INDIAN STATISTICAL INSTITUTE
Research and Training School

Periodical Examination

B.Stat. III Year

MATHEMATICS

Duration : 3 hours — Maximum marks : 100 — Date: 5.10.64

Separate Answer-book should be used for each group.

GROUP A

1. Show that a field F is a vector space over F.

2. State whether the following statements are true or false. If false, give a counter-example.

   (i) If $A = \{\alpha_1, \alpha_2, \ldots, \alpha_r\}$ is linearly independent, then no α_i is the null vector.

   (ii) If $A = \{\alpha_1, \alpha_2, \ldots, \alpha_r\}$ is linearly dependent, then α_1 is linearly dependent on $B = \{\alpha_2, \alpha_3, \ldots, \alpha_r\}$.

   (iii) If α and β are linearly dependent on γ, then α is linearly dependent on β ;

   (iv) If $A = \{\alpha_1, \alpha_2, \ldots, \alpha_r\}$ is linearly independent, then α_1 is linearly independent of $T = \{\alpha_2, \alpha_3, \ldots, \alpha_r\}$.

3. a_1, a_2, a_3 are fixed real numbers. Show that the set of vectors in R^4, $\{(x_1, x_2, x_3, x_4)\}$ with $x_4 = a_1x_1 + a_2x_2 + a_3x_3$, is a subspace V of R^4. Find a basis and the dimension of V.

4. Let V be a vector space, ϕ its null vector, $A \subset V$, $[A]$ the set spanned by A, and S and T two subspaces of V. State whether or not the following subsets of V are subspaces :

   (i) V (ii) $\{\phi\}$, (iii) $[A]$ (iv) $S \cap T$ (v) $S \cup T$
   (vi) $[S \cup T]$, (vii) $S + T$

5. Show that two finite-dimensional vector spaces over the same field are isomorphic if and only if they have the same dimension.

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6. Defined below are some transformations, σ, from a vector space U into another vector space V, both defined over the same field R, the real line. State whether σ is a linear transformation or not; if linear, state whether or not/ it is (a) on to V; (b) one-to-one.

(i) $U = V = R^2$; $(x,y) \in U$, $\sigma(x,y) = (x^2, y^2)$.

(ii) $U = V = R^n$; $(x_1, x_2, \ldots, x_n) \in U$,

$$\sigma(x_1, x_2, \ldots, x_n) = (\sum_{i=1}^{n} a_i x_i, 0, 0, \ldots, 0),$$

a_i's being fixed real numbers.

(iii) $U = R^m$, $V = R^n$; $n > m$;

$$(x_1, x_2, \ldots, x_m) \in U, \ \sigma(x_1, x_2, \ldots, x_m) = (x_1, x_2, \ldots, x_m, 0, 0, \ldots, 0)$$

(iv) $U = R^n$, $V = R^m$; $n > m$;

$$(x_1, x_2, \ldots, x_n) \in U, \ \sigma(x_1, x_2, \ldots, x_n) = (x_1, x_2, \ldots, x_m)$$

(v) $U = R^n$, $V = R$. $(x_1, x_2, \ldots, x_n) \in U$

$$(x_1, x_2, \ldots, x_n) = \sum_{i=1}^{n} a_i x_i; \quad a_i\text{'s being fixed real numbers.}$$

GROUP B

7. State and prove the Cauchy criterion for the ~~convergence of the~~ convergence of the series $\sum a_n$ of not necessarily positive terms.

(You are not expected to assume the corresponding result for sequences). (10)

8. Discuss the convergence or divergence of the series $\sum a_n$ where a_n is one of the following

(i) $1/n(\log n)^x$ $\qquad x > 0$

(ii) $\frac{1}{n} - \log(1 + \frac{1}{n})$

(iii) $(-1)^n / n^x (\log n)^y$ $\qquad$ x,y arbitrary

(iv) $\dfrac{(-1)^{[\sqrt{n}]}}{n^x}$ (24)

9(a) If $a_n > 0$ for all n and $s_n = a_1 + \dots + a_n$, prove that the divergence of $\sum a_n$ implies that of $\sum_n a_n/s_n$.

(b) A series $\sum (-1)^n a_n$ ($a_n > 0$ for all n) is such that

$$\frac{a_n}{a_{n+1}} = 1 + \frac{c}{n} + \frac{\alpha_n}{n^2}, \quad \{\alpha_n\} \text{ a bounded sequence.}$$

Prove that the series converges if $c > 0$. (16)

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INDIAN STATISTICAL INSTITUTE
Research and Training School

Periodical Examination

B. Stat. III Year

Probability

Time: 2½ hours — Maximum Marks : 100 — Date: 20.10.64

1. X is a random variable uniformly distributed over the interval $[-\pi, +2\pi]$. Obtain the density function of cos X.

   Is this density function continuous everywhere? Give reasons for your answer.

   Also discuss the continuity of the distribution function. (25)

2(a). Prove that a distribution function F(x) is continuous at a point α if and only if α carries zero probability.

(b) Prove that $F(x) \longrightarrow 1$ (as $x \longrightarrow \infty$). (25)

3. μ is a probability distribution on a finite interval $[a,b]$. What is the definition of

$$\overline{\int} f(x)\,d\mu \quad \text{and} \quad \underline{\int} f(x)\,d\mu \; ?$$ (25)

4. In a probability distribution, the probability is carried by 3 points a,b, and c. Probability at a is p_1, at b is p_2 and at c is p_3. Prove rigorously that

$$\int x^2\,d\mu = p_1 a^2 + p_2 b^2 + p_3 a^2.$$ (25)

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INDIAN STATISTICAL INSTITUTE
Research and Training School

Periodical Examination

B.Stat. III Year

Statistics (Theory & Practical)

Time : $2\frac{1}{2}$ hours | Maximum Marks : 100 | Date : 20.10.64

1. In a large population, there is an unknown proportion π of smokers. A simple random sample of 10 individuals is drawn from this population, and r denotes the number of smokers in the sample.

   It is required to test the hypothesis that $\pi = 0.5$, and the following alternative tests are proposed :

   (i) if $r = 5$, accept the hypothesis, otherwise reject it;

   (ii) if $r = 4, 5$ or 6 accept the hypothesis, otherwise reject it.

   (a) Calculate the probability of wrong inference when π is actually 0.5, for the two methods (i) and (ii). [20]

   (b) Suppose π is actually 0.3. If method (i) is used, what is the probability of wrong inference? [10]

   [You have to compute the numerical values of the probabilities in (a) and (b).]

2. For the same population as in question 1, it is desired to extimate the value of π and the following method is proposed : draw a simple random sample of 10 individuals and let r denote the number of smokers in the sample. Calculate the two values $\frac{r}{10} - \frac{1}{5}$ and $\frac{r}{10} + \frac{1}{5}$, and say that π lies between these values.

   If π is actually 0.5, what is the probability that the above statement is incorrect? Calculate the numerical value of this probability. [20]

3. The values of Sin x at the points given below are well known

x (in degrees)	0	30	45	60	90
Sin x	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\sqrt{\frac{3}{2}}$	1

Evaluate Sin 75° by using a fourth degree polynomial interpolation formula.

(Please turn over)

4. Evaluate by quadrature the integral

$$\int_0^1 (1 - x^2)^{\frac{1}{2}} \, dx$$

and hence find the value of π correct to five places of decimals, after deciding upon a suitable number of intervals by using an error formula. [25]

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INDIAN STATISTICAL INSTITUTE
Research and Training School

Periodical Examination

B. Stat. III Year

Economics

Duration : 2½ Hours | Maximum Marks : 100 | Date: 9.11.64

Answer any FOUR questions. All questions carry equal marks.

1. What are the chief distinguishing features of the present-day economy?

2. Examine the character of the growth of India's national Income, with special reference to the sectoral changes in the economy, during the period 1950-51 - 1960-61.

3. Critically evaluate the growth of economic welfare of the Indian people during the first and second 5-year Plans.

4. "If Indian agriculture is to improve and economic welfare is to expand, the present emphasis on heavy industries has to be abandoned and a smaller and more modest Fourth 5-year Plan should be formulated." - Comment.

5. What advantages, if any, does the national economy of a country derive from foreign trade? Illustrate your answer with Indian experience.

6. Write short notes on ay four of the following :

   1) Terms of Trade
   2) Rates of Exchange
   3) Balance of Trade
   4) Balance of Payments
   5) Invisibles
   6) I.O.U.
   7) Foreign Exchange Reserves

7. Analyse the changes in the structure of India's foreign Trade between 1950-51 and 1960-61.

8. "A study of the Foreign Trade Statistics of India reveals the existence of stagnation in her agriculture." Do you agree? Give reasons for your views.

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INDIAN STATISTICAL INSTITUTE
Research and Training School

Final Examination, 1964

B. Stat. III Year

Biochemistry (Theory)

Duration : 2 hours | Maximum Marks: 100 | Date: 16.11.64

1. Give one example for each of the following :

Nucleotide, Ketoacid, Coenzyme, Pentose, Organic phosphate ester, Dipeptide, Amino-acid. (10)

2. Describe the glycolytic pathway of glucose metabolism in mammalian muscle. (20)

3(a) What are the deficiency symptoms and natural sources for the following vitamins :

i) Vitamin A
ii) Thiamin
iii) Riboflavin
iv) Niacin (20)

(b) How can you estimate Vitamin C chemically in natural source. (10)

4(a) What is an enzyme? Define turnover number.

(b) Describe the properties of the following enzymes.

i) Catalase
ii) Amylase
iii) Urease (20)

5. What is hormone? What are the principal hormones secreted by pituitary gland? Describe their action. (20)

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INDIAN STATISTICAL INSTITUTE
Research and Training School

Mid-year Examination

B. Stat. III Year

MATHEMATICS I

Duration: 3 Hours | Maximum Marks: 100 | Date: 7 December 1964

1(a) Define a field, and a vector space over a field. (4)

(b) Show that the set of solutions of the homogeneous linear differential equation

$$\frac{d^2x}{dt^2} - 3\frac{dx}{dt} + 2x = 0$$

is a vector space over the field of real numbers. (4)

Show that e^t, e^{2t} form a basis of this vector space. (12)

2(a) If S and T are subspaces of a vector space, show that S+T and $S \cap T$ are subspaces and that

$$\dim (S \cap T) + \dim (S + T) = \dim (S) + \dim (T)$$ (10)

(b) Show that any set of $r (< n)$, linearly independent vectors in an n-dimensional vector space V, can be extended to a basis of V. (10)

3(a) Define a linear transformation from a vector space U into a vector space V and show that the transformation is one-to-one if and only if its nullity is zero. (5)

(b) Prove that for a linear transformation on U,

$$\text{rank} + \text{nullity} = \dim.(U).$$ (10)

4(a) Show that with respect to a basis $e_1, e_2, \ldots, e_n$ of V, a linear transformation from V into itself can be uniquely represented by a matrix. (5)

(b) Show that this transformation is one-to-one if and only if the matrix is nonsingular. (5)

(c) Show that the sum and product of matrices of such linear transformations is the matrix of the sum and product respectively of the linear transformations. (10)

5(a) Show that the set of all $n \times n$ matrices with real elements is a vector space of dimension n^2. (5)

(b) Hence prove that if A is any square matrix, there is an integer N such that $I, A, A^2, \ldots, A^N$ are linearly dependent. (10)

(c) If $A = \left(\left(\begin{matrix} 2 & 1 \\ 0 & -1 \end{matrix}\right)\right)$

find a polynomial $p(A)$ such that $p(A) = 0$. (10)

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INDIAN STATISTICAL INSTITUTE
Research and Training School

Mid-year Examination

B.Stat. III Year

MATHEMATICS II

Duration: 3 Hours | Maximum Marks: 100 | Date: 7 December 1964

1. Discuss the convergence or divergence of the following series with n^{th} terms a_n given by

(i) $a_n = \frac{1}{n(\log n)^x}$ $(x > 0)$

(ii) $a_n = \frac{(-1)^n}{\log n}$

(iii) $a_n = \frac{\text{Sin } nx}{n}$

(iv) $a_n = \frac{1}{n} - \log\left(1 + \frac{1}{n}\right)$ (20)

2. Let $\sum_{n=0}^{\infty} a_n$ and $\sum_{n=0}^{\infty} b_n$ be two series which converge to sums α and β respectively. Let

$c_n = a_0 b_n + a_1 b_n + \dots + a_n b_0$ $(n = 0, 1, 2 \dots\dots)$

If $\sum a_n$ is absolute convergent, prove that the series $\sum c_n$ is convergent and has sum $\alpha\beta$ (15)

If $a_n = b_n = \frac{(-1)^n}{(n+1)^x}$

where $x > 0$, show that the series $\sum c_n$ converges <u>if and only if</u> $x > \frac{1}{2}$. (15)

3. Let $p_n (n = 1, 2, \dots)$ be the sequence of primes i.e. $p_1 = 2$, $p_2 = 3$, $p_3 = 5$, etc. Prove that the series $\sum 1/p_n$ diverges, and the series $\sum \frac{1}{p_n^{\,x}}$ converges for every $x > 1$. (20)

(Please turn over)

4(a) Prove that the series

$$1 - \frac{1}{2} + \frac{1}{3} - \ldots\ldots$$

converges, say to sum s. If the series is rearranged with p positive and q negative terms alternating, prove that the resulting series converges to the sum

$$s + \frac{1}{2}\log\frac{p}{q}$$ (15)

(b) Prove that the series $\sum a_n$ where

$$a_n = \frac{(-1)^{[\sqrt{n}]}}{n}$$ ($[x]$ denotes the greatest integer . x)

converges. (15)

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INDIAN STATISTICAL INSTITUTE
Research and Training School

Mid-year Examination

B.Stat. III Year

PROBABILITY

Duration : 3 hours | Maximum Marks: 100 | Date: 8 December 1964

1(a) Are the following functions distribution functions of probability distributions? Give reasons.

(i) $F(x) = x$, (ii) $F(x) = 0,\ x < 0,$

$= 1 - \frac{1}{2+x},\ x \geq 0.$

(iii) $F(x) = 0,\ x \leq 0$

$= 1 - \frac{1}{2+x},\ x > 0.$

(iv) $F(x) = e^{x},\ x \leq 0,$

$= 1,\ x > 0.$

(v) $F(x) = 0,\ x \leq 0,$

$= 1,\ x > 0.$

(vi) $F(x) = 0,\ x < 0,$

$= 1,\ x \geq 0.$ (12)

(b) Among the functions above which really are distribution functions, which represent

(i) discrete distributions,
(ii) continuous distributions,
(iii) absolutely continuous distributions?

If a distribution above is discrete, which are the points carrying positive probability and what is the probability carried by each such point?

If a distribution above is absolutely continuous, find the density function. (10)

2. Consider the distribution P on $[0, 1]$ having density function $2x$. What is its expectation?

Suppose you are given a small positive quantity $\epsilon > 0$. Determine a partition of $[0,1]$ so that the lower and upper approximative sums of $\int^1 x\, dP$ lie between

$\int_0^1 x\, dP - \epsilon$ and $\int_0^1 x\, dP + \epsilon$. (16)

(Please turn over)

3. The random variable X has frequency function $f(x) = kx^2$ on $[-2, +1]$ and outside $[-2, 1]$. Determine the value of the constant k. Find the frequency function of the random variable X^2, Calculate $E(X^2)$. (20)

4. The random variable X takes values 1, 2, 3, ..., n.... with probabilities $\frac{k}{1^4}$, $\frac{k}{2^4}$, $\frac{k}{3^4}$, ..., $\frac{k}{n^4}$ ... respectively, where k is a constant.

How many moments does this distribution have? Give reasons. (12)

5. Prove that if a point 'a' carries zero probability (according to distribution on $(-\infty, \infty)$), the distribution function is continuous there. Point out where exactly in the proof you make use of countable additivity.

Give an example of a finitely additive interval function (defined on $(-\infty, \infty)$) for which the foregoing result is not true. (16)

6. X is a random variable having the normal distribution with mean 0 and s.d.1. Construct a continuous function $\phi(X)$ such that the distribution of $\phi(X)$ is neither continuous nor discrete.

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INDIAN STATISTICAL INSTITUTE
Research and Training School
Mid-year Examination

B.STAT. III YEAR

Statistics Theory

Duration: 3 hours | Maximum marks: 100 | Date: 4 December 1964.

1.(a) State Weierstrass' theorem which enables us to replace a function $\phi(x)$ by a polynomial in a given interval (x_0, x_n). What should be known about $\phi(x)$ in order to approximate it by Newton's forward interpolation formula? When do you use this formula? [10]

(b) Derive Simpson's one-third rule for mechanical quadrature. [10]

2.(a) Consider the equation $x - \phi(x) = 0$. Suggest a procedure for numerically evaluating an approximate root of this equation. [6]

(b) State and prove the conditions of validity of the above procedure. [6]

(c) Suggest a similar procedure to find an approximate solution of the following system of equations. [8]

$$x - \phi(x, y) = 0, \quad y - \psi(x, y) = 0.$$

3.(a) Ignoring finite population correction, compare the precisions of unbiased estimators of population mean based on a simple random sample of size n and a stratified simple random sample of the same size, with proportional allocation. [12]

(b) Explain when and how you can use a table of random numbers to draw a random sample of size n from a population where a characteristic X has the cumulative distribution function $F(x)$. [8]

4.(a) What do you understand by a statistical 'hypothesis'? [3]

(b) Define the terms 'simple' and 'composite' parametric hypotheses. In each of the following examples, examine whether the given hypothesis is simple or composite:

i) Two binomial populations $B(n_1, \pi_1)$ and $B(n_2, \pi_2)$; hypothesis: $\pi_1 = \pi_2$ [2]

ii) Two normal populations $N(\mu_1, 1)$ and $N(\mu_2, 4)$; hypothesis: $\mu_1 = \mu_2 + 3 = 10$. [2]

(c) How will you test

i) the hypothesis in case b(i); [5]
ii) the hypothesis $\mu_1 = \mu_2 + 3$ in case b(ii)? [5]

5.(a) Give precise definitions of errors of first and second kind of a test. [5]

(b) A characteristic X follows a probability density function $f(x, \theta)$. A random sample of size n is drawn and, to test the hypothesis $H_0 : \theta = \theta_0$, the following test procedure is adopted. Calculate the sample variance and, if it is non-negative, accept the hypothesis, otherwise, reject the hypothesis.

i) what is the critical region corresponding to this test? [2]

ii) what is the error of the first kind and, for any alternative $\theta = \theta_1$, what is the error of the second kind? [3]

Please turn over

5 (contd)

(c) A random variable obeys the 'triangular' distribution

$$f(x\,;\,\theta) = 1 - |\,x - \theta\,| \quad \text{when } \theta - 1 \leq x \leq \theta + 1$$
$$= 0 \quad \text{elsewhere.}$$

To test the hypothesis $\theta = 2$, one observation x is made and the following procedure adopted.

If $x < \frac{5}{4}$ or $> \frac{11}{4}$, reject the hypothesis.

i) Find the error of the first kind of this test. [5]

ii) If $\theta = \frac{2}{4}$, find the error of the second kind with respect to this value of θ. [5]

INDIAN STATISTICAL INSTITUTE
Research and Training School
Mid-year Examination

B. STAT. III YEAR

Statistics (Practical)

Duration 3 hours — Maximum marks: 100 — Date: 5 December 1964

1. The following table shows the values of an unknown function y for certain values of the argument x.

x	y
9	11
16	-24
25	75
36	416
49	805
64	1231

Find the value of x for which y has minimum by replacing y by a suitable polynomial.

[Note: If you replace x by $\sqrt{x}$, the independent variable becomes equally spaced].

2.(a) Draw two random samples of sizes 15 and 20 respectively from two normal populations $N(-2,1)$ and $N(3,5)$.

(b) Consider the first set of 15 values. Assuming that this is a random sample from a normal population $N(\mu, 1)$, test the hypothesis $\mu = 0$ against alternatives $\mu < 0$.

(c) Consider the two samples in (a) to have come from normal populations with unknown means μ_1 and μ_2 and variances 1 and 5 respectively. Test whether $\mu_1 - \mu_2 + 4 = 0$.

3. Candidates appeared at a competitive test at five centres. A simple random sample of scores was drawn from each centre and the sample mean and standard deviation were calculated. These are shown below.

Centre No.	1	2	3	4	5
No. of candidates	250	385	475	500	325
Sample size	12	15	20	25	18
Sample mean	40	55	20	15	60
Sample s.d.	10.9	12.5	13.4	20.8	35.0

Obtain an unbiased estimate of the overall average score and unbiased estimate of the variance of this estimate.

4. The following table gives p^H values for the arterial blood of dogs (a) breathing normally, (b) after a period of breathing air containing 5 percent carbon dioxide.

dog no.	p^H value (a)	p^H value (b)	dog no.	p^H value (a)	p^H value (b)
1	7.42	7.26	8	7.34	7.26
2	7.53	7.30	9	7.45	7.23
3	7.36	7.26	10	7.42	7.06
4	7.43	7.39	11	7.53	7.34
5	7.43	7.38	12	7.48	7.28
6	7.15	6.69	13	7.42	7.29
7	7.50	7.32			

Test the hypotheses: (i) p^H value does not change with CO_2,
(ii) p^H value does not decrease with CO_2,
both the hypotheses being tested first by taking each dog to have given two values and also considering the two sets of values as constituting two independent samples.

INDIAN STATISTICAL INSTITUTE
Research and Training School

Mid-year Examination

B. Stat. III Year

ECONOMICS

Duration: 3 Hours | Maximum Marks: 100 | Date: 10 December 1964

Separate Answer-book should be used for each Group

GROUP -A
(Answer any three questions)

1. How would you differentiate between the modern industrial economy and the economic system preceding it? (20)

2. Examine the pattern of economic growth in India, in terms of the relative shift in the position of the different sectors of the economy. (20)

3. "Agriculture, which could serve as the basis of rapid expansion of Indian economy, is today, acting as a brake, impeding its growth." – Comment. (20)

4. Would you agree with the assertion that Indian economic developed has been accompanied by a fairly satisfactory rate of expansion of welfare? (20)

5. In what respect has India's foreign Trade helped her economic development, during the period 1950-1 – 1960-1? (20)

6. Write short notes on the following :

   1) Terms of Trade.

   2) Adverse Balance of Payment.

   3) Foreign Exchange Reserves. (20)

GROUP – B

7. Discuss the problem of industrialisation and the different views about tackling them on the eve of the first five year plan of U.S.S.R. (20)

   Or,

   What was the 'Scissors Crisis' of the twenties in the U.S.S.R.? Trace the course of its development and discuss the steps taken to overcome it. (20)

8. 'Important developments in the economy at large had to occur before a realistic plan could be produced'. Critically examine the course of these developments. (20)

   Or,

   'In 1929 the maximum variant of the plan was accepted. But the assumptions on which this was done went wrong and there were difficulties. Give a broad outline of this variant. What were the assumptions and what steps were taken to meet those difficulties. (20)

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INDIAN STATISTICAL INSTITUTE
Research and Training School

Mid-year Examination

B.Stat. III Year

GEOLOGY THEORY

Duration: 3 Hours | Maximum Marks: 100 | Date: 11 December 1964

Answer SIX questions in all. Answer question No. 1 and 2 and two from each group.

1. What do you understand by the doctrine of organic evolution? State some of the evidences furnished by the study of fossils in support of evolution. (16)

2. Confirm or correct any five of the following statements, with reasons where necessary:

   i) Herbivorous dinosaurs used to live mainly on dicotyledonous plants.

   ii) Birds are glorified reptiles.

   iii) A rock-unit is defined essentially by the fossils contained therein.

   iv) Barauni petroleum refinery has been constructed in Bihar because petroleum is found along with coal in the Gondwana deposits of Bihar.

   v) Because of the presence of the principal raw materials for steel in sufficient quantity in the State of West Bengal, the location of Durgapur Steel Plant is justified.

   vi) India ranks first in the world in the deposit of Copper and Silver and last in the deposit of radioactive sands, for which India can produce very little atomic energy. (20)

Group A

3. Discuss the material basis of our technological civilisation. Compare and constrast the current standard of living in India with contemporary standards in U.S.A., U.S.S.R., U.K. and Japan on material terms. (16)

4. Make an estimate of the yearly production in important metals, minerals and power that would be necessary to sustain a standard of living in India in the year 2000 equal to that of Japan's in 1961. (Take into consideration the increase in population by the year 2000). Comment critically on the known resources of India in metals, minerals and power, in relation to your estimate. (16)

5. Answer the following to the points:

   i) What are the organic fuels? Where are they found in India?

   ii) What is the current Indian consumption of petroleum products and what is the projected consumption by the end of the fourth five year plan?

   iii) How many million tons of petroleum crude India produces now and wherefrom? How this production matches with that of U.S.A., U.K., U.S.S.R. and Japan?

   iv) In which era and rocks, the crude petroleum is found in India? (16)

(Please turn over)

Group B

6. What are the two basic principles of Stratigraphy? What would be the procedures in the working out of stratigraphy of sedimentary rocks of an area? (16)

7. Describe the different stratigraphic units. What relation can exist between a bio-stratigraphic unit and a rock-stratigraphic unit? (16)

8. Briefly review the stratigraphy of India. (16)

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INDIAN STATISTICAL INSTITUTE
Research and Training School
Periodical Examination

B. Stat. III year

MATHEMATICS

Date: 8 March 1986 | Maximum marks: 100 | Time: 3 hours

Answer separate group in separate answerscript.

GROUP A

1. Discuss the uniform convergence of the following series:

$$\sum_{n=0}^{\infty} \frac{1}{n^x} \ (x > 1), \quad \sum_{n=0}^{\infty} \frac{x^n}{n!} \ (x \text{ arbitrary}),$$

$$\sum_{n=0}^{\infty} (-1)^n \frac{x^{n+1}}{n+1}, \quad \sum_{1}^{\infty} \frac{\cos nx}{n} \quad (0 \leq x \leq 2\pi)$$ (20)

2. (a) Prove that if $\sum_{0}^{\infty} a_n x^n$ is a power series and if $r = \frac{1}{\mu}$ where

$$\mu = \overline{\lim_{n \to \infty}} \ |a_n|^{\frac{1}{n}},$$

then the series converges if $|x| < r$ and does not converge if $|x| > r$. What happens if $x = \pm r$?

b) Prove rigorously that the above series represents a function continuous in $]-r, r[$. (8 + 4)

3. Discuss completely the 'binomial' series $\sum_{0}^{\infty} \binom{\alpha}{n} x^n$ (α real) with regard to convergence and uniform convergence. (18)

GROUP B

1. A and B are linear transformations from a vector space into itself.

a) What can you say regarding the (i) nonsingularity, (ii) inverse, (iii) transpose and (iv) rank of AB in terms of the corresponding property of A and of B ? (8)

b) Give upper and lower bounds for the rank of A+B in terms of the ranks of A and B. (3)

2. An $n \times n$ Markov matrix is defined to be any $n \times n$ real matrix $A = ((a_{ij}))$ which satisfies the two properties

$$0 \leq a_{ij} \leq 1,$$

$$\sum_{j=1}^{n} a_{ij} = 1, \quad \text{for } i = 1, 2, \ldots, n.$$

Prove that the product of two Markov matrices is a Markov matrix. Also prove that A^k is a Markov matrix for all positive integers k. (8)

3. a) Formulate the problem of simultaneous linear equations in a matrix form. (2)

Please Turn Over

3.b) State and prove a necessary and sufficiency condition for the existence of solution to this problem. (8)

c) Show the existence of solutions to the following system of equations. Obtain the family of solutions by reducing the matrix of coefficients to the normal form.

$$x_1 - x_2 + x_3 = 2$$
$$3x_1 - x_2 + 2x_3 = -6$$
$$3x_1 + x_2 + x_3 = -18$$ (6)

4.a) State what changes the determinant of a square matrix undergoes on applying an elementary operation. Interpret this in terms of elementary matrices. (4)

b) Define the adjoint $\bar{A}$ of a square matrix A and show that

$$\det. \bar{A} = (\det. A)^{n-1}$$ (5)

c) Evaluate the determinant of

$$\begin{vmatrix} 18 & 11 & 13 \\ 27 & 23 & 26 \\ 45 & 87 & 92 \end{vmatrix}$$

by using results on elementary operations on matrices. (6)

INDIAN STATISTICAL INSTITUTE
Research and Training School
Periodical Examination
B. Stat. III year

PROBABILITY

Date: 15 March 1965 | Maximum marks: 100 | Time: $2\frac{1}{2}$ hrs.

1. P is the probability distribution whose range is $[-1, +1]$ and density function is $K.x^2$ where K is a constant. Determine the value of K.

   P_θ is the distribution obtained by shifting P bodily through a distance of θ. In other words, if P is the distribution of the random variable X, P_θ is the distribution of $(X + \theta)$.

   Now consider a population whose distribution is P_θ. We wish to estimate θ and draw a random sample of size 3.

   Show that the sample mean and the sample median are unbiassed estimators of θ.

   Compute the variances of the sample mean and the sample median. Which estimator is more efficient? (35)

2. The joint distribution of X and Y has density function $K.xy$ inside the triangle whose vertices are $(0, 0)$, $(1,0)$ and $(0, 2)$ and zero outside this triangle. Determine the value of the constant K.

   a) Compute $E(X), E(Y), E(X+Y), E(XY)$. Is $E(XY) = E(X).E(Y)$ in this case?

   b) Obtain the density function of X and that of Y.

   c) Are X and Y independent?

   d) Obtain the density function of XY. (35)

3. a) State and prove Tchebycheff's inequality. (15)

   b) Define the spectrum of a one-dimensional distribution and prove that it is a closed set. (15)

INDIAN STATISTICAL INSTITUTE
Research and Training School
Statistics
Second Periodical Examination

B. Stat. III Year

Duration: 2½ hours | Maximum Marks: 100 | Date: 22 Februrary 1965

1(a) A critical region ω_0 is uniformly most powerful of size α for testing the hypothesis $\theta = \theta_0$ about the parameter θ of a probability density $f(x ; \theta)$. Prove that the power curve of ω_0 will lie above the horizontal line at distance α parallel to the axis of θ. [10]

(b) For $f(x ; \theta) = \frac{1}{\theta \cdot \sqrt{2\pi}} e^{-\frac{x^2}{2\theta}}$, $\theta > 0$

obtain a uniformly most powerful test for the hypothesis $\theta = \theta_0$ against alternatives $\theta > \theta_0$. [10]

2(a) State and prove Neyman-Pearson's lemma. [10]

(b) Use this lemma to derive a locally unbiased most powerful test for the hypothesis $\theta = \theta_0$ regarding the parameter θ of $N(\theta, \sigma^2)$ where σ^2 is a known quantity. [15]

3. Derive an unbiased estimate of the mean of a population characteristic when a sample of size two is selected from the population without replacement and with probability proportional the size of the unit. Obtain its variance. [15]

4. Discuss without the derivation of any formulae the different methods of increasing the precision of the estimate of population mean.

Show that the ratio estimate $\hat{Y}_R$ produces more precise results only if the correlation coefficient of the variables Y and X is greater than half of the ratio of coefficient of variation of $\bar{X}$ to the coefficient of variation of $\bar{Y}$. [20]

5. In a paddy field a certain number of plots were selected at random to estimate the total yield of grain (Y) of the field. The total produce of grain with straw (X) of the field was weighed. From the sample plots the weight of grain (y_i) and weight of grain with straw (x_i) were obtained. The coefficients of variation were obtained to be $C_{yy} = 1.13$, $C_{yx} = 0.78$ and $C_{xx} = 1.11$.

i) Suggest two methods of estimating the total produce of grain. [10]

ii) Compute the gain or loss in precision by the ratio method of estimation compared to estimation only from the y_i. [10]

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INDIAN STATISTICAL INSTITUTE
Research and Training School
Periodical Examination
B. Stat III year
ECONOMICS

Date: 22 March 1965. Full marks : 100 Time: $2\frac{1}{2}$ hrs

Answer any four questions. All questions carry equal marks.

1. What do you understand by the terms economic development and under development.

2. How would you characterise the economic structure of India as it stood in 1950-51? Illustrate ~~such~~ your answer with some examples of the sectoral break down.

3. Briefly review the evolution of ideas regarding economic planning in India with particular references to the question of priorities in investment.

4. How would you distinguish between the long-term perspectives of the first three plans of India?

5. 'The First 5-year Plan can hardly claim credit for the performance of the Indian economy during its duration' comment.

6. Critically examine the achievements of the first three 5-year plans of India.

INDIAN STATISTICAL INSTITUTE
Research and Training School
Periodical Examination

B. Stat. III year

Engineering

Date: 1 March 1965 — Maximum marks 50 — Time: $1\frac{1}{2}$ hours

1. A beam, simply supported at its ends, is required to carry a uniformly distributed load of 3/4 ton / ft. (including its own weight) along the whole span. If the maximum stress due to bending is not to exceed 8 tons per square inch and the maximum deflection is not to be greater than 1/400 (span), determine the greatest span for which a 12 in. X 5 in. R. S. J. could be used.

   For a 12 in. X 5 in, $I = 220.1$ in^4

   E for steel = 13,000 tons / in^2.

   For the span determined, state clearly the values of the maximum bending stress and maximum deflection. (25)

2. a) A horizontal beam AB of constant flexural rijidity is simply supported at its ends and has a span of 18 feet. It carries uniformly distributed vertical loading of 0.5 Ton per foot over its whole length together with a vertical load of 1 ton at 8 feet from the end A.

   Sketch the shearing force and bending moment diagrams for the beam indicating all main values.

   b) If the above beam carrying uniformly distributed loading of 0.5 ton per feet only over its whole length, is rijidly fixed at the left hand A and simply supported on non-yielding support at the right hand B find the reaction at the support B.

INDIAN STATISTICAL INSTITUTE
Research and Training School

Periodical Examination

B. Stat. III Year

SOCIOLOGY

Duration: 2½ hours   Maximum Marks: 100   Date: 5 April 1965

Answer Question 1 and any 3 from the rest.

1. Define Society, Social group and Social event. "Sociology is the scientific study of human society." - Elucidate.

2. Define Kinship. Explain the importance of the study of Kinship in our social life.

3. Why is the family an omnipresent social institution?

4. What are endogamy and exogamy? How do they influence caste-formations?

5. Define marriage. Enumerate different forms of marriage with examples from Indian life.

6. Write notes on :-

(a) Unilateral groupings, (b) Lineage, (c) Genealogical Method,
(d) Matrikins, (e) Gotra and (f) Rank.

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INDIAN STATISTICAL INSTITUTE
Research and Training School
Annual Examination, 1965
B. Stat. III Year

MATHEMATICS 1

Duration: 3 hours. Maximum marks: 100 Date: 19.5.1965

1.a) Let $a_0, a_1, a_2, \ldots$ be a sequence of real constants. If

$$\lim_{n \to \infty} |a_n|^{1/n} = 0$$

show that the power series $\sum_{n=0}^{\infty} a_n x^n$ converges for all x and uniformly over every bounded interval of x-values. (10)

b) Deduce rigorously that the function which it defines, namely

$$f(x) = \sum_{n=0}^{\infty} a_n x^n$$

is indefinitely differentiable everywhere. (10)

2.a) Let S and C be functions of x defined by the power series

$$S(x) = \sum_{n=0}^{\infty} (-1)^n \frac{x^{2n+1}}{(2n+1)!}, \quad C(x) = \sum_{n=0}^{\infty} (-1)^n \frac{x^{2n}}{(2n)!}$$

Show that S and C are defined everywhere and are indefinitely differentiable. (5)

b) The ' denoting differentiation, show that

$$S' = C, \quad C' = -S$$ (5)

c) Prove the identities

$$C(x+y) = C(x)C(y) - S(x)\,S(y)$$
$$S(x+y) = S(x)C(y) + C(x)\,S(y)$$

for all x and y. (10)

d) Prove that C and S are periodic functions. (20)

e) Identity their periods with 2π, the length of the circumference of the circle of unit radius in the plane. (10)

3.a) Examine for uniform convergence the series

$$\sum_{n=1}^{\infty} (-1)^{n-1} \frac{x^n}{n}$$

and establish that the series uniformly converges in any interval of the form $-1 + \delta \leq x \leq 1$, but not in the interval $-1 < x < 1$. (15)

b) Use the identity

$$\frac{1}{1+x^2} = 1 - x^2 + x^4 - \cdots + (-1)^n x^{2n} + \cdots \quad (|x| < 1)$$

to prove rigorously that

$$\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \cdots$$ (15)

INDIAN STATISTICAL INSTITUTE
Research and Training School
Annual Examination, 1965
B. Stat. III Year
MATHEMATICS II

Duration: 3 hours | Maximum marks: 100 | Date: 20.5.1965

1.a) Show that in the vector space of real n-tuples, the vectors $(1,1,\ldots,1)$, $(0,1,1,\ldots,1)$, $(0,0,1,1,\ldots,1)$, ..., $(0,0,0,\ldots,0,1)$ are linearly independent. (4)

b) Prove the existence of orthonormal basis in a finite-dimensional inner product space, explaining the construction of such a basis. (10)

c) Define an orthogonal matrix. Construct a 3×3 orthogonal matrix whose first row is

$$\left(\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}} \right)$$ (6)

2.a) Show that the set of linear functionals on an n-dimensional vector space V, is a vector space; call it V*. (6)

b) Given a basis $\{\alpha_1, \alpha_2, \ldots, \alpha_n\}$ for V, find a basis for V*. (10)

3.a) Explain the term 'normal' form of a matrix. (3)

b) Factor the following matrix, into a product of elementary matrices, by reducing to normal form:

$$\begin{pmatrix} 1 & -1 & 0 \\ -1 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$ (8)

4.a) State Cramer's Rule for solving a set of simultaneous equations in n unknowns. (4)

b) Applying this rule, solve for x, y, z :

$$\begin{aligned} x + 2y + z &= 4 \\ x - y + z &= 5 \\ 2x + 3y - z &= 1 \end{aligned}$$ (10)

c) For what values of x is the following matrix singular ?

$$\begin{pmatrix} 3-x & 2 & 2 \\ 1 & 4-x & 1 \\ -2 & -4 & -1-x \end{pmatrix}$$ (5)

5.a) State the Cayley - Hamilton Theorem. (3)

b) Apply the theorem to the matrix

$$\begin{pmatrix} 1-c+c^2 & 1-c \\ c(1-c) & c \end{pmatrix}$$

and find its inverse. (10)

6.a) Establish the correspondence between real quadratic forms and real symmetric matrices. (5)

b) For the matrix

$$A = \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix},$$

i) find the eigenvalues and a set of eigenvectors which form an orthonormal basis. (6)

ii) Obtain an orthogonal matrix P such that PAP' is diagonal. (10)

INDIAN STATISTICAL INSTITUTE
Research and Training School
Annual Examination 1965
B.Stat.III Year
PROBABILITY

Duration: 3 hours | Maximum Marks: 100 | Date: 24.5.1965

1. X and Y are two random variables we know that $E(X)=\lambda$, $E(Y) = 1$, $E(X^2) = 5$, $E(Y^2) = 2$, correlation coefficient of X and Y is $\frac{1}{10}$. Obtain the correlation coefficient of $(X + 2Y)$ and $(X - Y)$. (7)

2. a) Prove that a covariance matrix is non-negative definite. (7)

   b) The covariance matrix of X, Y and Z is

$$\begin{pmatrix} 2 & 1 & 1 \\ 1 & 3 & 0 \\ 1 & 0 & \alpha \end{pmatrix}$$

   In the joint distribution of X, Y and Z, the whole probability lies on a plane. Determine the value of α.

   What is the correlation coefficient of X and Z?

   Does the whole probability lie on a straight line? Give reasons.
   (5 + 5 + 3) =13

3. In the joint distribution of X and Y, the whole probability lies inside the triangle whose vertices are (0,0), (1,0) and (0,1). The density function inside this triangle is $K(x+y)$.

   a) Determine the value of K. (7)

   b) Obtain $E(X)$, $E(Y)$, $E(XY)$. $(3 \times 6) =$ (18)

   c) Obtain the density function of X. (7)

   d) Obtain the density function of XY. (7)

   e) Are X and Y independent? (3)

4. $C_n \cdot e^{-\underline{x}' A \underline{x}}$, where $\underline{x}' = (x_1, \ldots, x_n)$ and A is positive definite is a probability density function. Determine the value of C_n (in a neat, compact form).
   Show that the covariance matrix of the distribution is A^{-1}. (10)

5. Consider a simple random sample of size 7 from the distribution whose density function is $2x$ on $[0, 1]$.
   Obtain the density functions of

   a) the least observation, and (7)

   b) the sample median. (7)

6. $F(x)$ is the distribution function of one-dimensional distribution. Prove that $F(x) \to 0$ as $x \to -\infty$. Point out where exactly you make use of countable additivity.. (7)

INDIAN STATISTICAL INSTITUTE
Research and Training School
Annual Examination, 1965
B. Stat. III Year

STATISTICS THEORY

Duration: 3 hours Maximum marks : 100 Date 25.5.1965

1.a) For estimating the parameter θ of a p.d.f. $f(x; \theta)$ from a random sample of size n, obtain the Cramer - Rao lower bound to the variance of an unbiased estimator. (6)

b) Derive a set of necessary and sufficient conditions that the variance of an unbiased estimator does attain the bound in 1(a). (8)

c) Verify the above conditions for finding the uniformly minimum variance unbiased estimator of σ^2 when the population is $N(0, \sigma^2)$. (6)

2.a) Using the Neyman - Pearson lemma obtain a most powerful test for testing the hypothesis $p = p_0$ against an alternative $p = p_1$ in random samples of size n from a Bernoulli population with parameter p. Examine whether your test is uniformly most powerful for some class of alternatives. (7)

b) Define the 'likelihood ratio criterion' for testing a composite hypothesis. (5)

c) $x_1, \ldots, x_m, x_{m+1}, \ldots, x_{m+n}$ are m+n independent observations of which each of $x_1, \ldots, x_m$ have come from $N(0, \sigma_1^2)$ and each of $x_{m+1}, \ldots, x_{m+n}$ from $N(0, \sigma_2^2)$. Obtain the likelihood ratio test for the hypothesis $\sigma_1^2 = \sigma_2^2$ and show how F-distribution is helpful in carrying out this test. (8)

3.a) Define 'confidence intervals.' (4)

b) Show how the likelihood function can be used to obtain confidence intervals for large samples. (8)

c) Use the above method to obtain a confidence interval for the mean of a Poisson population. (8)

4. Consider a population of N units numbered in some order from 1 to N.

a) Describe how you would obtain an 'every k-th' systematic sample. (4)

b) Show that if N is a multiple of k, the mean of a systematic sample is an unbiased estimator of the population mean. (6)

c) Obtain the conditions under which systematic sampling is more precise than simple random sampling. (10)

5. EITHER

a) Explain the methods of increasing precision of estimates of treatment comparisons in experimental designs. (10)

b) Assuming a suitable linear model, derive the analysis of variance table for a randomised block design. (10)

OR

a) Write in brief and precise terms the relative advantages and disadvantages of the randomised block and Latin square designs. (10)

b) Assuming randomisation only derive the analysis of variance table for a completely randomised design with t treatments with unequal replications. (10)

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INDIAN STATISTICAL INSTITUTE
Research and Training School
Annual Examination, 1965
B. Stat. III Year

STATISTICS PRACTICAL

Duration: 3 hours | Maximum marks: 100 | Date: 25.5.1965

1. Compute $\log_e 4$ by evaluating a definite integral using Simpson's $\frac{1}{3}$-rule of mechanical quadrature by taking the integrand at equal intervals of width 0.1. What is the number of places of decimals upto which log 4 is obtained without error?

[You may use the relation $\log_e 4 = 2 \log_e 2$] (15)

2. The population figures for 120 villages in a certain region are known for the year 1961, from which the total population of these villages is found to be 1,48,500. A simple random sample with replacement of 10 villages from the above list was drawn in 1964, and the populations of these villages are shown in the following table:

Sample village No.	Population 1961	Population 1964
1	1534	2305
2	955	1200
3	2080	2150
4	1180	850
5	808	605
6	1850	2250
7	3034	4280
8	4050	5360
9	658	508
10	2355	1260

a) i) Obtain an unbiased estimate of the total population of the 120 villages in 1964, using the data of 1964 only. (6)

ii) Give the estimated variance of your total in (i). (9)

b) i) Obtain an estimate of the total population of the 120 villages in 1964, using the data for 1961 as auxiliary information. (9)

ii) Compute the precision of this estimate. (15)

c) Compare the results in (a) and (b) and give your comments. (6)

3.a) Obtain a randomised Latin Square of order 3 and describe your procedure. (8)

b) It was suggested that different treatments applied on apples affect their sales. In a particular market, numbers sold per 20 customers of each of 4 differently treated apples (treatments A, B, C and D) are recorded on 6 days of a week.

	Mon.	Tues	Wed.	Thus.	Fri.	Sat.
A	35	55	25	65	70	65
B	20	40	10	10	45	30
C	24	25	35	12	35	45
D	31	30	15	6	30	25

i) Test the hypothesis that the treatments have no differential effects on sale. (20)

ii) Test if (α) the treatment A and D have different effects, (β) treatment A is superior to treatment D. (12)

INDIAN STATISTICAL INSTITUTE
Research and Training School
Annual Examination, 1965
B. Stat. III Year

ECONOMICS I

Duration: 3 hours | Maximum marks : 100 | Date : 18. 5. 1965.

Answer different group in separate answerscripts

GROUP A

Maximum marks: 60

Answer any three questions

1. Describe the major structural characteristics of the Indian economy in 1950-51. To what extent would you consider them as typical of an under developed economy ? (20)

2. Comment on the view thqt the process of evolution of ideas regarding economic planning in India began more than 25 years ago. (20)

3. How would you distinguish between the first three five year plans of India in terms of shifts in their basic strategies ? Were these shifts along sound lines ? (12 + 8) = (20)

4. Critically examine the developments in the sphere of Indian agriculture and their impact on planning efforts in India during the period 1950-1 - 1960-1. (20)

5. 'The continued existence of the private sector in the Indian economy is quite consistent with planned economic development'. Do you agree? (20)

6. What are the measures taken by the Government of India for mobilisation of resources? Discuss their effectiveness. (12 + 8) = (20)

GROUP B

Answer any one question. (Max. marks: 20)

7. Discuss the view that administrative fixation of prices is hampering the growth of the Soviet economy. (20)

8. Discuss the recent changes in the organization and management of the economy of the U.S.S.R. (20)

GROUP C

Maximum marks : 20

Answer any one question

9. a) State with the help of Domar's model the conditions necessary for growth of an economy with full utilization of capacity. (12)

b) Discuss the effects on the level of employment and capacity utilization when the rate of growth falls short of the equilibrium rate. (8)

10. a) Derive the income path over time from the Mahalanobis two-sector model. Examine critically the assumptions underlying. (12)

b) Show that the model does not allow for an independent savings function. (8)

INDIAN STATISTICAL INSTITUTE
Research and Training School
Annual Examination, 1965
B. Stat. III Year
ECONOMICS II

Duration: 3 hours   Maximum marks : 100   Date: 18.5.1965

Answer any five questions.

1. How do you account for the continuous rise in consumer prices since 1962 ? Would the extension of state trading to essential articles help to arrest the process ? (13 + 7) = (20)

2. Review the nature of changes in the structure of India's foreign trade since 1950-1. To what extent does it reflect changes in the structure of the economy ? (5 + 15) = (20)

3. Outline the principal developments in the sphere of banking in India since 1950-1. Examine the role the banking system has played in the country's economic development. (7 + 13) = (20)

4. How would you differentiate between the functions of the Reserve Bank of India and the State Bank of India ? Would you agree with the view that monetary policy loses its relevance in a planned economy ? (13 + 7) = (20)

5. Briefly review the trend in the expansion of rural credit since 1950-1 . How far has it corresponded to the need of developmental finance for agriculture ? (10 + 10) = (20)

6. To what extent has the union budget kept pace with the twin aims of ensuring a rapid rate of economic development and reduction of social inequalities ? (20)

7. Do you think that the loans raised by the Government during the Planning period, the methods used and sources tapped have been economically sound ? (10 + 10) = (20)

8. There is a growing tendency among the state Governments to depend more and more for their developmental expenditure on loans and grants from the centre, rather than mobilising resources within the States. Is one tendency justified ? (20)

INDIAN STATISTICAL INSTITUTE
Research and Training School
Annual Examination, 1965
B. Stat. III Year

BIOLOGY

Duration: 3 hours | Maximum marks: 100 | Date: 21.5.1965

Answer any five questions

1. Give statistics on the area under and production of rice in the important agricultural regions of the world. Explain why the yield of rice per hectare in Japan and China is greater than in India or Pakistan. Suggest methods of improving the yield of rice in India. (8 + 6 + 6) = (20)

2. Give an illustrated account of the spikelets in a grain sorghum. Compare them with the spikelets of rice and any species of wheat. (8 + 12) = (20)

3. Mention the scientific names of ten plants which yield fibre of commercial value. Give morphological description of any of the fibre plants with illustrations. (5 + 10 + 5) = (20)

4. Write short notes on any four of the following

   a) Coimbatore sugarcanes
   b) Clonal propagation in the cocoanut
   c) Heterosis,
   d) Inbreeding minimum
   e) Accessory chromosome (4 × 5) = (20)

5. Write a detailed account of the methods of breeding cross-fertilising crops. Why selection for vigour in inbred lines is likely to delay the attainment of complete homozygosity ? (14 + 6) = (20)

6. What is polyploidy ? How can you artificially induce a polyploid ? What is the role of polyploidy in evolution and practical agriculture ? (4 + 6 + 10) = (20)

INDIAN STATISTICAL INSTITUTE
Research and Training School
Annual Examination, 1965
B. Stat. III Year

ENGINEERING

Duration: 3 hours Maximum marks : 100 Date: 22.5.1965

a) Attempt any five questions
b) All questions carry equal marks

1.a) Develop a formula for the theoretical discharge over a V-notch.

Explain the way in which this may be modified to give the actual discharge, giving reasons why the theoretical discharge does not agree with the actual discharge.

b) A 90 degree V-notch has a coefficient of discharge of 0.62. Calculate the discharge when the observed head is 3 feet above the bottom of the V.

2.a) Define coefficients for flow from orifices.

b) A vertical cylindrical Tank, 1 feet in diameter, has a 3/4 " dia. orifice in the base. In an experiment to determine the coefficient of discharge of the orifice, readings were taken of the head H above the orifice and the time t. When discharging freely, the following results were obtained:-

H feet	3.0	2.75	2.5	2.25	2.0	1.75	1.5	1.25	1.0
t seconds	0	7.6	15.5	23.9	32.8	42.1	52.3	63.3	75.4

Determine the coefficient of discharge.

3. a) Derive Bernoulli's equation for the flow of an incompressible, frictionless fluid.

b) A venturimeter fitted to a pipe of 18 " bore has a throat diameter of 8 ". Find the quantity of water flowing when the venturihead is 7 " of water. Take coefficient of discharge, C_d. = 0.06.

4.a) A diver is working on the sea bottom at a depth of 74 feet. What is the pressure, above atmosphere, in pounds per square inch, at this depth? 1 cuft. sea water weighs 64 lb.

b) A circular plate 4 feet diameter is placed vertically in water so that the centre of the plate is 4 feet below the surface. Find the depth of the centre of pressure and the total pressure on the plate. Prove any formula which you use.

5.a) A masonry dam of rectangular cross-section of 20 feet high and 10 feet wide has the water level with its top. Find (1) the total pressure on 1 foot length of the dam, (2) the point at which the resultant cuts the base. The weight of 1 cuft. of masonry is 120 lbs.

b) Write your conclusions about the stability of the dam from your answers.

6. A beam of span L carries a downward load of intensity w lb./unit length on the right hand half of the span and an upward load of wL/4 at mid span. Calculate the deflection at the centre of the span. Derive any formula you use.

7. In a torsion experiment, a steel test price 3/4 inch. diameter is subjected to a gradually increasing torque. When the torque reaches 1500 lb. inches, the angle of twist is 1.20 degrees in a length of 5 " Determine (a) the maximum shearing stress and (b) the modulus of rigidity of steel. Derive any formula, which you use.

INDIAN STATISTICAL INSTITUTE
Research and Training School
Annual Examination, 1965
B. Stat. III Year

SOCIOLOGY

Duration: 3 hours | Maximum marks: 100 | Date: 26.5.1965

Answer question '5' and any three from the rest.

1. What is Social Structure ? How can you ascertain the Social Structure of a given society ? (25)

2. Discuss the role of social research in the context of Five Year Plans for India's development. (25)

3. EITHER

Distinguish between 'Customary' and 'Contractual' institutions. Compare briefly their roles in primitive and modern societies. (25)

OR

Define 'Voluntary Association'. How do you distinguish it from 'Institution'? Illustrate your answer from primitive and modern societies. (25)

4. EITHER

What do you mean by 'Incorporeal' and 'Corporeal' property ? Write briefly the concept of property in simple and civilized society. (25)

OR

Write short notes indicating the social significance attached to the following customs:-

(a) lobola (b) kula and (c) potlatch (25)

5.

5. Discuss with examples the need for the application of statistical methods in the study of sociology. (25)
