Fergusson College (Autonomous)

Pune

Learning Outcomes-Based Curriculum

For

F. Y. B. Sc. (Computer Science)

With effect from June 2019

Program Outcomes (POs) for B.Sc. Programme	
PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the disciplines that form a part of an graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO3	**Social competence:** Display the understanding, behavioural skills needed for successful social adaptation , work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	**Research-related skills and Scientific temper:** Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	**Trans-disciplinary knowledge:** Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence:** Performing dependently and also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PSO No.	Program Specific Outcomes(PSOs) Upon completion of this programme the student will be able to
PSO1	**Academic competence:** (i) Apply the knowledge, facts, and rules of basic and applied sciences (Physics, Chemistry, Mathematics and Statistics) for understanding elements of Electronic Science. (ii) Identify basic elements and systems of the real analog world and modern digital world.
PSO2	**Personal and Professional Competence:** (i) Demonstrates the ability to build and test basic blocks of modern digital systems and computers. (ii) Operate basic and advanced tools, equipment and Instruments. (iii) Discuss performance parameters for selection of sensors, actuators, linear and digital ICs.
PSO3	**Research Competence:** (i) Design and build Electronics systems in various domains like Computers, consumer products, medical, transportation, agriculture and defence. (ii) Formulate and provide creative, innovative and effective solutions to real world problems using hardware –software co-design tools for microcontroller / embedded systems and IoTs. (iii)Develop and utilizes modern tools (like PSPICE, MATLAB, Simulink) for mathematical modelling and simulation for future ready systems.
PSO4	**Entrepreneurial and Social competence:** Employ the process of thinking independently, taking initiative, working in a team effectively, preparing project reports and developing capability to lead the team through real life projects.

Programme Structure

Year	Course Code	Course Title	Course	No. of credits
	Semester I			
F.Y. B.Sc.	STC1101	Descriptive Statistics	TCore-1	2
	STC1102	Probability theory and discrete probability distributions	TCore-2	2
	STC1103	Statistics Practical - I	PCore-1	2
	ELC1101	Fundamentals of Logic Circuit Design	TCore-3	2
	ELC1102	Sequential Logic Circuits	TCore-4	2
	ELC1103	Electronics Practical - I	PCore-2	2
	CSC1101	Basic Programming using C	TCore-5	2
	CSC1102	Database Management System: SQL	TCore-6	2
	CSC1103	Computer Science Practical - I	PCore-3	2
	CSC1104	Computer Science Practical - II	PCore-4	Grade
	MTC1101	Discrete Mathematics	TCore-7	2
	MTC1102	Algebra	TCore-8	2
	MTC1103	Mathematics Practical - I	PCore-5	2
	Semester II			
	STC1201	Multiple Regression, Time Series and Simulation	TCore-1	2
	STC1202	Continuous Probability Distributions and Inference	TCore-2	2
	STC1203	Statistics Practical - II	PCore-1	2
	ELC1201	Computer Instrumentation	TCore-3	2
	ELC1202	Computer Organization	TCore-4	2
	ELC1203	Electronics Practical - II	PCore-2	2
	CSC1201	Advance Programming using C	TCore-5	2
	CSC1202	Relational Database Management System: PL / SQL	TCore-6	2
	CSC1203	Computer Science Practical - III	PCore-3	2
	CSC1204	Computer Science Practical - IV	PCore-4	Grade
	MTC1201	Graph theory	TCore-7	2
	MTC1202	Calculus	TCore-8	2
	MTC1203	Mathematics Practical - II	PCore-5	2

Year	Course Code	Course Title	Course	No. of credits
S.Y. B.Sc.	**Semester III**			
	ELC2301	8051 Microcontroller	TCore-1	3
	ELC2302	Communication Principles	TCore-2	3
	ELC2303	Electronics Practical III	PCore-1	2
	CSC2301	Data Structures	TCore-3	3
	CSC2302	Web Technologies	TCore-4	3
	CSC2303	Computer Science Practical – I (Lab on Data Structures)	PCore-2	2
	CSC2304	Computer Science Practical – II (Lab on Web Technologies)	PCore-3	Grade
	MTC2301	Applied Algebra	TCore-5	3
	MTC2302	Numerical Techniques	TCore-6	3
	MTC2303	Mathematics practical	PCore-4	2
	Semester IV			
	ELC2401	ARM 7 Based LPC 2148 Microcontroller	TCore-1	3
	ELC2402	Advanced Communication and Networking	TCore-2	3
	ELC2403	Electronics Practical IV	PCore-1	2
	CSC2401	Exploring OOP's using Java	TCore-3	3
	CSC2402	PHP Programming	TCore-4	3
	CSC2403	Computer Science Practical – III (Lab on Java)	PCore-2	2
	CSC2404	Computer Science Practical – IV (Lab on PHP Programming)	PCore-3	Grade
	MTC2401	Computational Geometry	TCore-5	3
	MTC2402	Operation Research	TCore-6	3
	MTC2403	Mathematics practical	PCore-4	2

Year	Course Code	Course Title	Course	No. of credits
T.Y. B.Sc.	**Semester V**			
	CSC3501	System Programming Concepts	TCore-1	3
	CSC3502	Advance Java	TCore-2	3
	CSC3503	Design And Analysis of Algorithms	TCore-3	3
	CSC3504	Software Development	TCore-4	3
	CSC3505 (Elective –I) **OR** CSC3506 (Elective –II)	Data Analytics	DElect-1	3
		Digital Image Processing	DElect-2	3
	CSC3507 (Elective –I) **OR** CSC3508 (Elective – II)	Android Programming	DElect-3	3
		Artificial Intelligence	DElect-4	3
	CSC3511	Computer Science Practical – I (Lab on System Programming)	PCore-1	3
	CSC3512	Computer Science Practical – II (Lab on Advance Java)	PCore-2	3
	CSC3513	Computer Science Project – I	PCore-3	3
	Semester VI			
	CSC3601	Operating System Concepts	TCore-1	3
	CSC3602	Python Programming	TCore-2	3
	CSC3603	Theoretical Computer Science	TCore-3	3
	CSC3604	Computer Networks	TCore-4	3
	CSC3605 (Elective –I) **OR** CSC3606 (Elective – II)	Big Data Analytics	DElect-1	3
		Biometrics	DElect-2	3
	CSC3607 (Elective –I) **OR** CSC3608 (Elective –II)	e-Commerce	DElect-3	3
		Internet of Things	DElect-4	3
	CSC3611	Computer Science Practical – III (Lab on Operating System Concepts)	PCore-1	3
	CSC3612	Computer Science Practical – IV (Lab on Python)	PCore-2	3
	CSC3613	Computer Science Project – II	PCore-3	3

F.Y. B.Sc. Semester I		
Title of the Course and Course Code	**Descriptive Statistics STC1101**	**Number of Credits : 02**

Course Outcomes (COs)

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

CO1	Describe basic features of the data.
CO2	Summarize and interpret the data using different graphs.
CO3	Examine data and represent in the form of table and graph.
CO4	Analyze the data using different quantitative measures.
CO5	Compare different data sets and conclude the best fit.
CO6	Build predictive models for the data.

Unit No.	Title of Unit and Contents
I	**Data condensation and Graphical methods** Raw data, attributes and variables, discrete and continuous variables, Presentation of data using frequency distribution and cumulative, frequency distribution. (Construction of frequency distribution is not expected), Graphical Presentation of frequency distribution – histogram, stem and leaf chart, less than and more than type ogive curves, Numerical problems related to real life situations.
II	**Measures of central tendency and dispersion** Measures of Central tendency: Mean, Mode, Median. Examples, where each one of these is most appropriate, Partition values: Quartiles, Box-Plot. Variance, Standard Deviation, Coefficient of Variation. (Section 2.1 to should be covered for raw data, ungrouped frequency distribution and exclusive type grouped frequency distribution)
III	**Moments** Raw and Central moments: definition, computations for ungrouped and grouped data (only up to first four moments), Relation between raw and central moments upto fourth order, Numerical problems related to real life situations.
IV	**Measures of Skewness and Kurtosis** Concept of symmetric frequency distribution, skewness, positive and negative skewness, Measures of Skewness-Pearson's measure, Bowley's measure (β_1, γ_1). Kurtosis of a frequency distribution, measure of kurtosis (β_2, γ_2) based upon moments, type of kurtosis: leptokurtic, platykurtic and mesokurtic, Numerical problems related to real life situations.

V	**Correlation and Linear Regression** Bivariate data, Scatter diagram, Correlation, Positive Correlation, Negative correlation, Zero Correlation Karl Pearson's coefficient of correlation (r), limits of r ($-1 \leq r \leq 1$), interpretation of r, Coefficient of determination (r^2), Meaning of regression, difference between correlation and regression, Fitting of line $Y = a+bX$ Concept of residual plot and mean residual sum of squares, Numerical Problems.
VI	**Non-Linear Regression** Second degree curve, Growth curve models of the type $Y = ae^{bX}$, $Y = ab^X$, $Y = aX^b$ Logistic model $Y = k / (1+e^{a+bx})$, Numerical problems related to real life situations.

References:

1. Fundamentals of Applied Statistics (3rd Edition), Gupta and Kapoor, S. Chand and Sons, New Delhi, 1987.
2. An Introductory Statistics, Kennedy and Gentle.
3. Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1989.
4. Introduction to Linear Regression Analysis, Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Wiley

Title of the Course and Course Code	Probability Theory and Discrete Probability Distributions STC1102	Number of Credits : 02

Course Outcomes (COs)

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

CO1	Identify and compare different probability distributions for different types of data.
CO2	Compute chance of an event based on prior knowledge of conditions related to that event.
CO3	Apply different forms of discrete probability distributions to the observed data.
CO4	Analyze the statistical measures used in various fields.
CO5	Conclude based on a pattern of observed data.
CO6	Develop analytical thinking for a problem or a solution from different points of view.

Unit No.	Title of Unit and Contents
I	**Detailed Review / Revision of Theory of Probability** Counting Principles, Permutation, and Combination, Deterministic and non-determination models, Random Experiment, Sample Spaces (finite and countably infinite), Events: types of events, Operations on events, Probability - classical definition, probability models, axioms of probability, probability of an event, Theorems of probability (with proof) $0 \leq P(A) \leq 1$, $P(A) + P(A') = 1$, $P(A) \leq P(B)$ when $A \subset B$, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ Numerical problems related to real life situations.
II	**Advanced Theory of Probability** Concepts and definitions of conditional probability, multiplication theorem $P(A \cap B)=P(A).P(B\|A)$, Bayes' theorem (without proof), Concept of Posterior probability, problems on posterior probability, Definition of sensitivity of a procedure, specificity of a procedure. Application of Bayes' theorem to design a procedure for false positive and false negative, Concept and definition of independence of two events, Numerical problems related to real life situations.
III	**Discrete Random variable** Definition of random variable and discrete random variable, Definition of probability mass function, distribution function and its properties, Definition of expectation and variance, theorem on expectation, Determination of median and mode using p.m.f, Numerical problems related to real life situations.
IV	**Standard Discrete Probability Distributions** Discrete Uniform Distribution: definition, mean, variance, Bernoulli Distribution: definition, mean, variance, additive property, Binomial Distribution: definition, mean, variance, additive property, Geometric Distribution (p.m.f $p(x) = pqX$, $x = 0,1,2.....$): definition, mean, variance, Poisson Distribution: definition, mean, variance, mode, additive property, limiting case of B (n, p), Illustration of real life situations, Numerical problems related to real life situations.

Learning Resources:

1. Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1989.
2. Fundamentals of Applied Statistics (3rd Edition), Gupta and Kapoor, S. Chand and Sons, New Delhi, 1987.
3. Modern Elementary Statistics, Freund J.E., Pearson Publication, 2005.
4. Probability, Statistics, Design of Experiments and Queuing theory with applications Computer Science, Trivedi K.S., Prentice Hall of India, New Delhi,2001.
5. A First course in Probability 6th Edition, Ross, Pearson Publication, 2006.
6. Introduction to Discrete Probability and Probability Distributions, Kulkarni M.B., Ghatpande S.B., SIPF Academy, 2007.

Title of the Course and Course Code	**Statistics Practical – I STC1103**	**Number of Credits : 02**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Identify the appropriate diagram for the given data.	
CO2	Discuss various applications of statistical measures using R software.	
CO3	Execute the computational techniques using R software.	
CO4	Analyze different concepts of statistics using R software.	
CO5	Validate the fundamental knowledge and represent using R software.	
CO6	Write a program using R to build different regression models for the given data and estimate the error.	

Sr. No.	**Title of Experiment/ Practical**
1	Introduction to R and graphical methods using R
2	Measures of Central Tendency, verification using R
3	Measure of Dispersion, verification using R
4	Measures of Skewness and Kurtosis, verification using R
5	Basic Probability Theory
6	Advanced Theory of Probability
7	Fitting of Binomial, Poisson and Geometric distribution. Verification using R
8	Correlation and Linear Regression, verification using R
9	Model Sampling from Discrete Probability Distributions, verification using R
10	Fitting of Second degree and Exponential curves, verification using R

F.Y. B.Sc. Semester II		
Title of the Course and Course Code	**Multiple Regression, Time Series and Simulation STC1201**	**Number of Credits : 02**

Course Outcomes (COs) **On completion of the course, the students will be able to:**	
CO1	Identify the skill set required for data analysis.
CO2	Explain and interpret different models of forecasting.
CO3	Apply appropriate simulation techniques to match simulated outcomes closely with real outcomes.
CO4	Analyze data related to time and predict its future behaviour.
CO5	Select the best prediction method in case of multivariate situations.
CO6	Build advanced predictive models.

Unit. No.	**Title of Unit and Contents**
I	**Multiple and Partial Correlation and Regression (for trivariate data)** Yule's notation and concept of multiple regression, Fitting of multiple regression plane, Partial regression coefficient, interpretation, Multiple correlation coefficient, concept, definition, computation and interpretation, Partial correlation coefficient, concept, definition, computation and interpretation, Numerical Problems
II	**Time Series** Meaning and Utility, Components of Time Series, Additive and Multiplicative models, Methods of estimating trend: moving average method, least squares method and exponential smoothing method, Elimination of trend using additive and multiplicative models, Measurement and estimation of seasonal variations using link relative method and ratio to trend method, Simple time series models: AR (1), AR (2), Numerical problems related to real life situations.
III	**Non parametric tests** Run test, Sign test, Kolmogrov - Smirnov test, Mann – Whitney test, Numerical problems related to real life situations.
IV	**Simulation** Introduction to Simulation, merits and demerits, Monte Carlo Simulation Pseudo-random number generator, requisites of a good random number generator, testing these requirements by using various test of hypothesis using Run test, goodness of fit test, Sign test etc. Model Sampling from uniform and exponential distribution, Model sampling from Normal distribution using Box-Muller transformation, Numerical problems related to real life situations.
V	**Queueing Model** M/M/1: FIFO as an application of exponential distribution, Poisson distribution and Geometric distribution, Interarrival rate (λ) service rate (μ), traffic intensity ($\rho = \lambda/\mu < 1$), queue discipline, probability distribution of number of customers in queue, average queue length, average waiting time in , queue, system.

References:

1. Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1989.
2. Statistical Methods, J. Medhi, New Age International, 1992.
3. Time Series Methods, Brockell and Devis, Springer, 2006.
4. Time Series Analysis,4th Edition, Box and Jenkin, Wiley, 2008.
5. Simulation and Modelling Analysis, Kelton and Law, Tata McGraw Hill, 2007.
6. System Simulation with Digital Computer, Narsingh Dev, Prentice Hall, 2003.

Title of the Course and Course Code	**Continuous Probability Distributions and Inference STC1202**	**Number of Credits : 02**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Identify the errors involved in using sample data for prediction.	
CO2	Infer the reliability of hypothesis scientifically using different tests of hypothesis.	
CO3	Apply different forms of continuous probability distributions.	
CO4	Explain research questions using the sample data.	
CO5	Test an assumption regarding population parameters using sample data.	
CO6	Develop application of test procedures to different hypothesis problems.	

Unit. No.	**Title of Unit and Contents**
I	**Continuous Random Variable** Definition of continuous random variable (r.v.), Probability density function (p.d.f.), Cumulative distribution function (c.d.f.), its properties, Calculation of mean, mode, median, variance, standard deviation for continuous r. v. Numerical problems related to real life situations.
II	**Standard Continuous Probability Distributions** Uniform Distribution: statement of p.d.f., mean, variance, nature of probability curve, Exponential Distribution: statement of p.d.f. of the form, $f(x) = (1/\theta)\, e(-x/\theta)$, mean, variance, nature of probability curve, lack of memory property, Normal Distribution: statement of p.d.f., identification of parameters, nature of probability density curve, standard normal distribution, symmetry, distribution of aX+b, aX+bY+c where X and Y are independent normal variables, computations of probabilities using normal probability table, normal approximation to binomial and Poisson distribution, central limit theorem (statement only), normal probability plot, Pareto Distribution: p.d.f., mean, variance, applications, Numerical problems related to real life situations.
III	**Testing of hypothesis** Definitions: population, statistic, SRSWR, SRSWOR, random sample from a probability distribution, parameter, statistic, standard error of estimator, Concept of null hypothesis and alternative hypothesis, critical region, level of significance, type I and type II error, one sided and two sided tests, p-value.
IV	**Large Sample Tests** $H_o: \mu = \mu_o$ Vs $H_1: \mu \neq \mu_o$, $\mu < \mu_o$, $\mu > \mu_o$ (One sided and two-sided tests)**,** $H_o: \mu_1 = \mu_2$ Vs $H_1: \mu_1 \neq \mu_2$, $\mu_1 < \mu_2$, $\mu_1 > \mu_2$(One sided and two-sided tests) **,** $H_o: P = P_o$ Vs $H_1: P \neq P_o$, $P < P_o$, $P > P_o$ (One sided and two-sided tests)**,** $H_o: P_1 = P_2$ Vs $H_1: P_1 \neq P_2$,

	$P_1 < P_2$, $P_1 > P_2$ (One sided and two-sided tests), Numerical problems related to real life situations.
V	**Tests based on t, Chi-square and F-distribution** $H_o: \mu = \mu_o$ Vs $H_1: \mu \neq \mu_o$, $\mu < \mu_o$, $\mu > \mu_o$ (One sided and two-sided tests)**,** $H_o: \mu_1 = \mu_2$ Vs $H_1: \mu_1 \neq \mu_2$, $\mu_1 < \mu_2$, $\mu_1 > \mu_2$(One sided and two-sided tests) Paired t-test, Chi square test for goodness of fit, Test for independence of attributes (m X n contingency table), Test for significance of variation for a population. (One sided and two sided tests), Test for equality of population variances (One sided and two sided tests), Numerical problems related to real life situations.

References:

1. A First course in Probability 6th Edition, Ross, Pearson Publication, 2006.
2. Modern Elementary Statistics, Freund J.E., Pearson Publication, 2005.
3. Probability, Statistics, Design of Experiments and Queuing theory with applications Computer Science, Trivedi K.S., Prentice Hall of India, New Delhi, 2001.
4. Common Statistical Tests, Kulkarni M.B., Ghatpande S.B., Gore S.D., Satyajeet Prakashan, Pune, 1999.

Title of the Course and Course Code	**Statistics Practical – II STC1203**	**Number of Credits : 02**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Identify appropriate tests of hypotheses to the given data.	
CO2	Discuss and implement various applications of statistical techniques using R.	
CO3	Apply R software for validating the results.	
CO4	Compare parametric and non-parametric tests of hypothesis.	
CO5	Review an build statistical techniques using different computational methods.	
CO6	Hypothesize real life problems and analyze them using appropriate inferential techniques.	

Sr. No.	**Title of Experiment / Practical**
1	Multiple Regression, Multiple and Partial Correlation Coefficient, verification using R
2	Time Series-I
3	Time Series-II
4	Model Sampling from Continuous probability distributions, verification using R
5	Fitting of Normal distribution, verification using R
6	Computations of probabilities of Normal and Exponential distributions, verification using R
7	Large sample tests of hypothesis
8	Non-parametric tests, verification using R
9	Tests based on chi-square distribution, verification using R
10	Tests based on t and F distributions, verification using R