

**DAWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE
(AUTONOMOUS)**



**POST GRADUATE AND RESEARCH DEPARTMENT OF
MATHEMATICS**

B.Sc. Mathematics (MAP)

**CURRICULUM AND SCHEME OF EXAMINATIONS
Choice Based Credit System (CBCS)
&
Outcome Based Education(OBE)**

(with effect from the academic year 2021-2022)



1. PREAMBLE

The curriculum of B.Sc. Mathematics is structured in a way that the students acquire in-depth knowledge to perceive the principles of the core. Basics in Algebra, Calculus , Analytical Geometry , Differential Equations and Transform Techniques are covered exclusively to prepare the students to proceed to the next level of Higher Mathematics of Linear Algebra, Real and Complex Analysis, Mechanics. A list of varied electives namely, Operations Research, Graph Theory, Number Theory, Programming Language 'C', Mathematical Modelling, Programming with Python are furnished to bridge between the Main and Applied Mathematics. The comprehensive curriculum design yields an excellent career opportunity in Research, Education, Public and Private Sectors, Business sectors, Banking, IT Industries and in every domain of contemporaries.

2. PROGRAM LEARNING OUTCOMES

The comprehensive course outline enables the students to enhance Computational skills and Mathematical reasoning. The program develops the ability to think critically, logically and analytically thereby preparing the students to enhanced career opportunities in Industries, Commerce, Education and Research.

NATURE AND EXTENT OF BACHELOR'S DEGREE PROGRAMME

Mathematics is the culmination of in-depth of knowledge of Algebra, Calculus, Differential equations and several other branches of Mathematics. This also leads to selected areas like Computer science and Statistics. Mathematics is a diverse discipline that deals with data, measurement and observations from science, with inference, deduction and proof and with mathematical models of natural phenomena of human behaviour and of social systems.

AIMS OF BACHELOR'S DEGREE PROGRAMME IN MATHEMATICS

The overall aim of B.Sc. Mathematics is to

- develop broad and balanced knowledge and understanding of definitions, concepts, principles and theorems.
- enhance the ability of learners to apply the knowledge and skills acquired by them during the programme to solve specific theoretical and applied problems in mathematics.
- provide students/learners sufficient knowledge and skills enabling them to undertake further studies in mathematics and its allied areas on multiple disciplines concerned with mathematics.

GRADUATE ATTRIBUTES IN MATHEMATICS

The graduate attributes in mathematics are mentioned in the expected course learning outcomes of each course which provides critical thinking, analytical reasoning, problem solving and research related skills etc.,



COURSE STRUCTURE

FIRST SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part - I	Language Paper -I	5	3	40	60	100
Part - II	English Paper -I	4	3	40	60	100
Part - III	Core Paper-I: Algebra and Trigonometry	5	4	40	60	100
	Core Paper-II: Differential Calculus	4	4	40	60	100
	Allied Paper- I: Financial Accounting	9	5	40	60	100
Part - IV	Basic Tamil/Adv. Tamil/Non Major Elective -I	1	2	40	60	100
	Soft Skills -I	2	3	50	50	100

SECOND SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext. Marks	Total
Part - I	Language Paper -II	5	3	40	60	100
Part - II	English Paper -II	5	3	40	60	100
Part - III	Core Paper-III: Analytical Geometry	4	4	40	60	100
	Core Paper-IV: Integral Calculus and Vector Analysis	5	4	40	60	100
	Allied Paper- II : Cost & Management Accounting	9	5	40	60	100
Part - IV	Basic Tamil/Adv. Tamil/ Non Major Elective -II	1	2	40	60	100
	Soft Skills -II	1	3	50	50	100



THIRD SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext.Marks	Total
Part - I	Language Paper -III	5	3	40	60	100
Part - II	English Paper -III	5	3	40	60	100
Part - III	Core Paper-V: Differential Equations	5	4	40	60	100
	Core Paper-VI: Elementary Number Theory	4	4	40	60	100
	Allied Paper- III : Probability & Statistics - I	9	5	40	60	100
Part - IV	Environmental Studies	1		EXAM IN THE IV SEMESTER		
	Soft Skills -III	1	3	50	50	100
	Extra disciplinary		2			

FOURTH SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext.Marks	Total
Part - I	Language Paper -IV	5	3	40	60	100
Part - II	English Paper -IV	5	3	40	60	100
Part - III	Core Paper-VII: Integral Transform	4	4	40	60	100
	Core Paper-VIII: Discrete Mathematics	5	4	40	60	100
	Allied Paper- IV : Probability & Statistics - II	9	5	40	60	100
Part - IV	Internship		2			
	Environmental Studies	1	2	40	60	100
	Soft Skills -IV	1	3	50	50	100
	Value added course		2			
	Extra disciplinary		2			

**FIFTH SEMESTER**

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext.Marks	Total
Part - III	Core Paper-IX: Algebraic Structures	6	4	40	60	100
	Core Paper -X: Real Analysis-I	6	4	40	60	100
	Core Paper-XI: Mechanics	6	4	40	60	100
	Core Paper – XII: Operations Research	6	4	40	60	100
	Elective Paper -I: Programming Language Python With Practicals	6	5	40	60	100
Part - IV	Project		2			
	Value Education		2	40	60	100
	Value added course		2			

SIXTH SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext.Marks	Total
Part - III	Core Paper-XIII: Linear Algebra	6	4	40	60	100
	Core Paper -XIV: Real Analysis-II	6	4	40	60	100
	Core Paper-XV: Functions of a Complex variable	6	4	40	60	100
	Elective Paper -II: Machine Learning using R	6	5	40	60	100
	Elective Paper -III: Tropical Linear Algebra	6	5	40	60	100
Part – V	Extension Activity		1			



List of Elective Subjects

Group - A

1. PROGRAMMING LANGUAGE 'C' WITH PRACTICALS.
2. PROGRAMMING LANGUAGE PYTHON WITH PRACTICALS.
3. MATHEMATICAL MODELING.
4. NUMERICAL METHODS.

Group - B

5. GRAPH THEORY.
6. OPERATIONS RESEARCH.
7. SPECIAL FUNCTIONS.
8. MACHINE LEARNING USING R (THEORY & PRACTICALS)
9. TROPICAL LINEAR ALGEBRA.

Extra Disciplinary Course:

- Predictive Modelling with R (practicals)
- Numerical Methods

Value Added Course:

- Data Analytics
- LateX
- Neural Networks and Algorithm

**Tally Table:**

Subject	No. of Subjects	Total Marks	credits
Core – Theory Papers	15	1500	60
Elective Papers	3	300	15
Allied Papers	4	400	20
Language	4	400	12
English	4	400	12
Soft skills	4	400	12
Non Major electives/ Basic Tamil	2	200	4
Environmental Science	1	100	2
Value Education	1	100	2
Internship	1		2
Project	1		2
Value added course	2		4
Extension Activity	1	100	1
Grand Total	39	3900	148

- 40 % CIA is applicable to all subjects except JOC, COP and SWAYAM courses which are considered as extra credit courses.
- The students are advised to complete a **SWAYAM-MOOC** before the completion of the 3rd semester and the course completed should certificate be submitted to the HOD. Two credits will be given to the candidates who have successfully completed.
- A **Field Trip** preferably relevant to the course should be undertaken every year.

Components of Continuous Internal Assessment

Components		Marks	Total
Theory			
CIA I	50	(50+50 = 100/4)	40
CIA II	50		
Generic Activity		25	
Attendance		10	
		5	



B.Sc. DEGREE COURSE IN MATHEMATICS SYLLABUS (MAP)

Title of the Course		ALGEBRA AND TRIGONOMETRY					
Paper Number		I					
Category	Core	Year	I	Credits	4	Course Code	
		Semester	I				
Course Outline	Unit 1						
	Theory of Equations :Polynomial equations with Imaginary and irrational roots- Relation between rootsand coefficients- Symmetric functions of roots in terms of coefficients. Reciprocal equations - Standard form-Increase or Decrease the roots of the given equation -Removal of terms Approximate solutions of roots of polynomials by Newton's method, Horner's method.						
	Book 1.Chapter 6 : Section 9 to 12. Chapter 6: section 16, 16.1, 16.2, 17, 30.						
	Unit 2						
	Summation of Series : Binomial- Exponential -Logarithmic series (Theorems without proof): Chapter 3: Section 10, Book 2 - Chapter 4: Section 3, 3.1, 3.5, 3.6, 3.7 (omit 3.4)						
Unit 3							
Symmetric- Skew Symmetric- Hermitian- Skew Hermitian- Orthogonal Matrices- Eigen values & EigenVectors- Similar matrices- Cayley - Hamilton Theorem, Diagonalization. Book 2 - Chapter 2: Section 6.1 to 6.3, 9.1, 9.2, 16, 16.1, 16.2, 16.3.							
Unit 4							
Expansions of powers of $\sin \theta$, $\cos \theta$ - Expansions of $\cos^n \theta$, $\sin^n \theta$, $\cos^m \theta \sin^n \theta$. Expansions of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ - Expansions of $\tan (\theta_1+\theta_2 +\dots+\theta_n)$ - Expansions of $\sin x$, $\cos x$, $\tan x$ in terms of x - Sum of roots of trigonometric equations – Formation of equation with trigonometric roots. Book :3 - Chapter 2, Section 2.1, 2.1.1, 2.1.2,2.1.3 Chapter 3, Section 3.1 to 3.6							
Unit 5							
Hyperbolic functions-Relation between circular and hyperbolic functions - Formulas in hyperbolicfunctions – Inverse hyperbolic functions. Inverse function of exponential functions – Values of $\text{Log}(u+iv)$ - Complex index. Sums of Trigonometric series – Applications of binomial, exponential, , logarithmic and Gregory'sseries - Difference method. Book : 3 - Chapter 4, Section 4.1 to 4.7. Chapter 5, Section 5.1 to 5.3 Chapter 6, Section 6.1 to 6.6.3							



SYLLABUS-2021-2022(CBCS AND OBE PATTERN)

Contents and treatment as in	<ol style="list-style-type: none">1. Algebra, Volume I by T. K. Manicavachagam Pillay, T. Natarajan, K.S. Ganapathy, Viswanathan Publication 2007. Unit – 1 and 2.2. Algebra, Volume II by T. K. Manicavachagam Pillay, T. Natarajan, K.S. Ganapathy, Viswanathan Publication 2008. Unit – 3, 4 and 5.3. Trigonometry by P. Duraipandian and Kayalal Pachaiyappa, Muhil Publishers.
Reference Books	<ol style="list-style-type: none">1. Algebra by S. Arumugam (New Gama publishing house, Palayamkottai).2. Algebra and Trigonometry, Volume I and II by P.R. Vittal, V. Malini (Margham Publishers).3. Trigonometry, Calculus, Dr. P.R. Vittal, Margham Publications, Chennai.4. Trigonometry by T.K. Manickavachagam Pillay. S. Viswanathan (Printers and Publishers) Pvt. Ltd.
e-Resources	<ol style="list-style-type: none">1. http://mathworld.wolfram.com2. http://www.themathpage.com/3. http://mathworld.wolfram.com4. http://ocw.mit.edu/courses/mathematics/



Title of the Course		DIFFERENTIAL CALCULUS				
Paper Number		II				
Category	Core	Year	I	Credits	4	Course Code
		Semester	I			
Course Outline	Unit 1 Successive differentiation - n^{th} derivative- standard results – Trigonometrical transformation – formation of equations using derivatives - Leibnitz's theorem and its applications Chapter 3 section 1.1 to 1.6, 2.1 and 2.2					
	Unit 2 Total differential of a function – special cases – implicit functions - partial derivatives of a function of two functions - Maxima and Minima of functions of two variables- Lagrange's method of undetermined multipliers. Chapter 8 : Section 1.3 to 1.5 and 1.7, Section 4, 4.1 and 5.					
	Unit 3 Envelopes – method of finding envelopes – Curvature- circle, radius and centre of curvature- Cartesian formula for radius of curvature – coordinates of the centre of curvature – evolute-and involute - radius of curvature and centre of curvature in polar coordinates – p-r equation Chapter 10 Section 1.1 to 1.4 and Section 2.1 to 2.7					
	Unit 4 Polar coordinates - angle between the radius vector and the tangent – slope of the tangent in the polar coordinates – the angle of intersection of two curves in polar coordinates- polar sub tangent and polar sub normal – the length of arc in polar coordinates. Chapter 9 Section 4.1 to 4.6					
	Unit 5 Definition-Asymptotes parallel to the axes – special cases – another method for finding asymptotes -asymptotes by inspection – intersection of a curve with an asymptote. Chapter 11 - Section 1 to 7.					
Contents and treatment as in	"Calculus", Volume - 1 by S. Narayanan and T.K. Manicavachagompillay -S.Viswanathan publishers – 2006.					
Reference Books	1. Calculus , Dr. P.R. Vittal&Dr. V. Malini, Margham Publications, Chennai. 2. Calculus by Thomas and Fenny, Pearson Publication. 3. Calculus by Stewart					
e-Resources	1. http://www.themathpage.com/ 2. http://mathworld.wolfram.com 3. http://www.univie.ac.at/future.media/moe/galerie.html 4. http://www.analyzemath.com/calculus					



Title of the Course		ANALYTICAL GEOMETRY				
Paper Number		III				
Category	Core	Year	I	Credits	4	Course Code
		Semester	II			
Course Outline	Unit 1 Chord of contact – polar and pole,- conjugate points and conjugate lines. Polar coordinates: General polar equation of straight line – Polar equation of a circle on A_1A_2 as diameter, Equation of a straight line, circle, conic – Equation of chord, tangent, normal. Equations of the asymptotes of a hyperbola.					
	Unit 2 Introduction – System of Planes - Length of the perpendicular – Orthogonal projection. Chapter 2 Sec 2.1 to 2.10.					
	Unit 3 Representation of line – angle between a line and a plane- co-planar lines- shortest distance 2 skewlines- Length of the perpendicular- intersection of three planes Chapter 3 :Sec 3.1 to 3.8.					
	Unit 4 Equation of a sphere - general equation - section of a sphere by a plane - equation of the circle -tangent plane - angle of intersection of two spheres- condition for the orthogonality -radical plane. Chapter 6 : Sec 6.1 to 6.8.					
	Unit -5 Equation of a cone with vertex as origin, Equation of a quadric cone given the vertex and the guiding curve, Condition for a general equation of second degree to represent a cone, equation of right circular cone given the vertex, axis and semi vertical angle, equation of the enveloping cone of a sphere with centre at origin.					
Contents and treatment as in	1. Analytical Geometry of 2D by P.Durai Pandian- Muhil publishers for Unit – 1 2. Analytical Solid Geometry of 3D by Shanthy Narayan and Dr.P.K. Mittal-S.Chand& Co.Pvt.Ltd.- for Unit – 2 to 5					
Reference Books	1. Analytical Geometry of Two Dimension by T.K.Manikavachakam Pillai and S.Narayanan.S.Viswanathan (Printers and Publishers) Pvt. Ltd. 2. Analytical Geometry of Three Dimension by T.K.Manikavachakam Pillai and S.Narayanan.S.Viswanathan (Printers and Publishers) Pvt. Ltd.					
e-Resources	1. http://mathworld.wolfram.com . 2. http://www.univie.ac.at/future.media/moe/galerie.html					



Title of the Course		INTEGRAL CALCULUS					
Paper Number		IV					
Category	Core	Year	I	Credits	4	Course Code	
		Semester	II				
Course Outline	Unit 1 Reduction formulae– Types, $\int x^n e^{ax} dx$, $\int x^n \cos ax dx$, $\int x^n \sin ax dx$, $\int \cos^n x dx$, $\int \sin^n x dx$, $\int \sin^m x \cos^n x dx$, $\int \tan^n x dx$, $\int \cot^n x dx$, $\int \sec^n x dx$, $\int \operatorname{cosec}^n x dx$, $\int x^n (\log x)^m dx$ -Bernoulli's formula. Chapter 1 Section 13, 13.1 to 13.10,14,15.1.						
	Unit 2 Multiple Integrals- definition of the double integrals- evaluation of the double integrals- double integrals in polar coordinates – triple integrals – applications of multiple integrals – volumes of solids of revolution – areas of curved surfaces – change of variables – Jacobians. Chapter 5 Section 1, 2.1, 2.2, 3.1, 4, 6.1, 6.2, 6.3, 7 Chapter 6 Section 1.1, 1.2, 2.1 to 2.4						
	Unit 3 Beta and Gamma functions - infinite integral – definitions – recurrence formula of Γ functions -properties of β -functions - relation between β and Γ functions. Evaluation of double and triple integrals using Beta gamma functions.						
	Unit 4 Introduction - directional derivative- Gradient- divergence- curl- Laplacian Differential Operator. Chapter 2 Sections 2.1 - 2.13.						
	Unit 5 Line, surface and volume integrals - Integral Theorems - Gauss, Greens and Stokes (Without proof) –Problems. Chapter 3 Sections 3.1 to 3.6 and Chapter 4 Sections 4.1 to 4.5.						
Contents and treatment as in	1. "Calculus", Vol- II by S. Narayanan and T.K. Manicavachagampillay - S. Viswanathan publishers– 2007 for Unit 1 , Unit 2 , Unit 3. 2. "Vector Analysis" by P.Duraipandian and Kayalal Pachaiyappa, S.Chand For Unit 4, Unit 5.						
Reference Books	1. Integral Calculus and differential equations : Dipak Chatterjee (TATA McGrawHill Publishing company Ltd.). 2. Vector Algebra and Analysis by Narayanan and T.K.Manickvachagam Pillay S.Viswanathan Publishers. 3. Vector Analysis: Murray Spiegel (Schaum Publishing Company, New York).						
e-Resources	1. http://mathworld.wolfram.com . 2. http://www.sosmath.com						



Title of the Course		DIFFERENTIAL EQUATIONS				
Paper Number		V				
Category	Core	Year	II	Credits	4	Course Code
		Semester	III			
Course Outline	Unit 1 Ordinary Differential Equations: Concept of existence and uniqueness . Variable separable-Homogeneous Equation-Non-Homogeneous Equations of first degree in x and y-Linear Equation-Bernoulli's Equation-Exact differential equations. Chapter 2: Section 1 to 6.					
	Unit 2 Equation of first order but not of higher degree: Equation solvable for dy/dx- Equation solvable for y- Equation solvable for x- Clairauts form-Linear Equations with constant coefficients-Particular integrals e^{ax} , $\sin ax$, $\cos ax$, x^m , Ve^{ax} where V is $\sin ax$ or $\cos ax$ or x^m . Chapter 4: Section 1, 2.1, 2.2, 3.1. Chapter 5: Section 4.					
	Unit 3 Simultaneous linear differential equations- Linear Equations of the Second Order -Complete solution in terms of a known integrals-Reduction to the Normal form- Change of the Independent Variable - Method of Variation of Parameters. Chapter 6: Section- 6 Chapter 8:Section- 1,2,3,4.					
	Unit 4 Partial differential equation: Formation of PDE by Eliminating arbitrary constants and arbitrary functions-complete integral-singular integral-General integral- Lagrange's Linear Equations $Pp+Qq=R$. Chapter 12: Section- 1, 2, 3.1, 3.2, 4.					
	Unit 5 Special methods - Standard forms - Charpit's Methods - Related problems Chapter 12: Section-5.1, 5.2, 5.3, 5.4, 6.					
Contents and treatment as in	"Differential Equations and its applications", by S.Narayanan, T.K.Manikavachagam Pillay --S.Viswanathan (Printers and Publishers) Pvt. Ltd(2006).					



SYLLABUS-2021-2022(CBCS AND OBE PATTERN)

Reference Books	<ol style="list-style-type: none">1. Mathematics for B.Sc-Branch-I Volume –III by P.Kandasamy ,K.ThilagavathyS.Chand Publications.2. Differential equations with applications and historical notes by George F.Simmons,2ndEd,TataMcgraw Hill Publications .3. Differential Equations by ShepleyL.Ross, 3 rdEd ,JohnWiely and sons 1984.4 .Differential Equations by N.P.Bali,Laxmi Publications Ltd,New Delhi-2004.4. Ordinary and Partial differential Equation by Dr.M.D.Raisinghania ,S.Chand.
e-Resources:	<ol style="list-style-type: none">1. http://mathworld.wolfram.com2. http://www.analyzemath.com/calculus/Differential_Equations/applications.html



Title of the Course		ELEMENTARY NUMBER THEORY				
Paper Number		VI				
Category	Core	Year	II	Credits	4	Course Code
		Semester	III			
Course Outline		Unit 1 Introduction – divisibility- primes- The Binomial theorem. Chapter 1- Sections - 1.1 to 1.4				
		Unit 2 Congruences, Solution of Congruences, Chinese Remainder Theorem- primitive roots and power Residues- Number Theory from an Algebraic view point - Groups, rings and fields. Chapter – 2 Sections 2.1 to 2.3, 2.8 (cor 2.42, Th 2.43 and cor 2.44 are omitted) - 2.10.- 2.11				
		Unit 3 Quadratic Residues , Quadratic reciprocity , The Jacobi Symbol Chapter – 3 Sections 3.1 to 3.3				
		Unit 4 Greatest Integer Function, Arithmetic function, The Mobius Inversion formula Combinational Number Theory Chapter – 4 Sections 4.1 to 4.3 and 4.5				
		Unit 5 The equation $ax+by=c$, Simultaneous Linear Equations, Pythagorean Triangle, Assorted examples. Chapter – 5 Sections 5.1 to 5.4				
Contents and treatment as in		“An introduction to the Theory of Numbers (Vth edition)”, by Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery John Wiley & Sons, Inc.2001.				
Reference Books		1. Elementary theory of numbers, cy. Hsiung, Allied publishers, 1995. 2. Elementary Number Theory, Allyn and Bacon Inc., Boston, 1980. 3. Introduction to Analytic Number Theory, Tom. M. Apostol, Narosa Publishing House, New Delhi, 1989.				
e-Resources:		1. https://nptel.ac.in . 2. https://mathonline.wikidot.com				



Title of the Course		INTEGRAL TRANSFORMS				
Paper Number		VII				
Category	Core	Year	II	Credits	4	Course Code
		Semester	IV			
Course Outline		UNIT 1 The Laplace Transforms-Definitions-Sufficient conditions for the existence of the Laplace transform(without proof)-Laplace transform of periodic functions-some general theorems-evaluation of integrals using Laplace transform-Problems. Chapter 5: Section-1 to 5.				
		UNIT 2 The inverse Laplace Transforms- Applications of Laplace Transforms to ordinary differentialequations with constant co-efficients and variable co-efficients, simultaneous equations and equations involving integrals-Problems. Chapter 5: Section-6 to 12.				
		UNIT 3 Fourier series- Expansion of periodic functions of period 2π - Expansion of even and odd functions, Half range Fourier series- Change of intervals –Problems. Chapter 6: Section-1 to 6.				
		UNIT 4 Fourier Transform- Infinite Fourier Transform(Complex form) – Properties of Fourier Transform – Fourier cosine and Fourier sine Transform – Properties – Parseval’s identity – Convolution theorem - Problems. Chapter 6: Section-8 to 15.				
		UNIT 5 Z Transforms: Definition of Z-Transform and its properties - Z- Transforms of some basic functions- Formation of difference equations – Solution of difference equations using Z – transform- Examples and simple problems				
Contents and treatment as in		1. “Calculus-Volume III” – S.Narayanan and T.K.ManicavachagamPillai. (Ananda Book Depot) (for Units I to IV) 2. “Engineering Mathematics for Semester III- Third Edition – T.Veerarajan (Tata McGraw-HillPublishing Company Ltd, New Delhi) (for Unit-V)				



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Reference Books	<ol style="list-style-type: none">1. Engineering Mathematics Volume III – P.Kandasamy and others (S.Chand and Co.)2. Advanced Engineering Mathematics- Stanley Grossman and William R.Devit.3. Engineering Mathematics III-A.Singaravelu, Meenakshi Agency, Chenani, 2008
e-Resources:	<ol style="list-style-type: none">1. http://mathworld.wolfram.com.2. http://www.sosmath.com.



SYLLABUS-2021-2022(CBCS AND OBE PATTERN)

Title of the Course		DISCRETE MATHEMATICS				
Paper Number		VIII				
Category	Core	Year	II	Credits	4	Course Code
		Semester	IV			
Course Outline		Unit 1 Integers: Set, some basic properties of integers, Mathematical induction, divisibility of integers, representation of positive integers Chapter 1 - Sections 1.1 to 1.5				
		Unit 2 Boolean algebra & Applications: Boolean algebra, two element Boolean algebra, Disjunctive normal form, Conjunctive normal form Chapter 5 - Sections 5.1 to 5.4				
		Unit 3 Application, Simplification of circuits, Designing of switching circuits, Logical Gates and Combinatorial circuits. Chapter 5 - Section 5.5, 5.6				
		Unit 4 Recurrence relations and Generating functions: Sequence and recurrence relation, Solving recurrence relations by iteration method, Modeling of counting problems by recurrence relations, Linear (difference equations) recurrence relations with constant coefficients, Generating functions, Sum and product of two generating functions, Useful generating functions, Combinatorial problems. Chapter 6 - Section 6.1 to 6.6				
		Unit 5 Propositional logic and Predicate logic: Propositional logic, Adequate system of connectives, Translation of sentences in a Natural Language into Statement Formula, Logical validity of arguments, Predicate Logic, Negation of a statement obtained by qualification of a predicate, Logical operations on predicates or quantified predicates, Symbolization of sentences by using predicates, Quantifiers and connectives, Logical validity of arguments. Chapter 8 - Sections 8.1, 8.5 to 8.8 (Omit Section 8.2 to 8.4)				
Contents and treatment as in		"Introduction to Discrete Mathematics", 2 nd edition, 2002 by M. K. Sen and B. C. Chakraborty, Books and Allied Private Ltd., Kolkata.				
Reference Books		<ol style="list-style-type: none"> Discrete mathematics for computer scientists and mathematicians by J. L. Mertz, Abraham Kendel and T. P. Baker prentice-hall, India. Discrete mathematics for computer scientists by John Truss-Addison Wesley. Elements of Discrete Mathematics, C. L. Liu, New York Mcgraw-Hill, 1977. 				
e-Resources:		<ol style="list-style-type: none"> https://brilliant.org/wiki/discrete-mathematics/. https://www.tutorialspoint.com/discrete_mathematics/. 				



INTERNSHIP

SEMESTER: IV

Credits : 2

Duration: 30 days

Students have to undergo an Internship Program during the summer vacation immediately after the fourth semester and are required to submit a project report.

Internal Evaluation (Viva voce) only.



Title Of The Course		PROBABILITY AND STATISTICS – I				
Paper Number		III				
Category	Allied	Year	II	Credits	5	Course Code
		Semester	IV			
Course Outline		Unit 1 Concept of sample space- Events- Definition of Probability (Classical, Statistical & Axiomatic)- Addition and Multiplication laws of Probability- Independence- Conditional Probability- Baye's theorem – Simple Problems.				
		Unit 2 Random Variables (Discrete and Continuous) Distribution function- Expected values and Moments- Moment generating function – Probability generating function- Examples				
		Unit 3 Characteristic function- Uniqueness and Inversion theorems (Statements and applications only)- Cumulants - Chebychev's Inequality – Simple Problems. Convergence in probability, Weak Law of large numbers with numerical examples, Central Limit Theorem				
		Unit 4 Concepts of bivariate distributions- Correlation and Regression- Linear Prediction- Rank Correlation coefficient, Intra class correlation coefficient, Concepts of partial and multiple correlation coefficients- Simple problems.				
		Unit 5 Standard Distributions – Bernoulli Distribution, Binomial- Poisson- Normal- Uniform distributions- Geometric- Exponential- Gamma -Beta distributions- Inter relationship between distributions.				
Contents and treatment as in		Elements of Mathematical Statistics, by S.C.Gupta & V.K.Kapoor, Sultan Chand & Sons, New Delhi.				
Reference Books		<ol style="list-style-type: none"> 1. Hogg R.V. & Craig A.T. (1988) : Introduction to Mathematical Statistics, McMillan. 2. Mood A.M. & Graybill F.A. & Boes D.G. (1974): Introduction to theory of Statistics, McGraw Hill. 3. Snedecor G.W. & Cochran W.G. (1967) : Statistical Methods, Oxford and IBH. 				
e-Resources:		<ol style="list-style-type: none"> 1. https://nptel.ac.in 2. https://www.wikipedia.org. 3. http://ebooks.lpu.de.in.statistics. 				



SYLLABUS-2021-2022(CBCS AND OBE PATTERN)

Title of the Course		PROBABILITY & STATISTICS - II				
Paper Number		IV				
Category	Allied	Year	II	Credits	5	Course Code
		Semester	IV			
Course Outline		Unit 1 Sampling Distributions – Concept of Standard error – Sampling distribution based on normal distribution- t, z, Chi Square and F distributions.				
		Unit 2 Point estimation – Concepts of unbiasedness – consistency – efficiency and sufficiency- Cramer Rao inequality – Methods of estimation- Maximum likelihood- moments - minimum square and their properties (Statement only).				
		Unit 3 Test of significance – Standard error- Large sample test, Exact test based on normal, t, chi-square and F distribution with respect to population mean/means, proportion/proportions, variance and correlation coefficient. Test of independence of attributes based on contingency tables- Goodness of fit based on chi-square.				
		Unit 4 Analysis of Variance: One way, two way classification concepts & Problems. Interval estimation – Confidence intervals for population mean/means- Proportion/proportions and variances based on t, Chi-Square and F.				
		Unit 5 Test of hypothesis- Type I and II errors- Power of test – Neymann Pearson lemma- Likelihood ratio test-concepts of most powerful test-statements and results only-simple problems, Concept of p-value, Power of test.				
Contents and treatment as in		Elements of Mathematical Statistics, by S.C.Gupta & V.K.Kapoor, Sultan Chand & Sons, New Delhi.				
Reference Books		<ol style="list-style-type: none"> 1. Hogg R.V. & Craig A.T. (1988): Introduction to Mathematical Statistics, McMillan. 2. Mood A.M. & Graybill F.A. & Boes D.G. (1974): Introduction to theory of Statistics, McGraw Hill. 3. Snedecor G.W. & Cochran W.G(1967) : Statistical Methods, Oxford and IBH. 4. Hoel P.G. (1971) : Introduction to Mathematical Statistics, Wiley. 5. Wilks S.S. Elementary Statistical Analysis, Oxford and IBH. 				
e-Resources:		<ol style="list-style-type: none"> 1. https://nptel.ac.in 2. https://www.wikipedia.org. 3. http://ebooks.lpu.de.in.statistics. 				



Title of the Course		ALGEBRAIC STRUCTURES					
Paper Number		IX					
Category	Core	Year	III	Credits	4	Course Code	
		Semester	V				
Course Outline	Unit 1 Introduction to groups- Subgroups- cyclic groups and properties of cyclic groups- Lagrange's Theorem- A counting principle. Chapter 2 Section 2.4 and 2.5.						
	Unit 2 Normal subgroups and Quotient group- Homomorphism- Automorphism. Chapter 2 Section 2.6 to 2.8.						
	Unit 3 Cayley's Theorem- Permutation groups. Chapter 2 Section 2.9 and 2.10.						
	Unit 4 Definition and examples of ring- Some special classes of rings- homomorphism of rings- Ideals and quotient rings- More ideals and quotient rings. Chapter 3 Section 3.1 to 3.5.						
	Unit 5 The field of quotients of an integral domain- Euclidean Rings- The particular Euclidean ring. Section 3.6 to 3.8.						
Contents and treatment as in		"Topics in Algebra" – I. N. Herstein, Wiley Eastern Ltd.					
Reference Books		1. Modern Algebra by M.L.Santiago, McGraw Hill Education India pvt Ltd. 2. Modern Algebra by S. Arumugam and others, New Gamma publishing House, Palayamkottai. 3. Modern Algebra by Visvanathan Nayak, Emerald Publishers, Reprint 1992.					
e-Resources:		1. https://nptel.ac.in 2. http://garsia.math.yorku.ca/~sdenton/algstruct .					



Title of the Course		REAL ANALYSIS -I					
Paper Number		X					
Category	Core	Year	III	Credits	4	Course Code	
		Semester	V				
Course Outline	Unit 1 Sets and Functions: Sets and elements- Operations on sets- functions- real valued functions- equivalence-countability - real numbers- least upper bounds. Chapter 1 Section 1. 1 to 1.7						
	Unit 2 Sequences of Real Numbers: Definition of a sequence and subsequence- limit of a sequence- convergent sequences- divergent sequences- bounded sequences- monotone sequences- Chapter 2 Section 2.1 to 2.6						
	Unit 3 Operations on convergent sequences- operations on divergent sequences- limit superior and limit inferior- Cauchy sequences. Chapter 2 Section 2.7 to 2.10						
	Unit 4 Series of Real Numbers: Convergence and divergence- series with non-negative terms- alternating series- conditional convergence and absolute convergence- tests for absolute convergence- series whose terms form a non-increasing sequence- the class l^2 Chapter 3 Section 3.1 to 3.4, 3.6, 3.7 and 3.10						
	Unit 5 Limits and Metric Spaces: Limit of a function on a real line-. Metric spaces - Limits in metric spaces. Continuous Functions on Metric Spaces: Function continuous at a point on the real line-Reformulation- Function continuous on a metric space. Chapter 4 Section 4.1 to 4.3 Chapter 5 Section 5.1-5.3						
Contents and treatment as in	"Methods of Real Analysis" : Richard R. Goldberg (Oxford and IBH Publishing Co.).						
Reference Books	1. Principles of Mathematical Analysis by Walter Rudin, Tata McGraw Hill. 2. Mathematical Analysis Tom M Apostol, Narosa Publishing House.						
e-Resources:	1. https://mathcs.org/analysis/reals/numseq/sequence.html . 2. http://www-groups.mcs.st-andrews.ac.uk/~john/analysis/index.html 3. http://www.phengkimving.com .						



Title of the Course		MECHANICS					
Paper Number		XI					
Category	Core	Year	III	Credits	4	Course Code	
		Semester	V				
Course Outline	Unit 1 Force- Newtons laws of motion - resultant of two forces on a particle- Equilibrium of a particle. Forces on a rigid body – moment of a force – general motion of a rigid body- equivalent systems of forces – parallel forces – forces along the sides of a triangle – couples. Chapter 2 - Section 2 .1 , 2.2 , Chapter 3 - Section 3.1. Chapter 4 - Section 4 .1 to 4.6.						
	Unit 2 Resultant of several coplanar forces- equation of the line of action of the resultant- Equilibrium of a rigid body under three coplanar forces . Centre of mass – finding mass centre – a hanging body in equilibrium, Hanging strings- equilibrium of a uniform homogeneous string – suspension bridge Chapter 4 - Section 4.7 to , Chapter 5 - Section 5.1, 5.2. Chapter 6 - Section 6.1 to 6.3. Chapter 9 - Section 9.1, 9.2						
	Unit 3 Kinematics -Basic units – velocity – acceleration- coplanar motion . Work, Energy and power – work – conservative field of force – power – Rectilinear motion under varying Force: Simple harmonic motion (S.H.M.) – S.H.M. along a horizontal line- S.H.M. along a vertical line Chapter 1 - Section 1.1 to 1.4 Chapter 11 - Section 11.1 to 11.3 , Chapter 12 - Section 12.1 to 12.3						
	Unit 4 Projectiles -Forces on a projectile- projectile projected on an inclined plane. Impact: Impulsive force - impact of sphere - impact of two smooth spheres – impact of a smooth sphere on a plane – oblique impact of two smooth spheres Chapter 13 - Section 13.1, 13.2 Chapter 14 - Section 14.1, 14.5						
	Unit 5 Circular motion – Conical pendulum – simple pendulum – central orbits -general orbits - central orbits-conic as centered orbit. Moment of inertia, Perpendicular and parallel axes theorem Chapter 15 - Section 15.1, 15.2, 15.6 Chapter 16 - Section 16.1 to 16.3 Chapter 17 -Section 17.1, 17.1.1						



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Contents and treatment as in	"Mechanics" by P. Duraipandian ,LaxmiDuraipandian , MuthamizhJayapragasham, S. Chandand Co limited 2008 .
Reference Books	<ol style="list-style-type: none">1. Dynamics – K. ViswanathaNaik and M. S. Kasi, Emerald Publishers.2. Dynamics – A. V. Dharmapadam, S. Viswanathan Publishers.3. Mechanics – Walter Grenier.
e-Resources:	<ol style="list-style-type: none">1. https://www.wikipedia.org/2. https://physics.info



Title of the Course		OPERATIONS RESEARCH				
Paper Number		XII				
Category	CORE	Year	III	Credits	5	Course Code
		Semester	VI			
Course Outline		Unit -1: Linear programming – Formulation – Graphical solution – Simplex method – Simple applications. Big-M method.				
		Unit -2: Linear programming - Principle of Duality – Primal – Dual relation -Dual simplex method – Simple applications. Transportation Problem: Finding initial solution by North West Corner Rule – Vogel’s Approximation method and Matrix minimum method – Procedure for finding optimal solution – Both minimisation and maximisation cases – Unbalanced and degenerate transportation problems.				
		Unit -3: Assignment Problem: Formulation – Minimisation cases – procedure for getting optimum solution – Unbalanced problem – Maximisation problem – Problems with restrictions. Game Theory: Two Person Zero-Sum game with saddle point – without saddle point –dominance rule – Solving 2 x n or m x 2 game by graphical method.				
		Unit -4: Networks: Rules for network construction – Critical Path Method - Time calculation sin PERT – PERT algorithm (Crashing excluded) – Related problems.				
		Unit -5: Sequencing Problem – n jobs through 2 machines – n jobs through 3 machines – n jobs through m machines. Graphical method.				
Contents and treatment as in		P.K. Gupta and D. S. Hira, Operations Research, S. Chand & Co.				
Reference Books		<ol style="list-style-type: none"> 1. <i>KanthiSwaroop, P.K. Gupta, Manmohan, Operations Research –Sultan Chand & sons.</i> 2. <i>H.A. Taha, Operations Research Prentice Hall of India, New Delhi</i> 3. <i>Sundaresan, Ganapathy Subramanian, Ganesan., Resource Management Technique – Meenakshi Agency.</i> 				
e-Resources:		https://nptel.ac.in http://mathworld.wolfram.com .				



Title of the Course		PROGRAMMING IN PYTHON WITH PRACTICALS (THEORY)				
Paper Number		I				
Category	Elective	Year	III	Credits	5	Course Code
		Semester	V			
Course Outline		Unit 1 Basics of Python Programming:Features – History – Future – Python Interpreter and Interactive Mode – Writing and Executing First Python Programme – Values and Types – Data Types – Operators and Expressions – Operations on Strings – Type Conversion – Comments – Functions and Modules. Chapter 2: Section 2.1 – 2.22				
		Unit 2 Control Flow Statements:Introduction to Decision Control Statements –Conditional Branching –Loops Structures – Nested Loops – Break – Continue – Pass – Else Statement Used with Loops. Chapter 3: Section 3.1 – 3.8				
		Unit 3 Functions:Introduction – Defining a function– Function Call – Variable Scope and Lifetime – Fruitful Function –Lambda – Function Composition – Documentation Strings –Recursive Functions Chapter 4: Section 4.1 – 4.8, 4.10 (Omit 4.9)				
		Unit 4 Strings:Concatenating, Appending, and Multiplying Strings – Immutable – Formatting Operator – Built-in String Methods and Functions – Slice Operation – Comparing Strings – IteratingString. Lists, Tuples and Dictionaries:Sequence – Lists. Chapter 5: Section 5.1 – 5.5, 5.8, 5.9 (Omit 5.6, 5.7) Chapter 6: Section 6.1 to 6.2				
		Unit 5 Lists, Tuples and Dictionaries: Tuple – Dictionaries File Handling:Opening and Closing Files – Reading and Writing Files.Error and Exception Handling:Introduction – Handling Exceptions. Chapter 6: Section 6.4 to 6.5 (Omit 6.3) Chapter 7: Section 7.4, 7.5 Chapter 8: Section 8.1, 8.2				
Contents and treatment as in		“Problem Solving and Programming with Python”, by ReemaThareja (Second Edition, 2019,OXFORD University Press)				



Reference Books	<ol style="list-style-type: none">1. "Problem Solving and Python Programming" by Mr. Ashok NamdevKamthane and Mr.Amit Ashok Kamthane (McGraw Hill Education (India) Private Limited).2. "Python Programming" by Ch.Sathyanarayana, M.Radhika Mani, B.N. Jagadesh,Universities Press (INDIA) Pvt.Ltd.
e-Resources:	<ol style="list-style-type: none">1. https://www.pythonforbeginners.com.2. https://www.w3schools.com.

PYTHON PRACTICALS

Write a Python Program for the following:

1. Compute the Area and Circumference of a Circle
2. To find the greatest among three numbers
3. Program to calculate roots of a quadratic equation
4. Determine the given number is an Armstrong number
5. Compute the G.C.D. of two Numbers
6. Sum the series: $1/1+2^2/2+3^2/3+\dots+n^2/n$
7. Finding Factorial of a number
8. To print the Fibonacci Series using recursion
9. Count the occurrences of a character in a string
10. Program to reverse a string
11. Calculate distance between two points
12. To add two matrices
13. Print a histogram of frequencies of characters occurring in a message
14. Generate Floyd's triangle.
15. Implement Tower of Hanoi problem

Question paper pattern:

External (60)+ Internal(40)

Internal:

Internal Practical Assessment + Attendance + Record = 30 + 5 + 5 = 40 marks

External:

- Answer any 2 questions out of 3 questions : **(2 x 30 = 60)**



SYLLABUS-2021-2022(CBCS AND OBE PATTERN)

PROJECT

SEMESTER: V

Credits : 2

Students have to undergo project during the fifth semester and are required to submit the report towards end of the fifth semester.

Internal Evaluation (Viva voce) only.



Title of the Course		LINEAR ALGEBRA				
Paper Number		XIII				
Category	Core	Year	III	Credits	4	Course Code
		Semester	VI			
Course Outline	Unit – 1: Vector spaces Vector spaces, subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vector space, Dimensions, Quotient space and its dimension.					
	Unit- 2: Homomorphism and Isomorphism of Vector Spaces Homomorphism and isomorphism of vector spaces, Linear transformations and linear forms on vector spaces, Dual Spaces, Null Space, Range space of a linear transformation, Rank - Nullity Theorem.					
	Unit–3: Algebra of Linear Transformation Minimal Polynomial of a linear transformation, Singular and non-singular linear transformations, Matrix of a linear Transformation, Change of basis, Eigen values and Eigen vectors of linear transformations.					
	Unit – 4: Inner Product Spaces Inner product spaces and norms, Cauchy-Schwarz inequality, Orthogonal sets and Basis, Orthonormal basis, Gram-Schmidt orthogonalization process, Orthogonal complements, Bessel's inequality.					
	Unit – 5: Adjoint Operators and their Properties The adjoint of a linear operator, Least squares approximation, Minimal solutions to systems of linear equations, Normal, Self - adjoint, Unitary and orthogonal operators and their properties.					
Contents and treatment as in						
Reference Books		<ol style="list-style-type: none"> 1. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005. 2. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005. 3. Andrilli, S., & Hecker, D. (2016). Elementary Linear Algebra (5th ed.). Academic Press, Elsevier India Private Limited. 4. Kolman, Bernard, & Hill, David R. (2001). Introductory Linear Algebra with Applications (7th ed.). Pearson Education, Delhi. First Indian Reprint 2003. 5. Lay, David C., Lay, Steven R., & McDonald, Judi J. (2016). Linear Algebra and its Applications (5th ed.). Pearson Education. 6. Friedberg, Stephen H., Insel, Arnold J., & Spence, Lawrence E. (2003). Linear Algebra (4th ed.). Prentice-Hall of India Pvt. Ltd. New Delhi. 				



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e-Resources:	<ol style="list-style-type: none">1. https://nptel.ac.in.2. http://ebooks.lpude.in.linearalgebra.
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Title of the Course		REAL ANALYSIS -II				
Paper Number		XIV				
Category	Core	Year	III	Credits	4	Course Code
		Semester	VI			
Course Outline		Unit 1 Continuous Functions on Metric Spaces: Open sets- closed sets- Discontinuous function on \mathbb{R}^1 . Connectedness, Completeness and Compactness :More about open sets- Connected sets. Chapter 5 Section 5.4 to 5.6 Chapter 6 Section 6.1 and 6.2				
		Unit 2 Bounded sets and totally bounded sets: Complete metric spaces- compact metric spaces, continuous functions on a compact metric space, continuity of inverse functions, uniform continuity. Chapter 6 Section 6.3 to 6.8				
		Unit 3 Calculus: Sets of measure zero, definition of the Riemann integral, - properties of Riemann integral. Chapter 7 Section 7.1 to 7.4(omit 7.3)				
		Unit 4 Derivatives- Rolle's theorem, Law of mean, Fundamental theorems of calculus. Chapter 7 Section 7.5 to 7.8				
		Unit 5 Taylor's theorem- Pointwise convergence of sequences of functions, uniform convergence of sequences of functions. Chapter 8 Section 8.5 Chapter 9 Section 9.1 and 9.2				
Contents and treatment as in		"Methods of Real Analysis"- Richard R. Goldberg (Oxford and IBH Publishing Co)				



SYLLABUS-2021-2022(CBCS AND OBE PATTERN)

Reference Books	<ol style="list-style-type: none">1. Principles of Mathematical Analysis by Walter Rudin, TataMcGrawHill.2. Mathematical Analysis Tom M Apostol, Narosa Publishing House.
e-Resources:	<ol style="list-style-type: none">1. https://nptel.ac.in.2. https://mathonline.wikidot.com.3. https://en.wikipedia.org/wiki/Metric_space.



Title of the Course		FUNCTIONS OF A COMPLEX VARIABLE				
Paper Number		XV				
Category	Core	Year	III	Credits	4	Course Code
		Semester	VI			
Course Outline	Unit 1 Analytic Functions: Functions of a Complex Variable – Limit- Theorems on Limits – Continuous functions- Differentiability – Cauchy – Riemann equations – Analytic functions- Harmonic functions – Conformal mapping. Chapter 1 – sec 2.1 to 2.9.					
	Unit 2 Bilinear Transformations: Elementary transformations – Bilinear transformations – Cross ratio- Fixed Points of Bilinear Transformations – Mapping by Elementary Functions - The Mapping $w = z^2$, z^n , n is a positive integer, $w = e^z$, $\sin z$, $\cos z$. Chapter 3 – sec 3.1 to 3.4 , Chapter 5 – sec 5.1 to 5.5					
	Unit 3 Complex Integration – definite integral – Cauchy's Theorem – Cauchy's integral formula – Higher derivatives. Chapter 6 – sec 6.1 to 6.4					
	Unit 4 Series expansions – Taylor's series – Laurent's Series – Zeroes of analytic functions-Singularities. Chapter 7 – 7.1 to 7.4					
	Unit 5 Residues – Cauchy's Residue Theorem – Evaluation of definite integrals. Chapter 8 – 8.1 to 8.3.					
Contents and treatment as in	"Complex Analysis" by Dr.S.Arumugam, Thangapandi Isaac, Dr.A.Somasundaram, SciTechpublications(India) Pvt Ltd, 2002.					
Reference Books	1. Complex variables and Applications (Sixth Edition) by James Ward Brown and Ruel V. Churchill, Mc.Grawhill Inc. 2. Complex Analysis by P.Duraipandian, Kayalak Pachaiyappa, S.Chand & Co Pvt.Ltd. 3. Complex Analysis, T.K.Manickavachagom Pillay, S.Viswanathan Publishers Pvt. Ltd.					
e-Resources:	1. http://ebooks.lpude.in.complexanalysis . 2. https://nptel.ac.in .					



Title of the Course		MACHINE LEARNING USING R (THEORY)				
Paper Number		II				
Category	Elective	Year	III	Credits	5	Course Code
		Semester	VI			
Course Outline		Unit 1: INTRODUCTION TO MACHINE LEARNING Machine learning – examples of machine learning applications – Learning associations – Classification – Regression- Unsupervised learning – Supervised learning- Learning class from examples- PAC learning – Noise, model selection and generalization – Dimension of supervised machine learning algorithm.				
		Unit 2: DECISION THEORY Bayesian Decision theory – Introduction – Classification – Discriminant function – Bayesian networks -Association rule - Parametric Methods – Introduction – Estimation -Classification - Regression – Multivariate Methods – Data Parameter estimation - Classification – Complexity – Features – Dimensionality Reduction – Analysis – Multidimensional scaling – Linear discriminant analysis.				
		Unit 3 : CLUSTERING & REGRESSION Clustering – Mixture densities – k- means clustering – Supervised Learning after clustering – Hierarchical clustering – Nonparametric Methods – Density estimation – Generalization of multivariate data – Classification – Regression – Smoothing models – Decision Trees – Univariate trees – Multivariate trees – Learning rules from data – Linear Discrimination.				
		Unit 4: MULTILAYER PERCEPTRONS Structure of brain – Neural networks as a parallel processing - Perceptron – Multilayer perceptron – Backpropagation- Training procedures – Tuning the network size – Learning time.				
		Unit 5: LOCAL MODELS Competitive learning -Adaptive resonance theory – Self organizing map – Basis functions – Learning vector quantization – Assessing and Comparing Classification Algorithms – Combining Multiple Learners – Reinforcement Learning.				
Contents and treatment as in		<ol style="list-style-type: none"> 1. Ethem alpaydin, "Introduction to Machine Learning", MIT Press,2004. 2. Tom Mitchell, " Machine Learning", McGraw Hill, 1997. 				
Reference Books						



e-Resources:	https://nptel.ac.in http://mitpress.mit.edu/catalog/item/default.asp?type=2&tid=10341&mode=toc.
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MACHINE LEARNING USING R (PRACTICALS)

LIST OF EXPERIEMNTS

1. Evaluating the results of machine learning algorithms.
2. Implement Regression and Correlation Techniques.
3. Implement Classification Algorithms.
4. Implement Logistic Regression
5. Implement Reinforcement learning model

Title of the Course		TROPICAL LINEAR ALGEBRA					
Paper Number		III					
Category	Elective	Year	III	Credits	5	Course Code	
		Semester	VI				



Course Outline	Unit – 1: Tropical islands Planes, amoebas and their tentacles, Implicitization, curve counting compactifications
	Unit – 2: Tropical varieties: Hypersurfaces- the fundamental theorem, the structure theorem.
	Unit -3: Tropical varieties: Multiplicities and balancing, connectivity and fans, stable intersection.
	Unit -4: Max – linear systems: Bounded mixed integer solution to dual inequalities, the combinatorial method, the algebraic method, subspaces, generators, external and bases, column spaces, unsolvable systems.
	Unit- 5: Eigen Values and Eigen Vectors: The eigen problem: basic properties, maximum cycle mean is the principle eigen value, principle eigen space, finite eigen vectors, commuting matrices have a common eigen vector.
Contents and treatment as in	<ol style="list-style-type: none"> 1. Introduction to Tropical Geometry by Diane Maclagan, Bernd Sturmfels. 2. Peter Butkovic – Max – linear Systems: Theory and Algorithms, Springer Monographs in Mathematics
Reference Books	<ol style="list-style-type: none"> 1. Tropical Algebraic Geometry by Itenberg, Ilia, Mikhalkin, Grigory, Shustin, Eugenii I, Springer.
e-Resources:	https://nptel.ac.in http://mathworld.wolfram.com .

EXTRA DISCIPLINARY COURSES

Title of the Course	NUMERICAL METHODS
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SYLLABUS-2021-2022(CBCS AND OBE PATTERN)

Paper Number		I				
Category	E D P	Year	Credits	Course Code		
		Semester				
Course Outline	Unit 1 Interpolation and Approximation: First difference- Introduction-forward and backward difference-Newton's forward and backward difference formulas for equal intervals- Divided differences- Newton's divided difference formula- Lagrangian Polynomials for unequal intervals Chapter 5, Section 5.1, Chapter 6, Section 6.1 to 6.3 and Chapter 8, Section 8.1 to 8.5 and 8.7					
	Unit 2 Numerical Differentiation and Integration :Differentiation using Newton's forward and backward interpolation formulae- Numerical integration by trapezoidal, Romberg's method- Simpson's 1/3 and 3/8 rules. Chapter 9, Section 9.1 to 9.4, 9.6, 9.7 to 9.14					
	Unit 3 Taylor series method- Picard's method - Euler method for first order equation- Modified Euler method-Fourth order Runge – Kutta method for solving first order equations. Chapter 11, Section 11.1, 11.5 to 11.9, 11.11 to 11.13.					
	Unit 4 Numerical solution of ordinary differential equation by finite difference method- Numerical solution of partial differential equations - Elliptic equation, Poisson equation. Appendix E, Chapter 12, Section 12.1, 12.4 and 12.5 to 12.7					
	Unit 5 Numerical solution of partial differential equations - Parabolic equations, Hyperbolic equations. Chapter 12, Section 12.8 to 12.10					
Contents and treatment as in	"Numerical Methods", by Dr P.Kandasamy, Dr. K. Thilagavathy and Dr. K. Gunavathi. S.Chand and Company Ltd					
Reference Books	1. Numerical Methods With Programming in C by T. Veerarajan and T. Ramachandran. 2. Introductory Methods of Numerical Analysis by S.S.Sastry.					
e-Resources:	1. https://nptel.ac.in . 2. https://mathonline.wikidot.com					

Title of the Course	PREDICTIVE MODELING WITH R (PRACTICALS)
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SYLLABUS-2021-2022(CBCS AND OBE PATTERN)

Paper Number		II				
Category	E D P	Year	Credits	Course Code		
		Semester				
Course Outline	Unit – 1 Prediction versus interpretation, key ingredients of predictive Models, Terminology.					
	Unit – 2 Data transformations for individual predictors, Data transformations for multiple predictors, Dealing with missing values, Removing predictors, Adding predictors.					
	Unit – 3 Over Fitting Model Tuning- The problem of over fitting- Model tuning – Data splitting- Resampling Techniques.					
	Unit – 4 Quantitative Measures of performance, The variance – Bias Trade off computing. Linear Regression – Partial Least squares.					
	Unit – 5 Basic Regression Trees, Regression Model trees – Rule base models, Bagged trees, Random forests.					
Contents and treatment as in	<ol style="list-style-type: none"> 1. Applied Predictive Modeling by Max Kuhn-Kjell Johnson, Springer. 2. An introduction to Statistical Learning with Applications in R, Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, Springer. 					
Reference Books	<ol style="list-style-type: none"> 1. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Trevor Hastie , Robert Tibshirani , Jerome Friedman, Second Edition (Springer Series in Statistics). 					
e-Resources:	http://mathworld.wolfram.com .					

VALUE ADDED COURSE



SYLLABUS-2021-2022(CBCS AND OBE PATTERN)

Title of the Course		DATA ANALYTICS				
Paper Number		II				
Category	VAC	Year		Credits	3	Course Code
		Semester				
Course Outline		Unit – 1 Descriptive Statistics Introduction to the course Descriptive Statistics Probability Distributions, Inferential Statistics Inferential Statistics through hypothesis tests Permutation & Randomization Test.				
		Unit -2 Regression & ANOVA Regression ANOVA(Analysis of Variance, Machine Learning: Introduction and Concepts Differentiating algorithmic and model based frameworks.				
		Unit – 3 Regression : Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbours Regression & Classification.				
		Unit – 4 Supervised Learning with Regression and Classification techniques -1 Bias-Variance Dichotomy Model Validation Approaches Logistic Regression Linear DiscriminantAnalysis Quadratic DiscriminantAnalysis Regression and Classification Trees Support Vector Machines.				
		Unit –5 Prescriptive analytics Creating data for analytics through designed experiments Creating data for analytics through Active learning Creating data for analytics through Reinforcement learning.				
Reference Books		<ol style="list-style-type: none"> Hastie, Trevor, et al. The elements of statistical learning. Vol. 2. No. 1. New York: springer, 2009. Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John Wiley & Sons, 2010 				

Title of the Course	NEURAL NETWORKS AND ALGORITHM
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SYLLABUS-2021-2022(CBCS AND OBE PATTERN)

Paper Number		II				
Category	VAC	Year	Credits	3	Course Code	
		Semester				
Course Outline		UNIT – 1 Introduction to Artificial Intelligence System: Neural Network, Fuzzy logic, Genetic Algorithm. Fundamentals of Neural Networks: What is Neural Network, Model of Artificial Neuron, Learning rules and various activation functions				
		UNIT – 2 Neural Network Architecture: Single layer Feed-forward networks. Multilayer Feed-forward networks. Recurrent Networks.				
		UNIT – 3 Back propagation Networks: Back Propagation networks, Architecture of Back-propagation(BP) Networks, Back-propagation Learning, Variation of Standard Back propagation algorithms.				
		UNIT – 4 Adaptive Resonance Theory: Cluster Structure, Vector Quantization, Classical ART Network, Simplified ART Architecture, ART1 and ART2 Architecture and algorithms, Applications, Sensitivities of ordering of data				
		UNIT – 5 Introduction about Fuzzy set theory: Fuzzy versus Crisp, Crisp and fuzzy sets, Crisp and Fuzzy relations. Integration of Neural Network, Fuzzy logic and Genetic Algorithm: Hybrid system. Neural Networks, Fuzzy logic, and Genetic Algorithm Hybrids.				
Reference Books		<ol style="list-style-type: none"> 1. Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995. 2. Neural Networks, Fuzzy Logic and Genetic Algorithms, by S.Rajasekaran and G.A. Vijayalakshmi Pai. 3. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI. 4. Build_Neural_Network With MS Excel sample by Joe choong. 				



Title of the Course		LaTeX					
Paper Number		III					
Category	VAC	Year		Credits	3	Course Code	
		Semester					
Course Outline		Unit-1: The Basics- Document class – Page style – Page numbering – Formatting lengths –Parts of a document – Dividing the document – Bibliography.					
		Unit-2: The BIBTEX program – BIBTEX style files –Creating a bibliographic database -Table of contents, Index and Glossary,					
		Unit-3: Keeping tabs - Tables .Floats-Cross References In Latex. Typesetting Mathematics- The basics - Custom commands - More on mathematics.					
		Unit-4: New operators –Symbols -Theorems in LATEX–Designer theorems, Several kinds of boxes. Footnotes, Marginpars, and Endnotes.					
		Unit-5: Creating a simple document, structuring your document, graphic package Downloading and installing packages, common errors.					
Reference Books		<ol style="list-style-type: none"> 1. LATEX: A document preparation system (2nd edition) by Leslie. 2. A beginner.s introduction to typesetting with LATEX Peter Flynn. 3. LATEX for Complete Novices Version 1.4 Nicola L. C. Talbot 					
e-Resources:		https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf https://www.dickimaw-books.com/latex/novices/novices-report.pdf					



NON – MAJOR ELECTIVE I & II

Offered by Department of Mathematics for other department Students

Title of the Course		FUNCTIONAL MATHEMATICS - I				
Paper Number		I				
Category	N M E	Year	I	Credits	2	Course Code
		Semester	I			
Course Outline		Unit – 1 Ratio and Proportion				
		Unit – 2 Percentages				
		Unit – 3 Profit and Loss, Discounts				
		Unit – 4 Simple Interest and Compound interest				
		Unit – 5 Solutions of Simultaneous equations, Problems on Ages and Numbers.				
Contents and treatment as in		Quantitative Aptitude- R.S. Agarwal				
Reference Books		Analytical Reasoning by MK Panday				
e-Resources:		https://www.toppr.com/guides/quantitative-aptitude/				



Title of the Course		FUNCTIONAL MATHEMATICS - II				
Paper Number		I				
Category	N M E	Year	I	Credits	2	Course Code
		Semester	II			
Course Outline	Unit – 1 Time and work – Pipes and cisterns- Problem					
	Unit – 2 Time and Distance, Relative speeds- Problems on Races, Boats and Trains.					
	Unit – 3 Mensuration – Problems					
	Unit – 4 Polygons – Interior angles- Number of diagonals- Regular Polygons- Problems					
	Unit – 5 Stocks and Shares – Problems					
Contents and treatment as in	1. Quantitative Aptitude- R.S. Agarwal 2. Functional Mathematics, M. Sivananda Rani, Margham Publications, Chennai.					
Reference Books	Analytical Reasoning by MK Panday					
e-Resources:	https://www.toppr.com/guides/quantitative-aptitude/					

**B.COM**

Title of the Course		BUSINESS MATHEMATICS - I					
Paper Number		I					
Category	Allied	Year	I	Credits	5	Course Code	
		Semester	I				
Course Outline		Unit - 1 Set Theory – Definition, Elements and Types of Sets, Operations on Sets, Relations and Functions of Sets					
		Unit – 2 Ratio, Proportion and Variations					
		Unit – 3 Permutation and Combination, Binominal Theorem, Exponential and Logarithmic Series					
		Unit – 4 Differential Calculus: Differentiation – Meaning -, Rules: Maxima and Minima of Univariate Functions: Application of Maxima and Minima in Business					
		Unit – 5 Interest and Annuity – Banker’s Discount					
Reference Books		1. Business Mathematics – P.R.Vittal 2. Business Mathematics – D.C. Sancheti and V.K. Kapoor 3. Business Mathematics – B.M. Agarwal 4. Business Mathematics – R.S. Soni					
e-Resources:		1. http://mathworld.wolfram.com 2. http://www.aanalyzemath.com/calculus					

Title of the Course	BUSINESS MATHEMATICS – II
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SYLLABUS-2021-2022(CBCS AND OBE PATTERN)

Paper Number		II				
Category	Allied	Year	I	Credits	5	Course Code
		Semester	II			
Course Outline		Unit - 1 Plane Analytical Geometry: - Cartesian coordinate system: Length of a Line Segment – Section Formulae (Ratio) – Gradient of a Straight Line – Equations of a Straight Line				
		Unit – 2 Arithmetic, Geometric and Harmonic Progressions				
		Unit – 3 Integral Calculus: Integration, Meaning and Rules of Integration – Integration by Substitution and by Parts – Indefinite and Definite Integration – Application in Business (Trigonometric Functions to be excluded)				
		Unit – 4 Interpolation: Binomial, Newton and Lagrange’s Method				
		Unit – 5 Matrices – Meaning and Operations – Matrix inversion – Solutions to Linear Equations				
Reference Books		<ol style="list-style-type: none"> 1. Business Mathematics – P.R. Vittal 2. Business Mathematics – D.C. Sancheti and V.K. Kapoor 3. Business Mathematics – B.M. Agarwal 4. Business Mathematics – A.P. Varma 5. Business Mathematics – R.S. Soni 				
e-Resources:		<ol style="list-style-type: none"> 1. http://mathworld.wolfram.com 2. http://www.univie.ac.at/future.media/moe/galerie.html 				



SYLLABUS-2021-2022(CBCS AND OBE PATTERN)

Title of the Course		BUSINESS STATISTICS AND OPERATIONS RESEARCH – I				
Paper Number		III				
Category	Allied	Year	II	Credits	5	Course Code
		Semester	III			
Course Outline		Unit – 1 Introduction – Classification and tabulation of statistical data – Diagrammatic and graphical representation of data.				
		Unit – 2 Measures of Central tendency – Mean, median and mode – Dispersion, Range, Quartile Deviation, Mean Deviation , Standard Deviation – Measures of Skewness.				
		Unit – 3 Correlation – Karl Pearson’s Coefficient of Correlation – Spearman’s Rank Correlation-Regression Lines and Coefficients.				
		Unit – 4 Introduction to OR–Linear Programming Formulation–Graphical and Simplex method to solve LPP with all constraints of less than or equal to type only (Simple Problems only)				
		Unit – 5 Network Analysis – PERT and CPM (no crashing)				
Reference Books		<ol style="list-style-type: none"> 1. 1.Dr. P.R.Vittal, Business Statistics and Operations Research, Margham publications 2. Dr.S.P.Rajagopalan ,R.Sattanathan, Business Statistics & Operations Research, Margham Publications. 3. Dr.S.P.Gupta, Statistical Methods 4. Gupta and Hira, Operations Research, S.Chand. 5. Handy and A.Taha, Operations Research, Macmillan Publishers 				
e-Resources:		http://nptel.ac.in				



Title of the Course		BUSINESS STATISTICS AND OPERATIONS RESEARCH – II					
Paper Number		IV					
Category	Allied	Year	II	Credits	5	Course Code	
		Semester	IV				
Course Outline		Unit - 1 Time Series Analysis – Trend – Seasonal Variation – Cyclical variations.					
		Unit – 2 Index Numbers – Aggregative and Relative Index – Chain and Fixed Index – Wholesale Index – Cost of Living Index.					
		Unit – 3 Probability – Addition and Multiplication Theorem – Conditional probability – Baye’s Theorem (without proof) – Simple problems.					
		Unit – 4 Assignment and Transportation Problems.					
		Unit – 5 Game Theory - Games with saddle – Dominance – Graphical Method.					
Reference Books		<ol style="list-style-type: none"> 1. Dr. P.R.Vittal, Business Statistics and Operations Research, Margham publications 2. Dr.S.P.Rajagopalan ,R.Sattanathan, Business Statistics & Operations Research, Margham Publications. 3. Dr.S.P.Gupta, Statistical Methods 4. Gupta and Hira, Operations Research, S.Chand. 5. Handy and A.Taha, Operations Research, Macmillan Publishers 					
e-Resources:		http://nptel.ac.in					


B.Sc., CHEMISTRY & B.Sc., PHYSICS

Title of the Course		ALLIED MATHEMATICS-I				
Paper Number		I				
Category	Allied	Year	I	Credits	5	Course Code
		Semester	I			
Course Outline	Unit – 1 Algebra and Numerical Methods: Algebra: Summation of series - simple problems. Numerical Methods: Operators E, Δ, ∇ difference tables- Newton-Raphson method- Newton's forward and backward interpolation formulae for equal intervals, Lagrange's interpolation formula. Chapter 2, Section 2.1.3, 2.2, 2.2.1, 2.3, 2.3.3 Chapter 3, Section 3.4.1 and Chapter 5, Section 5.1 and 5.2.					
	Unit – 2 Matrices: Symmetric, Skew-Symmetric, Orthogonal, Hermetian, Skew-Hermetian and Unitary matrices. Eigen values and Eigen-vectors, Cayley-Hamilton theorem (without proof) – verification- Computation of inverse of matrix using Cayley - Hamilton theorem. Chapter 4, Section 4.1.1 to 4.1.6, 4.5, 4.5.2, 4.5.3.					
	Unit – 3 Theory Of Equations: Polynomial equations with real coefficients, irrational roots, complex roots, symmetric functions of roots, transformation of equation by increasing or decreasing roots by a constant, reciprocal equation-simple problem. Chapter 3, Section 3.1 to 3.4.1(omit section 3.2.1)					
	Unit – 4 Trigonometry: Expansions of $\sin(n\theta)$ and $\cos(n\theta)$ in a series of powers of $\sin\theta$ and $\cos\theta$ - Expansions of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ in a series of sines, cosines and tangents of multiples of " θ " - Expansions of $\sin\theta$, $\cos\theta$ and $\tan\theta$ in a series of powers of " θ " – Hyperbolic and inverse hyperbolic functions . Chapter 6, Section 6.1 to 6.3.					
	Unit – 5 Differential Calculus: Successive differentiation, nth derivatives, Leibnitz theorem (without proof) and applications, Jacobians, Curvature and radius of curvature in Cartesian co-ordinates, maxima and minima of functions of two variables- Simple problems Chapter 1, Section 1.1 to 1.3.1 and 1.4.3. .					
Contents and treatment as in	Allied Mathematics, Volume I and II, by P. Duraipandian and S. Udayabaskaran, S. Chand Publications					
Reference Books	1. S. Narayanan and T.K. Manickavasagam Pillai – Ancillary Mathematics, S. Viswanathan Printers, 1986, Chennai. 2. Allied Mathematics by Dr. A. Singaravelu, Meenakshi Agency.					
e-Resources:	1. http://www.themathpage.com 2. http://nptel.ac.in					



Title of the Course		ALLIED MATHEMATICS-II				
Paper Number		II				
Category	Allied	Year	I	Credits	5	Course Code
		Semester	II			
Course Outline	Unit – 1 Integral Calculus: Bernoulli's formula – Reduction formulae- $\int_0^{\pi/2} \sin^n x dx$, $\int_0^{\pi/2} \cos^n x dx$, $\int_0^{\pi/2} \sin^m x \cos^n x dx$ (m, n being positive integers), Fourier series for functions in $(0, 2\pi), (-\pi, \pi)$. Chapter 2: Section 2.7 & 2.9, Chapter 4: Section 4.1.					
	Unit – 2 Differential Equations: Ordinary Differential Equations: second order non- homogeneous differential equations with constant coefficients of the form $ay'' + by' + cy = X$ where X is of the form and -Related problems only. Partial Differential Equations: Formation, complete integrals and general integrals, four standard types and solving Lagrange's linear equation $Pp + Qq = R$. Chapter 5: Section 5.2.1, Chapter 6: Section 6.1 to 6.4					
	Unit – 3 Laplace Transforms: Laplace transformations of standard functions and simple properties, inverse Laplace transforms, Application to solution of linear differential equations up to second order- simple problems. Chapter 7: Section 7.1.1 to 7.1.4 & 7.2 to 7.3					
	Unit – 4 Vector Differentiation: Introduction, Scalar point functions, Vector point functions, Vector differential operator Gradient, Divergence, Curl, Solenoidal, Irrotational, identities. Chapter 8, Section 8.1 to 8.4.4					
	Unit – 5 Vector Integration: Line, surface and volume integrals, Gauss, Stoke's and Green's theorems (without proofs). Simple problems on these. Chapter 8, Section 8.5 to 8.6.3.					
Contents and treatment as in	Allied Mathematics, Volume I and II, P. Duraipandian and S. Udayabaskaran, S. Chand Publications.					
Reference Books	1. S. Narayanan and T.K. Manickavasagam Pillai – Ancillary Mathematics, S. Viswanathan Printers, 1986, Chennai. 2. Allied Mathematics by Dr. A. Singaravelu, Meenakshi Agency.					



SYLLABUS-2021-2022(CBCS AND OBE PATTERN)

e-Resources:	<ol style="list-style-type: none">1. http://www.sosmath.com2. http://www.analyzemath.com/Differential_Equations/applications.htm
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M.COM

Title of the Course		ADVANCED STATISTICS				
Paper Number		I				
Category	Elective	Year	I	Credits	5	Course Code
		Semester	I			
Course Outline		Unit – 1 Probability and Theoretical Distributions Probability –Definition - addition theorem -Multiplication theorem- conditional probability -Baye's theorem– simple problems Theoretical Distributions- Binomial ,Poisson and Normal distributions- simple problems.				
		Unit – 2 Statistical Inference-Testing of Hypothesis for large samples Testing of hypothesis- procedure-two types of error- one and two tailed tests - standard error - large sample – test for specified proportion –test for difference between proportions-test for specified mean –test for difference of mean of two samples.				
		Unit – 3 Testing of Hypothesis for Small samples Small samples: t-test: specified mean, equality of two means- paired t-test, F-test -equality of variances- Chi square test - independence of attributes and goodness of fit.				
		Unit – 4 Analysis of Variance and Decision Theory Analysis of variance-one way and two-way classification- Pay off table-Maximin principle - Minimax principle - Baye's Principle-Decision tree Analysis				
		Unit – 5 Correlation and Regression Correlation-types of Correlation-Karl Pearson's Coefficient of correlation - Rank correlation Coefficient-Regression - Regression equations- partial and multiple correlation (upto three variables)-partial and multiple regressions (upto three variables).				
Reference Books		1. S.P. Gupta, Statistical Methods, Sultan Chand, 2005. 2. P.R. Vittal, Quantitative Techniques, Margham Publications.				
e-Resources:		http://nptel.ac.in				



Title of the Course		RESOURCE MANAGEMENT TECHNIQUE				
Paper Number		II				
Category	Elective	Year	I	Credits	5	Course Code
		Semester	II			
Course Outline		Unit – 1 Transportation model- Balanced and Unbalanced Transportation problems-Initial basic feasible solution - North west corner rule , the row minima ,column minima, least cost method and Vogel's approximation methods – Optimum solution – Modi method.				
		Unit – 2 Assignment Problem- Balanced and Unbalanced – Minimization and Maximization - restricted assignment problem - travelling salesman problem . Sequencing problem: - Processing of n jobs through 2 machines- Processing of n jobs through 3 machines- Processing each of n jobs through m machines - Processing 2 jobs through m machines.				
		Unit – 3 Game Theory- Pure & Mixed Strategies - Dominance-Graphical method.				
		Unit – 4 Replacement Model1-Model-Replacement of an item whose maintenance cost increases with time and money value is not changed. Model 2-Replacement of an item whose maintenance cost increases with time and money value is changes with time. Model 3 - Replacement of items due to sudden Failure - Model 4-Staff replacement.				
		Unit – 5 PERT and CPM – Project Network diagram – Critical Path (Crashing Excluded)– PERT computations.				
Reference Books		<ol style="list-style-type: none"> 1. P.R.Vittal & V. Malini, Operations Research, Margham Publications.2007 2. Sundaresan, Ganapathy Subramanian, Resource Management Technique –A.R.Publications 				
e-Resources:		http://nptel.ac.in				



MOOC COURSES:

1. Mathematical Economics (SWAYAM)
2. Introduction to Commutative Algebra (SWAYAM)
3. Design and Analysis of Experiments (SWAYAM)
4. Critical Thinking (SWAYAM)
5. Statistical Inference(SWAYAM)
6. Statistical Mechanics(SWAYAM)
7. Applied Linear Algebra(SWAYAM)
8. Introduction to probability and Statistics(SWAYAM)
9. Probability Foundations for Electrical engineers(SWAYAM)
10. Transform Calculus and its applications in Differential Equations(SWAYAM)
11. Applied Multivariate Statistical Modeling (SWAYAM)
12. Descriptive Statistics with R Software(SWAYAM)
13. Fuzzy Sets, Logic and Systems & Applications(SWAYAM)
14. Advanced Partial Differential Equations (SWAYAM)
15. Applied Linear Algebra for Signal Processing, Data Analytics and Machine Learning(SWAYAM)
16. Introduction to Algebraic Topology (Part-I) from *NPTEL*
17. Introductory Mathematical Methods for Biologists (SWAYAM)
18. Introduction to Stochastic Processes (SWAYAM)
19. Operations Research(SWAYAM)
20. Ordinary and Partial Differential Equations and Applications (SWAYAM)
21. MCDM Techniques using R (SWAYAM)
22. Multivariable calculus(SWAYAM)
23. Numerical Linear Algebra (SWAYAM)
24. Computational Geometry(SWAYAM)
25. Advanced Probability Theory (SWAYAM)
26. Measure Theory (SWAYAM)
27. Introduction to Algebraic Geometry and Commutative Algebra(SWAYAM)
28. An Introduction to smooth Manifolds(SWAYAM)
29. First Course on Partial Differential Equations – I (*NPTEL*)
30. Discrete Mathematics(SWAYAM)
31. Introduction to Galois Theory (SWAYAM)
32. Variational Calculus and its applications in Control Theory and Nanomechanics(SWAYAM)
33. Graph Theory (SWAYAM)
34. Probabilistic Methods in PDE (SWAYAM)
35. Functional Analysis (SWAYAM)
36. Introduction to Probability (with examples using R) (*NPTEL*)
37. Algebra – II (*NPTEL*)
38. Fourier Analysis and Its Applications(SWAYAM)
39. Foundations of Mathematical Statistics (SWAYAM)
40. Algebra and Trigonometry (SWAYAM)
41. Descriptive Statistics(SWAYAM)



42. Probability and Probability Distributions (SWAYAM)
43. Data Analysis for life sciences(Edx)
44. Introduction to probability(Edx)
45. Data science probability(Edx)
46. Fat chance probability from the ground up(Edx)
47. Probability and statistics in data science using python. (Edx)
48. Data science linear regression (Edx)
49. Data science capstone(Edx)
50. Introduction to Algebra(Edx)
51. Linear Algebra – Foundations to Frontiers(Edx)
52. Introduction to linear models and matrix algebra(Edx)
53. Basics of statistical inferences and modelling using R(Edx)
54. Introduction to actuarial science(Edx)
55. Bio statistics(Edx)
56. Introduction to Geometry(Edx)
57. Differential equations, Fourier series and Partial differential equations. (Edx)
58. Transfer functions and Laplace transform(Edx)
59. Graph Algorithms(Edx)
60. Neural Dynamics(Edx)
61. Fundamentals of statistics(Edx)
62. Coordinate systems and infinite series (Edx)
63. The math of data science linear Algebra(Edx)
64. Quantum mechanics and quantum computation(Edx)
65. Mathematical Modelling(Edx)
66. Complex analysis with physical applications (Edx)
67. Math in sports(Edx)
68. Single variable calculus(Edx)
69. Applications of Linear Algebra(Edx)
70. Data Science(Edx)
71. Statistics and Data Science(Edx)
72. Machine Learning with python(Edx)
73. Introduction to Mathematical Thinking(COURSERA)
74. Mathematics for machine Learning(COURSERA)
75. Introduction to calculus(COURSERA)
76. Mathematics for Data science(COURSERA)
77. Introduction to discrete mathematics for CS(COURSERA)
78. Precalculus through data and modelling(COURSERA)
79. Matrix Algebra for engineers(COURSERA)
80. Data science math skills(COURSERA)
81. Advanced statistics for data science(COURSERA)
82. Introduction to logic(COURSERA)
83. Algebra and Algorithms(COURSERA)
84. Fibonacci numbers and the Golden ratio(COURSERA)
85. Introduction to Galois theory(COURSERA)
86. Mathematics for economists(COURSERA)
87. Discrete Mathematics(COURSERA)
88. Stochastic Processes(COURSERA)
89. Differential Calculus through Data and Modelling. (COURSERA)
90. Mathematical Game theory(COURSERA)
91. Introduction to enumerative combinatorics(COURSERA)



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92. Information theory(COURSERA)
93. Calculus through data and modelling applying differentiation(COURSERA)
94. Analytic combinatorics. (COURSERA)
95. Maths essentials(edX)