SHIVAJI UNIVERSITY, KOLHAPUR.

****

Accredited by NAAC with 'A^{++}' Grade

CHOICE BASED CREDIT SYSTEM

Syllabus

For

B.Sc. Part – II Statistics

SEMESTER III and IV

AS PER NEP 2020

To be implemented from academic year 2023-24

B. Sc. Part – II Semester – III
DSC–C7: STATISTICS –V
(Probability Distributions – I)
Theory: 36 hrs. Marks -50 (Credits: 02)

Course Outcomes: The students will acquire knowledge of

i) bivariate discrete distributions with real life situations.

ii) continuous random variable and find the various measures, probabilities using its probability distribution.

iii) transformation of univariate continuous random variable.

iv) some standard continuous probability distributions with real life situations.

v) the relations among the different distributions.

$p \leq 1, n$

CONTENTS:

Unit-1: **(18 hrs.)**

1.1 Some Bivariate Discrete Distributions:

Trinomial Distribution: Introduce Trinomial as extension of Binomial distribution. Definition, p.m.f., Notation: $(X_1, X_2) \sim Tri(n, p_1, p_2, p_3)$, $0 \leq p_1, p_2 \leq 1$; $p_3 = 1 - p_1 - p_2$ and n is positive integer. p.g.f., means, variances and covariance using p.g.f., correlation coefficient. Distribution of X_1+X_2 using p.g.f.

Generalization of Trinomial to Multinomial distribution. The marginal distribution of X_i, conditional distribution of X_i given X_j, conditional mean and conditional variance of X_i given X_j, $Cov(X_i, X_j)$ for i, j =1, 2.

Variance - covariance matrix of (X_1, X_2). Correlation coefficient between X_1 and X_2. Examples and problems.

Bivariate Poisson Distribution: Definition, p.m.f. Notation: $(X_1, X_2) \sim BP(\lambda_1, \lambda_2, \lambda_3)$, $\lambda_i > 0$ for i = 1, 2, 3. The marginal distribution of X_i, conditional distribution of X_i given X_j, conditional mean and conditional variance of X_i given X_j, $Cov(X_i, X_j)$ for i, j =1, 2. Variance - covariance matrix of (X_1, X_2). Correlation coefficient between X_1 and X_2. Examples and problems.

1.2 Univariate Continuous Distributions:

Definition of the continuous sample space with illustrations, Definition of continuous random variable (r. v.), probability density function (p. d. f.), cumulative distribution function (c. d. f.) and its properties.

Expectation of r. v., expectation of function of r. v., mean, median, mode, quartiles, variance, harmonic mean.

Raw and central moments, skewness and kurtosis, examples.

Moments generating function (m. g. f.): Definition and properties: (i) Standardization property $M_X(0) = 1$, (ii) Effect of change of origin and scale, (iii) Uniqueness property of m. g. f., if exists, (statement only).

Generation of raw and central moments. Cumulant generating function (c. g. f.): Definition, relations between cumulants and central moments (up to order four). Examples.

Transformations of univariate continuous random variable: Transformation of univariate continuous r. v.: Distribution of Y = g(X), where g(.) is monotonic or non-monotonic functions by using (i) Jacobian of transformation, (ii) Distribution function and (iii) m. g. f. methods. Examples and problems.

Unit-2: **(18 hrs.)**

2.1 Some Univariate Continuous Distributions defined on Finite Interval :

Uniform distribution: Definition of Uniform distribution over (a, b), c.d.f., m.g.f., mean, variance, moments. Distribution of: (i) (X– a) / (b–a), ii) (b–X) / (b–a), (iii) Y = F(X), where F(.) is c.d.f. of any continuous r.v. X.

Beta distribution of first kind: Beta distribution of first kind with parameters m & n. Mean, mode, variance, symmetric when m = n. Uniform distribution as a particular case when m = n = 1, distribution of (1–X).

2.2 Some Univariate Continuous Distributions defined on Infinite Interval :

Beta distribution of second kind: Beta distribution of second kind with parameters m & n. Mean, mode, variance, relation between beta distribution of first kind and second kind.

Exponential Distribution: p.d.f. with parameter θ (θ > 0):

$$f(x;\theta) = \begin{cases} \theta e^{-\theta x} & \text{if } x > 0 \\ 0 & \text{if otherwise} \end{cases}$$

c.d.f., m.g.f., c.g.f., mean, variance, C.V., moments, Cumulants, median, quartiles, lackof memory property, and distribution of $-\theta \times \log_e(X)$, where X~U (0, 1).

Gamma distribution: Gamma distribution with scale parameter θ and shape parameter n. Special case when θ = n = 1. m.g.f., c.g.f., mean, mode, variance, moments, cumulants, β_1, β_2, γ_1 and γ_2 coefficients, additive property: distribution of sum of i.i.d. exponential variates.

Laplace (Double Exponential) Distribution: p.d.f. with parameters μ and θ ($-\infty < \mu < \infty$ and $\theta > 0$):

$$f(x;\theta,\mu) = \begin{cases} \frac{\theta}{2} e^{-\theta|x-\mu|} & \text{if } -\infty < x < \infty \\ 0 & \text{if otherwise} \end{cases}$$

Nature of the probability curve, Distribution function, quartiles, moment generating function, mean, variance, moments, β_1, β_2, γ_1 and γ_2 coefficients.

Laplace distribution as a distribution of the difference of two i.i.d. exponential variates with parameter θ, examples and problems.

References and Recommended Readings:

1) Parimal Mukhopadhyaya: An Introduction to the Theory of Probability. World Scientific Publishing.

2) Hogg R. V. and Criag A.T.: Introduction to Mathematical Statistics (Third edition), Macmillan Publishing, New York.

3) Gupta S. C. & Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.

4) Goon, A.M., Gupta M.K. and Dasgupta B: Fundamentals of Statistics Vol. I andVol. II World Press, Calcutta.

5) Mood A.M., Graybill F.A.: Introduction to theory of Statistics. (Chapter II, IV, V,VII) and Boes D.C. Tata, McGraw Hill, New Delhi. (Third Edition)

6) Walpole R.E. & Mayer R.H.: Probability & Statistics. (Chapter 4, 5, 6, 8, 10) MacMillan Publishing Co. Inc, New York.

B. Sc. Part – II Semester – III
DSC–C8: STATISTICS –VI
(Statistical Methods–I)
Theory: 36 hrs. Marks -50 (Credits: 02)

Course Outcomes: The students will acquire knowledge of

i) obtaining multiple linear regression equations and their applications.

ii) the concept of multiple correlations, partial correlation and their computations.

iii) need, construction and utility of various index numbers.

iv) the concepts related to national income and different methods of estimation of national income.

$p \leq 1, n$

CONTENTS:

Unit-1: **(18 hrs.)**

1.1 Multiple Linear Regression (for trivariate data only): Concept of multiple linear regression, Plane of regression, Yule's notation, correlation matrix. Fitting of regression plane by method of least squares, definition of partial regression coefficients and their interpretation. Residual: definition, order, properties, derivation of mean and variance, Covariance between residuals. Residual plot.

1.2 Multiple and Partial Correlation (for trivariate data only): Concept of multiple correlations. Definition of multiple correlation coefficient $R_{i.jk}$, derivation of formula for multiple correlation coefficient. Properties of multiple correlation coefficient;

(i) $0 \leq R_{i.jk} \leq 1$, (ii) $R_{i.jk} > |r_{ij}|$, (iii) $R_{i.jk} > |r_{ik}|$, $i \neq j$, $i \neq k$, i, j, k = 1, 2, 3. Interpretation of $R_{i.jk} = 1$ and $R_{i.jk} = 0$, coefficient of multiple determination $R^2_{1.23}$. Concept of partial correlation. Definition of partial correlation coefficient $r_{ij.k}$, derivation of formula for $r_{ij.k}$. Properties of partial correlation coefficient; (i) $-1 \leq r_{ij.k} \leq 1$, (ii) $b_{ij.k} \times b_{ji.k} = r^2_{ij.k}$. Examples and problems

Unit-2: **(18 hrs.)**

1.1 Index Numbers: Meaning and utility of index numbers, problems in construction of index numbers. Types of index numbers: price, quantity and value. Unweighted and weighted index numbers by using (i) aggregate method, (ii) average of price or quantity relative method (A.M. or G.M. is to be used as an average). Index numbers by using; Laspeyres, Paasche's, and Fishers formula. Tests of index numbers: Unit test, time reversal test and factor reversal tests. Cost of living index number: definition, construction by using (i) Family Budget and (ii) Aggregate expenditure method. Purchasing power of money**.**

2.2 National Income: (i) Definitions of national income by (a) Marshall, (b) Pigou and (c) Fisher. **(ii)** Different concept of national income (a) gross national product (GNP), (b) net national product (NNP). (**iii)** Personal income, disposable income, per capita income, gross domestic product (GDP), national income at market price, national income at factor cost, national income at current prices, national income at constant prices. (**iv)** Methods of estimation of national income and the difficulties in methods. (a) output method, (b) income method, (c) expenditure method. **(v)** Importance of national income.

References and Recommended Readings:

1) Cochran, W.G: Sampling Techniques, Wiley Eastern Ltd., New Delhi.
2) Des Raj: Sampling Theory.
3) Gupta S. C. and Kapoor V. K., "Fundamentals of Applied Statistics", Sultan andChand.
4) Dr. Kore B. G. and Dr. Dixit P. G.: "Statistical Methods-I", Nirali Prakashan, Pune.
5) Mukhopadhay, Parimal: Theory and Methods of Survey Sampling, Prentice Hall.
6) Srivastav D. S: A Text book of Demography.
7) Sukhatme, P.V. and Sukhatme, B.V.: Sampling Theory of Surveys with Applications, Indian Society of Agricultural Statistics, New Delhi.

8) M. K. Jhingan : Macro Economic Theory : Vrinda Publications Pvt. Ltd. New Delhi
9) R. D. Gupta : Keynes Post – Keynesian Economics : Kalyani Publishers, New Delhi.
10) M. L. Sheth : Macro Economics : Lakshmi-Narayan Agarwal education publishers, Agra
11) H. L. Ahuja : Modern Economics : S. Chand publishers, New Delhi.
12) Goon A. M., Gupta M. K., Das Gupta B. : Fundamentals of Statistics, Vol.I and II,World Press, Calcutta.
13) Gupta S. P. : Statistical Methods, Sultan Chand and Sons, New Delhi.
14) Gupta V.K. & Kapoor S.C. Fundamentals of Mathematical Statistics.- Sultan & Chand
15) Gupta V.K. & Kapoor S.C. Fundamentals of Applied Statistics.- Sultan & Chand

B. Sc. Part – II Semester – IV
DSC–D7: STATISTICS –VII
(Probability Distributions – II)
Theory: 36 hrs. Marks -50 (Credits: 02)

Course Outcomes: The students will acquire knowledge of

i) some standard continuous probability distributions with real life situations.

ii) finding the various measures of continuous random variable and probabilities by using its probability distributions.

iii) the relationships among different distributions.

iv) continuous bivariate r.vs. and probability distributions of their transformations.

v) concept of sampling distribution of a statistic.

vi) some sampling distributions of a statistic : Normal, Chi-Square, t and F distributions with their applications and interrelations.

CONTENTS:

Unit-1: **(18 hrs.)**

1.1 Normal distribution: Normal distribution with parameters μ & σ^2, Definition of standard normal distribution, properties of normal curve, m.g.f., c.g.f., mean, variance, median, mode, mean deviation, moments, cumulants, measures of skewness & kurtosis, distribution of linear combination of variates. Distribution of X^2 , where X~N(0,1).

1.2 Continuous Bivariate Distributions: Definition of bivariate continuous r. v. (X, Y), Joint p.d.f., c.d.f. with properties, marginal and conditional distribution, independence of r. vs., evaluation of probabilities of various regions bounded by straight lines. Expectation of function of r.vs., means, variances, covariance, correlation coefficient, conditional expectation, regression as conditional expectation if it is linear function of other variable and conditional variance, proof of (i) $E(X \pm Y) = E(X) \pm E(Y)$, (ii) $E[E(X/Y)] = E(X)$.

If X and Y are independent r. v.s then (i) $E(XY) = E(X) \times E(Y)$, (ii) $M_{X+Y}(t) = M_X(t) \times M_Y(t)$. Examples.

Unit-2: **(18 hrs.)**

2.1 Transformation of continuous bivariate random variables: Distribution of transformation of bivariate r.v.s by using method of (i) uniqueness of m.g.f. and (ii) jacobian of transformation.

Obtaining probability distribution of (X+Y), X/Y and X/(X+Y) where X and Y are independent Gamma variates with identical scale parameters. Examples and problems.

2.2 Exact Sampling Distributions:

Chi-Square distribution: Definition of Chi-square r.v., derivation of p.d.f. of Chi-square r.v. with n degrees of freedom by using m.g.f. Mean, variance, mode, moments, c.g.f., cumulants, skewness and kurtosis. Additive property.

Student's t-distribution: Definition of Student's t -variate. Derivation of p.d.f., mean, mode, variance, moments, β_1, β_2, γ_1 and γ_2 coefficients.

Snedecor's F distribution: Definition of F-variate. Derivation of p.d.f. , mean, variance and mode. Distribution of 1/F. Interrelation between t, F and Chi-square (Without Proof).

References and Recommended Readings:

1) Trivedi R. S. : Probability and Statistics with Reliability and Computer Science Application, Prentice –Hall of India Pvt. Ltd., New Delhi.

2) Parimal Mukhopadhyay: An Introduction to the Theory of Probability. World Scientific Publishing.

3) Hogg R. V. and Criag A. T. : Introduction to Mathematical Statistics (Third edition), Mac-

Millan Publishing, New York.
4) Goon A. M., Gupta M. K. and Dasgupta B.: Fundamentals of Statistics Vol. I and Vol. II World Press, Calcutta.
5) Gupta S. C. & Kapoor V. K. : Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.
6) Gupta S. C. & Kapoor V. K. :Applied Statistics. Sultan Chand & sons, New Delhi.
7) Mood A. M., Graybill F. A. and Boes D. C.: Introduction to theory of Statistics. (Chapter 2, 4, 5, 7) and Tata, Mc-Graw Hill, New Delhi. (Third Edition)
8) Walpole R. E. & Mayer R. H.: Probability & Statistics. (Chapter 4, 5, 6, 8, 10) Mac-Millan Publishing Co. Inc, New York.

B. Sc. Part – II Semester – IV
DSC–D8: STATISTICS –VIII
(Statistical Methods – II)
Theory: 36 hrs. Marks -50 (Credits: 02)

Course Outcomes: The students will acquire knowledge of

i) the concept and use of time series analysis.

ii) the meaning, purpose and use of Statistical Quality Control, construction and working of control charts for variables and attributes.

iii) applying the appropriate small sample tests and large sample tests in various situations.

CONTENTS:

Unit-1: (18 hrs.)

1.1 Time Series Analysis: Meaning and need of time series analysis. Components of time series : (i) Secular trend (ii) Seasonal variation (iii) Cyclical variation (iv) Irregular variation. Additive and Multiplicative model. Utility of time series analysis. Measurement of trend by using: (i) Moving average method (ii) Progressive average method (iii) Least square method. Measurement of seasonal indices by simple average method.

1.2 Statistical Quality Control (S.Q.C.): Meaning and purpose of S.Q.C., Process control, Product control, chance causes, assignable causes, Shewhart's control chart- construction & working, lack of control situation. Control charts for variables- mean chart and range chart. Construction and working of mean & range charts for unknown standards. Revised control limits. Control charts forAttributes –Defects, defectives, fraction defective, control chart for fraction defective (p-chart) for fixed sample size and unknown standards, construction and working of chart. Control charts for number of defects (C-chart) for unknown standards, construction and working of C-chart.

Unit-2: (18 hrs.)

2.1 Testing of Hypothesis - I: Notion of Population, Sample, Parameter, Statistic, Sampling distribution of Statistics $\overline{X}$ and S^2 when sample is drawn from normal distribution (statement only). Hypothesis, simple and composite hypothesis, null and alternative hypothesis, type I and type II errors, critical region, level of significance, p–value. One and two tailed test, power of test.

2.2 Testing of Hypothesis - II: General procedure of testing of hypothesis.

Small Sample Tests:

t – test : test for means: i) H_0: $\mu = \mu_0$, ii) H_0: $\mu_1 = \mu_2$, (when $\sigma_1^2 = \sigma_2^2$), iii) Paired t-test.

χ^2 – test : Test for population variance H_0: $\sigma^2 = \sigma_0^2$ (Mean known and unknown),

F–test : test for equality of two population variances; H_0: $\sigma_1^2 = \sigma_2^2$

Large Sample Tests:

A) Tests for means: i) Testing of population mean; H_0 : $\mu = \mu_0$

ii) Testing equality of population means; H_0: $\mu_1 = \mu_2$

B) Tests for proportion: i) Testing of population proportion; H_0 : $p = p_0$

ii) Testing equality of population proportions; H_0: $p_1 = p_2$

C) Tests for correlation by using Fisher's Z–Transformation:

i) Testing of population correlation; H_0 : $\rho = \rho_0$

ii) Testing equality of population correlations; H_0: $\rho_1 = \rho_2$.

D) χ^2 – tests for: i) Goodness of fit of given probability distribution and

ii) Test for independence of attributes when data is in the form of :

a) mxn contingency table and

b) 2x2 contingency table - Yate's correction for continuity.

References and Recommended Readings:

1) Chatfield C. : "The Analysis of Time Series –An Introduction", Chapman & Hall.

2) Gupta S. C. & Kapoor V. K., "Fundamentals of Applied Statistics", Sultan Chand & Sons, New Delhi.

3) Kendall M.G. : "Time Series", Charles Griffin.

4) Dr. Kore B. G. and Dr. Dixit P. G.: "Statistical Methods-II", Nirali Prakashan, Pune.

5) Montgomery D. C. : "Introduction to quality Control", John Wiley and sons.

6) Snedecor G.W. and Cochoran W. G. "Statistical Methods",Lowa State University Press.

7) Mayer, P. L. : Introductory Probability and Statistical Applications, AddisionWeseley Pub. Comp. London.

8) Kulkarni, M. B. Ghatpande, S. B. and Gore, S. D. :"Common Statistical Tests"Satyajeet Prakashan, Pune – 11029.

9) Gupta, S. P. :"Statistical Methods", Sultan Chand and Sons, 23, Daryaganj, New Delhi 110002.

10) MukhopadhyaParimal : "Applied Statistics", New Central Book Agency, Pvt. Ltd. Calcutta.

11) MukhopadhyaParimal: "Mathematical Statistics", New Central Book Agency, Pvt. Ltd. Calcutta.

Equivalence for Theory Papers

Old Syllabus		**Revised Syllabus**	
Semester No. Paper No.	**Title of the Paper**	**Semester No. Paper No.**	**Title of the Paper**
Semester III Paper V	Probability Distributions-I	Semester III DSC – C7 **STATISTICS - V**	Probability Distributions-I
Semester III Paper VI	Statistical Methods-I	Semester III DSC – C8 **STATISTICS - VI**	Statistical Methods-I
Semester IV Paper VII	Probability Distributions-II	Semester IV DSC – D7 **STATISTICS - VII**	Probability Distributions-II
Semester IV Paper VIII	Statistical Methods-II	Semester IV DSC – D8 **STATISTICS - VIII**	Statistical Methods-II

B. Sc. Part – II (Semester – III and IV)
Statistics Practical
(Practical Paper-II and Practical Paper-III)
Marks -100 (Credits: 08)

Pre requisites: Knowledge of the topics in the theory papers and MS-Excel.

Course Outcomes: Students will able to;

i) fit plane of multiple regression, judge for its goodness of fit by residual plot and compute multiple and partial correlation coefficients.

ii) know applications of some standard continuous probability distributions.

iii) know applications of some standard bivariate discrete probability distributions.

iv) understand how to obtain random sample from various probability distributions.

v) sketch of the p.m.f./p.d.f. for given parameters.

vi) fit and test the goodness of fit of specified distribution for given data.

vii) test various hypothesis about parameters of specified distribution for given data.

viii) construct various control charts.

ix) apply appropriate statistical methods while doing project on real life problems.

Practical Paper-II (Credit 2+2)
List of Groups and Practicals for Paper-II :

Group No.	Group Name	Practical No.	Name of Practical
1	**Model Sampling From Univariate Discrete Distributions on Finite Support**	**1**	Model Sampling from Discrete Uniform Distribution
		2	Model Sampling from Binomial Distribution
		3	Model Sampling from Hypergeometric Distribution
2	**Fitting and Testing Goodness of Fit of Univariate Discrete Distributions on Finite Support**	**1**	Fitting and Testing Goodness of Fit of Discrete Uniform Distribution
		2	Fitting and Testing Goodness of Fit of Binomial Distribution
		3	Fitting and Testing Goodness of Fit of Poisson Distribution
3	**Model Sampling From Univariate Discrete Distributions on Infinite Support**	**1**	Model Sampling from Poisson Distribution
		2	Model Sampling from Geometric Distribution
		3	Model Sampling from Negative Binomial Distribution
4	**Fitting and Testing Goodness of Fit of Univariate Discrete Distributions on Infinite Support**	**1**	Fitting and Testing Goodness of Fit of Poisson Distribution
		2	Fitting and Testing Goodness of Fit of Geometric Distribution
		3	Fitting and Testing Goodness of Fit of Negative Binomial Distribution
5	**Model Sampling From Univariate Continuous Distributions**	**1**	Model Sampling from Continuous Uniform and Exponential Distribution
		2	Model Sampling from Laplace (Double Exponential) Distribution
		3	Model Sampling from Normal Distribution
6	**Fitting and Testing Goodness of Fit of Univariate Continuous Distributions**	**1**	Fitting and Testing Goodness of Fit of Uniform and Exponential Distribution
		2	Fitting and Testing Goodness of Fit of Laplace (Double Exponential) Distribution
		3	Fitting and Testing Goodness of Fit of Normal Distribution
7	**Exponential and Laplace Distribution**	**1**	Applications of Exponential and Laplace Distribution
8	**Normal Distribution**	**1**	Applications of Normal Distribution

Practical Paper-III (Credit 2+2)
List of Groups and Practicals for Paper-III :

Group No.	Group Name	Practical No.	Name of Practical
1	**Trivariate Data Analysis**	**1**	Multiple Regression Equations
		2	Multiple Correlation Coefficients
		3	Partial Correlation Coefficients
2	**Time Series and SQC**	**1**	Time Series : Computation of Secular Trend and Seasonal Component
		2	SQC: Control Charts for Variables (R and $\overline{X}$ charts)
		3	SQC: Control Charts for Attributes (p, np and c Charts)
3	**Index Numbers**	**1**	Index Numbers–I
		2	Index Numbers–II
4	**National Income**	**1**	National Income
5	**Testing of Hypotheses**	**1**	Practical on Basic Terminologies with respect to Hypothesis Testing
		2	Large Sample Test for Testing of Hypothesis about population Mean (s).
		3	Large Sample Test for Testing of Hypothesis about population Praportion (s).
		4	Large Sample Test for Testing of Hypothesis about population Correlation (s).
6	**Application of Chi-Square, Student's t and F Statistics**	**1**	Applications of Chi-Square Statistic
		2	Applications of Studen's t-Statistic
		3	Applications of F-Statistic
7	**Application of Bivariate Discrete Distributions**	**1**	Applications of Trinomial Distribution
		2	Applications of Bivariate Poisson Distribution
8	**Plotting of Probability Distributions by using MS-Excel**	**1**	Sketching of Discrete Probability Distributions
		2	Sketching of Continuous Probability Distributions

Note:

a) Practicals should be conducted as per the "Statistics Practical Workbook for B. Sc. II" which is made available on Shivaji University Website under Syllabus.

b) Students must complete all practicals by using MS-EXCEL.

c) MS-EXCEL should be used at the time of practical examination for computation purpose.

d) For fitting of all distributions, test of goodness of fit is necessary.

e) For model sampling from all distributions, inverse c.d.f. transformation Method has to be used in Practical - II.

f) For practicals on fitting of discrete distributions, probabilities are to be calculated by recurrence relation only.

g) Student must complete the entire practical to the satisfaction of the teacher concerned.

h) Project Work OR Study Tour: Students should do project, especially on real life problems. Primary data will be preferable. Students will be asked to use statistical techniques/tools which they have learnt during their B. Sc. I and B. Sc. II program. Students may do project work in groups and number of students in a group should not exceed FOUR. **OR**

Statistics Department of affiliated college may organize Study Tour to Industry or Educational Instituitions where students can learn about Statistics/ possible areas where Statistical Methods can be applied. Students will be asked to write Study Tour Report.

i) Student must produce the laboratory journal along with the completion certificate signed by Head of Department, at the time of University practical examination.

Laboratory Requirements:
Laboratory should be well equipped with at least 20 computers along with MS-Office, at least two printers, sufficient back up facility (UPS/ Inverter/ Generator).

Nature of Practical Examination:

a) Student will be asked to solve/attempt any FOUR problems out of EIGHT for every Practical Paper (Practical Paper II and Paper III). These EIGHT problems are selected from EIGHT Groups, ONE problem from each Group. Each problem will carry 10 marks.
b) 5 marks will be reserved for Practical Journal complition and 5 marks for oral on entire practical work. (Paper-II and Paper–III).

c) 10 marks will be reserved for Project Work OR Study Tour Report and oral on it.

d) MS-EXCEL should be used for computaton purpose. Students evaluation during practical examination will be online and students should demonstrate / explain his computations to the examiner.

e) Practical examination of each Paper will be of 4 hours duration which includes oral as well as online demonstration.
f) There should be two subject experts at the time of Practical Examination.

Nature of Question Paper for Theory Examination (40+10 Pattern) as per NEP–2020:

Maximum Marks: 40
Duration : 2 Hrs

Que. 1 Select the most correct alternative from the following [8 Marks]
i) to viii) MCQ One mark for each with four options
A) B) C) D)

Que. 2 Attempt any TWO of the following [16 Marks]
a)
b)
c)

Que. 3 Attempt any FOUR of the following [16 Marks]
a)
b)
c)
d)
e)
f)