

Total No. of Questions :4]

SEAT No. :

P517

[5522]-501

[Total No. of Pages : 2

T.Y. B.Sc.

PHYSICS

PH-333 : Classical Mechanics

(2008 Pattern) (Semester-III) (Paper - III)

Time : 2 Hours]

[Max. Marks : 40

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of log tables and calculators is allowed.*

Q1) Attempt all of the following. (1 mark each)

[10]

- a) State Newton's second Law of motion.
- b) Define Range of the projectile.
- c) What will be the nature of orbit if $e > 1$ and $E > 0$?
- d) What is meant by central force?
- e) Define the term impact parameter.
- f) What do you meant by elastic scattering?
- g) State the principle of virtual work.
- h) What do you mean by inertial Frame of reference?
- i) Give Hamilton's equations of motion.
- j) Calculate the fictitious force acting on a freely falling body of mass 7 kg with reference to a frame moving vertically downward on earth with an acceleration of 3 m/s^2 .

Q2) Attempt any two of the following:

[10]

- a) Show that the path of charged particle moving parallel to constant electric field is straight line.
- b) State and prove Kepler's third law.
- c) Show that kinetic energies in final state in Lab frame and CM frame are

related as $T_{\text{Lab}} = T_{\text{CM}} + \frac{1}{2} (m_1 + m_2)V^2$

Where V is velocity of centre of mass.

P.T.O.

Q3) Attempt any two of the following. **[10]**

- a) System of particles consists of particles 3 gm located at A (2, 3, 0), 5 gm at point B (-2, -3, 2) and 2 gm at point C (3, 1, 1). Find the co-ordinates of centre of mass of the system.
- b) The distance between sun and earth is suddenly reduced to half of it's present distance. What will be duration of year?
- c) Calculate the deviation of freely falling body from a height of 150 metres at latitude 30°N due to coriolis acceleration.

Q4) A) Attempt any one of the following. **[8]**

- a) Derive the equation of motion for a simple pendulum of length l and Mass of bob m by using Lagrange's equation and give advantages of Lagrangian formulation.
- b) Find the relation between the scattering angles in the Lab and CM systems in two body elastic collisions.

B) Attempt any one of the following. **[2]**

- a) What do you mean by Pseudo Force?
- b) A body is projected at such an angle that the horizontal range is three times the maximum height. Find the angle of projection.



Total No. of Questions : 4]

SEAT No. :

P518

[Total No. of Pages : 3

[5522] - 502

T. Y. B. Sc

PHYSICS

**PH - 335: 'C' Programming and Computational Physics
(2008 Pattern) (Paper V) (Semester - III)**

Time : 2 Hours]

[Max. Marks :40

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Flow - charts may be drawn with Pencil.*
- 4) *Use of electronic calculator and logtable is allowed.*

Q1) Attempt all of the following questions (1 mark each)

[10]

- a) State at least four data types of variables in c language with syntax to declare them.
- b) How many maximum number of integers can be stored in array arr [2] [5], when "arr" is identifier of integer type array?
- c) Draw atleast four shapes used in flow charts and state their Purposes.
- d) Write syntax of any one of loop structures in C language.
- e) What is the meaning of " Call by reference" for argument passing in C language?
- f) What is the difference between ' break' and 'continue' statement in C language?
- g) Write syntax of 'print f' Function in C language.
- h) How many significant digits are there in the following numbers.
 - i) 1.000
 - ii) 1000

P.T.O.

- i) State atleast two differences between high-level and low-level programming language.
- j) What is a 'Pixel' on digital screen?

Q2) Attempt any Two from following questions (5 marks each): **[10]**

- a) Calculate : $\int_1^2 \frac{1}{x} . dx$ using Simpson's 1/3 rule with at least 9 intermediate points in the interval.
- b) Draw flow chart to check if given integer is a Prime number.
- c) Write a c program to swap values of two integer identifiers by using only two variables.

Q3) Attempt any two from following questions. (5 marks each) **[10]**

- a) Write a note on storage classes in C language.
- b) Explain how bisection method works with the help of following equation: $x^2-4=0$ with allowed error 0.1 and interval. [1,7] can [-10,10] be considered as initial 'interval'?
- c) Write output of following program when integer 'a' is stored at memory location 6422312.

```
# include <stdio.h>

void main ()
{
    long int a =10,*ptr;
    ptr=& a;
    Printf(“% \ d\t%d”, a, *ptr);
    Printf(“h%/d\t% d”, & a, ptr);
}
```

Q4) A) Attempt any one of the following questions. [8]

- a) i) Write a note on relational operators in C language.
- ii) Write a C program to find Factorial of given integer.

- b) i) Write a note on atleast two different types of errors in computation.
- ii) Write a c program to find roots of $x^2 - 4 = 0$ using Newton Raphson method.

B) Attempt any one from following questions. [2]

- a) Write a C Program using for loop to print integers from 1 to 9.
- b) What is the output of following program.

```
# include < stdio.h >
# include < math. h >
void main ( )
{
inti; n = 6 ;
for (i = 1; i <= 10 ; i + +)
{
If (i == n)
continue
Print f (“ % d \ n” ; i);
}
}
```



Total No. of Questions :4]

SEAT No :

[Total No. of Pages : 2

P519

[5522]-503

T.Y. B.Sc.

PHYSICS

PH-336 (E) : Medical Electronics

(Paper-VI) (Elective -I) (2008 Pattern) (Semester- III)

Time : 2 Hours]

[Max. Marks :40

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*

Q1) Attempt all of the following (one mark each).

[10]

- a) What is sensor?
- b) What is resting potential?
- c) State the normal B.P. values of male and female.
- d) Define low pass filter.
- e) Define the term 'Diastole'.
- f) State the uses of chromatography.
- g) State the principle of temperature radiation thermometry.
- h) What is the normal range of WBC count in human being?
- i) What are bio- potential electrodes?
- j) State the uses of spectrophotometry.

Q2) Attempt any two.

- a) Explain the principle, construction and working of ultrasonic flow meter. **[5]**
- b) Explain the use of OPAMP as active filter. **[5]**
- c) Draw functional blocks of electrocardiogram and explain in brief. **[5]**

P.T.O.

Q3) Attempt any two.

- a) Write a short note on short wave diathermy. [5]
- b) Explain band requirements for blood pressure. [5]
- c) Explain conversion of physiological changes into electrical signals. [5]

Q4) A) Attempt any one

- a) Explain standard and unipolar limb system used for recording the electrocardiogram. [8]
- b) What is plethysmography? Explain the working of plethysmograph in brief. [8]

B) Attempt any one

- a) What is impedance matching? [2]
- b) Explain the basic principle of capacitive transducer. [2]

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Total No. of Questions :4]

SEAT No. :

P520

[5522]-504

[Total No. of Pages : 3

T.Y. B.Sc.

STATISTICS (Principal)

ST. 331: Distribution theory - I

(2008 Pattern) (Semester - III) (Paper - I)

Time : 2 Hours]

[Max. Marks : 40

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of scientific calculator and statistical tables is allowed.*
- 4) *Symbols and abbreviations have their usual meaning.*

Q1) Attempt each of the following :

a) Choose the correct alternative in each of the following : **[1 each]**

i) If $X \sim \beta_2(3, 4)$ then mean of $\frac{1}{X}$ is

- A) 3 B) 4 C) 2 D) 1

ii) A random variable (r.v.) X has $E(X) = 3$ and $E(X^2) = 13$ then upper bound for $P[|X - 3| > 8]$ is

- A) $\frac{3}{4}$ B) $\frac{1}{2}$ C) $\frac{1}{16}$ D) $\frac{1}{4}$

iii) If $X \sim W(\alpha, 1)$ distribution then the mean of X is

- A) $\alpha\sqrt{\alpha+1}$ B) $\alpha^2\sqrt{\alpha+1}$ C) $\sqrt{\frac{1}{\alpha}+1}$ D) $\alpha\sqrt{2}$

iv) If $(x_1, x_2, \dots, x_8) \sim MD(n, P_1, P_2, \dots, P_8)$ then the rank of Variance and Covariance matrix is

- A) 7 B) 8 C) 9 D) 10

P.T.O.

- b) State whether each of the following statements is true or false : **[1 each]**
- If X follows $\beta_1(9, 8)$ then the distribution of $\frac{X}{1-X}$ is $\beta_2(9, 8)$
 - The probability density function of first order statistic is $n.f(x). [1-F(x)]^{n-1}$
- c) Define Convergence in distribution. **[1]**
- d) State the Weak Law of Large Numbers (WLLN). **[1]**
- e) Define multinomial distribution with parameters $(n; P_1, P_2, \dots, P_k)$. **[1]**
- f) State the central limit theorem (CLT) for independent and identically distributed random variables. **[1]**

Q2) Attempt any two of the following : **[5 each]**

- Let $X_{(1)}, X_{(2)}, \dots, X_{(n)}$ be the order statistics corresponding to random sample X_1, X_2, \dots, X_n of size n from a continuous distribution with p.d.f. $f(x)$ and distribution function $F(x)$. Obtain the probability density function of i^{th} order statistic $X(i)$.
- If $X \sim W(\alpha, \beta)$ distribution, find the distribution of $Y=X^2$.
- If $X \sim G(\alpha_1, \lambda_1)$, $Y \sim G(\alpha_1, \lambda_2)$ and X, Y are independent variates then find the distribution of $\frac{X}{Y}$.

Q3) Attempt any two of the following : **[5 each]**

- State and prove Chebycher's in equality for a continuous r.v. X with $E(X)=\mu$ and $\text{Var}(X) = \sigma^2 < \infty$.
- Let X_1, X_2, \dots, X_k are k independent Poisson variates with parameters $\lambda_1, \lambda_2, \dots, \lambda_k$ respectively. Show that the conditional distribution of X_1, X_2, \dots, X_k given $X_1+X_2+\dots+X_k=n$ is multinomial distribution.
- Let X_1, X_2, \dots, X_{100} be iid random variables having mean $\mu=75$ and variance $\sigma^2=225$. Using central limit theorem find $P\left[|\bar{X}-\mu|<6\right]$.

Q4) Attempt any one of the following :

- a) i) Let $(X_1, X_2, \dots, X_k) \rightarrow MD(n, P_1, P_2, \dots, P_k)$. Obtain moment generating function (m.g.f.) of (X_1, X_2, \dots, X_k) hence find $Cov(X_p, X_j)$. [6]
- ii) Let $X \rightarrow \beta_1(m, n)$. Derive the expression for the r^{th} raw moment of X . Hence find variance of X . [4]
- b) i) Let X_1, X_2, \dots, X_n be a random sample from $U(0, \theta)$ find the distribution of $X_{(n)}$. Also find $Var(X_{(n)})$. [6]
- ii) If $\{X_k\}$ is a sequence of independent r.v. each assuming three values $-1, 0, 1$ with the following probabilities. $P[X_k = -1] = P[X_k = 1] = \frac{1}{k}$ and $P[X_k = 0] = 1 - \frac{2}{k}$. Examine whether the WLLN holds for this sequence. [4]



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SEAT No. :

P521

[5522]-505

[Total No. of Pages : 3

T.Y. B.Sc. (Regular)

STATISTICS (PRINCIPAL)

ST - 333 : Statistical Process Control (Online Methods)

(2008 Pattern) (Semester - III) (Paper - III)

Time : 2 Hours]

[Max. Marks : 40

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Use of scientific calculator and statistical tables is allowed.
- 4) Symbols and abbreviations have their usual meaning.

Q1) Attempt each of the following:

a) Choose the correct alternative in each of the following: [1each]

i) Which of the following is not process tool?

- | | |
|-------------------|----------------|
| A) Pareto Diagram | B) Regression |
| C) Control Chart | D) Check Sheet |

ii) Natural tolerance band is always _____.

- | | |
|--------------|------------------|
| A) 3σ | B) 6σ |
| C) σ | D) None of above |

iii) If U and L denote UCL and LCL on an \bar{X} chart. Assume that standards are not specified control. Then the estimate of process standard deviation (σ) is

- | | |
|--|-----------------------------------|
| A) $\frac{(U-L)}{2} \cdot \frac{A_2}{d_2}$ | B) $\frac{(U-L)}{2A_2d_2}$ |
| C) $\frac{(U-L)}{2} \cdot \frac{d_2}{A_2}$ | D) $\frac{(U-L)}{2} \cdot A_2d_2$ |

iv) C-chart is based on

- | | |
|---------------------------------|--------------------------|
| A) Poisson distribution | B) Binomial distribution |
| C) Hyper geometric distribution | D) Normal distribution |

P.T.O.

- b) In each of the following, state whether the given statement is true or false. **[1each]**
- i) The points out of the control units on R-chart are also considered while constructing \bar{X} -chart.
 - ii) The chance causes in the manufacture can be discovered & corrected.
- c) Define the following terms: **[1each]**
- i) Modern definition of quality.
 - ii) Specification limit
- d) i) How process shift is determined on control chart? **[1]**
- ii) State any two advantages of attribute control chart. **[1]**

Q2) Attempt any two of the following. **[5]**

- a) Write note on Online Process Control.
- b) Explain the construction of p-chart for variable sample size when standards are not given based on stabilized control limits.
- c) The following is a record of the number of point defects per unit for metal disk equipment painted by dipping 6, 5, 7, 5, 4, 6, 8, 7. Draw a suitable control chart and comment.

Q3) Attempt any two of the following. **[5 each]**

- a) A normally distributed quality characteristic is controlled by \bar{X} and R chart and it is found that the process is under control. It is given that for \bar{X} chart and for R chart.

$$\begin{array}{l|l} UCL_{\bar{X}} = 626 & UCL_R = 18.795 \\ CL_{\bar{X}} = 620 & CL_R = 8.236 \quad n = 4 \\ LCL_{\bar{X}} = 614 & LCL_R = 0 \end{array}$$

- i) Find estimate of process standard deviation.
 - ii) If the specification limits were 610 ± 15 , what would be the estimate of process fraction defectives?
- b) Explain the roles of normal distribution and Chebychev's inequality in establishing 3- σ limits on control chart.

c) Write a short note on cause and effect diagram.

Q4) Attempt any one of the following:

[4+6]

- a) i) Distinguish between assignable cause and chance cause.
- ii) Define capability index C_{pk} and interpret the followings
 - 1) $C_{pk} = 1.64$
 - 2) $C_{pk} = 1.33$
 - 3) $C_{pk} = C_p$
- b) i) Explain the procedure of CRL chart
- ii) Explain the factors to be considered for basis of sub grouping.
- iii) State dimensions of the quality.

[5+3+2]



Total No. of Questions : 4]

SEAT No. :

P522

[Total No. of Pages : 12

[5522]-506

T.Y. B.Sc.

STATISTICS (Principal)

ST-336: (A) Operations Management

(2008 Pattern) (Paper - VI) (Semester - III)

Time : 2 Hours]

[Max. Marks :40

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of scientific calculator and statistical tables is allowed.*
- 4) *Symbols and abbreviations have their usual meanings.*

Q1) Answer each of the following:

- A) Choose the correct alternative in each of the following: **[1 each]**
- a) A critical path in the network is
 - i) The shortest path
 - ii) The longest path
 - iii) The path with maximum number of activities
 - iv) The path with minimum number of activities
 - b) If the three time estimates of an activity in PERT are 14, 17, 20 days, then the expected time of the activity is
 - i) 17 days
 - ii) 14 days
 - iii) 20 days
 - iv) 22 days
 - c) In Hurwitz criterion the decision maker is complete optimistic if the value of α is
 - i) 0
 - ii) 1
 - iii) 0.5
 - iv) 0.25

P.T.O.

- d) In ABC analysis 'A' type of items are those which have
- i) Low usage value
 - ii) Low unit price
 - iii) High usage value and requirement in large amounts
 - iv) High usage value requirement in small amounts
- B) In each of the following cases state whether the given statement is true or false: **[1 each]**
- a) In PERT, activity durations follow, Normal distribution.
 - b) An event representing the joint start of two or more activities is called a merge event.
- C) Explain the following terms: **[1 each]**
- a) Critical Activity.
 - b) Earliest start time of an event.
- D) Explain the following terms: **[1 each]**
- a) State the formula for Economic order Quantity in an inventory model with uniform rate of demand, finite replenishment with shortages.
 - b) State minimax criterion of decision making.

Q2) Attempt any two of the following: **[5 each]**

- a) Write a short note on VED analysis.
- b) The following table gives activities and time estimates.

Activity	t_o	t_m	t_p
10-20	6	9	12
10-50	4	7	8
20-30	14	17	20
20-40	7	10	13
20-50	3	5	9
30-70	13	18	25
40-60	10	14	16
40-70	12	15	18
50-60	9	11	12
60-70	17	20	25

- i) Draw the project network.
- ii) What is the variance of the project?

- c) The purchase price of an instrument is Rs. 50,000. Its per year running cost (Rs.) and resale value (Rs.) are as given below.

Year	1	2	3	4	5	6	7
Running cost	5,000	6,000	7,000	9,000	12,500	16,000	18,000
Resale value	30,000	15,000	7,500	3,750	2,000	2,000	2,000

Determine the optimal replacement time.

Q3) Attempt any two of the following: **[5 each]**

- a) Derive an expression lot size with uniform rate of demand, instantaneous infinite replenishment with no shortages.
- b) The research department of a popular company is thinking of launching a shampoo of three different types. The manager has to decide one of the three types to be launched based on the following estimated pay off values for various levels of estimated sales. What should be the manager's decision under:

- i) Maximax criterion
ii) Laplace criterion

Types of shampoo	Estimated level of sales		
	15,000	10,000	5,000
Egg shampoo	30	10	10
Clinic shampoo	40	15	5
Delux shampoo	55	20	3

- c) A manufacturing company requires 12,000 parts of a machine annually. Each unit costs Rs.40. The ordering cost is Rs. 45 per order and the carrying charges are 20% of the average inventory per year. What should be the Economic Order quantity? How frequently the orders be placed?

Q4) Attempt any one of the following:

- a) The following table indicates normal time and cost and crash time and cost of the activities of a project. **[10]**

Activity	Normal		Crash	
	Time (Days)	Cost (Rs.)	Time (Days)	Cost (Rs.)
1-2	8	7,000	6	9,000
1-3	4	8,000	3	10,000
2-4	2	6,000	1	7,000
2-5	10	8,000	5	15,000
3-4	5	8,000	3	10,000
4-5	3	5,000	1	10,000

Crash the relevant activities upto 2 stages systematically and determine the project duration if the indirect cost is Rs. 1000 per week.

b) Answer the following:

- i) A glass factory is considering the following three courses of action to handle their backlog: S_1 : To arrange for sub-contracting, S_2 : To begin overtime production and S_3 : To construct new facilities. The choice depends upon the future demand which may be low, medium or high with probabilities 0.1, 0.5 and 0.4 respectively. The pay off matrix is given below. Represent this decision situation in the form of a decision tree and hence indicate the most preferred decision. [5]

Demand	Probability	S_1	S_2	S_3
Low	0.1	10	-20	-150
Medium	0.5	50	60	20
High	0.4	50	100	200

- ii) What is meant by float of an activity? Explain total float, free float and independent float. [5]

EEE

Total No. of Questions : 4]

P522

[5522]-506

T.Y. B.Sc.

STATISTICS (Principal)

ST-336: (B) Actuarial Statistics

(2008 Pattern) (Paper - VI) (Elective -I) (Semester - III)

Time : 2 Hours]

[Max. Marks :40

Instructions to the candidates:

- 1) All questions are compulsory.*
- 2) Figures to the right indicate full marks.*
- 3) Use of scientific calculator and statistical tables is allowed.*
- 4) Symbols and abbreviations have their usual meanings.*

Q1) A) In each of the following cases, choose correct alternative: **[1 each]**

a) If $s(x)$ is survival function at age X then $s(\infty)$ is

- | | |
|--------|---------------|
| i) 1 | ii) ∞ |
| iii) 0 | iv) $-\infty$ |

b) If δ is constant force of mortality then $\delta =$

- i) $-V$
- ii) $\log V$
- iii) V
- iv) $-\log V$

c) The relationship between A_x and \bar{A}_x is $\bar{A}_x =$

i) $\frac{\delta}{z} Ax$

ii) $\frac{i^2 Ax}{\delta}$

iii) $\frac{i^2 A^2 x}{\delta}$

iv) $\frac{i}{\delta} Ax$

d) _____ is an Annuity in which payments are made at the beginning of the year.

i) Annuity Due

ii) Annuity Immediate

iii) Continuous Annuity

iv) m^{th} ly Annuity

B) In each of the following case, state whether the given statement is true or false: **[1 each]**

a) $K(x)$ is continuous random variable.

b) With compound interest i (*p.r.p.a*), effective rate of interest in the n^{th} year is also i .

C) Explain each of the following terms: **[1 each]**

a) Speculative risk

b) Loss Function

D) Give meaning of each of the following notation: **[1 each]**

a) ${}_{t|}uq_x$

b) $\bar{A}_{x:n}^1$

Q2) Attempt any two of the following:

[5 each]

- a) i) State any three characteristics of insurable risk.
ii) Explain role of an actuary in an insurance company.
- b) Find the amount to which Rs. 50,000 will accumulate after 8 years if the rate of interest is
i) 5% as the force of interest
ii) 5% as the effective rate of interest.
iii) 5% per annum payable quarterly.
Comment on it.
- c) Let Z be the present value random variable for a discrete one year term insurance of 1000 issue to (x) . It is given that $E(Z) = 19$ & $V(Z) = 17689$. Calculate effective rate of interest i .

Q3) Attempt any two of the following:

[5 each]

- a) The changed force of mortality is given by
 $\hat{\mu}_{x+t} = \mu_{x+t} + c, 0 \leq t \leq 1, \hat{q}_x = 0.02$ where \hat{q}_x is based on force of mortality $\hat{\mu}_{x+t}$ & $q_x = 0.01$ where q_x is based on the force of mortality μ_{x+t} , find C .
- b) Suppose a survival mode is defined by the following values of P_x .

x	0	1	2	3	4
P_x	0.9	0.8	0.6	0.3	0

- i) What is corresponding value of $s(x)$ for $x = 0, 1, 2, 3, 4$ & 5?
ii) Using radix $l_0 = 10,000$, find value of l_x & d_x for $x = 0, 1, 2, 3,$ & 4.
iii) What is the value of w ?
iv) Verify that $\sum_{x=0}^{w-1} d_x = l_0$
v) Find ${}_3d_0$.
- c) Under the assumption of uniformity of deaths in the unit interval of time with usual notation prove that.

$$\mu_{x+t} = \frac{q_x}{1-tq_x}$$

Q4) Attempt any one of the following:

- a) i) Obtain $E(Z)$ where Z is net single premium in terms of v for [6]
- 1) n year term insurance
 - 2) Whole life insurance
 - 3) n year pure endowment insurance when benefit is payable at the end of year of death.
- ii) Suppose the effective rate of interest is zero. Show that $\bar{P}(\bar{A}_x)$ is the reciprocal of complete expectation, i.e. expectation of $f(x)$. [4]
- b) i) Describe n -year temporary life annuity immediate. [5]
- ii) Given that $A_{60} = 0.34487$, $A_{61} = 0.35846$, $p_{60} = 0.98624$, calculate i . [5]

EEE

Total No. of Questions : 4]

P522

[5522]-506

T.Y. B.Sc.

STATISTICS (Principal)

ST-336: (C) Time Series Analysis

(2008 Pattern) (Paper - VI) (Elective -I) (Semester - III)

Time : 2 Hours]

[Max. Marks :40

Instructions to the candidates:

- 1) All questions are compulsory.*
- 2) Figures to the right indicate full marks.*
- 3) Use of scientific calculator and statistical tables is allowed.*
- 4) Symbols and abbreviations have their usual meaning.*

Q1) Attempt each of the following:

A) In each of the following cases, choose the correct alternative: **[1 each]**

- a) A time series consist of:
 - i) Short term variation
 - ii) Long term variation
 - iii) Irregular variation
 - iv) All of the above

b) The last period's forecast was 70 and demand was 60. What is the simple exponential smoothing forecast with alpha of 0.4 for the next period.

i) 63.8

ii) 65

iii) 62

iv) 66

c) Which of the following graph can be used to detect seasonality in time series data?

1) Multiple box

2) Autocorrelation

i) Only 1

ii) Only 2

iii) 1 and 2

iv) None of these

d) Sum of weights in exponential smoothing is _____.

i) > 1

ii) 1

iii) < 1

iv) None of these

B) State whether each of the following statement is True or False: **[1 each]**

a) The calculation of the Durbin-Watson statistic is based on moving averages.

b) Forecasting is a technique that can aid in future planning.

- C) a) State AR(1) model and one of its property. **[1 each]**
 b) State multiplicative model of time series.
- D) a) Define Autocorrelation function. **[1 each]**
 b) State use of Box-Cox transformation.

Q2) Attempt any two of the following: **[5 each]**

- a) Write a note on Time series Analysis and explain any two components.
- b) Explain the use of transformation in time series. Explain any one type of transformation.
- c) The following data give the sales (in “000” Rs.) of a company for the years 1985 - 1994.

Year (t)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Sales (Y)	50	82	65	86	70	52	90	65	87	43

Calculate 3 yearly moving averages.

Q3) Attempt any two of the following: **[5 each]**

- a) Write a note on exponential smoothing.
- b) Explain utility of time series plots.
- c) Estimate the trend using 20% smoothing constant for the following time series.

Year (t)	1	2	3	4	5	6	7	8	9	10
Y _t	99	95	83	100	109	105	97	104	94	105

Q4) Attempt any one of the following:

- a) i) Explain the concept of moving averages. Also mention its merits and demerits. [5]
- ii) Explain utility of Box-Jenkins technique. [5]
- b) i) Define autocorrelation function and state its properties. [5]
- ii) Discuss how non-parametric tests are useful in time series modeling. [5]

EEE

Total No. of Questions : 4]

SEAT No. :

[Total No. of Pages : 2

P1740

[5522]-601

T.Y.B.Sc.

PHYSICS

**PH - 345 (B): Advanced Electronics
(2008 Pattern) (Semester - IV) (Paper - V)**

Time : 2 Hours]

[Max. Marks : 40

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Draw neat diagrams wherever necessary.*
- 4) *Use of log tables and calculators is allowed.*

Q1) Attempt all of the following (one mark each)

[10]

- a) What is a block body?
- b) What is linearization of signal?
- c) State the principle of photo diode detector.
- d) State peltier effect in thermometer.
- e) Draw neat symbol of solar cell.
- f) What is LVDT?
- g) State the working principle of gas thermometers.
- h) Draw the symbols of 'No' and 'Nc' switches.
- i) State the properties of LASER light.
- j) State the types of motion.

P.T.O.

Q2) Attempt any two (five marks each). **[10]**

- a) Draw the block diagram of a process control loop. Explain the elements of the diagram in brief.
- b) Explain principle, construction and working of bimetal strip thermal sensor.
- c) Explain construction, and working of a narrow band pyrometer.

Q3) Attempt any two (five marks each). **[10]**

- a) Write a short note on the common software functions of a modern programmable logic controller (PLC).
- b) Explain principle, construction and working of a photo emissive detector.
- c) State and explain features of instrumentation amplifier.

Q4) a) Attempt any one.

- i) State the characteristics of photo detector. List the types of photo detectors and explain any one in detail. **[8]**
- ii) Explain the principle, construction and working of a broad band (total radiation) pyrometer. **[8]**

b) Attempt any one.

- i) What is servomechanism? **[2]**
- ii) What is the need of lead compensation? **[2]**



Total No. of Questions : 4]

SEAT No. :

[Total No. of Pages : 4

P1741

[5522]-602

T.Y.B.Sc.

PHYSICS

**PH - 346 (G): Physics of Nanomaterials
(2008 Pattern) (Semester - IV) (Paper - VI) (Elective - II)**

Time : 2 Hours]

[Max. Marks : 40

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Draw neat diagrams wherever necessary.*

Q1) Attempt all of the following (one mark each)

[10]

- a) What do you mean by 'Nano'?
- b) What is quantum size effect?
- c) What is bottom up approach?
- d) State any two hybrid methods for synthesis of Nanoparticles.
- e) State any two types of sputter deposition.
- f) Define exciton.
- g) Which type of detectors used in uv-visible - NIR spectrophotometer?
- h) What are the different types of carbon nanotubes?
- i) State hazardous effects of nanomaterials.
- j) State any two applications of nanomaterials in medical field.

P.T.O.

Q2) Attempt any two of the following (Five marks each): [10]

- a) With help of schematic representation of the different stages of Sol-gel technique, Explain process of sol-gel method.
- b) Explain electrical properties of nanomaterials.
- c) With the help of neat diagram, explain working of scanning electron microscope.

Q3) Attempt any two of the following (Five marks each): [10]

- a) Explain the classification of nanomaterials on the basis of their origin and dimensions.
- b) Write note on X-ray diffraction technique.
- c) Explain the applications of nanomaterials in defense and sport field.

Q4) a) Attempt any One of the following. [8]

- i) What is the working principle of Electrochemical deposition technique. Explain electrical terms with mechanism of Electrodeposition process.
- ii) State Hund's rule. Explain different types of magnetic materials for preparation of nanoparticles.

b) Attempt any One of the following. [2]

- i) What are the aerogels?
- ii) Draw a neat diagram of Transmission electron microscope.



Total No. of Questions : 4]

SEAT No. :

P1741

[5522]-602

T.Y.B.Sc.

PHYSICS

PH - 346 (H): Microcontrollers

(2008 Pattern) (Semester - IV) (Paper - VI) (Elective - II)

Time : 2 Hours]

[Max. Marks : 40

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Draw neat diagrams wherever necessary.*
- 4) *Use of log tables and calculators is allowed.*

Q1) Attempt all of the following (One mark each):

[10]

- a) Name the 16 bit registers in the 8051?
- b) Give one instruction performing bit operation in 8051.
- c) Give the difference between LJMP and SJMP.
- d) Give the ASCII code for 'A' and 'a'.
- e) What is the size of RAM in 8051?
- f) Give the name of timers in 8051.
- g) What is the output of INC R1?
- h) Which register bank is selected when 8051 is powered up?
- i) Which I/O part need pull - up resister?
- j) What is the output of Mov A₉ © Ro?

Q2) Attempt any two (Five marks each): **[10]**

- a) Draw block diagram of μc 8051.
- b) Describe various addressing modes of 8051.
- c) Describe 4 parts in μc 8051 in brief with example.

Q3) Attempt any two (Five marks each): **[10]**

- a) Write an assembly language program to convert packed BCD number to two ASCII numbers and place them in R5 and R6.
- b) Ten hex numbers are stored in RAM location from 50H onwards. Write a program to copy the given block of data in the RAM from 70H location.
- c) Write an assembly language program to display hexadecimal numbers (0-9 A - F) continuously with the time delay of 5sec.

Q4) a) Attempt any one (Eight marks): **[8]**

- i) Explain structure of internal memory organization of μc 8051.
- ii) Explain PSW register of μc 8051.

b) Attempt any one (two marks): **[2]**

- i) Discuss in brief assembler directives.
- ii) Explain the instruction 'SWAPA' and Add A9, R3.



Total No. of Questions : 4]

SEAT No. :

P1742

[5522]-603

[Total No. of Pages :3

T.Y.B.Sc.

STATISTICS (Principal)

ST-343: Statistical Process Control (Offline Methods)

(2008 Pattern) (Semester - IV) (Paper-III)

Time : 2Hours]

[Max. Marks : 40

Instructions:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of scientific calculator and statistical tables is allowed.*
- 4) *Symbols and abbreviations have their usual meaning.*

Q1) Attempt each of the following:

A) In each of the following cases, choose the correct alternative: **[1 each]**

a) In case of acceptance sampling with lot quality?

- i) AOQ is always bigger than p.
- ii) AOQ is always smaller than p.
- iii) AOQ is always equal to p.
- iv) There is no order relation between AOQ and P.

b) For single sampling plan, with $N=100$, $n= 20$ if. $ATI=40$ then the probability of rejecting the lot is.

- | | |
|-----------|----------|
| i) 0.25 | ii) 0.75 |
| iii) 0.66 | iv) 1 |

c) The minimal path set of the three component series system is.

- | | |
|------------|-----------|
| i) {1,2,3} | ii) {2,3} |
| iii) {1,3} | iv) {1,2} |

d) In case of double sampling plan, N, n_1, n_2, c_1, c_2 , let d_1 be number of defectives obtained in the first sample. A second sample of size n_2 is selected if

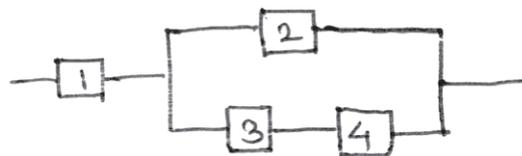
- | | |
|---------------------------|--------------------------|
| i) $d_1 \leq c_1$ | ii) $d_1 \leq c_2$ |
| iii) $c_1 \leq d_1 < c_2$ | iv) $c_1 < d_1 \leq c_2$ |

P.T.O.

- B) In each of the following, state whether the given statement is true or false. **[1 each]**
- A coherent system is bounded above by the performance of a parallel system.
 - Cause and effect diagram gives idea about which causes are important.
- C) Define the following terms: **[1 each]**
- Acceptable Quality Level (AQL)
 - Decreasing failure rate
- D) a) State any two advantages of double sampling plan. **[1]**
- b) Define parallel system of n components. **[1]**

Q2) Attempt any two of the following: **[5 each]**

- Derive the expression for AOQ in double sampling plan.
- Obtain structure function and draw fault tree diagram of the following reliability block diagram.



- Write a short note on ISO.

Q3) Attempt any two of the following. **[5 each]**

- A single sampling plan has $N=10000$, $n=100$ and $c=2$. Obtain ATI if $p=0.2$.
- Show that hazard rate of a series system of components having independent life times is the sum of component hazard rates.
- For the structure function $1-(1-X_1)(1-X_2)(1-X_3X_4)$, draw a reliability block diagram. Also find path vectors and path sets.

Q4) Attempt any one of the following.

- a) i) Distinguish 100% inspection and sampling inspection.
ii) Define survival function. Obtain the survival function and hazard rate of a life time (T) which follows exponential distribution.

[4+6]

- b) i) For a double sampling plan $N=4000$, $n_1=50$, $C_1=0$, $n_2=100$, $C_2=3$ compute ASN if the lot is of quality 0.03.
ii) Write note on acceptance sampling plan with rectification.
iii) Explain normal, reduced and tightened sampling.

[4+3+3]



Total No. of Questions : 4]

SEAT No. :

P1743

[5522]-604

[Total No. of Pages : 4

T.Y.B.Sc.

STATISTICS (Principal)

ST-345 : Operations Research

(2008 Pattern) (Semester - IV) (Paper-V)

Time : 2 Hours]

[Max. Marks : 40

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of scientific calculator and statistical tables is allowed.*
- 4) *Symbols and abbreviations have their usual meaning.*

Q1) Attempt each of the following:

- a) Choose the correct alternative in each of the following: **[1 each]**
- i) In LPP, if the region formed by the constraints gives a straight line then, the solution of the problem is
 - 1) unbounded
 - 2) alternate
 - 3) degenerate
 - 4) infeasible
 - ii) For minimization problem, the objective function coefficient for an artificial variable is
 - 1) +M
 - 2) -M
 - 3) Zero
 - 4) 1
 - iii) In assignment problem, decision variables can take values
 - 1) either -1 or 1
 - 2) either -1 or 0
 - 3) either 0 or 1
 - 4) either 1 or 2
 - iv) In transportation problem, the optimum solution is obtained by using
 - 1) North West Corner Rule (NWCR)
 - 2) Least Cost Method
 - 3) Modified Distribution Method (MODI)
 - 4) Vogel's Approximation Method (VAM)

P.T.O.

- b) In each of the following, state whether the given statement is True or False: **[1 each]**
- i) The number of variables in primal is same as number of equations in dual.
 - ii) Every sequencing problem must have unique optimum solution
- c) Define each of the following: **[1 each]**
- i) Slack variable.
 - ii) An optimal solution to an LPP.
- d) i) Explain an idle time of a machine in sequencing problem. **[1 each]**
- ii) State the canonical form of LPP. **[1]**

Q2) Attempt any two of the following: **[5]**

- a) Write the dual of the following LPP:

$$\text{Maximize } z = 7x_1 + 2x_2 + 3x_3$$

Subject to the constraints

$$3x_1 + 2x_2 + 5x_3 \leq 2$$

$$6x_1 + 4x_2 + x_3 = 8$$

$$4x_1 + x_2 - 7x_3 \geq 10$$

x_1 unrestricted in sign, $x_2, x_3 \geq 0$.

- b) Explain the following terms used in an LPP.
- i) solution
 - ii) feasible solution
 - iii) a basic feasible solution
 - iv) degenerate solution
 - v) non-degenerate solution

- c) A company manufactures four variants of the same product and in the final part of the manufacturing process there are assembly, polishing and packing operations. For each variant the time required for those operations is shown below (in minutes) as is the profit per unit sold.

Variant	Assembly	Polish	Pack	Profit
1	2	3	2	1.50
2	4	2	3	2.50
3	3	3	2	3.00
4	7	4	5	4.50

Given the current state of labour force the company estimate that, each year, they have 1,00,000 minutes of assembly time, 50,000 minutes of polishing time and 60,000 minutes of packing time available. Formulate the problem as an LPP.

Q3) Attempt any two of the following: [5 each]

- a) What are pseudo-random numbers? Explain linear congruential method of generating random numbers.
- b) Find the sequence of jobs that minimizes total elapsed time (in hours) required to complete the following jobs. Each job is to be processed on two machines A and B, first on machine A and then on machine B.

Job	1	2	3	4	5	6	7
A	5	4	7	6	9	10	11
B	3	9	8	2	7	6	8

Obtain the total elapsed time and idle time for both machines.

- c) Solve the following LPP by graphical method.

$$\text{Maximum } z = 4x_1 + 6x_2$$

Subject to

$$2x_1 + 4x_2 \leq 24$$

$$x_1 \leq 10$$

$$x_2 \leq 5$$

$$x_1, x_2 \geq 0.$$

Q4) Attempt any one of the following:

- a) i) The assignment costs of 5 operators to five machines are given in the following table:

Machines	Operators				
	I	II	III	IV	V
A	12	48	69	35	42
B	68	27	35	47	51
C	44	61	83	22	45
D	38	47	26	61	72
E	56	32	49	58	66

Write the assignment of machines to various operations so as to minimize the total cost. [8]

- ii) State the relation of assignment problem with transportation problem. [2]
- b) i) Obtain initial basic feasible solution of the following transportation problem using Vogel's approximation method.

Source \ Destinations	D ₁	D ₂	D ₃	Availability
	S ₁	8	16	16
S ₂	23	28	32	80
S ₃	18	17	27	80
Requirements	150	80	50	

Check whether the solution is optimal. [7]

- ii) What do you mean by an unbalanced transportation problem (TP)? Explain how to convert it into balanced TP, giving an illustration. [3]



Total No. of Questions : 4]

SEAT No. :

P 1744

[Total No. of Pages : 7

[5522]-605

T.Y.B.Sc.

STATISTICS (Principal)

ST - 346 (A) : Medical Statistics

(2008 Pattern) (Semester - IV) (Paper - VI)

Time : 2 Hours]

[Max. Marks : 40

Instructions to the candidates :

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of scientific calculator and statistical tables is allowed.*
- 4) *Symbols and abbreviations have their usual meaning.*

Q1) Attempt each of the following:

A) In each of the following cases, choose the correct alternative: [1 each]

- a) Life table provides a broad picture of
 - i) only mortality
 - ii) only survivorship
 - iii) mortality and survivorship
 - iv) fertility
- b) The graph drawn by Dr. John Snow could find the cause of
 - i) Malaria
 - ii) Scurvy
 - iii) puerperal fever
 - iv) Cholera

P.T.O

- c) Pharmacodynamics is
- i) Absorption of drug in the body
 - ii) Distribution of drug in the body
 - iii) What drug does to the body
 - iv) What body does with drug
- d) In epidemiology, logit function of probability π is given by
- i) $\ln[(1-\pi)/\pi]$
 - ii) $\ln[\pi/(1-\pi)]$
 - iii) $\ln[\pi(1-\pi)]$
 - iv) $\ln[\pi/(1+\pi)]$
- B) In each of the following cases state whether the given statement is true or false: **[1 each]**
- a) A bias is a systematic error.
 - b) Humans are used in preclinical trials.
- C) Define the following terms: **[1 each]**
- a) $\pm 20\%$ rule for assessment of bioequivalence
 - b) blinding
- D) a) Explain the term efficacy of drug. **[1]**
- b) Explain the drawback of exponential growth model. **[1]**

Q2) Attempt any two of the following: **[5 each]**

- a) Write a short note on 'Crossover design' used in clinical trials.
- b) Explain in brief the discoveries in epidemiology made by the following:
 - i) William Harvey
 - ii) Florence Nightingale

- c) The following table relates to the number of animals of a certain species at age x :

X	0	1	2	3	4	5
l_x	1000	850	760	360	25	0

Prepare life-table containing columns d_x , q_x , L_x , T_x , e_x .

Q3) Attempt any two of the following: **[5 each]**

- a) Suppose μ_C and μ_T denote the mean responses of two formulations control (C) and test (T) with unknown variance. Explain how you test $H_0: \mu_T = \mu_C$ against $H_1: \mu_T \neq \mu_C$. Assuming equal sample sizes for both the test groups, find the expression of sample size of each group to get power $1-\beta$.
- b) Define survival function and interpret it. Also, state its properties.
- c) Consider the following data on vision grades of two eyes of 7477 women factory workers. Grade 1 represent normal vision and Grade 4 is the weakest vision. Using Bowker test, test whether there is any relation between the grade of left eye and right eye. Use 5% level of significance.

Vision grades of eyes of women workers

Right eye	1	2	3	4
Left eye				
1	1520	266	124	66
2	234	1512	432	78
3	117	362	1772	205
4	36	82	179	492

Q4) Attempt any one of the following:

- a) i) Explain in brief Phase II study in clinical trails. [4]
- ii) State the role of CRO [2]
- iii) A patient of high blood pressure is given an intravenous injection of 160mg. of a beta-blocker. Blood samples are taken for 8 hours and concentration values are recorded. Results are given below. Estimate C_{max} , T_{max} . Also calculate $AUC_{(0,480)}$ [4]

Time (min)	30	60	120	150	240	360	480
Concentration(mg/ml)	700	620	400	300	150	50	25

- b) i) Write a short note on 'Bioequivalence' [4]
- ii) Explain the term washout period. [2]
- iii) Write note on bathtub shaped hazard rate [4]

x x x

d) Peterson's estimator of population size N for single recapture is

i) $\frac{n_1 n_2}{m_2}$

ii) $\frac{n_1 m_2}{n_2}$

iii) $\frac{n_2 m_2}{n_1}$

iv) $\frac{m_2}{n_1 n_2}$

B) In each of the following cases state whether the given statement is true or false: **[1 each]**

a) Exponential model is sigmoidal.

b) Line transect methodology is mainly used to sample ecological population.

C) Define each of the following: **[1 each]**

a) Closed population

b) Stable equilibrium

D) a) It is conjunctured that population grows exponentially. Let $N_2 = 30$ and $N_3 = 80$. Estimate the intrinsic rate r . **[1]**

b) Explain two kinds of parameters in Leslie matrix model. **[1]**

Q2) Attempt any two of the following: **[5 each]**

a) Discuss the state of equilibria in Gompertz model.

b) Derive the expression for logistic growth model.

c) Explain the method of quadrat sampling to estimate population density in a forest. Also discuss scope and limitations of this method.

Q3) Attempt any two of the following:

[5 each]

- a) Describe line transect method for estimate animal population in forest. What is rational behind using exponential detection function?
- b) Given the following projection matrix

$$M = \begin{bmatrix} 2 & 5 \\ 0.6 & 0 \end{bmatrix}$$

Obtain stable population structure and comment on growth of the population.

- c) Describe capture-recapture method. Derive Peterson's estimator of population size (N) for single recapture, in case of closed population.

Q4) Attempt any one of the following:

- a) i) Define Simpson's index for diversity(λ). Compute λ for the following data: **[5]**

Species	1	2	3	4	5	6
No.of individuals	2	5	9	7	3	1

- ii) In Leslie matrix model state assumptions made, two kinds of parameters, model and its matrix representation. **[5]**
- b) What is meant by point to individual nearest neighbour distance in Poisson forest? Derive maximum likelihood estimator of parameter λ . Is this estimator unbiased? If not, obtain its bias and also give unbiased estimator of λ . **[10]**

x x x

Total No. of Questions : 4]

SEAT No. :

P 1745

[Total No. of Pages : 3

[5522]-606

T.Y.B.Sc.

STATISTICS (Principal)

ST - 346 : Statistical Computing Using R - Software

(2008 Pattern) (Semester - IV) (Paper - VI)

Time : 2 Hours]

[Max. Marks : 40

Instructions to the candidates :

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Each question is to be solved using R-Software installed on your computer.
- 4) Attach Computer printout of your work to the answer book supplied to you.

Q1) Attempt each of the following:

[1 each]

- a) Draw a random sample of size 10 from a $B(n = 6, p = 0.4)$.
- b) Create a data frame of student name and marks obtained in one subject for 2 students.
- c) Find median and standard deviation of the following observations:
27, 26, 28, 23, 25, 27, 25, 19, 24, 27.
- d) Draw box plot of the following observations:
38, 25, 39, 34, 35, 37, 29, 33, 28, 24, 29
- e) Simulate an experiment of tossing a die 80 times and prepare its frequency distribution.
- f) Let $X \sim P(m = 8.4)$, find $P(X < 4)$ and $P(X \geq 2)$.
- g) Create a vector x of observations 22, 24, 25, 36, 48, 56, 28, 37, 33, 28. From x vector, create vector y containing elements of x less than 25.
- h) Draw a simple random sample without replacement of size 10 from a population of 15 units.
- i) Access data 'rivers' and obtain its summary statistics.
- j) Let $X \sim N(3, 2^2)$, compute $P(-4 < X < 7)$.

P.T.O

Q2) Attempt any two of the following:

[5 each]

a) Compute geometric mean and harmonic mean for the following data:

x : 07 10 15 12 08

f : 12 17 25 17 5

b) Draw less than and more than ogive curves for the following data

Wage (in Rs.)	100-200	200-300	300 -400	400-500	500-600
No.of workers	12	40	36	18	14

c) Fit a Binomial distribution to the following data and find the expected frequencies

x	0	1	2	3	4	5	6	7
f	6	12	18	23	19	13	6	4

Q3) Attempt any two of the following :

[5 each]

a) following are the data on the time in minutes required to fill the bottles by two machines A and B:

A : 6.3, 4.8, 4.9, 5.6, 6.5, 6.8, 6.9, - -

B : 3.9, 4.9, 7.5, 6.1, 6.3, 5.2, 5.8, 6.3, 7.2

Can we conclude that average time required by machine B is more than that of A, test at 5% l.o.s?

b) Represent the following data of students of a college by a sub divided bar diagram:

Year	2014	2015	2016	2017	2018
BA	740	652	584	483	507
BSc	525	511	474	388	407
BCom	348	385	309	382	265

- c) The following data represent the turnover(x) in thousand rupees (₹) of a Hotel on week days:

Day	Sun	Mon	Tue	Wed	Thu	Fri	Sat
x	12.4	13.8	11.9	13.5	10.3	11.9	13.3

Can you conclude that on an average same turnover on all days, test the hypothesis at 5% level of significance?

Q4) Attempt any one of the following:

- a) i) Calculate coefficient of quartile deviation for the following data:

Marks	0-10	10-20	20-30	30-40	40-50	50-60
No. of students	10	19	21	16	8	6

- ii) Draw a pie chart for the following data:

Commodity	Food	Clothing	Housing	Education	Miscellaneous
Expenses (%)	30	20	15	05	30

[6+4]

OR

- b) i) Carry out ANOVA for the following data of yield (in kgs):

Manures		
A	B	C
24.5	25.2	24.7
26.6	25.8	23.9
25.8	24.4	24.2
22.2	-	24.4
-	-	29.1

- ii) Fit a regression line of Y on X for the following data:

X	12	17	21	28	35	38
Y	11	13	17	20	24	27

[7+3]

x x x
3