Proposed Syllabus for B.Sc. Mathematics paper for 6 semesters under Revised Choice Based Credit Scheme (CBCS)

Effective from the academic year 2020 - 21

Department of Mathematics
Bangalore University

Structure of B.Sc. Mathematics papers

Subjects	Paper	Instruction hrs/week	Duration of Exam(hrs)	Marks			Credits
				IA	Exam	Total	
I Semester							
Mathematics paper with practicals of 3credits	Theory Practical	4 3	3 3	30 15	70 35	100 50	2 1
II Semester							
Mathematics paper with practicals of 3credits	Theory Practical	4 3	3 3	30 15	70 35	100 50	2 1
III Semester							
Mathematics paper with practicals of 3credits	Theory Practical	4 3	3 3	30 15	70 35	100 50	2 1
IV Semester							
Mathematics paper with practicals of 3credits	Theory Practical	4 3	3 3	30 15	70 35	100 50	2 1
V Semester							
Two Mathematics papers with practicals of 3 credits each	Theory Practical	3 3	3 3	30 15	70 35	100 50	2 1
	Theory Practical	3 3	3 3	30 15	70 35	100 50	2 1
VI Semester							
Two Mathematics papers with practicals of 3 credits each	Theory Practical	3 3	3 3	30 15	70 35	100 50	2 1
	Theory Practical	3 3	3 3	30 15	70 35	100 50	2 1

Note: The structure of the syllabus of mathematics paper of B. Sc. is included in the structure of M.Sc. (Mathematics) syllabus.

MISSION AND VISION OF THE NEW SYLLABUS IN MATHEMATICS

Mission

- Improve retention of mathematical concepts in the student.
- To develop a spirit of inquiry in the student.
- To improve the perspective of students on mathematics as per modern requirement.
- To initiate students to enjoy mathematics, pose and solve meaningful problems, to use abstraction to perceive relationships and structure and to understand the basic structure of mathematics.
- To enable the teacher to demonstrate, explain and reinforce abstract mathematical ideas by using concrete objects, models, charts, graphs, pictures, posters with the help of FOSS tools on a computer.
- To make the learning process student-friendly by having a shift in focus in mathematical teaching, especially in the mathematical learning environment.
- Exploit techno-savvy nature in the student to overcome math-phobia.
- Propagate FOSS (Free and open source software) tools amongst students and teachers as per vision document of National Mission for Education.
- To set up a mathematics laboratory in every college in order to help students in the exploration of mathematical concepts through activities and experimentation.
- To orient students towards relating Mathematics to applications.

Vision

- To remedy Math phobia through authentic learning based on hands-on experience with computers.
- To foster experimental, problem-oriented and discovery learning of mathematics.
- To show that ICT can be a panacea for quality and efficient education when properly integratedand accepted.
- To prove that the activity-centered mathematics laboratory places the student in a problem solving situation and then through self exploration and discovery habituates the student into providing a solution to the problem based on his or her experience, needs, and interests.
- To provide greater scope for individual participation in the process of learning and becoming autonomous learners.
- To provide scope for greater involvement of both the mind and the hand which facilitates cognition?
- To ultimately see that the learning of mathematics becomes more alive, vibrant, relevant and meaningful; a program that paves the way to seek and understand the world around them. A possible by-product of such an exercise is that math-phobia can be gradually reduced amongst students.
- To help the student build interest and confidence in learning the subject.

Support system for Students and Teachers in understanding and learning FOSS TOOLS:

As a national level initiative towards learning FOSS tools, IIT Bombay for MHRD, Government of India is giving free training to teachers interested in learning open source soft wares like scilab, maxima, python, octave, geogebraand others.

(website: http://spoken-tutorial.org ; email: contact@spoken-tutorial.org ; info@spokentutorial.org)

REVISED SYLLABUS

FIRST SEMESTER

MATHEMATICS – I

(4 lecture hours per week+3 hours of practical /week per batch of not more than 15 students)

(56 HOURS)

THEORY

1. ALGEBRA - I

Matrices

Elementary row and column transformations (operations), equivalent matrices, theorems on it. Row- reduced echelon form, Normal form of a matrix, Rank of a matrix, Problems.

Homogeneous and Non – Homogeneous systems of m linear equations in n unknowns consistency criterion – criterion for uniqueness of solutions.

Eigenvalues and Eigenvectors of a square matrix of order 2 and 3, standard properties, Matrix polynomial, Cayley-Hamilton theorem (with proof). Finding A^{-1}, A^{-2} and A^2, A^3, A^4. Application Problems. **(14 lecture hours)**

2. CALCULUS – I

a) Differential Calculus

Successive Differentiation - n^{th} derivatives of the functions: e^{ax+b}, $(ax+b)^n$, $\log(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $e^{ax}\sin(bx+c)$, $e^{ax}\cos(bx+c)$ – Problems. Leibnitz theorem (with proof) and its applications.

Partial differentiation –Function of two and three variables - First and higher order derivatives - Homogeneous functions – derivatives- Euler's theorem and its extension (with proof) - Total derivative and differential - Differentiation of implicit functions and composite functions – Problems - Jacobians – Properties of Jacobians problems. Application Problems

b) Integral Calculus

Reduction formulae for $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \cot^n x\,dx$, $\int \sec^n x\,dx$, $\int \operatorname{cosec}^n x\,dx$, $\int \sin^m x \cos^n x\,dx$, with definite limit - problems. Differentiation under integral sign by Leibnitz rule- problems. **(28 lecture hours)**

3. GEOMETRY

Analytical Geometry of Three Dimensions

Recapitulation of elements of three dimensional geometry- Equation of the sphere in general and standard forms - equation of a sphere with given ends of a diameter. Tangent plane to a sphere, orthogonality of spheres.

Standard equations of right circular cone and right circular cylinder and problems.

(14 lecture hours)

Note: All the derivations (book works) must be through vector methods with reduction to corresponding Cartesian equivalents.

Suggested distribution of lecture hours

1. Matrices: 1 hour perweek
2. Differential Calculus and Integral Calculus: 2 hours perweek
3. Analytic Geometry of three dimensions: 1 hour perweek.

Text Books

1. Shanti Narayan and P K Mittal, Text book of *Matrices*, 5th ed., New Delhi, S. Chand and Co. Pvt. Ltd., 2013.
2. Shanthi Narayan and P K Mittal, *Differential Calculus*, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2014.
3. Shanthi Narayan and P K Mittal, *Integral Calculus*, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.
4. Shanthi Narayan and P K Mittal, *Analytical Solid Geometry*, New Delhi: S. Chand and Co. Pvt. Ltd., 2014.
5. Philip N. Klein, *Coding the Matrix: Linear Algebra through Computer Science Applications*, Newtonian Press, 2013.
6. Brian Heinold, *A Practical Introduction to Python Programming*, Department of Mathematics and Computer Science, Mount St. Mary's University, 2019.

Reference Books

1. B S Vatssa, *Theory of Matrices*, New Delhi: New Age International Publishers, 2005.
2. A R Vashista, *Matrices*, Krishna Prakashana Mandir, 2003.
3. G B Thomasand and R L Finney, *Calculus and analytical geometry*, Addison Wesley, *1995*.
4. J Edwards, *An elementary treatise on the differential calculus: withapplications and numerous example*, Reprint. Charleston, USA: BiblioBazaar, 2010.
5. N P Bali, *Differential Calculus*, India: Laxmi Publications (P) Ltd.., 2010.
6. S Narayanan & T. K. Manicavachogam Pillay, *Calculus*.: S. Viswanathan Pvt. Ltd., Vol. I & II, 1996.
7. Frank Ayres and Elliott Mendelson, *Schaum's Outline of Calculus*, 5th ed. USA: Mc. Graw Hill., 2008.
8. SPMahajan & Ajay Aggarwal, *Comprehensive Solid Geometry*, 1st ed.: Anmol Publications , 2000.
9. H. Anton, I Birens and S. Davis, Calculus, John Wiley and Sons, Inc, 2002.

Useful web links:

1. http://www.cs.columbia.edu/~zeph/3203s04/lectures.html
2. http://home.scarlet.be/math/matr.htm
3. http://www.themathpage.com/
4. http://www.abstractmath.org/
5. http://ocw.mit.edu/courses/mathematics/

6. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
7. http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm
8. http://mathworld.wolfram.com/Calculus.html
9. http://ocw.mit.edu/courses/mathematics/
10. http://www.univie.ac.at/future.media/moe/galerie.html
11. http://mathworld.wolfram.com/AnalyticGeometry.html
12. http://www.nptelvideos.in/2012/11/mathematics.html
13. https://www.my-mooc.com/en/categorie/mathematics
14. www.python.org
15. www.rosettacode.org
16. http://faculty.msmary.edu/heinold/python.html
17. https://kitchingroup.cheme.cmu.edu/pycse/pycse.html

PRACTICALS – 1

Mathematics practical with Free *and* Open Source *Software* (FOSS) tool for computer programs (3 hours/ week per batch of not more than 15 students)

LIST OF PROBLEMS

1. Introduction to Python: Basic syntax, variable types, basic operators, numbers, strings, lists, tuples, functions and input/output statements.
2. Some simple programs to understand the relational, conditional and logical operators.
   i) Compare two numbers (less than, greater than) using *if* statement
   ii) Sum of natural numbers using *while* loop
   iii) Finding the factors of a number using *for* loop.
   iv) To check the given number is prime or not (use *if... else* statement).
   v) Find the factorial of a number (use *if...if...else*).
   vi) Simple programs to illustrate *logical operators (and, or, not)*

   Note: Give the structure of a while...do loop to the students and illustrate with an example.
3. Python commands to reduce given matrix to echelon form and normal form with examples.
4. Python program/command to establish the consistency or otherwise and solving system of linear equations.
5. Python command to find the n^{th} derivatives.
6. Python program to find n^{th} derivative with and without Leibnitz rule.
7. Obtaining partial derivative of some standard functions
8. Verification of Euler's theorem, its extension and Jacobean.
9. Python program for reduction formula with or without limits.
10. Python program to findequation and plot sphere, cone, cylinder.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

SECOND SEMESTER
MATHEMATICS – II

(4 lecture hours per week+ 3 hours of practicals /week per batch of not more than 15 students)

(56 HOURS)

THEORY

1. ALGEBRA - II

Group Theory

Binary operation, algebraic structure-problems on finding identity and inverse. Definitions of semigroup and group, abelian group – problems on finite and infinite groups. Properties of group with proof – standard problems on groups – A finite semi group with both the cancellation laws is a group – Any group of order less than five is abelian – permutation groups.

Subgroups- theorems on subgroups (with proof)- problems. **(14 lecture hours)**

2. CALCULUS - II

a) Differential Calculus

Polar coordinates - Angle between the radius vector and the tangent - Angle of intersection of curves (polar form) polar sub-tangent and polar subnormal- perpendicular from pole on the tangent - Pedal equations. Derivative of an arc in Cartesian, parametric and polar forms (with derivations).

Curvature of plane curves - formula for radius of curvature in Cartesian, parametric, polar and pedal forms - centre of curvature - evolutes. Singular points – Asymptotes – Envelopes. Application Problems

b) Integral Calculus

Applications of Integral Calculus: computation of length of arc, plane area and surface area and volume of solids of revolutions for standard curves in Cartesian and Polar forms. Application Problems.

(28 lecture hours)

3. DIFFERENTIAL EQUATIONS – I

Recapitulation of Solutions of ordinary differential equations of first order and first degree.

Solutions of:

(i) Linear equations, Bernoulli's equation.

(ii) Exact equations(excluding reducible to Exact)

Equations of first order and higher degree – nonlinear first order, higher degree – solvable for p - solvable for y - solvable for x - Clairaut's equation - singular solution - Geometric meaning. Orthogonal trajectories in Cartesian and polar forms. Application Problems.

(14 lecture hours)

Suggested distribution of lecture hours

1. Algebra-II (Group theory) : 1 hour / week
2. Calculus-II (Differential calculus & Integral Calculus): 2 hours / week.
3. Differential Equations-I: 1 hour / week.

Text Books

1. Herstein I N, *Topics in Algebra*, 4th ed. New Delhi, India: Vikas Publishing House Pvt. Ltd, 1991.
2. Shanthi Narayan and P K Mittal, *Differential Calculus*, Reprint. New Delhi: SChand and Co. Pvt. Ltd., 2014.
3. Shanthi Narayan and P K Mittal, *Integral Calculus*, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.
4. M D Raisinghania, Ordinary and Partial Differential Equations, S Chand and Co. Pvt. Ltd., 2014.
5. Eric Ayars, *Computational Physics with Python*, California State University, Chico.
6. Hans Petter Langtangen and Anders Logg, *Solving PDEs in Python*, Springer, 2017.

Reference Books

1. Michael Artin, *Algebra*, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.
2. Vashista, *A First Course in Modern Algebra*, 11th ed.: Krishna Prakasan Mandir, 1980.
3. John B Fraleigh, *A First course in Abstract Algebra*, 3rd ed.: Narosa Publishing House., 1990.
4. R Balakrishan and N.Ramabadran, *A Textbook of Modern Algebra*, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
5. G B Thomasand R L Finney, *Calculus and analytical geometry, Addison Wesley, 1995.*
6. J Edwards, *An elementary treatise on the differential calculus: with applications and numerous example*, Reprint. Charleston, USA: BiblioBazaar, 2010.
7. N P Bali, *Differential Calculus*, New ed. New Delhi, India: Laxmi Publications (P) Ltd.., 2010.
8. S Narayanan & T. K. Manicavachogam Pillay, *Calculus.*: S. Viswanathan Pvt. Ltd., vol. I & II, 1996.
9. Frank Ayres and Elliott Mendelson, *Schaum's Outline of Calculus*, 5th ed. USA: Mc. Graw Hill., 2008.
10. E Spiegel, *Schaum's Outline of Advanced Calculus*, 5th ed. USA: Mc. Graw Hill., 2009.
11. M D Raisinghania, *Advanced Differential Equations*, S Chand and Co. Pvt. Ltd., 2013.
12. FAyres, *Schaum's outline of theory and problems of Differential Equations*, 1st ed. USA: McGraw-Hill, 2010.
13. S Narayanan and T K Manicavachogam Pillay, *Differential Equations.*: S V Publishers Pvt. Ltd., 1981.
14. G F Simmons, *Differential equation with Applications and historical notes*, 2nd ed.: McGraw-Hill Publishing Company, Oct 1991.
15. Hans Petter Langtangen, *A primer on Scientific programming with Python*, Springer, 2016.

Useful web links:

1. http://www.themathpage.com/
2. http://www.abstractmath.org/
3. http://ocw.mit.edu/courses/mathematics/
4. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
5. http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm
6. http://mathworld.wolfram.com/Calculus.html
7. http://ocw.mit.edu/courses/mathematics/
8. http://www.univie.ac.at/future.media/moe/galerie.html
9. http://tutorial.math.lamar.edu/classes/de/de.aspx
10. http://www.sosmath.com/diffeq/diffeq.html
11. http://www.analyzemath.com/calculus/Differential_Equations/applications.html
12. http://www.nptelvideos.in/2012/11/mathematics.html
13. https://www.my-mooc.com/en/categorie/mathematics
14. www.python.org
15. www.rosettacode.org
16. http://faculty.msmary.edu/heinold/python.html
17. https://kitchingroup.cheme.cmu.edu/pycse/pycse.html

PRACTICALS –II

Mathematics practicals with *Free and Open Source Software* (FOSS) tool for computer programs (3 hours/ week per batch of not more than 15 students)

LIST OF PROGRAMMES

1. i). Verifying whether given operator is binary or not
   ii). To find identity and inverse element of a group
2. Plotting of standard Cartesian curves(Part-1)
3. Plotting of standard Cartesian curves (Part-2)
4. Plotting of standard polar curves
5. Plotting of standard parametric curves
6. Surface area and Volume of curves
7. Solution of differential equation and plotting(Part-1)
8. Solution of differential equation and plotting(Part-2)
9. Solution of differential equation and plotting(Part-3)
10. Solution of differential equation and plotting the solution(Part-4)

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THIRD SEMESTER
MATHEMATICS-III

(4 lecture hours per week+ 3 hours of practicals /week per batch of not more than 15 students)

(56 HOURS)

THEORY

1. ALGEBRA - III

Groups

Order of an element of a group – properties related to order of an element- subgroup generated by an element of a group – Equivalence Class and partition of a set, coset decomposition of a group, Cyclic groups- properties- modulo relation- index of a group –Lagrange's theorem-consequences.

(14 lecture hours)

2. ANALYSIS – I

a) Sequences of Real Numbers

Definition of a sequences-Bounded sequences- limit of a sequences-convergent, divergent and oscillatory sequences- Monotonic sequences and their properties-Cauchy's criterion. Application Problems.

b) Series of Real Numbers

Definition of convergence, divergence and oscillation of series -properties of Convergence series - properties of series of positive terms – Geometric series Tests for convergence of series -p- series - comparison of series Cauchy's root Test -D Alembert's test. Raabe'stest ,- Absolute and conditional convergence-D' Alembert test for absolute convergence - Alternating series - Leibnitz test.

Summation of binomial, exponential and logarithmic series. Application Problems.

(28 lecture hours)

3. MATHEMATICAL METHODS -I

Definition and basic properties Laplace transform of some common functions and Standard results –Laplace transform of periodic functions- Laplace transforms ,of derivatives And the integral of function- Laplace transforms, Heaviside function convolution theorem (statement only) Inverse Laplace transforms. Application Problems. **(14 lecture hours)**

Suggested distribution of lecture hours

1. Algebra – III (Groups): 1 hour / week.
2. Analysis-I (sequences of real numbers and series of real numbers):2 hours /week
3. Mathematical Methods - I (1 hour / week.)

Text Books

1. Herstein I N, *Topics in Algebra*, 4th ed. New Delhi, India: Vikas Pub. House Pvt. Ltd, 1991.
2. Boumslag and Chandler, *Schaum's outline series on groups*, 2010.

3. S.C.Malik and Savita Arora, *Mathematical Analysis*, 2nd ed. New Delhi, India: New Age international (P) Ltd., 1992.
4. John Kerl, Concrete abstract algebra in Python, Notes.
5. Titus Adrian Beu, Introduction to Numerical programming, CRC Press, Taylor and Fransis.
6. Eric Ayars, *Computational Physics with Python*, California State University, Chico.

Reference Books

1. Michael Artin, *Algebra*, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.
2. Vashista, *A First Course in Modern Algebra*, 11th ed.: Krishna Prakasan Mandir, 1980.
3. John B Fraleigh, *A First course in Abstract Algebra*, 3rd ed.: Narosa Publishing House., 1990.
4. R Balakrishan and N.Ramabadran, *A Textbook of Modern Algebra*, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
5. Richard R Goldberg, *Methods of Real Analysis*, Indian ed. New Delhi, India: Oxford and IBH Publishing Co., 1970.
6. Raisinghania M.D., *Laplace and Fourier Transforms*. New Delhi, India: S. Chand and Co. Ltd. , 1995.

Usefulweb links:

1. http://www.themathpage.com/
2. http://www.abstractmath.org/
3. http://ocw.mit.edu/courses/mathematics/
4. http://www.math.unl.edu/~webnotes/contents/chapters.htm
5. http://www-groups.mcs.st-andrews.ac.uk/~john/analysis/index.html
6. http://web01.shu.edu/projects/reals/index.html
7. http://www.mathcs.org/analysis/reals/index.html
8. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
9. http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm
10. http://mathworld.wolfram.com/Calculus.html
11. http://ocw.mit.edu/courses/mathematics/
12. http://www.nptelvideos.in/2012/11/mathematics.html
13. https://www.my-mooc.com/en/categorie/mathematics
14. www.python.org
15. http://doc.sagemath.org/html/en/thematic_tutorials/group_theory.html
16. http://doc.sagemath.org/html/en/reference/groups/sage/groups/abelian_gps/abelian_group_morphism.html
17. https://kitchingroup.cheme.cmu.edu/pycse/pycse.html

PRACTICALS –III

Mathematics practicals with Free *and* Open Source Software (FOSS) tool for computer programs(3 hours/ week per batch of not more than 15 students)

LIST OF PROBLEMS

1. Examples for finding right and left coset and the index of a group.
2. Examples to verify Lagrange's theorem.
3. Illustration of convergent, divergent and oscillatory sequence.
4. Illustration of convergent, divergent and oscillatory series.
5. Using Cauchy's criterion to determine the convergence of a sequence.
6. To find the sum of the series.
7. Finding the Laplace transform.
8. Finding the inverse Laplace transform.
9. Laplace transform method of solving first order ordinary differential equations with constant coefficients.
10. Laplace transform method of solving second order ordinary differential equations with constant coefficients

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FOURTH SEMESTER
MATHEMATICS – IV

(4 lecture hours per week+ 3 hours of practicals /week per batch of not more than 15 students)

(56 HOURS)

THEORY

1. ALGEBRA –IV

Groups

Normal subgroups-examples and problems – Quotient group-Homomorphism and Isomorphism of groups-Kernel and image of a homomorphism-Normality of the Kernel-Fundamental theorem of homomorphism- properties related to isomorphism-Permutation group-Cayley's theorem. **(10 lecture hours)**

2. ANALYSIS -II

Fourier Series

Trigonometric Fourier series of functions with period 2π and period $2L$ - Half range Cosine and sine series. Application problems. **(10 lecture hours)**

3. CALCULUS - III

Differential Calculus

Definition of the limit of a function in ε-δ form – continuity- types of discontinuities. Properties of continuous function on a closed interval (boundedness, attainment of bounds and taking every value between bounds). Differentiability - Theorem : Differentiability implies Continuity - Converse not true. Rolle's Theorem- Lagrange's and

Cauchy's First Mean Value Theorem (Lagrange's form) - Maclaurin's expansion. Evaluation of limits by L' Hospital's rule

Continuity and differentiability of a function of two and three variables – Taylor's Theorem and expansion of functions of two variables- Maxima and Minima of functions of two variables. Method of Lagrange multipliers. **(22 lecture hours)**

4. DIFFERENTIAL EQUATIONS –II

Second and higher order ordinary linear differential equations with constant Coefficients-complementary function- particular integrals (standard types) Cauchy-Euler differential equation. Simultaneous linear differential equations (two variables) with constant coefficients. Solutions of second order ordinary linear differential equations with variables coefficients by the following methods.

(i) When a part of complementary function is given
(ii) Changing the independent variable
(iii) Changing the dependent variable
(iv) Variation of parameters
(v) Conditions for exactness and the solution when the equation is exact.

(14 lecture hours)

Suggested distribution of lecture hours

1. Algebra – IV, Analysis – II, Calculus - III: 3 hours / week.
2. Differential Equations II: 1 hour / week.

Text Books

1. Herstein I N, *Topics in Algebra*, 4th ed. New Delhi, India: Vikas Publishing House Pvt. Ltd, 1991.
2. Boumslag and Chandler, *Schaum's outline series on groups*, 2010.
3. Erwin Kreyszig, *Advanced Engineering Mathematics*, 8th ed. New Delhi, India: Wiley India Pvt. Ltd., 2010.
4. Shanthi Narayan and P K Mittal, *Differential Calculus*, Reprint. New Delhi: SChand and Co. Pvt. Ltd., 2014.
5. M D Raisinghania, *Ordinary and Partial Differential Equations*,S Chand and Co. Pvt. Ltd., 2014.
6. John Kerl, Concrete abstract algebra in Python, Notes.

Reference Books

1. Michael Artin, *Algebra*, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.
2. Vashista, *A First Course in Modern Algebra*, 11th ed.: Krishna Prakasan Mandir, 1980.
3. John B Fraleigh, *A First course in Abstract Algebra*, 3rd ed.: Narosa Publishing House., 1990.
4. R Balakrishan and N.Ramabadran, *A Textbook of Modern Algebra*, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
5. G B Thomas and R L Finney, *Calculus and analytical geometry*, Addison Wesley, 1995.

6. J Edwards, *An elementary treatise on the differential calculus: with applications and numerous example*, Reprint. Charleston, USA: BiblioBazaar, 2010.
7. N P Bali, *Differential Calculus*, Laxmi Publications (P) Ltd., 2010.
8. S Narayanan & T. K. Manicavachogam Pillay, *Calculus.*: S. Viswanathan Pvt. Ltd., Vol. I & II, 1996.
9. Frank Ayres and Elliott Mendelson, *Schaum's Outline of Calculus*, 5th ed.USA: Mc. Graw Hill., 2008.
10. E Spiegel, *Schaum's Outline of Advanced Calculus*, 5th ed. USA: Mc. Graw Hill., 2009.
11. M D Raisinghania, *Advanced Differential Equations*,S Chand and Co. Pvt. Ltd., 2013.
12. FAyres, *Schaum's outline of theory and problems of Differential Equations*, 1st ed. USA: McGraw-Hill, 2010.
13. S Narayanan and T K Manicavachogam Pillay, *Differential Equations.*: S V Publishers Private Ltd., 1981.
14. G F Simmons, *Differential equation with Applications and historical notes*, 2nd ed.: McGraw-Hill Publishing Company, Oct 1991.
15. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons,1984.

Useful web links:

1. http://www.themathpage.com/
2. http://www.abstractmath.org/
3. http://www.fourier-series.com/
4. http://mathworld.wolfram.com/
5. http://www.princeton.edu/~rvdb
6. http://www.zweigmedia.com/RealWorld/Summary4.html
7. http://ocw.mit.edu/courses/mathematics/
8. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
9. http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm
10. http://mathworld.wolfram.com/Calculus.html
11. http://ocw.mit.edu/courses/mathematics/
12. http://www.univie.ac.at/future.media/moe/galerie.html
13. http://tutorial.math.lamar.edu/classes/de/de.aspx
14. http://www.sosmath.com/diffeq/diffeq.html
15. http://www.analyzemath.com/calculus/Differential_Equations/applications.html
16. http://www.nptelvideos.in/2012/11/mathematics.html
17. https://www.my-mooc.com/en/categorie/mathematics
18. www.python.org
19. http://www.auraauro.com/uncategorized/demonstration-of-fourier-series-using-python-code/
20. https://kitchingroup.cheme.cmu.edu/pycse/pycse.html

PRACTICALS –IV

Mathematics practicals with *Free and Open Source Software* (FOSS) tool for computer programs(3 hours/ week per batch of not more than 15 students)

LIST OF PROBLEMS

1. Verification of normality of a given subgroup
2. Illustrating homomorphism and isomorphism of groups
3. To find full range trigonometric Fourier series of some simple functions with period 2π and 2L
4. Finding the half-range sine and cosine series of simple functions and plotting them.
5. Program to illustrate continuity of a function
6. Program to illustrate differentiability of a function
7. Program to verify Rolle's theorem
8. Program to verify and Lagrange's theorem
9. Evaluation of limits by L'Hospital's rule
10. Solution of second and higher order ordinary differential equations with constant coefficients
11. Solution of second order ordinary differential equations with variable coefficients
    i) Method of variation of parameters
    ii) When the equation is exact

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

FIFTH SEMESTER
MATHEMATICS - V

(3 lecture hours per week+ 3 hours of practicals /week per batch of not more than 15 students)

(42 HOURS)

THEORY

1. ALGEBRA - IV

Rings, Integral Domains, Fields

Rings, Types of Rings properties of rings – Rings of integers modulo n – Subrings – Ideals, Principal, Prime and Maximal ideals in a commutative ring - examples and standard properties following the definition - Homomorphism, Isomorphism - Properties - Quotient rings - Integral Domain- Fields - properties following the definition - Fundamental Theorem of Homomorphism of Rings - Every field is an integral domain - Every finite integral domain is a field - Problems.

(14 lecture hours)

2. MATHEMATICAL METHODS - II

Calculus of Variation

Variation of a function $f = f(x, y, y')$ – variation of the corresponding functional – extremal of a functional – variational problem – Euler's equation and its particular forms – Examples – standard problems like geodesics, minimal surface of revolution, hanging chain, Brachistochrone problem –Isoperimetric problems. Application Problems.

(14 Lecture hours)

3. NUMERICAL METHODS - I

Finite differences – Definition and properties of $\Delta, \nabla, \delta, \mu$ and E, the relation between them – The nth differences of a polynomial, Factorial notations, separation of symbols, divided differences and related theorems.

Newton – Gregory forward and backward interpolation formulae – Lagrange's and Newton's interpolation formulae for unequal intervals - Inverse interpolation

Numerical Integration: Quadrature formula – Trapezoidal rule -Simpon's 1/3 and 3/8 rule, Weddle's rule - problems. Application Problems.

(14 lecture hours)

Suggested distribution of lecture hours.

1. Algebra IV: 1 hour /week.
2. Calculus of Variation: 1 hours/week
3. Numerical Methods I : 1 hours/week

Text Books

1. Herstein I N, *Topics in Algebra*, 4th ed. New Delhi, India: Vikas Publishing House Pvt. Ltd, 1991.
2. Shanthi Narayan and P K Mittal, *Differential Calculus*, Reprint. New Delhi: SChand and Co. Pvt. Ltd., 2014.
3. M D Raisinghania, *Vector calculus*,S Chand Co. Pvt. Ltd., 2013.
4. M K Jain, S R K Iyengar, and R K Jain, *Numerical Methods for Scientific and Engineering Computation*, 4th ed. New Delhi, India: New Age International, 2012.
5. JaanKiusalaas, *Numerical methods in engineering with python 3*, Cambridge University press, 2013.
6. Philip N. Klein, *Coding the Matrix: Linear Algebra through Computer Science Applications*, Newtonian Press, 2013.

Reference Books

1. Michael Artin, *Algebra*, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.
2. Vashista, *A First Course in Modern Algebra*, 11th ed.: Krishna Prakasan Mandir, 1980.
3. John B Fraleigh, *A First course in Abstract Algebra*, 3rd ed.: Narosa Publishing House., 1990.
4. R Balakrishan and N.Ramabadran, *A Textbook of Modern Algebra*, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
5. G B Thomas and R L Finney, *Calculus and analytical geometry, Addison Wesley, 1995.*

6. B Spain, *Vector Analysis*, ELBS, 1994.
7. D E Bournes and, P C Kendall, *Vector Analysis*, ELBS, 1996.
8. S S Sastry, *Introductory methods of Numerical Analysis*, Prentice Hall of India, 2012.
9. Brian Heinold, *A Practical Introduction to Python Programming*, Department of Mathematics and Computer Science, Mount St. Mary's University, 2019.
10. Titus Adrian Beu, Introdution to numerical programming, CRC press, Taylor and Fransis.
11. J. C. Bautista, *Mathematics and Python programmings*, lulu.com, 2014.

Useful web links:

1. http://www.themathpage.com/
2. http://www.abstractmath.org/
3. http://ocw.mit.edu/courses/mathematics/
4. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
5. http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm
6. http://mathworld.wolfram.com/Calculus.html
7. http://www.univie.ac.at/future.media/moe/galerie.html
8. http://www.math.gatech.edu/~harrell/calc/
9. http://www.amtp.cam.ac.uk/lab/people/sd/lectures/nummeth98/index.htm
10. http://math.fullerton.edu/mathews/numerical.html
11. http://www.onesmartclick.com/engineering/numerical-methods.html
12. http://www.nptelvideos.in/2012/11/mathematics.html
13. https://www.my-mooc.com/en/categorie/mathematics
14. www.python.org
15. https://docs.sympy.org/latest/modules/series/fourier.html
16. https://docs.sympy.org/latest/modules/series/fourier.html

PRACTICALS –V

Mathematics practicals with *Free and Open Source Software* (FOSS) tools for computer programs (3 hours/ week per batch of not more than 15 students)

LIST OF PROBLEMS

2. Examples on different types of rings.
3. Examples on integral domains and fields.
4. Examples on subrings, ideals and subrings which are not ideals.
5. Homomorphism and isomorphism of rings- illustrative examples.
6. Example on Euler's equation in full form.
7. Example on particular forms of Euler's equation.
8. Examples on minimum surface of revolution and Brachistochrone problem.
9. Examples on Isoperimetric problems.
10. Programs on Interpolations with equal intervals.
11. Programs on Interpolations with unequal intervals.

12. Programs to evaluate integrals using Simpson's $\frac{1}{3}^{rd}$ and $\frac{3}{8}^{th}$ rule.

13. Programs to evaluate integrals using Weddle's rule.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

FIFTH SEMESTER

ELECTIVE - I
MATHEMATICS – VI(A)

(3 lecture hours per week+ 3 hours of practicals/week per batch of not more than 15 students)

(42 HOURS)

THEORY

1. CALCULUS - IV

Differential Calculus of Scalar and Vector Fields

Scalar field – gradient of a scalar field, geometrical meaning – directional derivative – Maximum directional derivative – Angle between two surfaces - vector field – divergence and curl of a vector field – solenoidal and irrotational fields – scalar and vector potentials – Laplacian of a scalar field – vector identities. Standard properties, Harmonic functions, Problems. Orthogonal curvilinear co-ordinates (only conversions)

(14 lecture hours)

2. CALCULUS – V

a) Line And Multiple Integrals

Definition of line integral and basic properties examples evaluation of line integrals.

Definition of double integral – its conversion to iterated integrals .Evaluation of double integrals by change of order of integration and by change of variables – computation of plane and surface areas, volume underneath a surface and volume of revolution using double integrals.

Definition of triple integral and evaluation – change of variables – volume as a triple integral .

(18 lecture hours)

b) Integral Theorems

Green's theorem (with proof) - Direct consequences of the theorem. The Divergence theorem (with proof) - Direct consequences of the theorem. The Stokes' theorem (with proof) - Direct consequences of the theorem.

(10 lecture hours)

Suggested distribution of lecture hours

1. Differential Calculus Of Scalar And Vector Fields: 1 hour /week.
2. Calculus VI (Line and Multiple Integrals and Integral theorems): 2 hours/week

Text Books

1. R Weinstock, *Calculus of Variation*, Dover Pub. Ltd., 1970.
2. M. D. Raisinghania, *Vector Calculus*, S Chand Co. Pvt. Ltd., 2013.
3. Philip N. Klein, *Coding the Matrix: Linear Algebra through Computer Science Applications*, Newtonian Press, 2013.
4. Hans Petter Langtangen, *A primer on Scientific programming with Python*, Springer, 2009.

Reference Books:

1. F B Hildebrand, *Methods in Applied Mathematics*,
2. B Spain, *Vector Analysis*, ELBS, 1994.
3. D E Bournesand and P C Kendall, *Vector Analysis*, ELBS. 1996.

Useful web links:

1. http://ocw.mit.edu/courses/mathematics/
2. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
3. http://mathworld.wolfram.com/Calculus.html
4. http://www.univie.ac.at/future.media/moe/galerie.html
5. http://www.math.gatech.edu/~harrell/calc/
6. http://www.nptelvideos.in/2012/11/mathematics.html
7. https://www.my-mooc.com/en/categorie/mathematics
8. www.python.org
9. http://kitchingroup.cheme.cmu.edu/blog/2013/02/02/Integrating-functions-in-python/
10. https://kitchingroup.cheme.cmu.edu/pycse/pycse.html

PRACTICALS – VI(A)

Mathematics practicals with *Free and Open Source Software* (FOSS) tools for computer programs (3 hours/ week per batch of not more than 15 students)

LIST OF PROBLEMS

1. To demonstrate the physical interpretation of gradient, divergence curl and laplacian.
2. Using cyclic notations to derive some more vector identities
3. Evaluation of the line integral with constant limits.
4. Evaluation of the double integral with constant limits.
5. Evaluation of the triple integral with constant limits.
6. Evaluation of the line integral with variable limits.
7. Evaluation of the double integral with variable limits.
8. Evaluation of the triple integral with variable limits.
9. Green's theorem.
10. Gauss divergence theorem.
11. Stokes' theorem

FIFTH SEMESTER
ELECTIVE - II
MATHEMATICS – VI(B)

(3 lecture hours per week+ 3 hours of practicals/week per batch of not more than 15 students)

(42 HOURS)

THEORY

1. Number Theory

Introduction to number theory - Divisibility– Prime and composite numbers - Euclidean algorithm – fundamental theorem of Arithmetic – The greatest common divisor and least common multiple – congruences – Linear congruences –Simultaneous congruences – Wilson's, Euler's and Fermat's Theorems and their applications.

(14 lecture hours)

2. Graph Theory

Konigsberg bridge problem, graph, subgraph, adjacency, incidency, degree of a vertex, finite and infinite graphs, order and size of a graph, multiple edges, loops, simple graph,multigraph,general graph,underlying graph, r - regular graph, complete graph,walk,trail, path, closed walk,circuit cycle, directed graph, connected and disconnected graphs, component of a graph,trees, pendant vertices in a tree, distance and centers in a tree, rooted and binary trees, spanning Trees - with fundamental theorems and examples. **(14 lecture hours)**

3. Fourier Transforms

The Fourier integral, Different forms of Fourier integral, Problems complex Fourier Transform, Self reciprocals, slit functions Basic properties of Fourier transforms, Linear, Change of scale, Shifting, Modulation. Derivation of a Function Extension.

Fourier sine and cosine Transform and Inverses properties, self reciprocal. The derivatives – theorems and problems.

(14 lecture hours)

Suggested distribution of lecture hours:

1. Number Theory: 1 hour / week.
2. Graph Theory: 1 hour / week
3. Fourier Transforms: 1 hour / week

Text Books

1. David M. Burton, *Elementary Number Theory*, 6th ed., Tata McGraw-Hill Edition, Indian reprint, 2007.
2. Frank Harary, *Graph Theory*, Addison-Wesley Publishing Company, 1969.
3. Douglas B. West, *Introduction to Graph Theory*, 2nd edition, Pearson, 2015.
4. F. B. Hildebrand, *Method of Applied Mathematics*, Dover Publications.
5. Mohammed Zuhair Al-Taie and Seifedine Kadry, *Python for Graph and Network Analysis*, Springer, 2017.

Reference Books

1. Neville Robinns, *Beginning Number Theory*, 2nd ed., Narosa Publishing House Pvt. Ltd., Delhi, 2007.
2. Narsingh Deo, *Graph Theory*, Prentice-Hall of India Pvt. Ltd., 2000
3. B Spain, *Vector Analysis*, ELBS, 1994.
4. Lokenath Debnath and D Bhatta, Integral *Transforms and their Applications*, Taylor and Fransis, 2002.

Useful web links:

1. http://ocw.mit.edu/courses/mathematics/
2. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
3. http://mathworld.wolfram.com/Calculus.html
4. http://www.univie.ac.at/future.media/moe/galerie.html
5. http://www.math.gatech.edu/~harrell/calc/
6. http://www.nptelvideos.in/2012/11/mathematics.html
7. https://www.my-mooc.com/en/categorie/mathematics
8. www.python.org
9. http://kitchingroup.cheme.cmu.edu/blog/2013/02/02/Integrating-functions-in-python/
10. https://www.geeksforgeeks.org/
11. https://www.python-course.eu/graphs_python.php
12. https://medium.com/apprentice-journal/the-graph-theory-an-introduction-in-python-5906d5be0e4b
13. https://pypi.org/project/graph-theory/

PRACTICALS –VI (B)

Mathematics practical with *Free and Open Source Software* (FOSS) tools for computer programs(3 hours/ week per batch of not more than 15 students)

LIST OF PROBLEMS

1. Check whether given number is prime or not.
2. Program to find the GCD and LCM
3. Program to compute elements of the sequences
4. Create a graph using adjacency matrix and then show all the edges that exist in the graph.
5. Find the adjacency matrix from the given digraph.
6. Find the degree of all vertices in a graph.
7. Program to find the connected components of a undirected graph.
8. Check whether given degrees of vertices represent a graph or tree.
9. To return a list of all paths (without cycles).
10. Find if there is a path between two vertices in a graph.
11. Detect cycle in a directed graph.
12. To find the Fourier integrals for the given function
13. To find the Fourier sine and cosine Transform

SIXTH SEMESTER

MATHEMATICS – VII

(3 lecture hours per week + 3 hours of practicals/week per batch of not more than 15 students)

(42 HOURS)

THEORY

1. ALGEBRA –V

Linear Algebra

Vector space – Examples – Properties – Subspaces – criterion for a subset to be a subspace –linear span of a set - linear combination – linear independent and dependent subsets – Basis and dimensions– Standard properties – Examples illustrating concepts and results.

Linear transformations – properties – matrix of a linear transformation – change of basis – range and kernel – rank and nullity – Rank – Nullity theorem –Eigen values and eigen vectors of linear transformation - Application Problems

(14 lecture hours)

2. DIFFERENTIAL EQUATIONS III

a) Orthogonal Curvilinear Coordinates

Definition of orthogonal curvilinear coordinates. Fundamental vectors or base vectors, Scale factors or material factors - quadratic differential form. Spherical, Cartesian, cylindrical co-ordinate systems-Theorem: The Spherical and cylindrical coordinate systems are orthogonal curvilinear coordinate system (excluding problems on conversion of one system to another).

b) Partial Differential Equations

Total differential equations-Necessary condition for the equation $Pdx+ Qdy+ Rdz= 0$ to be integrable - Simultaneous equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$

Formation of partial differential equation - Equations of First Order Lagrange's linear equation – Charpit's method, Standard types of first order non-linear partial differential equation (By known substitution).

Solution of second order linear partial differential equations in two variables with constant coefficients by finding complementary function and particular integral

Solution of one – dimensional heat equations, Solution of one – dimensional wave equations using Fourier series- Application Problems.

(28 lecture hours)

Suggested distribution of lecture hours:

1. Algebra-V (Linear Algebra) : 1 hours / week.
2. Differential Equations III: 2 hours / week

Text Books

1. Krishnamoorty V K and Mainra V P and Arora J L, *An Introduction to Linear Algebra*, Reprint, New Delhi, India: Affiliated East West Press Pvt. Ltd., 2003.
2. M. D. Raisinghania, *Vector Calculus*, S Chand Co. Pvt. Ltd., 2013.
3. M D Raisinghania, *Ordinary and Partial Differential Equations*,S Chand and Co. Pvt. Ltd., 2014.
4. Hans Petter Langtangen, *A primer on Scientific programming with Python*, Springer, 2009.

Reference Books

1. G Strang, Linear Algebra and its Applications, Thomson, 2007
2. B Spain, *Vector Analysis*, ELBS, 1994.
3. D E Bournes and, P C Kendall, *Vector Analysis*, ELBS, 1996.
4. Frank Ayres, *Schaum's outline of theory and problems of Differential Equations*, 1st ed. USA: McGraw-Hill, 1972.
5. GF Simmons, *Differential equation with Applications and historical notes*, 2nd ed.: McGraw-Hill Publishing Company, Oct 1991.
6. S Narayanan & T K Manicavachogam Pillay, *Differential Equations*.: S V Publishers Private Ltd., 1981.
7. I N Sneddon, *Elements of Partial Differential Equations*, 3rd ed.: Mc. Graw Hill., 1980.

Useful web links:

1. http://ocw.mit.edu/courses/mathematics/
2. http://mathworld.wolfram.com/Calculus.html
3. http://www.math.gatech.edu/~harrell/calc/
4. http://tutorial.math.lamar.edu/classes/de/de.aspx
5. http://www.sosmath.com/diffeq/diffeq.html
6. http://www.analyzemath.com/calculus/Differential_Equations/applications.html
7. http://www.nptelvideos.in/2012/11/mathematics.html
8. https://www.my-mooc.com/en/categorie/mathematics
9. www.python.org
10. https://docs.sympy.org/0.7.6/modules/mpmath/calculus/differentiation.html
11. https://apmonitor.com/pdc/index.php/Main/SolveDifferentialEquations
12. https://kitchingroup.cheme.cmu.edu/pycse/pycse.html

PRACTICALS –VII

Mathematics practicals with *Free and Open Source Software* **(FOSS) tools for computer programs(3 hours/ week per batch of not more than 15 students)**

LIST OF PROBLEMS

1. i) Vector space, subspace – illustrative examples.
   ii) Expressing a vector as a linear combination of given set of vectors.
   iii) Examples on linear dependence and independence of vectors.

2. i) Basis and Dimension – illustrative examples.
   ii) Verifying whether a given transformation is linear.
3. i) Finding matrix of a linear transformation.
   ii) Problems on rank and nullity.
4. Solutions to the problems on total and simultaneous differential equations.
5. Solutions to the problems on different types of Partial differential equations.
6. Solving second order linear partial differential equations in two variables with constant coefficient.
7. Solving some more second order linear partial differential equations in two variables with constant coefficient.
8. Solution of one dimensional heat equation using Fourier series with Dirichlet condition.
9. Solution of one dimensional heat equation using Fourier series with Neumann condition.
10. Solution of one dimensional wave equation using Fourier series with Dirichlet condition.
11. Solution of one dimensional wave equation using Fourier series with Neumann condition.

SIXTH SEMESTER
ELECTIVE - I

MATHEMATICS – VIII(A)

(3 lecture hours per week+ 3 hours of practicals /week per batch of not more than 15 students)

(42 HOURS)

THEORY

1. ANALYSIS - III

Complex Analysis

Complex numbers-Cartesian and polar form-geometrical representation-complex-Plane-Euler's formula- $e^{i\theta} = \cos\theta + i\sin\theta$. Functions of a complex variable-limit, continuity and differentiability of a complex function. Analytic function Cauchy-Riemann equations in Cartesian and Polar forms-Sufficiency conditions for analyticity(Cartesian form only)-Harmonic function-standard properties of analytic functions-construction of analytic function when real or imaginary part is given-Milne Thomson method.

Complex integration-the complex integration–properties, problems.Cauchy's Integral theorem-proof using Green's theorem- direct consequences.Cauchy's Integral formula with proof-Cauchy's generalized formula for the derivatives with proof and applications for evaluation of simple line integrals - Cauchy's inequality with proof – Liouville's theorem with proof. Fundamental theorem of algebra with proof.

Transformations – conformal transformation – some elementary transformations namely Translation,rotation,magnification and inversion - examples.

The bilinear transformation (B.T.)-cross ratio-invariant points of a B.T.-properties-

(i) B.T. sets up a one to one correspondence between the extended z-plane and the extended w-plane.

(ii) Preservation of cross ratio under a B.T.

(iii) A B.T. transforms circles onto circles or straight lines.

Problems on finding a B.T., and finding images under a B.T.and invariant points of a B.T. Discussion of transformations $w = z^2$, $w = \sin z$, $w = \cosh z$ and $w = e^z$.

(28 lecture hours)

2. NUMERICAL METHODS – II

Numerical solutions of algebraic and transcendental equations – method of successive bisection - method of false position – Newton-Raphson method. Numerical solutions of non-Homogeneous system of linear algebraic equations in three variables by Jacobi's method and Gauss-Seidel method. Computation of largest Eigen value of a square matrix by power method.

Solutions of initial value problems for ordinary linear first order differential equations by Taylor's series, Euler's and Euler's modified method and Runge-Kutta 4^{th} ordered method.

(14 lecture hours)

Suggested distribution of lecture hours:

1. Analysis-III (Complex Analysis): 2 hours / week.
2. Numerical Methods-II: 1 hour / week

Text Books

1. S Shanthinarayan, *Complex Analysis*, S Chand Co. Pvt. Ltd., 2012.
2. M K Jain, S R K Iyengar, and R K Jain, *Numerical Methods for Scientific and Engineering Computation*, 4th ed. New Delhi, India: New Age International, 2012.
3. B. Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India, 2007.
4. Brian Heinold, *A Practical Introduction to Python Programming*, Department of Mathematics and Computer Science, Mount St. Mary's University, 2019.
5. Titus Adrian Beu, *Introduction to Numerical programming*, CRC press, Taylor and Francis.

Reference Books

1. R V Churchil & J W Brown, *Complex Variables and Applications*, 5th ed.: McGraw Hill Companies., 1989.
2. L V Ahlfors, *Complex Analysis*, 3rd ed.: Mc Graw Hill. , 1979.
3. A R Vashista, *Complex Analysis*, Krishna Prakashana Mandir, 2012.
4. S S Sastry, *Introductory methods of Numerical Analysis*, Prentice Hall of India, 2012.

Useful web links:

1. http://www.mathes.org/analysis/reals/index.html
2. http://www.amtp.cam.ac.uk/lab/people/sd/lectures/nummeth98/index.htm
3. http://math.fullerton.edu/mathews/numerical.html
4. http://www.onesmartclick.com/engineering/numerical-methods.html
5. http://www.nptelvideos.in/2012/11/mathematics.html
6. https://www.my-mooc.com/en/categorie/mathematics

7. www python.org
8. https://docs.sympy.org/latest/modules/series/fourier.html
9. https://kitchingroup.cheme.cmu.edu/pycse/pycse.html

PRACTICALS –VIII (A)

Mathematics practicals with *Free and Open Source Software* (FOSS) tools for computer programs(3 hours/ week per batch of not more than 15 students)

LIST OF PROBLEMS

1. Some problems on Cauchy-Riemann equations (polar form).
2. Implementation of Milne-Thomson method of constructing analytic functions(simple examples).
3. Illustrating orthogonality of the surfaces obtained from the real and imaginary parts of an analytic function.
4. Verifying real and imaginary parts of an analytic function being harmonic (in polar coordinates).
5. Illustrating the angle preserving property in a transformation.
6. Illustrating that circles are transformed to circles by a bilinear transformation.
7. Examples connected with Cauchy's integral theorem.
8. Solving algebraic equation (Bisection method).
9. Solving algebraic equation (Regula-Falsi and Newton-Raphson methods
10. Solving system of equations (Jacobi and Gauss-Seidel methods).
11. Solving for largest eigenvalue by Power method.
12. Solving ordinary differential equation by modified Euler's method.
13. Solving ordinary differential equation by Runge-Kutta method of 4^{th} order.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

MATHEMATICS – VIII (B)
ELECTIVE - II

(3 lecture hours per week+ 3 hours of practical /week per batch of not more than 15 students)

(42 HOURS)

THEORY

1. Linear Programming

Linear inequalities and their graphs. Statement of the linear programming problem in standard form-classification of solutions-solution of linear programming problems by graphical method.

Illustrative examples on the solution of linear programming problems in two and three variables by the simplex method. (Maximization and minimization)

Transportation problem:- North West rule, Vogel's method, Row minima method, Column minima method. **(14 lecture hours)**

2. Particle Dynamics

Newton's laws of motion – Conservative forces and potential energy - Definitions of work, kinetic energy and power.

Motion of a particle in a uniform force field – simple harmonic motion – Two dimensional motion of projectiles, Inclined plane.

(14 lecture hours)

3. Improper Integrals

Gamma and Beta functions-results following definitions-Relations connecting the two functions-duplication formula-Applications to evaluation of integrals.

(14 lecture hours)

Text book:

1. Robert J. Vanderbei, *Linear Programming*, Springer, 1996.
2. A. R. Vasishtha and D. C. Agarwal, *Dynamics of a Particle*, Krishna Prakashana Media Pvt. Ltd., 2003.
3. Murrey R. Spiegel, *Theory and Problems of Advanced Calculas*, Schaum's Outline series.
4. Hans Petter Langtangen, *A primer on scientific programming with Python*, Springer, 2016.
5. Surg Kruk, *Practical Python A1 projects: Mathematical models of optimization problems*, A press, 2018.
6. J. C. Bautista, *Mathematics and Python programming*, lulu.com, 2014.

Reference Book:

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear programming and Network flows*, 2nd Ed., John Wiley and Sons, India, 2004.
2. Hamdy A. Taha, *Operations Research: An introduction*, 8th Ed., Tata McGraw Hill, Singapore, 2004.
3. A. P. Roberts, *Statics and Dynamics with Background in Mathematics*, Cambridge University press, 2003.
4. Lokenath Debnath and D. Bhatta, *Integral Transforms and their Applications*, Taylor and Fransis Group, 2002.
5. Dimitris Bertsimas and J. N. Tsitsiklis, *Introduction to linear Optimization*, Athena Scientific, 1997.

Useful web links:

1. http://www.mathcs.org/analysis/reals/index.html
2. http://www.amtp.cam.ac.uk/lab/people/sd/lectures/nummeth98/index.htm
3. http://math.fullerton.edu/mathews/numerical.html
4. http://www.onesmartclick.com/engineering/numerical-methods.html
5. http://www.nptelvideos.in/2012/11/mathematics.html
6. https://www.my-mooc.com/en/categorie/mathematics

7. www.python.org
8. http://coderview.stackexchange.com//
9. http://scibook.readthedocs.io/en/latest/intro.html
10. http://gist.github.com/mick001/f4864f36551e89ab7bc4.
11. http://www.analyticsvidhya.com/blog/2017/02/lintroductory-guide-on-linear-programming-explained-in-simple-english/
12. http://kitchingroup.cheme.cmu.edu/blog/2013/02/02/Integrating-functions-in-python/

PRACTICALS –VIII (B)

Mathematics practical with *Free and Open Source Software* (FOSS) tools for computer programs(3 hours/ week per batch of not more than 10 students)

LIST OF PROBLEMS

1. Graphs with linear inequalities.
2. Solution of linear programming problem by graphical method.
3. Implementation of the simplex method.
4. Implementation of solution procedure for the transportation problem.
5. Application of Newton's law of motion-problems on conservative forces and potential energy.
6. Problems on work done, kinetic energy and power.
7. Problems on simple harmonic motion.
8. Problems on two-dimensional motion of projectiles.
9. Problems on gamma and beta functions.
10. Problems on duplication formula.
11. Problems on evaluation of improper integrals in applications.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

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Structure of B.Sc. Mathematics papers

Semester	Title of the paper		Teaching hrs/week	Duration of Exam (hrs)	IA MARKS	EXAM MARKS	TOTAL MARKS	Semester Total
1	B.Sc. I	Theory	4 hrs	3 hrs	30	70	100	150
		Practical	3 hrs	3 hrs	15	35	50	
2	B.Sc. II	Theory	4hrs	3 hrs	30	70	100	150
		Practical	3 hrs	3 hrs	15	35	50	
3	B.Sc. III	Theory	4 hrs	3 hrs	30	70	100	150
		Practical	3 hrs	3 hrs	15	35	50	
4	B.Sc. IV	Theory	4 hrs	3 hrs	30	70	100	150
		Practical	3 hrs	3 hrs	15	35	50	
5	B.Sc. V	Theory	3 hrs	3 hrs	30	70	100	150
		Practical	3hrs	3 hrs	15	35	50	
	B.Sc. VI(A) or VI(B)	Theory	3 hrs	3 hrs	30	70	100	150
		Practical	3 hrs	3 hrs	15	35	50	
6	B.Sc. VII	Theory	3 hrs	3 hrs	30	70	100	150
		Practical	3 hrs	3 hrs	15	35	50	
	B.Sc. VIII(A) or VIII(B)	Theory	3 hrs	3 hrs	30	70	100	150
		Practical	3 hrs	3 hrs	15	35	50	

Note: In the Practical component out of 35 marks: 25 for practical exam - 5 for vivo +5 for lab record.

PATTERN OF THE QUESTION PAPER

FROM 1st TO 4th SEMESTER

Time: 3 Hours **Max.Marks:70**

I	Answer any FIVE of the following (8 questions are given)	5 × 2 = 10 Marks
II	Answer any THREE of the following (05 questions are given)	3 × 5 = 15 Marks
III	Answer any THREE of the following (05 questions are given)	3 × 5 = 15 Marks
IV	Answer any TWO of the following (03 questions are given)	2x 5 = 10 Marks
V	Answer any TWO of the following (03 questions are given)	2x 5 = 10 Marks
VI	Answer any TWO of the following (03 questions are given) Questions to be taken only from Application part	2x 5 = 10 Marks

PATTERN OF THE QUESTION PAPER

FOR 5th and 6th SEMESTER

I	Answer any FIVE of the following (8 questions are given)	5 × 2 = 10 Marks
II	Answer any THREE of the following (05 questions are given)	3 × 5 = 15 Marks
III	Answer any THREE of the following (05 questions are given)	3 × 5 = 15 Marks
IV	Answer any THREE of the following (05 questions are given)	3x 5 = 15 Marks
V	Answer any THREE of the following (05 questions are given) Questions to be taken only from Application part	3x 5 = 15 Marks

BANGALORE UNIVERSITY

REGULATIONS, SCHEME AND SYLLABUS

For the course

I to VI Semesters

BACHELOR OF SCIENCE IN COMPUTER SCIENCE
(BSc(CS))

(Choice Based Credit System (Semester Scheme) –Y2K14 Scheme)

Revised w.e.f.

Academic Year 2014-2015 and onwards

Regulations, Scheme of study and Examination for B Sc Degree Course Under Choice Based Credit System - Semester System (Y2K14 SCHEME) (Revised w.e.f. 2014 -2015)

R1.

a) Title of the course: **B. Sc in Computer Science**

b) Duration of the Course: Durations of the undergraduate programmes shall extend over FOUR semesters (TWO academic years) for the Associate Degree(Advance Diploma), SIX semesters (Three academic years) for the regular Bachelor Degree.

c) Scheme of study:

i) There shall be one theory paper and one practical from first semester to fourth semester. The practical paper corresponds to theory papers.

ii) There shall be two theory papers and two practical during fifth and sixth semesters.

iii) Medium of Instruction: The medium of instruction shall be English.

d) Scheme of Examination: At the end of each semester there shall be University examination of three hours duration in each of the theory and practical papers.

The question paper pattern for theory paper has two sections. (70 Marks)

Section –A contains 12 questions, students has to attend 10 questions. Each carries 2 Marks (10 * 2 = 20)

Section – B contains 8 questions (question may contain sub questions), students has to attend 5 questions. each carries 10 Marks (5 * 10 = 50)

R2. Each semester shall be of 90 working days from the date of commencement of the each Semester.

R3. Attendance: As per Bangalore University regulations in force for science degree courses.

R4. POWER TO REMOVE DIFFICULTIES

If any difficulty arises in giving effect to the provisions of these regulations, the Vice – Chancellor may by order make such provisions not inconsistent with the Act, Statutes, Ordinances or other Regulations, as appears to be necessary or expedient to remove the difficulty. Every order made under this rule shall be subject to ratification by the appropriate University Authorities.

Title of Papers, Scheme of Study and Examination for B Sc in Computer Science, Revised w.e.f. 2014–2015.

Sem	Paper	Title of the paper	Hours/ Week	Marks			Credits
				IA	Exam	Total	
I	CS1T	Programming Concepts using C	4	30	70	150	3
	CS1P	C Programming Lab	3	15	35		
II	CS2T	Data Structures	4	30	70	150	3
	CS2P	Data Structures Lab	3	15	35		
III	CS3T	Database Management System and Software Engineering	4	30	70	150	3
	CS3P	DBMS Lab	3	15	35		
IV	CS4T	Operating System and UNIX	4	30	70	150	3
	CS4P	UNIX Programming Lab	3	15	35		
V	CS5T1	Object Oriented Programming using JAVA	3	30	70	150	3
	CS5P1	Java Programming Lab	3	15	35		
	CS5T2	Visual Programming	3	30	70	150	3
	CS5P2	Visual Programming Lab	3	15	35		
VI	CS6T1	Web Programming	3	30	70	150	6
	CS6P1	Web Programming Lab	3	15	35		
	CS6T2	Computer Networks	3	30	70	150	
	CS6P2	Project Lab	3	15	35		

FOUNDATION COURSES

1) ENVIRONMENT & PUBLIC HEALTH
2) SCIENCE & SOCIETY
3) INDIAN CONSTITUTION & HUMAN RIGHTS

I Sem B Sc

CS1T: PROGRAMMING CONCEPTS USING C

Total Teaching Hours : 60 No of Hours / Week : 04

Unit-I

Introduction to Programming Concepts: Software, Classification of Software, Modular Programming, Structured Programming, Algorithms and Flowcharts with examples. Overview of C Language: History of C, Character set, C tokens, Identifiers, Keywords, Data types, Variables, Constants, Symbolic Constants , Operators in C, Hierarchy of Operators, Expressions, Type Conversions and Library Functions.

[12 Hours]

Unit-II

Managing Input and Output Operation: Formatted and Unformatted I/O Functions Decision making, branching and looping: Decision Making Statements - if Statement, if–else statement, nesting of if-else statements, else–if ladder, switch statement, ?: operator, Looping - while, do-while, for loop, Nested loop, break, continue, and goto statements. Functions: Function Definition, prototyping, types of functions, passing arguments to functions, Nested Functions, Recursive functions.

[12 Hours]

Unit-III

Arrays: Declaring and Initializing, One Dimensional Arrays, Two Dimensional Arrays, Multi Dimensional Arrays - Passing arrays to functions. Strings: Declaring and Initializing strings, Operations on strings, Arrays of strings, passing strings to functions. Storage Classes - Automatic, External, Static and Register Variables.

[12 Hours]

Unit-IV

Structures - Declaring and Initializing, Nested structure, Array of Structure, Passing structures to functions, Unions, typedef, enum, Bit fields. Pointers – Declarations, Pointer arithmetic, Pointers and functions, Call by value, Call by reference, Pointers and Arrays, Arrays of Pointers, Pointers and Structures. Meaning of static and dynamic memory allocation, Memory allocation functions.

[12 Hours]

Unit-V

Files - File modes, File functions, and File operations, Text and Binary files, Command Line arguments. C Preprocessor directives, Macros – Definition, types of Macros, Creating and implementing user defined header files.

[12 Hours]

TEXT BOOKS

1. E. Balaguruswamy, "Programming In ANSI C", 4th edition, TMH Publications, 2007
2. Ashok N. Kamthane, "Programming with ANSI and Turbo C", Pearson Education, 2006

REFERENCES BOOKS

1. Ashok N. Kamthane et. al., "Computer Programming and IT", Pearson Education, 2011
2. Mahapatra, " Thinking In C ", PHI Publications, 1998.
3. Yashwant Kanetkar, "Let Us C", 13th Edition, PHP, 2013.

CS1P: C PROGRAMMING LAB

PART – A

1) Write a C program to accept employee number, employee name, basic pay and calculate gross salary, deduction and find the net salary of an employee for the following details.

Dearness Allowance	40% of Basic Pay
House Rent Allowance	20% of Basic Pay
Provident Fund	12% of Basic Pay
Income Tax	4% of Basic Pay

2) Write a C Program to find the roots of the given quadratic equation using if-else if statement.
3) Write a menu driven C program to find ,
(i) Reverse of a number (ii) Factorial of N (Use Switch case)
4) Write a C program to find Sin(x). [$x - x^3/3! + x^5/5! - \ldots\ldots x^n/n!$]
5) Write a C program to arrange the given set of numbers in ascending and descending order.
6) Write a C program to find product of two N x M matrices.
7) Write a C program to calculate NCR= N!/ R! * (N-R)! Using function.
8) Write a C program to display Fibonacci series using recursive function.
9) Write a C program to compare two strings using pointers.
10) Write a C program to demonstrate the user defined header file.

PART – B

During practical examination the External and Internal examiners may prepare exam question paper related to theory syllabus apart from Part-A. (A minimum of 10 Programs has to be prepared).

Note :

a) The candidate has to write both the programs One from Part-A and other from Part-B and execute one program as of External examiner choice.
b) A minimum of 10 Programs has to be done in Part-B and has to be maintained in the Practical Record.
c) Scheme of Evaluation is as follows:

Writing two programs	- 10 Marks
Execution of one program	- 10 Marks
Formatting the Output	- 05 Marks
Viva	- 05 Marks
Record	- 05 Marks
Total	**- 35 Marks**

II Sem B Sc

CS2T: DATA STRUCTURES

Total Teaching Hours : 60 No of Hours / Week : 04

Unit-I

Introduction and Overview: Definition, Elementary data organization, Data Structures, data structures operations, Abstract data types, algorithms complexity, time-space tradeoff. Preliminaries: Mathematical notations and functions, Algorithmic notations, control structures, Complexity of algorithms, asymptotic notations for complexity of algorithms. String Processing: Definition, Storing Stings, String as ADT, String

operations, word/text processing, Pattern Matching algorithms.

[12 Hours]

Unit-II

Arrays: Definition, Linear arrays, arrays as ADT, Representation of Linear Arrays in Memory, Traversing Linear arrays, Inserting and deleting, Sorting: Bubble sort, Insertion sort, Selection sort, Searching: Linear Search, Binary search, Multidimensional arrays, Matrices and Sparse matrices.

[12 Hours]

Unit-III

Linked list: Definition, Representation of Singly linked list in memory, Traversing a Singly linked list, Searching a Singly linked list, Memory allocation, Garbage collection, Insertion into a singly linked list, Deletion from a singly liked list; Doubly liked list, Header liked list, Circular linked list.

[12 Hours]

Unit-IV

Stacks – Definition, Array representation of stacks, Linked representation of stacks, Stack as ADT, Arithmetic Expressions: Polish Notation, Application of Stacks, Recursion, Towers of Hanoi, Implementation of recursive procedures by stack. Queues – Definition, Array representation of queue, Linked list representation of queues Types of queue: Simple queue, Circular queue, Double ended queue , Priority queue, Operations on Queues, Applications of queues.

[12 Hours]

Unit-V

Graphs: Graph theory terminology, Sequential representation of Graphs: Adjacency matrix, traversing a Graph. Tree – Definitions, Binary trees, Representing binary trees in memory, Traversing binary trees

[12 Hours]

TEXT BOOKS

1. Seymour Lipschutz: Data Structures with C, Schaum's ouT*lines*, Tata McGraw-Hill, 2011.

REFERENCES BOOKS

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 2013.
2. Robert Kruse, C.L.Tondo, Bruce Leung, Shashi Mogalla, "Data Structures and Program Design using C", Pearson Education, 2009.
3. Forouzan, "A Structured Programming Approach using C", 2nd Edition, Cengage Learning India, 2008.

CS2P : DATA STRUCTURES USING C LAB

PART - A

1. Write a menu driven C program to perform the following string operations without using string functions: (i) String Length (ii) String Concatenation (ii) String Reverse
2. Write a C program to search for an element in an array using Binary search
3. Write a C program to sort a list of N elements using Bubble Sort Algorithm
4. Write a C program to demonstrate the working of stack using an array.
5. Write a C program for Towers of Hanoi problem.
6. Write a C program to find GCD of two numbers using recursion

7. Write a C program to convert and print a given valid fully parenthesized infix arithmetic expression to post fix expression, the expression consists of single character (letter or digit) as operands and +,-,*, / as operators, assume that only binary operators are allowed in the expression.
8. Write a C program to simulate the working of Circular Queue using an array.
9. Write a C program to construct a singly linked list and perform following operations
   a. LINSERT Inserting a node in the front of the list
   b. LDELETE Deleting the node based on value
   c. LSEARCH Searching a node based on value
   d. LDISPLAY Displaying all the nodes in the list
10. Write a C program to create and traverse a binary search tree.

PART – B

During practical examination the External and Internal examiners may prepare exam question paper related to theory syllabus apart from Part-A. (A minimum of 10 Programs has to be prepared).

Note :

a) The candidate has to write two the programs One from Part-A and other from Part-B and execute one program as of External examiner choice.
b) A minimum of 10 Programs has to be done in Part-B and has to be maintained in the Practical Record.
c) Scheme of Evaluation is as follows;

Writing two programs	- 10 Marks
Execution of one program	- 10 Marks
Formatting the Output	- 05 Marks
Viva	- 05 Marks
Record	- 05 Marks
Total	**- 35 Marks**

III Sem B Sc

CS3T: DATABASE MANAGEMENT SYSTEM AND SOFTWARE ENGINEERING

Total Teaching Hours: 60 No of Hours / Week : 04

1. DATA BASE MANAGEMENT SYSTEM

Unit - I

Introduction: Data, Database, DBMS, Characteristics of Database Approach, Database Users, Advantages of DBMS. Database System Concepts and Architecture: Data Models, Schemas, and Instances, DBMS Architecture and Data Independence, Database languages and interfaces, The Database system Environment, Classification of Database Management Systems. Data Modeling Using the Entity-Relationship Model: High level Conceptual Data Models for Database Design with an example, Entity types, Entity sets, Attributes, and Keys, ER Model Concepts, Notation for ER Diagrams, Proper naming of Schema Constructs.

[12 hours]

Unit - II

RDBMS: Relational database concepts – attribute, tuple, types of attributes – single, multi-valued, stored, derived etc., keys – primary, index, candidate, alternate, foreign, Relationships, Relational algebra operations– UNION, INTERSECTION,

DIFFERENCE, CARTESIAN PRODUCT, SELECTION, PROJECTION, JOIN, DIVISION, relational calculus, Domain, Domain integrity, Integrity rules – Entity integrity, referential integrity, Normalization and its properties, I, II and III Normal forms.

[12 hours]

Unit - III

DDL and DML in SQL: DDL commands - create table/views/index, drop, alter, DML commands – select, insert, delete, update, etc., DCL commands – grant, revoke, commit, TCL commands, SQL – query, sub-query, nested query, Joins – natural, inner, outer join, aggregate functions in SQL. PL / SQL: Introduction, Exceptions & Cursor Management, Database Triggers, Functions,

[12 hours]

2. SOFTWARE ENGINEERING

Unit - IV

Software and Software Engineering: Defining Software, Software Application Domains, Software Engineering, Software Process, Software Engineering Practice, Software Myths. Process Models: A Generic Process Model, Process Assessment and Improvement, Prescriptive Process Models, Specialized Process Models, Agile Development: Agility, Agility and the cost of change, Agile Process, Extreme Programming, Other Agile Process Models. Understanding Requirements: Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing the use cases, Building the Requirements Model, Negotiating Requirements, Validating Requirements.

[12 Hours]

Unit - V

Requirements Modeling: Requirements Analysis, Scenario-Based Modeling, UML Models that Supplement the Use Case, Data Modeling Concepts, Class-Based Modeling, Flow-Oriented Modeling, Creating a Behavioral Model, Design Concepts: The Design Process, Design Concepts, The Design Model, Architectural Design, Component-Level Design, User Interface Design, Pattern-Based Design, Quality Concepts: Software Quality, Review Techniques, Software Quality Assurance Software Testing Strategies: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, System Testing, The Art of Debugging, Software Testing Fundamentals, White box Testing, Block-Box Testing.

[12 hours]

Text Books

1. Remez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", 5th Edition, Pearson Education, 2007.
2. Roger S. Pressman – Software Engineering, A Practitioner's approach, 7th Edition, McGRAW-HILL Publication, 2010.

Reference Books

1. Pankaj Jalote, "An integrated approach to Software Engineering", 3nd Edition, Narosa Publishing House, 2013.
2. Abrahamsi. Silberschatz, Henry. F. Korth, S. Sudarshan, "Database System Concepts" 6th Edition, McGraw Hill, 2012.
3. C.J.Date, "Introduction to database systems", Eight Edition, Addison Wesley, 2003.
4. Ian Sommerville – Software Engineering, 9th Edition, Pearson Education Ltd, 2010.

CS3P : DATA BASE MANAGEMENT SYSTEM LAB

PART - A

1. The STUDENT detail databases has a table with the following attributes. The primary keys are underlined. STUDENT(regno: int, name: string, dob: date, marks: int)

i) Create the above table.

ii) Remove the existing attributes from the table.

iii) Change the date type of regno from integer to string.

iv) Add a new attribute phoneno to the existing table.

v) Enter five tuples into the table.

vi) Display all the tuples in student table.

2. A LIBRARY database has a table with the following attributes.

LIBRARY(bookid:int, title:string, author:string, publication:string, yearpub:int, price:real)

i) Create the above table.

ii) Enter the five tuples into the table

iii) Display all the tuples in student table.

iv) Display the different publishers from the list.

v) Arrange the tuples in the alphabetical order of the book titles.

vi) List the details of all the books whose price ranges between Rs. 100 and Rs. 300

3. The SALARY database of an organization has a table with the following attributes.

EMPSALARY(empcod:int, empnamee:string, dob:date, department:string, salary:real)

i) Create the above table.

ii) Enter the five tuples into the table

iii) Display all the number of employees working in each dapartment.

iv) Find the sum of the salaries of all employees.

v) Find the sum and average of the salaries of employees of a particular department.

vi) Find the least and highest salaries that an employee draws.

4. Consider the insurance database given below. The primary keys are underlined and the data types are specified.

PERSON(driver-id-no: string, name: string, address:strong)

CAR(regno: string, model: string, year: int)

ACCIDENT(report-no: int, date: date, location: String)

OWNS(driver-id-no: string, regno: string)

PARTICIPATED(driver-id-no: string, regno: string, report-no: int, damage-amount: int)

i) Create the above tables by properly specifying the primary keys and the foreign keys

ii) Enter atleast five tuples for each relation.

iii) Demonstrate how you

a) Update the damage amount for the car with a specific regno in the accident with report no 12 to 25000.

b) Add a new accident to the database.

iv) Find total number of people who owned cars that were involved in accidents in 2002

v) Find the number of accidents in which cars belonging to a specific model were involved

5. Consider the following database of students enrollment in courses and books adopted for each course.

STUDENT(regno: string, name: string, major: strong, bdate: date)

COURSE(course-no: int cname: string, dept: string)

ENROLL(reg-no: string, course-no: int, sem: int, marks: int)

BOOK-ADOPTION(course-no: int, sem: int, book-isbn: int)

TEXT(book-isbn: int, book-title: string, publisher: string, author: string)

i) Create the above tables by properly specifying the primary keys and the foreign keys

ii) Enter atleast five tuples for each relation.

iii) Demonstrate how you add a new text book to the database and make this book be adopted by some department.

iv) Produce a list of text books (include Course-no, book-isbn, book-title) in the alphabetical order for courses offered by the 'Compute Science' department that use more than two books.

v) List any department that has all its adopted books published by a specific publisher.

6. The following tables are maintained by a book dealer

AUTHOR(author-id: int, name: string, city: string, country: string)

PUBLISHER(publisher-id: int name: string, city: string, country: string)

CATLOG(book-id: int, title : string, author-id: int, publisher-id: int, category: int, year: int, price: int)

CATEGORY(category-id: int, description: string)

ORDER-DETAILS(order-no: int, book-id: int, quantity: int)

i) Create above tables by properly specifying the primary keys and the foreign keys.

ii) Enter atleast five tuples for each relation.

iii) Give the details of the authors who have 2 or more books in the catalog and the price of the books is greater than the average price of the books in the catalog and the year of publication is after 2010.

iv) Find the author of the book which has maximum sales.

v) Demonstrate how to increase price of books published by specific publisher by 10%

7. Consider the following database for BANK.

BRANCH(branch-name: string, branch-city: string, assets: real)

ACCOUNT(accno: int, banch-name: string, balance: real)

DEPOSITOR(customer-name: string, accno: int)

CUSTOMER(customer-name: string, customer-street: string, customer-city: string)

LOAN(loan-no: int, branch-name: string, amount: real)

ORROWER(customer-name: string, loan-no: int)

i) Create the above tables by properly specifying the primary keys and foreign keys.

ii) Enter atleast five tuples for each relation.

iii) Find all the customers who have atleast two accounts at the main branch.

iv) Find all customer who have an account at all the branches located in a specific city.

v) Demonstrate how t0 delete all account tuples at every branch located in specific city.

8. Consider the following database for ORDER PROCEESING.

CUSTOMER(cust-no: int, cname: string, city: string)

ORDER(orderno: int, odate: date, ord-amt: real)

ORDER_ITEM(orderno: int, itemno:int, qty: int)

ITEM(itemno: int, unitprice: real)

SHIPMENT(orderno: int, warehouseno: int, ship-date: date)

WAREHOUSE(warehouseno: int, city: string)

i) Create the above tables by properly specifying the primary keys and the foreign keys

ii) Enter atleast five tuples for each relation.

iii) List the order number and ship date for all orders shipped from particular warehouse.

iv) Produce a listing: customer name, no of orders, average order amount

v) List the orders that were not shipped within 30 days of ordering

PART – B

During practical examination the External and Internal examiners may prepare exam question paper related to theory syllabus apart from Part-A. (A minimum of 8 Programs has to be prepared).

Note :

a) The candidate has to write two the programs One from Part-A and other from Part-B and execute one program as of External examiner choice.
b) A minimum of 8 Programs has to be done in Part-B and has to be maintained in the Practical Record.
c) Scheme of Evaluation is as follows:

Writing two programs	- 10 Marks
Execution of one program	- 10 Marks
Formatting the Output	- 05 Marks
Viva	- 05 Marks
Record	- 05 Marks
Total	**- 35 Marks**

IV SEM B Sc
CS4T1: OPERATING SYSTEM AND UNIX

Total Teaching Hours : 60 No of Hours / Week : 04

Unit-I

Introduction: Definition, Types of Operating Systems, Functions of Operating System, services, system components System call. Process Management: Process Concept, Process Scheduling, Inter process communication, CPU Scheduling Criteria, Scheduling algorithm, Multiple Processor Scheduling, Real time Scheduling, Algorithm evolution.

[12 Hours]

Unit – II

Process Synchronization and deadlocks: The Critical Section Problem, Synchronization hardware, Semaphores, Classical problems of synchronization, Critical regions, monitors, Dead locks – system model, Characterization, Dead lock prevention, avoidance and detection, Recovery from dead lock, Combined approach to deadlock handling.

[12 Hours]

Unit - III

Memory management: Functions, single contiguous, Partitioned memory management: multiple relocatable partitioned memory management, paging segmentation, demand paging virtual memory management. File Management: Concept, access methods, directory structures, allocation methods, free space management, secondary storage structure. Disk Management: Disk Structure & Scheduling methods, Disk management, Swap – Space management.

[12 Hours]

Unit-IV

History of Unix, salient features, Unix Components, types of shell, Internal and External commands, Files and File Organization- Categories of files, Unix file system, directories, file related commands, Directory related commands, wild cards, Printing and Comparing files. Ownership of files, File attributes File permissions and Manipulations, Standard I/O, Redirection, pipe, filter.

[12 Hours]

Unit-V

Introduction to vi editor, The three modes of the vi editor, Invoking vi editor, Configuring the vi environment, Regular expressions, the grep command, The process - parent and child process, process creation, process related commands, Shell Programming - shell script features, shell variables, writing and executing a shell script, positional parameters, Branching control structures- if, case etc., Loop control structures

– while, until, for, etc., Jumping control structures – break, continue, exit, etc., Integer and Real arithmetic in shell programs, Debugging scripts.

[12 Hours]

TEXT BOOKS

1. Abraham Silberschatz and Peter Baer Galvin, "Operating System Concepts", 7th Edition, Pearson Education, 2002.
2. M.G.Venkateshmurthy, "Introduction to UNIX & SHELL Programming", First Edition, Pearson Education, 2004.

REFERENCE BOOKS

1. Forouzan,"Unix and Shell Programming", 1st Edition,2008 Cengage Learning India
2. H.M.Deitel, "Operating Systems", Pearson Learning Solutions, 3rd Edition, 2003.
3. William Stallings, "Operating Systems", 6th Edition, Pearson Education, 2010.

CS4P1: Shell Programming in Unix Lab

PART - A

1. Write a menu driven program to calculate (i) Simple interest (ii) Compound interest
2. To print all prime numbers between m and n (m<n).
3. Reverse a given number and check whether it is palindrome or not.
4. Shell script to find maximum and minimum of given set
5. To count the number of vowels in a given string.
6. Create a file containing the following fields: student No., student name, age, sex, height and weight. Print all the details in a neat format.
7. Write a C program to generate and print the GCD and LCM of two integers.
8. Shell script to take two numbers as arguments and output their sum using (i) bc (ii) expr. Include error checking to test whether two arguments were entered.
9. Find out the occurrences of three consecutive and identical word characters (like aaa or bbb) using (i) grep and (ii) sed.
10. Shell script to display all the file permissions.

PART – B

During practical examination the External and Internal examiners may prepare exam question paper related to theory syllabus apart from Part-A. (A minimum of 10 Programs has to be prepared).

Note :

a) The candidate has to write both the programs One from Part-A and other from Part-B and execute one program as of External examiner choice.
b) A minimum of 10 Programs has to be done in Part-B and has to be maintained in the Practical Record.
c) Scheme of Evaluation is as follows:

Writing two programs	- 10 (5 Marks each)
Execution of one program	- 10 Marks
Formatting the Output	- 05 Marks
Viva	- 05 Marks
Record	- 05 Marks
Total	**- 35 Marks**

V Sem B Sc

CS5T1: VISUAL PROGRAMMING

Total Teaching Hours: 52 No of Hours / Week : 03

Unit - 1

Introduction to Visual Programming: The integrated Development Environment – menu bar, tool bar, from designer, project explorer, properties window, from layout window,

The VB editor. The form object: Properties, events and methods pf forms; Properties – Name, Captain, Backcolor, Borderstyle, controlbox, maxbutton, minbutton, moveable, startup position, height, width, left, top, scalemode, window, state; Events –load, unload, Clerk, Activate, Deactivate, Resize, methods – Show, hide, cls, Unload, print, Controls – Properties and events of different controls such as command buttons, labels, textboxes image controls, timer, horizontal and vertical scroll bars, option buttons, check boxes, frames lists and combo boxes. Predefined Dialog Boxes – MsgBox and InputBO

[13 Hours]

Unit - II

Programming: Data types, variables; declaration and scope arithmetic operations, Study of form and code modules, private and public procedures, Main procedure, Sub and Functions. Mathematical and string Functions; Branching and Looping Statement; If – Then, if –Then –Else and Nested If Statements; Select Case –different forms; For – Next, While – Wend and Do – Loops statements; Arrays- declaration. Static and dynamic arrays. Array Function, menus and toolbars-Creating menus and toolbars, Working with the menu editor, Designing Multiple Document interface forms. Microsoft common controls.

[13 Hours]

Unit - III

OOP methods and properties of an object, class Modules, Encapsultation and Inheritance characteristics Dynamic Link Libraries (DLLs) and Windows API; Designing Help files; File handling – Sequential ,Random access and Binary files, Database connectivity – DAO and ADO Tables and Queries, ActiveX Data objects.

[13 Hours]

Unit – IV

Visual C++ Programming: Objects-Classes-VC++Components – Resources-Event Handling – Menus – Dialog Boxes – Importing VBX Controls – Files – MFC File Handling – Document View Architecture – Serialization. Interfacing Other Applications – Multiple Document Interface (MDI) – Splitter Windows – Exception Handling – Debugging – Object Linking and Embedding (OLE) – Database Application – DLL- ODBC.

[13 Hours]

Text Books:

1. Gurumit Singh, "Visual Basic 6", First Edition, Firewall Media, 2007.

Reference Books:

1. Charles Petzold, "Windows Programming", 5th Edition, Microsoft Press, 1999.
2. Steve Holzner, "Visual C++ Programming", Second Edition, PHI, 1994.
3. Go ttfried, "Programming with Visual Basic 6", PHI, 2000.

CS5P1 : Visual Programming Lab

PART - A

1. Write a VB Program to design a simple calculator to perform addition, subtraction, multiplication and division(Use functions for the calculations).
2. Design a User Interface (UI) to accept the student details such as name, department and total marks. Validate the input data and calculate the percentage and division.
3. Design a VB application which has MDI and Child forms. Create a menu having the items such as file (New, Open),Format (Font, Regular, Bold ,Italic) and Exit in the MDI form. Also create a text box and use a Common Dialog Box control for changing the font, fore color and back color of the text box.

4. VB program to Encrypt and Decrypt a string. (Use Rnd() to generate the Encryption and Decryption keys).
5. Design a small Alarm Clock Application.
6. Write a VB Program to Validate the username and password form the database and display the appropriate message.(Use Data Control)
7. Design a VB application to record the employee details such as EmpId, EmpName, Designation and BaiscPay. Calculate the DA, HRA, Deduction and Gross Salary.(Make the necessary assumptions)Use Select .. case for decision making.
8. VB program to calculate the simple interest and compound interest. Use DLLs for the calculation.
9. VC++ program to create a Dialog box and display the position of mouse pointer within the dialog box.
10. VC++ program to create and load a simple menu in a Window.

PART – B

During practical examination the External and Internal examiners may prepare exam question paper related to theory syllabus apart from Part-A. (A minimum of 10 Programs has to be prepared).

Note :

a) The candidate has to write both the programs One from Part-A and other from Part-B and execute one program as of External examiner choice.
b) A minimum of 10 Programs has to be done in Part-B and has to be maintained in the Practical Record.
c) Scheme of Evaluation is as follows:

Writing two programs	- 10 Marks
Execution of one program	- 10 Marks
Formatting the Output	- 05 Marks
Viva	- 05 Marks
Record	- 05 Marks
Total	**- 35 Marks**

CS5T2: OBJECT ORIENTED PROGRAMMING USING JAVA

Total Teaching Hours : 52 No of Hours / Week : 03

Unit - I

Introduction to JAVA: JAVA Evolution: Java History, Java Features, How Java Differs from C and C++, Java and Internet, Java and World Wide Web, Web Browsers, Hardware and Software Requirements, Java Support Systems, Java Environment. Overview of JAVA Language: Introduction, Simple Java program, More of Java Statements, Implementing a Java Program, Java Virtual Machine, Command Line Arguments, Programming Style. Constants, Variables, and Data Types: Introduction, Constants, Variables, Data Types, Declaration of Variables, Giving Values to Variables, Scope of Variables, Symbolic Constants, Type Casting, Getting Values of Variables, Standard Default Values, Operators and Expressions: Introduction, Arithmetic Operators, Relational Operators Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional Operators, Bitwise Operators, Special Operators, Arithmetic Expressions, Evaluation of Expressions, Procedence of Arithmetic Operators, Type Conversion and Associativity, Mathematical Functions. Decision Making and Branching: Introduction, Decision Making with if Statement, Simple if Statement, The if....else Statement, Nesting of if..else Statements, The else if Ladder, The Switch Statement, The ? : Operator. Decision Making and Looping: Introduction. The while

Statement, The do Statement, The for Statement, Jumps in Loops Labeled Loops.

[13 hours]

Unit -II

Classes, Arrays, Strings, Vectors and Interfaces: Classes, Objects and Methods: Introduction, Defining a Class, Adding Variables, Adding Methods, Creating Objects, Accessing Class Members, Constructors, Methods Overloading, Static Members, Nesting of Methods, Inheritance: Extending a Class Overriding Methods, Final Variables and Methods, Finalizer methods, Abstract Methods and Classes, Visibility Control. Arrays, Strings and Vectors: Arrays, One-dimensional Arrays, Creating an Array, Two - Dimensional Arrays, Creating an Array, Two – dimensional Arrays, Strings, Vectors, Wrapper Classes. Interfaces: Multiple Inheritance: Introduction, Defining Interfaces, Extending Interfaces, Implementing Interfaces, Accessing Interface Variables.

[13 Hours]

Unit - III

Packages, and Multithreaded Programming:

Packages: Putting Classes together: Introduction, Java API Packages, Using System Packages, Naming Conventions, Creating Packages, Accessing a Package, Using a Package, Adding a Class to a Package, Hiding Classes. Multithreaded Programming: Introduction, Creating Threads, Extending the Thread Class, Stopping and Blocking a thread, Life Cycle of a thread, Using Thread Methods, Thread Exceptions, Thread Priority, Synchronization, Implementing the 'Runnable' Interface. Managing Errors and Exceptions: Introduction, Types of Exception Handling Code, Multiple Catch Statements, Using Finally Statement, Throwing Our Own Exceptions, Using Exceptions for Debugging.

[13 Hours]

Unit - IV

Applet Programming, Graphics Programming, Input/Output:: Introduction, How Applets Differ from Applications, Preparing to Write Applets, Building Applet Code, Applet Life Cycle, Creating an Executable applet, Designing a Web Page, Applet Tag, Adding Applet to HTML File, running the Applet, More About HTML Tags, Displaying Numerical Values, Getting Input from the User. Graphics Programming: Introduction, The Graphics Class, Lines and rectangles, circles, and Ellipses, Drawing Arcs, Drawing Polygons, Lines Graphs, Using Control Loops in Applets, Drawing Bar Charts. Managing Input/Output Files in JAVA: Introduction, Concept of Streams, Stream Classes, Byte Stream Classes, Character Stream Classes, Using Streams, Other Useful I/O Classes, Using the File Class, Input / Output Exceptions, Creation of Files, Reading / Writing Characters, Reading / Writing Bytes, Handling Primitive Data Types, Concatenating and Buffering Files, Interactive Input and output, Other Stream Classes.

[13 Hours]

Text Books:

1. A.Balaguruswamy, "Programming with JAVA", A Primer, TMH, 1999.

Reference Books:

1. Thomas Boutel, "CGI programming in C and Perl", Addison – Wesley, 1996.
2. Jefry Dwight et al, Using CGI, Second Edition, Prentice Hall, India, 1997.
3. Patrick Naughton & Herbert Schildt, JAVA 2: The Complete Reference, THM, 1999.
4. Schildt, "JAVA The Complete Reference", 7th Edition.

CS5P2: JAVA PROGRAMMING LAB

PART - A

1. Write a program to find factorial of list of number reading input as command line argument.
2. Write a program to display all prime numbers between two limits.
3. Write a program to sort list of elements in ascending and descending order and show the exception handling.
4. Write a program to implement all string operations.
5. Write a program to find area of geometrical figures using method.
6. Write a program to implement constructor overloading by passing different number of parameter of different types.
7. Write a program to create student report using applet, read the input using text boxes and display the o/p using buttons.
8. Write a program to calculate bonus for different departments using method overriding.
9. Write a program to implement thread, applets and graphics by implementing animation of moving ball.
10. Write a program to implement mouse events and keyboard events.

PART – B

During practical examination the External and Internal examiners may prepare exam question paper related to theory syllabus apart from Part-A. (A minimum of 10 Programs has to be prepared).

Note :

a) The candidate has to write both the programs One from Part-A and other from Part-B and execute one program as of External examiner choice.

b) A minimum of 10 Programs has to be done in Part-B and has to be maintained in the Practical Record.

c) Scheme of Evaluation is as follows:

Writing two programs	- 10 Marks
Execution of one program	- 10 Marks
Formatting the Output	- 05 Marks
Viva	- 05 Marks
Record	- 05 Marks
Total	**- 35 Marks**

VI Sem B Sc

CS6T1: WEB PROGRAMMING

Total Teaching Hours : 52 No of Hours / Week : 03

Unit - I

Fundamentals of Web: Internet, WWW, Web Browsers, and Web Servers, URLs, MIME, HTTP, Security, The Web Programmers Toolbox. XHTML: Origins and evolution of HTML and XHTML, Basic syntax, Standard XHTML document structure, Basic text markup, Images, Hypertext Links, Lists, Tables, Forms, Frames, Syntactic differences between HTML and XHTML.

[13 Hours]

Unit - II

Java Script: Overview of JavaScript; Object orientation and JavaScript; General syntactic characteristics; Primitives, Operations, and expressions; Screen output and keyboard input; Control statements; Object creation and Modification; Arrays;

Functions; Constructor; Pattern matching using expressions; Errors in scripts; Examples.

[13 Hours]

Unit - III

Java Script and HTML Documents, Dynamic Documents with JavaScript, The JavaScript execution environment; The Document Object Model; Element access in JavaScript; Events and event handling; Handling events from the Body elements, Button elements, Text box and Password elements; The DOM 2 event model; The navigator object; DOM tree traversal and modification. Introduction to dynamic documents; Positioning elements; Moving elements; Element visibility; Changing colors and fonts; Dynamic content; Stacking elements; Locating the mouse cursor; Reacting to a mouse click; Slow movement of elements; Dragging and dropping elements.

[13 Hours]

Unit - IV

CSS: Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The Box model, Background images, The and tags, Conflict resolution. XML: Introduction; Syntax; Document structure; Document Type definitions; Namespaces; XML schemas; Displaying raw XML documents; Displaying XML documents with CSS; XSLT style sheets; XML Processors; Web services.

[13 Hours]

Text Books

1. Robert W Sebesta, "Programming the World Wide Web", 4th Edition, Pearson Education, 2008.

Reference Books

1. M.Deitel, P.J.Deitel, A.B.Goldberg, "Internet & World Wide Web How to program", 3rd Edition, Pearson Education / PHI, 2004.
2. Chris Bates, "Web Programming Building Internet Applications", 3rd Edition, Wiley India, 2006.
3. Xue Bai et al, "The Web Warrior Guide to Web Programming", Thomson, 2003.
4. Sklar, "The Web Warrior Guide to Web Design Technologies", 1st Edition, Cengage Learning India.

CS5P2: WEB PROGRMMING LAB

PART - A

1. Create a form having number of elements (Textboxes, Radio buttons, Checkboxes, and so on). Write JavaScript code to count the number of elements in a form
2. Create a HTML form that has number of Textboxes. When the form runs in the Browser fill the textboxes with data. Write JavaScript code that verifies that all textboxes has been filled. If a textboxes has been left empty, popup an alert indicating which textbox has been left empty.
3. Develop a HTML Form, which accepts any Mathematical expression. Write JavaScript code to Evaluates the expression and Displays the result.
4. Create a page with dynamic effects. Write the code to include layers and basic animation.
5. Write a JavaScript code to find the sum of N natural Numbers. (Use user-defined function)
6. Write a JavaScript code block using arrays and generate the current date in words, this should include the day, month and year.
7. Create a form for Student information. Write JavaScript code to find Total, Average, Result and Grade.

8. Create a form for Employee information. Write JavaScript code to find DA, HRA, PF, TAX, Gross pay, Deduction and Net pay.
9. Create a form consists of a two Multiple choice lists and one single choice list
   a) The first multiple choice list, displays the Major dishes available.
   b) The second multiple choice list, displays the Starters available.
   c) The single choice list, displays the Soft drinks available.
10. Create a web page using two image files, which switch between one another as the mouse pointer moves over the image. Use the on Mouse Over and on Mouse Out event handlers.

PART – B

During practical examination the External and Internal examiners may prepare exam question paper related to theory syllabus apart from Part-A. (A minimum of 10 Programs has to be prepared).

Note:

a) The candidate has to write both the programs One from Part-A and other from Part-B and execute one program as of External examiner choice.
b) A minimum of 10 Programs has to be done in Part-B and has to be maintained in the Practical Record.
c) Scheme of Evaluation is as follows:

Writing two programs	- 10 Marks
Execution of one program	- 10 Marks
Formatting the Output	- 05 Marks
Viva	- 05 Marks
Record	- 05 Marks
Total	**- 35 Marks**

CS6T2 : COMPUTER NETWORKS

Total Teaching Hours : 52 No of Hours / Week : 03

Unit - I

Introduction: Growth of computer networking, Complexity in network system, Motivation and Tools: Resource sharing, Growth of the internet, probing the internet, interpreting the ping response, tracing a route. Transmission Media: Copper wires, glass fibers, radio, satellite, Geosynchronous satellites, low earth orbit satellites, Low earth orbit satellite arrays, Microwave, Infrared, Light from a laser. Local Asynchronous Communications: Introduction, the need for asynchronous communications, using electric current to send bits, standards for communication, baud rate, Framing and errors, Half and Full duplex asynchronous communication, the effect of noise on communication. Long distance Communication: Sending signals across long distances, Modem hardware used for Modulations and Demodulation, Leased analog data circuites, optical, radio frequency and dialup Modems, carrier frequencies and Multiplexing, baseband and bradband technologies, wave length division multiplexing, spread spectrum, time division multiplexing [13 hours]

Unit - II

Packets, Frames and Error Detection: Concept of Packets, packets and Time-division Multiplexing, Packets and Hardware Frames, byte Stuffing, transmission errors, Parity bits and Parity checking, error detection, Detecting errors with checksums, detecting errors with CRC, Burst errors, frame formats and error detection mechanism. LAN Technologies and Network Topologies: Direct point-to-point communications, Shared Communications channels, LAN Topologies, Ethernet, Carries sense on CSMA,

Collision Detection and Backoff with CSMA/CD, Ring Topology and Token Passing, Self-Healing Token Passing Networks, ATM. Hardware addressing and Frame Type Identification: specifying a recipient, How LAN hardware uses addresses to filer packets, format of a physical addresses, broadcasting, Multicast addressing, identifying packet contents, frame headers and frame format. LAN Wiring, Physical Topology and Interface Hardware: speeds of LANs and computers, Network Interface Hardware, The connection between a NIC and a network, original thick Ethernet wiring, connection multiplexing, thin Ethernet wiring, twisted pair Ethernet, Network interface cards and wiring schemes, categories of wires. [13 hours]

Unit - III

Extending LANs: Fiber Optic Extensions, Repeaters, bridges, frame filtering, switching, Long-distance and Local Loop Digital Technologies: Digital telephony, Synchronous communication, SONET, ISDN, Asymmetric Digital Subscriber Line Technology, other DSL technologies, cable modem technology, upstream communication, Broadcast Satellite systems. WAN technologies and Routing: Large Networks and Wide Areas, Packet switches, forming a WAN, store and forward, Physical addressing in a WAN, Next-Hop forwarding, Source independence, Routing Table Computation, Shortest path computation in a Graph, distance vector routing, like-state routing, Example of WAN technologies. Network Characteristics: Network ownership, Network performance characteristics, Jitter. Protocols and Layering: the need for protocols, the seven layers, Stacks: Layered Software. [13 hours]

Unit - IV

Internetworking: internet architecture, A virtual Network, Layering and TCP/IP protocols. Internet Protocol Addresses, APR, IP Datagram's and Datagram Forwarding, IP Encapsulation, Fragmentation, and Reassembly, IPv6, ICMP, UDP, TCP, Internet routing, DNS, WWW, MAIL. [13 hours]

Text Books:

1. Douglas E Comer and M.S.Narayana, "Computer Networks and Internets", 5th edition, Pearson Education, 2013.

Reference Books:

1. Andrew S.Tanenbaum, "Computer Networks", Fifth Edition, Prentice Hall, 2012
2. Behrouz Ferouzan, "Introduction to Data Communications and Networking", TMH, 1999.
3. S. Keshav, "An Engineering Approach to Computer Networks", Pearson Education, 2nd Edition.

CS6P2: PROJECT LAB

Total Practical hours / week: 03 hours

Students are required to take up a problem and develop a system by making use of the existing infrastructure available in their respective colleges.

Scheme of Evaluation is as follows:

Project Demo	- 15 Marks
Project VIVA	- 15 Marks
Project Report	- 5 Marks
Total	**- 35 Marks**

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BANGALORE UNIVERSITY

Regulations and Syllabus
for
STATISTICS
in
Three Year BSc Course (CBCS 2017)

Eligibility

1. Only those candidates who have passed Pre-University course or an equivalent course with Mathematics/Business Mathematics/ Basic Mathematics/Applied Mathematics as one of the optional subjects are eligible to take Statistics as one of the optional subjects in BSc course.
2. Any student taking Statistics as one of the optional subjects in the B.Sc. course shall take Mathematics as another optional subject.

Scheme of Instruction/ Examination

1. The subject of Statistics in this course has to be taught by MSc/MA degree holders in Statistics / Applied Statistics.
2. The theory question paper for each paper shall cover all the topics in the pertaining syllabus with proportional weightage to the number of hours of instruction prescribed.
3. The practicals are to be conducted in batches as per the University norms for the faculty of science (normally 10 students per batch per teacher).
4. Two teachers are to be assigned for each batch with not more than 20 students for giving instructions, supervision, and correction of records.
6. It is expected that each student collects and uses real life data for the practical classes.
7. Students are required to use Statistical software, run the programmes, and enclose computer outputs to the practical records in the case of computer based practicals.
8. Maximum marks for each record in the examination is 5.
9. Study tour for the students is strongly recommended to gain practical knowledge of applications of Statistics in Industries/Agriculture/Medical field.

Scheme for theory and practicals

Sem.	Code number	Title of the paper (Theory / Practical)	Lecture/ Practical hours per week	Duration of exam	IA marks	Maximum marks	Total	Credits
I	ST 101	Basic Statistics-I	04	03	30	70	100	2
	ST 102	Practical –I	03	03	15	35	50	1
II	ST 201	Basic Statistics- II	04	03	30	70	100	2
	ST 202	Practical –II	03	03	15	35	50	1
III	ST 301	Statistical Inference-I	04	03	30	70	100	2
	ST 302	Practical –III	03	03	15	35	50	1
IV	ST401	Statistical Inference-II	04	03	30	70	100	2
	ST 402	Practical –IV	03	03	15	35	50	1
V	ST 501	Sampling Theory and Statistical Quality Control	03	03	30	70	100	2
	ST502	Practical –V	03	03	15	35	50	1
V	ST 503	Design of Experiments and Demography	03	03	30	70	100	2
	ST504	Practical –VI	03	03	15	35	50	1
VI	ST 601	Applied Statistics	03	03	30	70	100	2
	ST602	Practical –VII	03	03	15	35	50	1
VI	ST 603	Operational research	03	03	30	70	100	2
	ST604	Practical –VIII	03	03	15	35	50	1

Total credits: 24

STATISTICS

FIRST SEMESTER

4 hours lecture + 3 hours practical per week
(Theory 2 credits + Practical 1 credit)

ST 101: BASIC STATISTICS – I

(52 hours : 2 credits)

Unit 1

Organization and presentation of data: Meaning, importance, and scope of Statistics. Types of data:Primary and secondary data. Types of measurements: Nominal, ordinal, ratio, and interval. Classification and tabulation. Construction of frequency distribution.Graphical representation: Frequency curve, Ogives, histogram. **8 hrs**

Unit 2

Univariate data analysis: Measures of location: Arithmetic mean, median, mode, geometric mean, harmonic mean and their properties. Quantiles: quartiles, deciles, percentiles. Absolute and relative measures of dispersion: range, standard deviation, mean deviation, quartile deviation, coefficient of variation and their properties. Moments:Raw and central moments, properties., and relationship between them. Skewness and kurtosis: concept, measures, and properties. **16 hrs**

Unit 3

Bivariate data analysis: Bivariate data, Scatter diagram,Correlation, Karl Pearson's correlation coefficient, Spearman's rank correlation coefficient. Concept of errors, Principle of least squares. Simple linear regression and its properties. Fitting linear regression line and coefficient of determination. **10 hrs**

Unit 4

Multivariate data analysis: Multiple linear regression, multiple and partial correlation coefficients. Residual error variance. Coefficient of determination. **6 hrs**

Unit 5

Elements of probability: Random experiments, sample space,events, related results. Classical, empirical, and axiomatic approaches to probability. Properties of probability.Illustrations and applications. Addition thoerem. Conditional probability, independence of events.Law of total probability. Bayes theorem and applications. **12 hrs**

ST 102: PRACTICAL – I
List of Assignments

(30 hours : 1 credit)

(Demonstration using MS Excel)

1. Construction of frequency distribution andgraphical representation.
2. Measures of central tendency I
3. Measures of central tendency II (Positional averages & Partition values).
4. Measures of dispersion (Range,QD , MD,SD,and CV).

5. Moments, skewness, and kurtosis for a frequency distribution.
6. Correlation and regression for ungrouped data and Spearman's rank correlation coefficient.
7. Correlation and regression for grouped data
8. Analysis of trivariate data.
9. Computation of probabilities using combinatorial methods.
10. Application of addition rule, conditional probability, Bayes formula.

Text Books

1. Croxton, F.E, Cowden, D.J., and Klein, S. (1973). *Applied General Statistics,* 3/e, Prentice Hall Inc., New Jersey, USA.
2. Freund, J.E. and Walpole, R.E. (1987). Mathematical Statistics, 4/e,Prentice Hall Inc., New Jersey, USA.
3. Goon, A.M., Gupta, M.K., and Das Gupta, B. (1991). *Fundamentals of Statistics, Vol. I,* World Press, Calcutta.
4. Medhi, J. (1992).*Statistical Methods: An introductory Text,* New Age International, New Delhi.
5. Montgomery, D.C. and Runger, G.C. (2013). *Applied Statistics and Probability for Engineers,* Wiley India, New Delhi.

References

1. Anderson, T.W. and Sclove, S.L. (1978).*An Introduction to the Statistical Analysis of Data*, Houghton Mifflin and Co, New York.
2. Cooke, H.D., Craven, A.H., and Clarke, G.M. (1982): *Basic Statistical Computing*, Chapman and Hall, New York.
3. Mood, A.M., Graybill, F.A., and Boes, D.C. (1974): *Introduction to the Theory of Statistics*, McGraw Hill, New York.
4. Ross, S.M (2003).*Introduction to Probability Models*, 10/e, Academic Press, UK.
5. Snedecor, G.W. and Cochran, W.G. (1967). *Statistical Methods*, Iowa StateUniversity Press, USA.
6. Spiegel, M.R. (1967).*Theory and Problems of Statistics*, Schaum's PublishingSeries, London.

STATISTICS

SECOND SEMESTER

4 hours lecture +3 hours practical per week
(Theory 2 credits + Practicals 1 credit)

ST 201: BASIC STATISTICS – II

(52 hours : 2 Credits)

Unit 1

Random variables and expectation (Univariate): Distribution function, Discrete and continuous random variables, Probability mass and density functions- properties and illustrations. Expectation of a random variable and algebra of expectations and related results. Moments and moment generating function, properties and applications. Transformation of random variables. **9 hrs**

Unit 2

Discrete probability distributions: Discrete uniform, Bernoulli, binomial, Poisson, geometric, negativebinomial, and hypergeometric distributions – mean, variance, moments, and MGF. Recursive relations for moments of binomial and Poisson distributions. Approximations of binomial, negative binomial and hyper geometric distributions. **12 hrs**

Unit 3

Continuous probability distributions: Uniform, gamma, beta, exponential, Normal, and Cauchy distributions – mean, variance, moments, MGF, and properties. **16 hrs**

Unit 4

Random variables and expectation (Bivariate): Bivariate random variables, joint, marginal, and conditional distributions. Independence of random variables. Moments, covariance, and correlation coefficient. Properties of expectations of bivariate random variables. Mean and variance of linear combination of random variables. MGF of sum of independent random variables. **9 hrs**

Unit 5

Limit theorems: Chebyschev's inequality – proof and its role in approximating probabilities. Convergence of binomial, Poisson, gamma distributions to Normal distribution. Statement of central limit theorem and its applications. **6 hrs**

ST 202: PRACTICAL –II

List of Assignments

(30 hours : 1 credit)

(Demonstration using MS Excel and R software)

1. Univariate probability distributions: Expectation, moments, skewness, and kurtosis.
2. Bivariate probability distributions: Moments and correlation coefficient.
3. Applications of binomial distribution and fitting binomial distribution.

4. Applications of Poisson distribution and its fitting.
5. Computation of probabilities based on negative binomial, geometric, hyper geometric and discrete uniform distributions.
6. Applications of Normal distribution.
7. Fitting normal distribution.
8. Computation of probabilities based on rectangular and exponential distributions.
9. Applications of Chebyschev's inequality.
10. Applications of the central limit theorem.

Text Books

1. Goon A.M., Gupta, M.K., Das Gupta, B. (1991).*Fundamentals of Statistics*,Vol.I, World Press, Calcutta.
2. Hogg, R. V. and Craig, A.T. (1995).*Introduction to Mathematical Statistics*, 5/e, Prentice Hall, New Jersey, USA.
3. Medhi, J. (1992).*Statistical Methods: An introductory text*. New Age International, New Delhi.
4. Mukhopadhyay, P.(2015): *Mathematical Statistics*, Books and Allied Pvt Ltd., Kolkata.
5. Spiegel, M.R. (2001).*Probability and Statistics*, 4/e, Schaum's Outline Series, McGraw Hill, London.
6. Walpole, R.E., Myers, R.H., and Myers, S.L. (2017). *Probability and Statistics for Engineers and Scientists*, 9/e, Pearson, New Delhi.

References

1. Bhattacharya, G. K. and Johnson, R.A. (1986): Statistical Concepts and Methods, John Wiley, New York.
2. Dudewicz, E.J. and Mishra, S.N.(1980). *Modern Mathematical Statistics*, John Wiley, New York.
3. Montgomery, D.C. and Runger, G.C. (2013). *Applied Statistics and Probability for Engineers*, Wiley India, New Delhi.
4. Rohatgi, V.K. and Saleh, A.K. Md. E. (2002). *An Introduction to Probability Theory and Mathematical Statistics*, 3/e, John Wiley, New York.
5. Ross, S.M (2003).*Introduction to Probability Models*, 10/e, Academic Press, UK.

STATISTICS

THIRD SEMESTER

4 hours lecture + 3 hours practical per week
(Theory 2 credits + Practicals 1 credit)

ST 301: STATISTCAL INFERENCE - I

(52 hours : 2 credits)

Unit 1

Sampling distributions: Population and sample. Sampling distribution and standard error. Sampling distribution of mean, variance. Chi-square, t, and F distributions – mean, variance, M.G.F, and properties. **10 hrs**

Unit 2

Point estimation: Families of distributions - location and scale families. Single parameter exponential family. Point estimation. Concepts of estimator and estimate. Criteria for estimators: Unbiasedness, consistency. Invariance property of consistent estimators. Efficiency andrelative efficiency. Mean square error as a criterion for comparing estimators. Sufficient statistic. Statement of Neyman - Factorization theorem. Fisher information function. Statement of Cramer - Rao inequality and its applications. Minimum variance unbiased estimator and minimum bound estimator. **20 hrs**

Unit 3

Methods of point estimation: Maximum likelihood and method of moment estimation. Properties of maximum likelihood and moment estimators and examples. **6 hrs**

Unit 4

Interval estimation: Confidence interval, confidence coefficient, shortest confidence interval. Method of constructing confidence intervals using pivotal quantity. Construction of confidence intervals for mean, difference of two means, variance and ratio of variances,proportion, difference of two proportions, and correlation coefficient. **8 hrs**

Unit 5

Simulation: Introduction to simulation. Monte Carlo method. Generation of random observationsfrom uniform, exponential, Normal, Cauchy, binomial, Poisson distributions. Simple illustrations. **8 hrs**

ST 302: PRACTICAL III

List of Assignments

(30 hours : 1 credit)

(Demonstration using MS Excel and R Software)

1. Drawing random samples using random number tables .
2. Point estimation of parameters and obtaining estimates of standard errors.

3. Comparison of estimators by plotting mean square error.
4. Computing maximum likelihood estimates -1
5. Computing maximum likelihood estimates - 2
6. Computing moment estimates
7. Constructing confidence intervals based on large samples.
8. Constructing confidence intervals based on small samples.
9. Generating random samples from discrete distributions.
10. Generating random samples from continuous distributions.

Text Books

1. Goon A.M., Gupta, M.K., Das Gupta, B. (1991).*Fundamentals of Statistics*,Vol.I, World Press, Calcutta.
2. Hogg, R. V. and Craig, A.T. (1995).*Introduction to Mathematical Statistics*, 5/e, Prentice Hall, New Jersey, USA.
3. Medhi, J. (1992).*Statistical Methods: An introductory text*, New Age International, New Delhi.
4. Montgomery, D.C. and Runger, G.C. (2013). *Applied Statistics and Probability for Engineers*, WileyIndia, New Delhi.
5. Mukhopadhyay, P.(2015): *Mathematical Statistics*, Books and Allied (P) Ltd., Kolkata.
6. Spiegel, M.R. (2001).*Probability and Statistics*, 4/e, Schaum's Outline Series, McGraw Hill, London.
7. Walpole, R.E., Myers, R.H., and Myers, S.L. (2017). *Probability and Statistics for Engineers and Scientists*, 9/e, Pearson, New Delhi.

References

1. Bhattacharya, G. K. and Johnson, R.A. (1986): *Statistical Concepts and Methods*, John Wiley, New York.
2. Casella, G. and Berger, R.L. (1990). *Statistical Inference*, Duxbury Press, Belmont, California, USA. (2nd Edition).
3. Dudewicz, E.J. and Mishra, S.N.(1980). *Modern Mathematical Statistics*, John Wiley, New York.
4. Rohatgi, V.K. and Saleh, A.K. Md. E. (2002). *An Introduction to Probability and Statistics*, 2/e, John Wiley, New York.
5. Ross, S.M (2003). *Introduction to Probability Models*, 10/e, Academic Press, UK.

STATISTICS

FOURTH SEMESTER

4 hours lecture + 3 hours practical per week
(Theory 2 credits + Practicals 1 credit)

ST 401: STATISTICAL INFERENCE - II

(52 hours : 2 credits)

Unit 1

Introduction to tests of hypotheses: Statistical hypotheses- null and alternative, simple and composite hypotheses. Type-I and Type-II errors, test functions. Randomized and nonrandomized tests. Size, level of significance, power function, power of tests. Critical region.p-value and its interpretation. Illustrative examples. Most powerful (MP) test. Statement of Neyman – Pearson lemma and its applications. **12 hrs**

Unit 2

Tests of significance I: Large and small sample tests of significance.Tests for single mean, equality of two means, single variance, and equality of two variances for normal populations. Tests for proportions. **12 hours**

Unit 3

Tests of significance II: Tests for simple, partial,and multiple correlation coefficients and regression coefficients. Fisher's *Z*-transformation and its applications. Analysis of categorical data: contingency tables, tests for the independence andassociation of attributes. Chi-square tests for independence of attributes and goodness of fit. **12 hrs**

Unit 4

Nonparametric tests: Introduction to nonparametric tests. Run test for randomness. Sign test and Wilcoxon signed rank test for one and paired samples. Run test, median test, and Mann-Whitney-Wilcoxon test for two sample problems. Test for independence based on Spearman's rank correlation coefficient. **10 hrs**

Unit 5

Sequential tests: Need for sequential tests, Wald's SPRT for binomial proportion and Normal population mean when variance is known. **6 hrs**

ST 402: PRACTICAL – IV

List of Assignments

(30 hours : 1 credit)

(Demonstration of practicals using MS-Excel)

1. Evaluation of probabilities of Type-I and Type-II errors and powers of tests.
2. MP test for parameters of binomial and Poisson distributions.
3. MP test for the mean of a normal distribution and power curve.
4. Tests for mean, equality of means when variance is (i) known, (ii) unknown

under normality (small and large samples)

5. Tests for single proportion and equality of two proportions.
6. Tests for variance and equality of two variances under normality
7. Tests for correlation and regression coefficients.
8. Tests for the independence of attributes, analysis of categorical data and tests for the goodness of fit.(For uniform, binomial and Poisson distributions)
9. Nonparametric tests.
10. SPRT for binomial proportion and mean of a normal distribution.

Text Books

1. Chandra,T. K. and Chatterjee, D. (2005). *A First Course in Probability*, Narosa Publishing House, New Delhi..
2. Hogg, R. V. and Craig, A.T. (1995).*Introduction to Mathematical Statistics*, 5/e, Prentice Hall, New Jersey, USA.
3. Lehmann, E. L. and Romano, J. P. (2005). *Testing Statistical Hypotheses*, 2/e, John Wiley, NewYork.
3. Montgomery, D.C. and Runger, G.C. (2013). *Applied Statistics and Probability for Engineers*, Wiley.India, New Delhi.
4. Mukhopadhyay, P.(2015): *Mathematical Statistics*, Books and Allied (P) Ltd., Kolkata.
5. Walpole, R.E., Myers, R.H., and Myers, S.L. (2017). *Probability and Statistics for Engineers and Scientists*, 9/e, Pearson, New Delhi.

References

1. Bhattacharya, G. K. and Johnson, R.A. (1986): Statistical Concepts and Methods, John Wiley, New York.
2. Dudewicz, E.J. and Mishra, S.N.(1980). *Modern Mathematical Statistics*, John Wiley, New York.
3. Rohatgi, V.K. and Saleh, A.K. Md. E. (2002). *An Introduction to Probability Theory and Mathematical Statistics*, 2/e, John Wiley, New York.

STATISTICS

FIFTH SEMESTER

6 hours of lecture + 6 hours of practical per week
(Theory: 4 credits + Practicals: 2 credits)

ST 501: SAMPLING THEORY AND STATISTICAL QUALITY CONTROL

(39 hours : 2 credits)

Unit 1

Introduction to sampling theory: Need for sampling.Complete enumeration Vs sample surveys. Probability and non-probability sampling. Methods of drawing random samples. Survey methods, principal steps in a sample survey, planning, execution, analysis, and reporting stages. Sampling and non-sampling errors. **5 hrs**

Unit 2

Simple random sampling (SRS): Sampling with and without replacement. Unbiased estimators of population mean and total. Derivation of sampling variances. SRS for proportions. Derivation of the sampling variances andstandard errors. Confidence limits. Determination of sample size. Advantages and limitations of SRS. **8 hrs**

Unit 3

Stratified and systematic sampling: Stratified random sampling: Need for stratification, advantages, and limitations. Unbiased estimators of population mean and total. Derivation of the variance of the estimators and their estimation. Proportional, optimum and Neyman allocations. Comparison of variances with SRSWOR. Estimation of gain in precision due to stratification.

Linear systematic sampling, its advantages and limitations. Estimation of mean, total and variance of the estimators. Comparison with SRSWOR .Circular systematic sampling. **10 hrs**

Unit 4

Process control: Introduction to statistical quality control (SQC), aims and objectives. Chance and assignable causes of variation. Process control and product control. Control charts and basis for their construction. Action and warning limits. Various tools of SQC. Rational subgroups.Derivation of control limits, basis, construction, and interpretation of mean, range, and standard deviation charts, np-chart, p-chart, stabilized p-chart, c-chart and u-chart. Criteria for detecting lack of control. Process capability study: Natural tolerance limits and specification limits, process capability,PCR and interpretation. **10 hrs**

Unit 5

Product control: Lot acceptance sampling- Sampling inspection, 100 percent inspection and rectifying inspection. AQL, LTPD, Producer's risk and consumer's risk. Acceptance sampling plans – single and double sampling plans by attributes- Derivation of OC, AOQ, ASN, and ATI, functions. **6 hrs**

ST 502: PRACTICAL – V

List of Assignments

(30 hours : 1 credit)

1. Drawing of random sample under SRSWR and SRSWOR from a given population and estimation of the mean and total and the standard errors of the estimators. Construction of confidence intervals.
2. Estimation of the proportion, total, and the standard errors of the estimatorsbased on a random sample under SRSWR and SRSWOR .
3. Stratified random sampling.
4. Systematic sampling.
5. $\overline{X}$ – R charts. (Standard values known and unknown).
6. $\overline{X}$ – s charts. (Standard values known and unknown).
7. np and p charts. (Standard values known and unknown).
8. c and u charts. (Standard values known and unknown).
9. Drawing OC, AOQ, ASN, and ATI curves for single sampling plan.
10. Drawing OC, AOQ, ASN, and ATI curves for double sampling plan.

Text Books

1. Goon A.M., Gupta, M.K., Das Gupta, B. (1991).*Fundamentals of Statistics*,Vol.I, World Press, Calcutta.
2. Grant, E.L. and Leavenworth, R. S. (1996). *Statistical Quality Control*. 7th edition, McGrawHill, New York.
3. Mahajan, M. (2001).*Statistical Quality Control*, Dhanpat Rai & Co. (P) Ltd. New Delhi.
4. Montgomery, D.C. (2013). *Introduction to Statistical Quality Control*, (Wiley Int. Edn.)
5. Cochran,W. G. (2007). *Sampling Techniques*. 3/e, John Wiley and Sons, New York.
6. Alwan, L. C. (2000). *Statistical Process Analysis*, McGraw Hill, New York.

References

1. John, S.O. and Followell, R. F. (1990). Statistical Process Control. (East West Press, India.
2. Mukhopadhyay, P (1996). Applied Statistics. Calcutta Publishing House.
3. Des Raj and Chandok, P. (1998). *Sampling Theory*, Narosa, New Delhi.
4. Mukhopadhyay, P. (2015): *Mathematical Statistics*, Books and Allied (P) Ltd., Kolkata.
5. Murthy, M.N. (1977). Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
6. Sampath, S. (2006). *Sampling Theory and Methods*, 2/e, Narosa, New Delhi.

ST 503: DESIGN AND ANALYSIS OF EXPERIMENTS

(39 hours : 2 credits)

Unit 1

Analysis of variance: Meaning and assumptions. Fixed, random and mixed effect models. Analysis of variance of one-way and two-way classified data with and without interaction effects. Multiple comparison tests: Tukey's method, critical difference. **10 hrs**

Unit2

Experimental designs: Principles of design of experiments. Completely randomized, randomized block, and Latin square designs (CRD, RBD, and LSD) -layout formation and the analysis using fixed effect models. **10 hrs**

Unit 3

Efficiency of a design and missing plot technique: Comparison of efficiencies of CRD, RBD, and LSD . Estimation of single missing observation in RBD and LSD and analysis. **5 hrs**

Unit 4

Factorial experiment: Factorial experiment: Basic concepts, main effects, interactions, and orthogonal contrasts in $2^2$and 2^3 factorial experiments. Yates' method of computing factorial effects total. Analysis and testing the significance of effects in $2^2$and 2^3 factorial experiments in RBD. **8 hrs**

Unit 5

Confounding: Need for confounding. Complete and partial confounding in a 2^3 factorial experiment in RBD - layout and its analysis. **6 hrs**

ST 504: PRACTICAL – V

List of Assignments

(30 hours : 1 credit)

(Demonstration of practicals using MSExcel)

1. ANOVA for one way classified data.
2. ANOVA for two way classified data.
3. Analysis of CRD.
4. Analysis of RBD.
5. Analysis of LSD.
6. Missing plot techniques in RBD and LSD
7. Analysis of 2^2 factorial experiment using RBD layout.
8. Analysis of 2^3 factorial experiment using RBD layout.
9. Analysis of 2^3 factorial experiment using RBD layout. (Complete confounding)
10. Analysis of 2^3 factorial experiment using RBD layout. (Partial confounding)

Text Books

1. Goon A.M., Gupta, M.K., Das Gupta, B. (1991).*Fundamentals of Statistics*,Vol.I, World Press, Calcutta.
2. Montgomery, D.C. (2014). *Design and Analysis of Experiments*, Wiley. New York.
3. Joshi, D. D. (1987).*Linear Estimation and Design of Experiments*. New Age International (P) Limited, New Delhi.

References

1. Cochran, W.G. and Cox, G. M. (1992).*Experimental Designs*, John Wiley and Sons, New York.
2. Mukhopadhya, P.(2015): *Mathematical Statistics*, Books and Allied (P) Ltd., Kolkata.

STATISTICS

SIXTH SEMESTER

6 hours lecture + 6 hours practical per week
(Theory 4 credits + Practicals 2 credits)

ST 601: APPLIED STATISTICS

(39 hours : 2 credits)

Unit 1

Time series analysis: Components of time series. Additive and multiplicative models. Measurements of trend by moving averages and by least squares. Construction of seasonal indices by simple averages and ratio to moving averages. **8 hrs**

Unit 2

Index numbers: Introduction. Price and quantity index numbers. Construction of index numbers: Simple and weighted methods. Tests for consistency of index numbers. Consumer price index. Problems involved in the construction of general and consumer price index numbers. Uses and limitations. **7 hrs**

Unit 3

Demography: Sources of demographic data. Measurement of mortality: Crude, specific, and standardized death rates. Infant and maternal mortality rates. Measurement of fertility: crude, age specific general, and total fertility rates. Reproduction rates. Life table: Components of a life table, force of mortality, and expectation of life. Construction of a life table. Uses of a life table. **10 hrs**

Unit 4

Clinical trials: Introduction, therapeutic and prophylactic trails. Observational, crosssectional, prospective, retrospective, and randomized controlstudies.Odds ratio and its confidence interval. Relative risk and its confidence interval. Diagnostic efficacy. Application of Bayes theorem. Sensitivity, specificity, false negative andfalse positive rates. Receiver operating characteristic (ROC) curve. Body mass index. **7 hrs**

Unit 5

Official Statistics and national income: History of Indian Statistical System. Pre and post independence era .CSO NSSO and their activities. National income. Basic concepts of GNP, GDP, NNP. National Income at factor cost – NDP, per capita income. Real national income. Methods of estimating national income. Problems in estimating national income. Uses of national income statistics. National accounts statistics of CSO. **7 hrs**

ST 602: PRACTICALS - VII

List of Assignments

(30 hours : 1 credit)

1. Time series 1: Measurement of trend.
2. Time series 2: Measurement of seasonal variation .
3. Construction of index numbers and consumer price index numbers.
4. Tests for consistency of index numbers.

5. Vital Statistics 1: Computation of various mortality rates.
6. Vital Statistics 2: Computation of various fertility rates.
7. Vital Statistics 3: Life table construction and computation of reproduction rates.
8. Clinical trials 1: (Odds ratio, relative risk, and confidence interval)
9. Clinical trials 2: (ROC curve and computation of various rates)
10. National income.

Text Books

1. Goon A.M., Gupta, M.K., Das Gupta, B. (1991). *Fundamentals of Statistics*, Vol. II, World Press, Calcutta.
2. Montgomery, D.C. and Runger, G.C. (2013). *Applied Statistics and Probability for Engineers*, Wiley India, New Delhi.
3. Sundar Rao, P.S.S. and Richard, J. (2012). *Introduction to Biostatistics and Research Methods*, 5/e, Prentice Hall of India, New Delhi.
4. Saluja, M. R. (1972). *Indian Official Statistical Systems*, Statistical Publishing Society, Calcutta.

References

1. CSO (1980). *National Accounts Statistics* - Sources and Health, Govt. of India, New Delhi.
2. UNESCO: Principles for Vital Statistics Systems. Series M -12.
3. Sen, A. (1997). Poverty and Inequality, Stanford University Press, USA.
4. Mukhopadhyay, P. (2015). *Applied Statistics*, Books and Allied Pvt Ltd., Kolkata.

ST 603: OPERATIONS RESEARCH

(39 hours : 2 Credits)

Unit 1

Introduction to OR and LPP: Definition and scope of operations research (OR). Modeling and solution. Linear programming problem (LPP): Definition, standard and canonical forms. Formulation of LPP. Basic feasible solutions, degenerate and non degenerate solutions. Graphical solution and simplex algorithm for solving an LPP.Artificial variable, Charnes' Big- M Method. Criteria for unbounded, multiple, andinfeasible solutions. Concept of duality in LPP. **14 hrs**

Unit 2

Transportation and assignment problems: Mathematical formulation of transportation problem. Existence of feasible solution. Finding initial basic feasible solution: North - West corner rule and Vogel's method. Test for optimality. Transportation algorithm. Problem of degenerate solution. Unbalanced transportation problem.

Mathematical formulation of assignment problem and Hungarian algorithm. Unbalanced assignment problem.

8 hrs

Unit 3

Game Theory: Basic concepts of game theory. Two-person zero sum game. Pure and mixed strategies. Maximin–Minimax principles, Games with saddle point. Principle of dominance. Games without saddle point. Mixed strategies. Determination of optimum solution for a 2x2 game. Solution by graphical method for 2xn and mx2 games. **5 hrs**

Unit 3

Inventory and replacement theory: Description of an inventory system. Inventory costs. Demand, lead time, and reorder level. Inventory models. EOQ model with and without shortages.

Need for replacement. Replacement policy for items which deteriorate with time. Optimum policy with discrete and continuous time. Group replacement policy. **8 hrs**

Unit 5

Queuing theory: Characteristics of a queuing system. Steady state system size distribution in M/M/1 queuing system (only statement). Waiting time distributions. Little's formula, measures of effectiveness, derivation of expressions for expected queue length, and expected system size(length) and expected waiting times. Description of M/M/C queuing system. **4 hrs**

604: PRACTICAL - VIII

List of Assignments

(30 hours : 1 credit)

(Demonstration of practicals using TORA software)

1. Formulation of linear programming problem (LPP) - graphical solution.
2. Solution of LPP - simplex algorithm - 1
3. Solution of LPP - simplex algorithm - 2
4. Transportation problems - 1 (IBFS)
5. Transportation problems - 2 (OBFS)
6. Assignment problems
7. Game theory problems.
8. Inventory problems
9. Replacement problems
10. Queuing problems

Text Books

1. Churchman, C.W, Ackoff, R.L., and Arnoff, E.L. (1957). *Introduction to Operations Research*, John Wiley and Sons, New York.
2. Kanthi Swaroop, Manmohan and P.K. Gupta (2012). *Operations Research*, Sultan Chand, New Delhi.
3. Kalavathy, S.(2004). *Operations Research*, Vikas Publishing House Pvt. Ltd. New Delhi.
4. Shenoy, G.V., Srivastava, U. K., and Sharma, S.C. (2009). *Operations Research for Management, 2/e*, New Age International, New Delhi.

References

1. Mustafi, C.K. (2006). *Operations Research: Methods and Practice*, 3/e, New Age International, New Delhi.
2. Mital, K.V. and Mohan, C. (2004). *Optimization Methods*, 3/e, New Age International, New Delhi.
3. Narag, A. S. (1970). *Linear Programming and Decision Making*, S. Chand, New Delhi.
4. Hillier, F.S. and Leiberman, G. J. (1962). *Introduction to Operations Research*, Holden Day, New York.
6. Taha, H.A. (2010). *Operational Research: An Introduction*, Macmillan, New York.

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