4 M) • Effects (4 M) • Preventive measures (5 M)
2	**Give a note on**

	(d) Floods **(e) Cyclone** **(f) Landslides** **(15 M)** BTL2 **Answer : Refer : 6.52 – 6.57 - A. Ravikrishnan** • Definition of flood: Whenever the magnitude of water flow exceeds the carrying capacity of the channel within its banks, the excess of water over flows on the surroundings causes floods (1 M) • Causes and effects (2 M) • Preventive measures of floods (2 M) • Definition: Cyclone is a meteorological phenomenon, intense depressions forming over the open oceans and moving towards the land. On reaching the shores, it move into the interior of the land or along the shore lines. (1 M) • Causes and effects (2 M) • Preventive measures of cyclone (2 M) • Definition: The movement of earthy materials like coherent rock, mud, soil and debris from higher region to lower region due to gravitational pull is called landslides. (1 M) • Causes and effects (2 M) • Preventive measures of landslides (2 M)

UNIT V HUMAN POPULATION AND THE ENVIRONMENT

Population Growth, Variation Among Nations – Population Explosion – Family Welfare Programme – Environment and Human Health – Human Rights – Value Education – HIV / AIDS – Women and Child Welfare – Role of Information Technology in Environment and Human Health – Case Studies.

Q. No.	PART-A
1.	**Define immigration and emigration. (Coim A.U. Dec 2009)** BTL1 **Immigration -** Arrival of individuals from neighbouring population. **Emigration -** Dispersal of individuals from the original population to new areas
2.	**Define population and population density. (Coim A.U. Dec 2009, Chen A.U. Apr 2011)** BTL1 **Population**-Group of Individuals belonging to the same species, which live in a given area at a given time. **Population density**-Number of individuals of the population per unit area (or) unit volume
3.	**Define birth rate and death rate.** BTL1 **Birth rate or Natality**-No. of live birth per 1000 people in a population in a given year **Death rate or Mortality**-No. of deaths per 1000 people in a population in a given year
4.	**Define doubling time with reference in population growth. (Chen A.U. Dec 2008, 2013)** BTL1 Time required for a population to double its size at a constant annual rate. $Doubling\ time = Td = \frac{70}{r}$ Where, r - Annual growth rate. If a nation has 2% annual growth; its population will double in the next 35 year.
5.	**What are the reasons behind the increased population growth in the less developed nations compared with developed nations? (Chen AU Dec 2007)** BTL1 • Due to decrease in the death rate and increase in the birth rate • The availability of antibodies, immunization, increased food production, clean water and air decreases the famine-related deaths and infant mortality. • In agricultural based countries, children are required to help parents in the fields.

6.	**Write population equation. (Coim. A.U. Dec 2008)** BTL1 $Pt + 1 = Pt + (B - D) + (I - E)$ Where Pt and Pt+1 = sizes of population in an area at two different point s in time t and t+1; B-Birth rate I-Immigration; D-Death Rate; E-Emigration.
7.	**List the characteristics of population growth.** BTL4 • Exponential growth • Doubling time • Infant mortality rate • Total fertility rates (TFR) • Replacement level • Male-Female Ratio • Demographic transition
8.	**Mention the various problems of population growth.** BTL4 • Increasing demands for food and natural resources • Inadequate housings and health services • Loss of agricultural lands • Unemployment and socio-political unrest • Environmental pollution
9.	**What is population explosion? (Chen AU Jun 2007, May 2008, TCY A.U. Dec 2008, Dec 2009, Dec2010, Apr 2015)** BTL1 The enormous increase in population due to low death rate and high birth rate.
10.	**What are the effects of population explosion? (Chen A.U. Dec 2009)** BTL1 • Poverty • Environmental degradation • Over exploitation of natural resources • Renewable resources like forests, grass lands are also under threat • Will increase disease, economic inequity and communal war • Leads to development of slums • Lack of basic amenities like water supply and sanitation, education, health, etc • Unemployment and low living standard of people
11.	**How the age structure of population can be classified?** BTL4 • Pre-productive population (0-14 years) • Reproductive population (15-44 years) • Post reproductive population (Above 45 years)
12.	**State the reasons of population explosion.** BTL1 • Invention of modern medical facilities; Illiteracy • Decrease in death rate and increase in birth rate • Availability of antibiotics, Food, clean water, air, etc. • Decreases the famine-related deaths and infant mortality • In agricultural based countries- Children are required
13.	**What is family welfare programme?** BTL1 Programme implemented by the government of India. An integral part of overall national policy of growth covering human health, maternity, family welfare, child care and women's right, education, nutrition, health, employment, shelter, safe drinking water

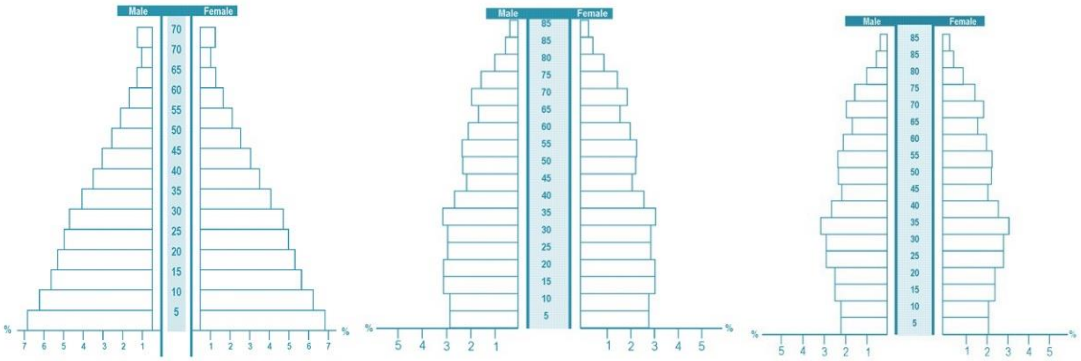
14.	**Define population stabilization ratio.** BTL1 Ratio of crude death rate to crude birth rate.
15.	**What are the objectives of family welfare programme? (TNV A.U. Dec 2009)** BTL1 • Slowing down the population explosion by reducing the fertility • Pressure on the environment due to over exploitation of natural resources is reduced
16.	**List the factors influencing family size.** BTL4 • Reduce infant mortality rate to below 30 per 1000 infant • Achieve 100% registration of births, deaths, marriage and pregnancy • Encourage late marriage, late child-bearing, breast feeding • Enables to improve women's health, education and employment • Prevent and control of communicable disease and AIDS/HIV • Promote vigorously the family norms • Making school education up to age 14 free and compulsory
17.	**What is meant by NIMBY syndrome? (Chen A.U. Dec 2008)** BTL1 NIMBY-**N**ot **I**n **M**y **B**ack **Y**ard. Describes the opposing of residents to the nearby location of something they consider undesirable, even clearly a benefit for many
18.	**List the factors influencing human health.** BTL4 • Nutritional Factors • Biological Factors • Chemical Factors • Psychological Factors
19.	**What is meant by human rights?** BTL1 The fundamental rights which are possessed by all human beings irrespective of their caste, nationality, sex and language. These cannot be taken away by any legislature. Every citizen must enjoy certain rights and also has certain duties towards the country.
20.	**List the features of draft declaration of human rights**. BTL4 • Human rights to freedom • Human rights to property • Human rights to freedom of religion • Human rights to culture and education • Human rights to constitutional remedies • Human rights to equality • Human rights against exploitation • Human rights to food and environment • Human rights to good health
21.	**What is education? List its types.** BTL1 **Education-**learning through which knowledge about the particular thing can be acquired **Types of Education** • **Formal Education**-Self related. Will read, write, get jobs and tackle the problems • **Value Education**–Instrument to analyse our behavior and provide proper direction to youth. Teaches distinction between right and wrong, helpful, loving, etc. • **Value-based environmental education**-Provide knowledge on principles of ecology, fundamentals of environment and biodiversity
22.	**Write the importance of value education. (Chen A.U. Dec 2008, 2013)** BTL2

	• Improve the integral growth of human being • Create attitudes and improvement towards sustainable lifestyle • Increase awareness about our national history, cultural heritage, constitutional rights, national integration, community development and environment • Create and develop awareness about the values, role and their significance
23.	**What is role playing element of value education?** BTL1 Acting out the true feelings of the actors by taking the role of another person but without the risk of reprisals.
24.	**Mention the types of values imported through value education.** BTL1 • Universal Values or Social Values • Cultural Values • Individual Values • Global Values • Spiritual Values
25.	**Define the term HIV/AIDS.** BTL1 **HIV**-**H**uman **I**mmunodeficiency **V**irus; **AIDS**-**A**cquired **I**mmuno **D**eficiency **S**yndrome; a condition in humans in which the immune system begins to fail, leading to life-threatening opportunistic infections.
26.	**What are the factors which do not influence transmission of HIV?** BTL1 Tears, food, air, cough, handshake, mosquito, flies, insect bites, urine, saliva during kissing, sharing of utensils, cloths, toilet, bathroom etc.
27.	**Mention some effects of HIV/AIDS. (Chen A.U. Dec 2008, 2011, 2014)** BTL1 • Large number of death occurs, which affect environment and natural resources • Loss of labour and level of production decreases • Required more water for maintaining hygiene in AIDS affected locality • People affected by HIV, cannot perform work well, due to lack of energy and frequent fever and sweating
28.	**What are the major precautions to avoid AIDS? (Chen AU May 2008)** BTL1 • Avoid indiscriminate sex and encourage the use of condoms and also avoid the use of sharing razors needles and syringes • Prevention of blood borne HIV transmission • Aids awareness programmes should be encouraged • Counseling services should be provided • Drug treatment
29.	**State the role of information technology in Environment. (Coim A.U. Dec 2009, Chen AU Jan 2006)** BTL4 • Plays a vital role in the field of environmental education. • Means collection, processing, storage and dissemination of information. • Numbers of software have been developed to study about the environment. • The internet facilities, information through satellites, World Wide Web, and geographical information systems provide us up-to-date information on various aspects of environment and weather.
30.	**What is value education? Give its significance. (NOV/DEC 2013)** BTL4 An instrument used to analyse our behavior and provide proper direction to our youths. Teaches them the distinction between right and wrong, to be compassionate, helpful, loving, generous and

	tolerant. So that a youth can move towards the sustainable future.
31.	**What do you mean by Doubling Time? (NOV/DEC 2013)** BTL1 Period of time required for a quantity to double in size or value. Generally applied to denote the population growth.
32.	**State the role of Information Technology in health protection.** BTL1 • Health organization turning to package solution of IT for streamlining services oriented work in effective manner. • Health service technology such as finance and accounting, pathology, patient administration • Helps the doctor to monitor the health of the people effectively • Online help of expert doctors can be used for the patient • The outbreak of epidemic diseases can be conveyed easily • Effective function of a hospital • Drugs and its replacement can be administered efficiently • The data regarding birth and death rate, immunization and sanitation programmes can be maintained accurately with the help of computers
33.	**What is environmental impact assessment?** BTL1 Formal process of predicting the environmental consequences of any development projects. Used to identify the environmental, social and economic impacts of the project prior to decision making.
34.	**What is GIS?** BTL1 Graphical Information System (GIS) acts as a technique of superimposing various thematic maps with the use of digital data on a large number of inter-related aspects. Considered to be an effective tool in environmental management.
35.	**List out the benefits of EIA.** BTL4 • Reduce the cost and time • Performance of the project improved • Waste treatment and cleaning expenses are minimized • Usages of resources are decreased • Biodiversity is maintained • Human health is improved (
36.	**Mention the key element of EIA.** BTL1 • **Scoping** – To identify the key issues of the concern in the planning process at early stage, aid site selection and identify any possible alternatives. • **Screening -**To decide whether an EIA is required or not. • **Identifying and evaluating alternatives-**Knowing alternative sites and techniques and their impacts. • **Mitigation measures dealing with uncertainty-**Action taken to prevent adverse effect of a project. • **Environmental statements**-Final stage of EIA process which reports the findings of the EIA.
37.	**What is child welfare? Mention the schemes towards child welfare.** BTL1 **Child Welfare** • Children occupy 40% of the total population. • Out of 21 Million Children born every year in India, 20 Million are estimated to be

	working as Child Labour in hazardous industries **Organizations towards Child Welfare** • UN Conventions on Rights of Child or International Laws • Rights of child • …Right to Survival • …Right to Participation • …Right to Development • …Right to Protection • Ministry of HRD • Centre for Science and Environment (CSE) • Environment degradation and child welfare So it is essential to keep our environment clean to children for better and healthy life Poverty
38.	**What is women welfare? List the various organization function towards women welfare.** BTL1 Welfare to improve the status of the women by providing opportunities in education, employment and economic independence (1M) **Organizations Towards Women Welfare** • NNWM (National Network for Women and Mining): Fighting for the "Gender Audit" of India's mining companies • UNDW (United Nations Decade for Women): Women welfare related issues on international agenda • CEDAW (Convention on Elimination of all forms of Discrimination against Women) • NGO's as Mahila Mandals • Ministry for Women and Child Welfare (1M)
	PART – B
1.	
	(i) Can you recall population characteristics & variations among nations? (7M) BTL1 **(ii) What is population explosion and state the views on population growth. (6M)** BTL2 **(i) Answer: Page:** 7.3 – 7.8-**A. Ravikrishnan** **Characteristics of population growth** • Exponential growth • Doubling time • Infant mortality rate • Total fertility rates • Replacement level • Male-Female ratio • Demographic transition (3M) **Variation of population among nation based on age structure** • Pre-productive population (0-14 years) • Reproductive population (15-44 years) • Post Reproductive population (above 45 years) • Pyramid shaped variation of population (Increase) • Bell shaped variation of population (Stable)

- Urn shaped variation of population (Decrease) (2M)



- Diagrams (2M)

(ii) Answer: Page: 7.8 – 7.11**-A. Ravikrishnan**

Population explosion–Enormous increase in population due to low death rate and high birth rate is termed as population explosion. (1M)

Causes of population explosion

- Invention of modern medical facilities; Illiteracy
- Decrease in death rate and increase in birth rate
- Availability of antibiotics, Food, clean water, air, etc.
- Decreases the famine-related deaths and infant mortality
- In agricultural based countries- Children are required (3M)

Effect of Population Explosion

Poverty; Environmental degradation; Unsustainable environment; Over exploitation of natural resources; Renewable resources become under threat; Increase disease, economic inequity and communal war; development of slums; lake of basic amenities; Unemployment. (2M)

2.

(i) How would you explain the family welfare programs (8M) BTL2

(ii) Show family planning in Indian context. (5M) BTL2

(i) Answer: Page: 7.11 – 7.14-A. Ravikrishnan.

Family welfare programme

- An integral part of overall national policy of growth covering human health, maternity, family welfare, child care and women's right, education, nutrition, health, employment, shelter, safe drinking water (1M)

Objectives of family welfare programme

- Slowing down the population explosion by reducing the fertility
- Pressure on the environment is reduced (1M)

Objectives of family planning

- Reduce infant mortality rate to below 30 per 1000 infant
- Achieve 100% registration of births, deaths, marriage and pregnancy
- Encourage late marriage and late child-bearing.
- Encouraging breast feeding
- Enables to improve women's health, education and employment
- Making family planning available to all women who wanted do

- Constrain the spread of AIDS/HIV
- Prevent and control of communicable disease
- Promote vigorously the family norms
- Making school education up to age 14 free and compulsory (3M)

Methods of family planning

- Traditional method
- Modern method
- Temporary method (3M)

(ii) Answer: Page: 7.14-A. Ravikrishnan. (BTL2)

Family planning in India

- It was started in the year 1952
- In 1970's Indian government forced family planning campaign all over the country
- In 1977, national family programme and ministry of health and family welfare redesigned
- In 1978, the government legally raised the minimum age of marriage for men from 18 to 21 and for women 15 to 18
- In 1981, census report showed that there was no drop in population. Since then funding for family planning programmes has been increased further
- The first country that implemented the family welfare programme at government level
- Centrally sponsored programme. For this, the states receive 100% assistance from central government
- The ministry of health and family welfare have started the operational aims and objectives of family welfare
    - To promote the adoption of small family size norm, on the basis of voluntary acceptance
    - To ensure adequate supply of contraceptives to all eligible couples within easy each
    - Extensive use of public health education for family planning (5M)

3.

Discuss the influence of environmental parameters and pollution on human growth. (13M) BTL2

Answer: Page: 7.14 – 7.17-A. Ravikrishnan

Factors influencing human health-A state of complete physical, mental, social and spiritual well-being and not merely the absence of disease or infirmity. "The Ability To Lead A Socially And Economically Productive Life."

- Nutritional factors
- Biological factors
- Chemical factors
- Psychological factors (3M)

Holistic concept of health-Recognizes the strength of social, economic, political and environmental influences on health

Determinants of health- Heredity, Health and family welfare services, Environment, Life-style Socio-economic conditions. Disease result from complex interaction between man and the environment.

Disease-"Maladjustment of the human organism to the environment". (2M)

Environmental degradation due to population explosion

- All that which is external to man is the environment
- The concept of environment is complex
- The external environment or the Macro-environment to be responsible for millions of preventable diseases originating in it (1M)

Environmental hazards

- **Physical:** Air, water, soil, housing, climate, geography, heat, light, noise, debris, radiation, etc. and their health effects
- **Biological**: bacteria, viruses, parasites, microbial agents, insects, rodents, animals and plants, etc. and their health effects
- **Chemical**: Combustion of fossil fuel liberates SO_2, NO_2, CO_2 ; Industrial effluents; Pesticides; Heavy metals; Chloro fluoro carbons and their health effects
- **Psychosocial**: Cultural values, customs, beliefs, habits, attitudes, morals, religion, education, lifestyles, health services, social and political organization and their health effects (7M)

4.

(i) Write short notes on human rights. (5M) BTL4

(ii) Discuss the salient features of draft declaration of Human Rights and environment. (8M) BTL2

(i) Answer: Page: 7.17-7.19 A. Ravikrishnan.

Human rights

- The fundamental rights which are possessed by all human beings irrespective of their caste, nationality, sex and language
- These cannot be taken away by any legislature or an government act
- Seen as belonging to men and women by their very nature
- India is a democratic country
- Aim of India is to ensure happiness to all the citizens with equal rights, opportunities and comforts
- Every citizen must enjoy certain rights and also has certain duties towards the country
- Include civil and political rights, such as the right to life and liberty, freedom of expression, and equality before the law; and social, cultural and economic rights, including the right to participate in culture, the right to food, the right to work, and the right to education.
- All human beings are born free and equal in dignity and rights
- They are endowed with reason and conscience and should act towards one another in a spirit of brotherhood (5 M)

(ii) Answer: Page: 7.17-7.19**-A. Ravikrishnan.** BTL2

Features of draft declaration of human rights

- Human rights to freedom
- Human rights to property
- Human rights to freedom of religion
- Human rights to culture and education
- Human rights to constitutional remedies
- Human rights to equality

	• Human rights against exploitation • Human rights to food and environment • Human rights to good health (8M)
5.	
	Summarize the objectives, concepts, types of values and elements of value education? How can the same be achieved? (13M) BTL3 **Answer: Page: 7.20 – 7.24-A. Ravikrishnan** **Education**-learning through which knowledge about the particular thing can be acquired **Types of Education** • Formal Education-Self related • Value Education–Instrument to analyse our behavior and provide proper direction to youth • Value-based environmental education-Provide knowledge on principles of ecology, fundamentals of environment and biodiversity (1M) **Objectives of value education** • To improve the internal growth of human beings. • To create attitudes and improvement towards sustainable life style. • To increase awareness on national history, our cultural heritage, constitutional rights, national integration, community development and environment. • To create and develop awareness about the values and their significance and role. • To understand about our natural environment in which land and, air and water are interlinked. (2M) **Concepts of value education** • Why and how can we use less resources and energy? • Why do we need to keep our surrounding clean? • Why should we use less fertilizers and pesticides? • Why it is important for us to save water and keep our water sources clean? • Separate our garbage into degradable and non-degradable types before disposal (2M) **Types of values** • **Universal Values or Social Values**: Expresses the human nature reflected as joy, compassion, tolerance, service, truth, etc • **Cultural Values:** To reflect true and the false behaviour of human beings in language, aesthetics, education, law, economics, etc • **Individual Values:** Parents and Teachers shape individual values to a greater extent • **Global Values:** To reduce disturbance of Harmony leading to ecological imbalance • **Spiritual Values:** To become more self-disciplined (3M) **Elements of value education–How the objectives can be achieved** • Telling Modeling • Role playing • Problem solving • Studying biographies of great man (5M)
6.	
	Explain the objectives, benefits and key elements of EIA (13M) (TNV AU Dec. 2009) BTL2

Answer: Page:7.32 – 7.34-A. Ravikrishnan

Objectives of EIA

- To identify the main issues and problems of the parties
- To identify who is the party
- To identify what are the problems of the parties
- To identify why are the problems arise (2M)

Benefits of EIA

- Reduce the cost and time
- Performance of the project improved
- Waste treatment and cleaning expenses are minimized
- Usages of resources are decreased
- Biodiversity is maintained
- Human health is improved (2M)

Key element of EIA

- **Scoping** – To identify the key issues of the concern in the planning process at early stage, aid site selection and identify any possible alternatives. (2M)
- **Screening** -To decide whether an EIA is required or not. (2M)
- **Identifying and evaluating alternatives**-Knowing alternative sites and techniques and their impacts. (1M)
- **Mitigation measures dealing with uncertainty**-Action taken to prevent adverse effect of a project. (2M)
- **Environmental statements**-Final stage of EIA process which reports the findings of the EIA. (2M)

7.

Explain in details about women welfare and child welfare. (13M) BTL2

Answer: Page: 7.28 – 7.32-A. Ravikrishnan

Women welfare

Welfare to improve the status of the women by providing opportunities in education, employment and economic independence (1M)

Need for Women Welfare

- As women suffer Gender Discrimination
- Due to physical and mental torture given to them
- Violation of Human Rights to Women.
- Neglecting of Women in Policy making and decision making (2M)

Objectives of Women Welfare

- To provide Education
- To impart Vocational Training
- To generate awareness about the environment
- To improve employment opportunities
- To restore Dignity, Status and Equality (2M)

Objectives National Commission for Women by Government of India

- To examine constitutional and human rights for women.
- To review existing legislations.
- To sensitize the enforcement and administrative machinery to women's causes (1M)

	Organizations Towards Women Welfare • NNWM (National Network for Women and Mining): Fighting for the "Gender Audit" of India's mining companies • UNDW (United Nations Decade for Women): Women welfare related issues on international agenda • CEDAW (Convention on Elimination of all forms of Discrimination against Women) • NGO's as Mahila Mandals • Ministry for Women and Child Welfare (2M) **Child Welfare** • Children occupy 40% of the total population. • Out of 21 Million Children born every year in India, 20 Million are estimated to be working as Child Labour in hazardous industries (1M) **Reason for Child Labour** • Poverty • Want of Money (1M) **Organizations towards Child Welfare** • **UN Conventions on Rights of Child or International Laws**-Formulated a set of International Standards to promote and protect the wellbeing of Children in our society • **Rights of child** • …Right to Survival • …Right to Participation • …Right to Development • …Right to Protection • **Ministry of HRD**-Concentrates on child's health, education, nutrition, clean and safe drinking water, sanitation and environment • **Centre for Science and Environment (CSE)**-Scientific report says that "Children consume more water, food and air than adults and hence more susceptible to environmental contamination • **Environment degradation and child welfare**-Children are more affected due to environmental pollution. So it is essential to keep our environment clean to children for better and healthy life Poverty (3M)
8.	
	Write a note on Indian constitution. (13M) BTL1 **Answer: Page: 7.19 – 7.20-A. Ravikrishnan** **Indian constitution; Article 14-30 .** • Article 14: Provides Equality before Law • Article 15: Prohibits Discrimination • Article 16: Provides Equal Opportunity • Article 19: Provides Freedom of Speech and Expression • Article 20: Provides Protection from Conviction • Article 22: Lays down the Rights of a person in Custody • Article 23: Prohibits forms of Forced Labour • Article 24: Prohibits appointment of Child Labour • Article 25: Provides Freedom to Practice any Religion

	• Article 26: Right to establish Charitable Institutions • Article 27: Prohibits Tax for Promoting Religion • Article 28: Guarantees Secular Character in Education • Article 29: Right to conserve their Language for Minorities • Article 30: Right of Minority to run Educational Institutions • Article 32: Right to Constitutional Remedies for enforcement of Rights by proceeding in Supreme Court (13M)
	PART-C
1.	
	(i) Narrate the role of information technology in environment protection (TNV AU Dec.2008 Dec. 2009, June 2013, Nov. 2011) (8M) BTL4 **(ii) Describe the case studies on role of IT in environment protection. (7M)** BTL5 **Answer: Page: 7.34 – 7.37-A. Ravikrishnan** **(i) Role of IT in environment** **Software for environment education** • **Remote Sensing**-Gather information about an object without contact with it • In agriculture • In forestry • In land cover • Water resources Remote sensing (2M) • **Data base** • The ministry of environment and forest • National Management Information System (NMIS) • Environment Information System (ENVIS) (1M) • **Geographical Information System (GIS) –**Superimposing various thematic maps • Water resources, soil type, forest land • Interpretations of polluted zones, degraded lands • Check unplanned growth and environmental problems (1M) • **Satellite data** • Forest cover information • Information on monsoon, ozone layer depletion, smog etc. • Discovery of new reserves of oils, minerals, etc. (1M) • **World Wide Web** • Online learning centers • Provides the current and relevant information on principles, queries, and applications of environmental science. • Stores all digital files related to teaching (1M) • **General applications** • Easily Accessible around The World • Disaster Management-Suitable warning system, disaster preparedness • Opened up a large number of scientific and technological resources and skills to reduce disaster risk. • Internet

	• Aerial sensor technologies to detect and classify objects on earth. • To capture, store, manipulate, analyse, manage and present geographical data. • Store books, pictures and other data that reduces paper waste that helps us in saving trees. • E-bills has significantly increased, which also contribute in saving trees. (2M) **(ii) Answer: Page: 7.38 – 7.39-A. Ravikrishnan** **Case studies on Role of IT in environment** • Study on polluted back waters of Kerala • Ocean study monitor (OCM) to study phytoplanktons • GIS for forest management • National Emission Data System (NEDS) • Environment Information System (ENVIS) (7M)
2.	
	(i) **Explain the role of IT in protection of human health. (10 M) (AU June 2013, Dec. Nov. 2009)(10M)** BTL4 **(ii) Explain the case study on role of IT in human health protection. (5M)** BTL5 **(i) Answer: Page: 7.39–7.40-A. Ravikrishnan** **Role of IT in human protection** • Health service technology- Finance and accounting, pathology, patient administration. • Helps the doctor to monitor the health of the people effectively. • Online help of expert doctors can be used for the patient. • The outbreak of epidemic diseases can be conveyed easily. • Effective function of a hospital. • Drugs and its replacement can be administered efficiently. • The data maintenance- birth and death rate, immunization and sanitation programmes • Spreading awareness about diseases and preventive measures to be taken. • Reduces panic and provides information about prevention and treatment options. • Airports-Screened passengers for high temperature and other symptoms • Robots that emulate or simulate living biological organisms. • Nano-Robots act as delivery systems within the organism • e-Health for healthcare practice. • Gaining momentum in academic research as well as in psychology, clinical work, and mental health counselling. • Statistics about diseases like malaria, fluorosis, AIDS, etc. • DNA databases about population, medical records, fingerprints, etc • Saves lives in critical care and emergency situations. • Bioinformatics for drug discovery and thus contributing to human health. • Provide a great support in maintaining individual fitness. (10M) (ii) **Answer: Page: 7.40–7.41-A. Ravikrishnan** **Case study** Health services on New south wales (3 M) National Institute of Occupational health (2M)
3.	

Explain HIV/AIDS, its sources, diagnosis, mode of transmission of HIV infection and control and preventive measures.(15M) BTL2

Answer: Page: 7.24 – 7.28-**A. Ravikrishnan**

HIV-**H**uman **I**mmunodeficiency **V**irus; **AIDS**-**A**cquired **I**mmuno **D**eficiency **S**yndrome; a condition in humans in which the immune system begins to fail, leading to life-threatening opportunistic infections. (2M)

Sources of HIV infection.

- AIDS has spread from Africa.
- HIV has transferred to human from African monkey or Chimpanzees.
- HIV contaminated polio vaccine, prepared from monkey's kidney.
- Spread through hepatitis-B viral vaccine in Los Angels New York.
- Spread through small pox vaccine programme of Africa. (2 M)

Symptoms or diagnosis of HIV/AIDS

Minor symptoms

- Persistent cough for more than one month
- General skin disease
- Viral infection
- Fungus infection in mouth and throat
- Frequent fever, headache, fatigue

Major symptoms

- Fever for more than one month
- Diarrhea for more than one month
- Cough and TB for more than six months
- Fall of hair from the head
- 10% of body weight get reduced within a short period. (4M)

Mode of transformation of HIV.

- Sexual transmission, presence of STD increases likelihood of transmission.
- Exposure to infected blood or blood products.
- Use of contaminated clotting factors by hemophiliacs.
- Sharing contaminated needles.
- Transplantation of infected tissues or organs.
- Certain body fluids from an HIV-infected person-Blood, Semen, Rectal fluids, vaginal fluids, Breast milk.
- Having unprotected sex with someone who has HIV.
- Receiving blood transfusions, blood products, or organ/tissue transplants that are contaminated with HIV.
- Contact between broken skin, wounds, or mucous membranes and HIV-infected blood or blood-contaminated body fluids.
- Women are more vulnerable to HIV. Transmission of HIV to their new born babies happen easily.
- Women around 18-20 years are at risk, since their cervical tissue is more vulnerable to invading HIV. (5M)

Control and preventive measure

- Education

	• Prevention of blood borne HIV transmission • Primary health care • Counselling services • Drug treatment (2M)

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