B.Sc. Mathematics

Syllabus

AFFILIATED COLLEGES

Program Code: 22A

2023 – 2024 onwards

BHARATHIAR UNIVERSITY

**(A State University, Accredited with "A++" Grade by NAAC,
Ranked 21st among Indian Universities by MHRD-NIRF)**

Coimbatore - 641 046, Tamil Nadu, India

Program Educational Objectives (PEOs)	
The **B. Sc. Mathematics** program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	Acquire knowledge in functional areas of Mathematics and apply in all the fields of learning.
PEO2	Recognise the need for life long learning and demonstrate the ability to explore some mathematical content independently.
PEO3	Employ mathematical ideas encompassing logical reasoning ,analytical, numerical ability , theoretical skills to model real-world problems and solve them.
PEO4	Develop critical thinking ,creative thinking, self confidence for eventual success in career.
PEO5	Analyze , interpret solutions and to enhance their Entrepreneurial skills, Managerial skill and leadership
PEO6	To prepare the students to communicate mathematical ideas effectively and develop their ability to collaborate both intellectually and creatively in diverse contexts.
PEO7	Rewarding careers in Education, Industry, Banks, MNCs and pursue higher studies

Program Specific Outcomes (PSOs)	
After the successful completion of **B. Sc. Mathematics** program, the students are expected to	
PSO1	Maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for extended learning.
PSO2	Identify the applications of Mathematics in other disciplines and society.
PSO3	Develop an in-depth knowledge in Mathematics appreciating the connections between theory and its applications .
PSO4	Demonstrate their mathematical modeling ability, problem solving skills, creative talent and power of communication necessary for various kinds of employment.
PSO5	Develop mathematical aptitude and the ability to think abstractly.
PSO6	Learn independently and improve ones performance.
PSO7	Students are equipped to appear competitive examinations.

Program Outcomes (POs)	
On successful completion of the **B. Sc. Mathematics** program	
PO1	Students are empowered with analytical and logical skills-to formulate results and construct mathematical argument.
PO2	Ability to organize, analyze and interpret data accurately in both academic and non -academic context.
PO3	Demonstrate effective communication of mathematical ideas and creative thinking skills to facilitate solving real world problems as a team and independently.
PO4	Appreciate and identify the connections between Mathematics and other disciplines.
PO5	Competency to obtain employment in education , public and private sectors..
PO6	Identify the area of interest for extended learning from the understanding gained from the domain and allied areas of Mathematics.
PO7	Develop mathematical aptitude and make critical observations.
PO8	Garner innovative ideas to face global challenges.
PO9	Instill a sense of responsibility in tackling professional and social issues ethically.
PO10	Trigger their passion for research in unexplored areas of Mathematics.

BHARATHIAR UNIVERSITY: COIMBATORE 641 046

B. Sc. Mathematics Curriculum (Affiliated Colleges)
(CBCS PATTERN)

(*For the students admitted from the academic year **2023-2024** and onwards*)

Scheme of Examination

Part	Title of the Course	Hours/ Week	Examination				Credits
			Duration in Hours	Maximum Marks			
				CIA	CEE	Total	
	Semester I						
I	Language - I	6	3	25	75	100	4
II	English - I	6	3	25	75	100	4
III	Core Paper I - Classical Algebra	4	3	25	75	100	4
III	Core Paper II-Calculus	5	3	25	75	100	4
III	Allied A : Paper I Chosen by the college	7	3	25	75	100	4
IV	Environmental Studies*	2	3	-	50	50	2
	Total	**30**		**125**	**425**	**550**	**22**
	Semester II						
I	Language – II	6	3	25	75	100	4
II	English – II	4	3	25	25	50@@	2
II	Effective English :Language Proficiency for Employability http://kb.naanmudhalvan.in/Special:Filepath/Cambridge_Course_Details.pdf	2	-	25	25	50##	2
III	Core Paper III - Analytical Geometry	4	3	25	75	100	4
III	Core Paper IV-Trigonometry, Vector Calculus and Fourier Series	5	3	25	75	100	4
III	Allied A: Paper II Chosen by the College	7	3	25	75	100	4
IV	Value Education – Human Rights*	2	3	-	50	50	2
	Total	**30**		**150**	**400**	**550**	**22**
	Semester III						
I	Language – III	6	3	25	75	100	4
II	English – III	6	3	25	75	100	4
III	Core Paper V- Differential Equations and Laplace Transforms.	3	3	25	75	100	4

III	Core Paper VI- Statics	3	3	25	75	100	4
III	Allied B : Paper I – Chosen by the college	7	3	20	55	75	3
IV	Skill based Subject - Operations Research -I	3	3	25	25	50@@	2
IV	Tamil** / Advanced Tamil* (OR) Non-major elective - I (Yoga for Human Excellence)* / Women's Rights*	2	3	-	50	50	2
	Total	**30**		**145**	**430**	**575**	**23**
	Semester IV						
I	Language – IV	5	3	25	75	100	4
II	English – IV	5	3	25	75	100	4
III	Core Paper VII-Dynamics	3	3	25	75	100	4
III	Core Paper VIII- Programming in C	2	3	20	55	75	3
III	Core Paper VIII -Programming in C Practical	1	3	10	15	25	1
III	Allied B - Paper II Chosen by the college	5	3	20	55	75	3
III	Allied B - Paper II Chosen by the college (For Practical Paper)	2	3	20	30	50	2
IV	Skill based Subject - Operations Research – Paper II	3	3	25	25	50@@	2
IV	Office Fundamentals :Digital Skills for Employability http://kb.naanmudhalvan.in/Special:Filepath/Microsoft_Course_Details.xlsx	2	-	25	25	50##	2
IV	Tamil**/Advanced Tamil* (OR) Non-major elective -II (General Awareness*)	2	3	-	50	50	2
	Total	**30**		**195**	**480**	**675**	**27**
	Semester V						
III	Core Paper IX-Real Analysis-I	5	3	25	75	100	4
III	Core Paper X- Complex Analysis-I	6	3	25	75	100	4
III	Core Paper XI- Modern Algebra-I	6	3	25	75	100	4
III	Core Paper XII- Discrete Mathematics	5	3	25	75	100	4
III	Elective I	5	3	20	55	75	3
IV	Skill based Subject - Operations Research - Paper III	3	3	25	25	50@@	2
	Total	**30**		**145**	**380**	**525**	**21**

	Semester VI						
III	Core Paper XIII - Real Analysis-II	5	3	25	75	100	4
III	Core Paper XIV - Complex Analysis-II	5	3	25	75	100	4
III	Core Paper XV -Modern Algebra-II	5	3	25	75	100	4
III	Elective II	5	3	20	55	75	3
III	Elective III	5	3	25	75	100	4
IV	Skill Based Subject - Operations Research- Paper IV	3	3	25	25	50@@	2
IV	Project Based learning 2- Advanced Platform Technology -(Govt(auto) & Govt (Non-Auto)) / Data Analytics & Visualization - Aided (Non-auto) & SF(Non-Auto) http://kb.naanmudhalvan.in/Bharathiar_University_(BU)	2	-	25	25	50##	2
V	Extension Activities ** / Swachh Bharath @			50		50	2
	Total	**30**		**220**	**405**	**625**	**25**
	Grand Total	**180**		**980**	**2520**	**3500**	**140**
# All computer papers have theory and practical exams							
	Theory			**20**	**55**	**75**	**100**
	Practicals			**10**	**15**	**25**	

Note

Naan Mudhalvan –Courses- external 25 marks will be assessed by Industry and internal will be offered by respective course teacher.

* No Continuous Internal Assessment (CIA). Only University Examinations

** No University Examinations. Only Continuous Internal Assessment (CIA).

@ Swachh Bharath Internship Scheme (SBIS) is to be added for 2 credits in the extension activities.

@@ University semester examination will be conducted for 50 marks (As per existing pattern of Examination) and it will be converted for 25 marks.

Allied Subjects(Colleges can choose any two subjects)

1.Physics 2. Chemistry 3.Accountancy 4.Statistics.

List of Elective papers

(Colleges can choose any one of the paper as electives)

Elective – I	**A**	Astronomy- I
	B	Numerical -Methods-I
Elective – II	**A**	Astronomy—II
	B	Numerical Methods-II

Elective – III	**A**	Graph Theory
	B	Automata Theory & Formal Languages
	C	Programming in C++ #
	D	Number Theory
	E	Introduction to Industry 4.0


First
Semester

Course code		CLASSICAL ALGEBRA	L	T	P	C
Core/Elective/Supportive		Core Paper – I	4	-	-	4
Pre-requisite		Knowledge of Limits	Syllabus Version		2023 - 2024	

Course Objectives:

1.To enable the students to learn Binomial ,Exponential , Logarithmic series and their application to summation of series.
2.To study intensively the convergence and divergence of different types of series.
3. To demonstrate the standard methods to solve both polynomial and transcendental type equations.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the concept of Binomial ,Exponential , Logarithmic series and their application to summation of series.	K1
2	Acquire a clear knowledge regarding methods to find an approximate roots of the equations .	K2
3	Apply the appropriate tests to find the convergence or divergence of an infinite series.	K3
4	ApplyDescartes's rule of signs to find the number of positive and negative roots if any in a polynomial equation .	K3
5	Analyze the relation between roots and coefficients of the polynomial equations.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Summation Of Series Using Binomial And Exponential Theorem	12 hours

Binomial, exponential theorems-their statements only- their immediate application to summation and approximation only.

Unit:2	Logarithmic Series, Convergence And Divergence Of Series	12 hours

Logarithmic series theorem-statement and proof-Immediate application to summation and approximation only. Convergency and divergency of series –definitions, elementary results- comparison tests-De -Alembert's and Cauchy's tests.

Unit:3	Absolute Convergence Of Series	12 hours

Absolute convergence-series of positive terms-Cauchy's condensation test-Raabe's test.

Unit:4	Theory Of Equations	12 hours

Roots of an equation- Relations connecting the roots and coefficients- transformations of equations-character and position of roots-Descarte's rule of signs-symmetric function of roots-Reciprocal equations.

Unit:5	**Multiple Roots**	**12 hours**
Multiple roots-Rolle's theorem - position of real roots of f(x) =0 – Newton's method of approximation to a root – Horner's method.		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Algebra-T.K .Manicavachasam Pillai, T.Natarajan& K.S Ganapathy , (S.Viswanatham Printers & Publishers Private Ltd-2006)

Reference Books

1	Mathematics for B.Sc. Branch I -Vol. I- P. Kandasamy and K.Thilagavathy (For B.Sc-I semester) (S. Chand and Company Ltd, New Delhi, 2004.)
2	Algebra - N.P.Bali(Publisher: Laxmi Publications-New Delhi Edition 2010) .

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.brainkart.com/article/Introduction-to-Binomial,-Exponential-and-Logarithmic-series_35107/
2	http://www.jjernigan.com/172/ConvergenceDivergenceNotes.pdf
3	http://home.iitk.ac.in/~psraj/mth101/lecture_notes/Lecture11-13.pdf https://maths4uem.files.wordpress.com/2015/09/1028-infinite-series.pdf https://ocw.mit.edu/high-school/mathematics/exam-prep/concept-of-series/series-convergence-divergence/

Course Designed By: 1.Dr.T.Narppasalai Arasu
2.Dr.M.Anandhi

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	S	S	S	M	S	S
CO2	S	M	M	M	S	S	S	M	M	S
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		CALCULUS	L	T	P	C
Core/Elective/Supportive		Core Paper – II	5	-	-	4
Pre-requisite		Higher Secondary Level Mathematics.	Syllabus Version		2023 - 2024	

Course Objectives:

To orient the students to get an idea of curvatures, Integration of different types of functions, its geometrical applications, double, triple and improper integrals.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify areas in Mathematics and other fields where Calculus is useful.	K1
2	Understand the concepts of Evolutes and Envelopes, methods to find curvature and evolutes.	K2
3	Apply the concept of change of variables in double and triple integrals.	K3
4	Apply double , triple integral to find the area and volume respectively.	K3
5	Apply the Beta and gamma function to solve the multiple integrals.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Curvature	15 hours

Curvature-radius of curvature in Cartesian and polar forms-evolutes and envelopes- Pedal equations- total differentiation- Euler's theorem on homogeneous functions.

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Unit:2	Integration	15 hours

Integration of $f'(x)/f(x)$, $f'(x)\sqrt{f(x)}$,$[(px+q)/\sqrt{(ax^2+bx+c)}]$, $[\sqrt{(x-a)/(b-x)}]$, $[\sqrt{(x-a)(b-x)}]$,$1/[\sqrt{(x-a)(b-x)}$,$1/(a\cos x+b\sin x+c)$, $1/(a\cos^2 x+b\sin^2 x+c)$,Integration by parts-Bernoulli's Formula.

Unit:3	Evaluation Of Double And Triple Integrals	15 hours

Reduction formulae- problems- evaluation of double and triple integrals- applications to calculations of areas and volumes-areas in polar coordinates.

Unit:4	Change Of Variables In Double And Triple Integrals	15 hours

Change of order of integration in double integral- Jacobians- Change of variables in double and triple integrals.

Unit:5	Beta And Gamma Functions	15 hours

Beta and Gamma integrals-their properties, relation between them- evaluation of multiple integrals using Beta and Gamma functions - Improper Integrals.

	Total Lecture hours	75 hours

Text Book(s)

1	Calculus Vol 1 - S. Narayanan and T.K.M. Pillai. (Viswanathan Publishers 2008)
2	Calculus Vol 2- S. Narayanan and T.K.M. Pillai.(Viswanathan Publishers 2008)

Reference Books	
1	Mathematics for BSc – Vol I and. II - P. Kandasamy &K.Thilagarathy(S.Chand and Co-2004)
2	A Text book of calculus- Shanthi Narayanan &J.N.Kapoor(S.Chand& Co.2014)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://ocw.mit.edu/resources/res-18-006-calculus-revisited-single-variable-calculus-fall-2010/study-materials/ https://www.whitman.edu/mathematics/calculus_online/chapter15.html
2	https://www.khanacademy.org/math/calculus-home
3	https://www.sac.edu/FacultyStaff/HomePages/MajidKashi/PDF/MATH_150/Bus_Calculus.pdf
4	http://nptel.ac.in/courses/111104085/29
5	http://www.math.odu.edu/~jhh/Volume-1.PDF http://www.math.odu.edu/~jhh/Volume-2.PDF https://www.math.cmu.edu/~wn0g/2ch6a.pdf
6	https://nptel.ac.in/courses/111/105/111105122/http://www.staff.ttu.ee/~lpallas/multipleintegrals.pdf
Course Designed By: 1.Dr.C.Janaki 2.Dr.M.Anandhi	

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	S	S	S	S	S	S
CO2	S	M	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Second Semester

Course code		ANALYTICAL GEOMETRY	L	T	P	C
Core/Elective/Supportive		Core Paper – III	4	-	-	4
Pre-requisite		Basic Knowledge In Trigonometry &Vector Algebra.	Syllabus Version		2023 - 2024	

Course Objectives:

Emphasis to enhance student knowledge in three dimensional analytical geometry and the geometrical aspects of three dimensional figs, viz, sphere, cone and cylinder.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Gain knowledge about the regular geometrical figures and their properties.	K1
2	Describe the geometric concepts.	K2
3	Find equation to tangent, normal at a point on a conic	K3
4	Analyze condition of tangency and find the tangent plane to the central conicoid	K4
5	Analyze conics to explain natural phenomenon	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Straight Lines	12 hours

Analytical Geometry 3D-Straight lines-coplanarity of straight line-shortest distance (S.D) and equation of S.D between two lines-simple problems.

Unit:2	Sphere	12 hours

Sphere: standard equation of sphere-results based on the properties of a sphere-tangent plane to a sphere- equation of a circle.

Unit:3	System Of Spheres	12 hours

Tangency of spheres- coaxial system of spheres- radical planes- Orthogonal spheres.

Unit:4	Cone And Cylinder	12 hours

Cone whose vertex is at the origin- envelope cone of a sphere-right circular cone-equation of a cylinder-right circular cylinder.

Unit:5	Conicoid	12 hours

Nature of a conicoid- standard equation of central conicoid –enveloping cone- tangent plane- condition for tangency –director Sphere- director plane .

	Total Lecture hours	60 hours

Text Book(s)

1	Analytical Geometry - P. Durai Pandian & others (Emerald Publishers 1998).
2	Solid Geometry- N.P. Bali(Laxmi Publications (P) Ltd,2015)

Reference Books	
1	Solid Geometry- M.L. Khanna(Jainath& Co Publishers, Meerut)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://www.brainkart.com/article/Three-Dimensional-Analytical-Geometry_6453/
2	http://egyankosh.ac.in/bitstream/123456789/11990/1/Unit-2.pdf
Course Designed By: 1.Dr.C.Janaki 2.Dr.M.Anandhi	

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	S	S	M	S	S	S	S	S
CO2	S	M	S	S	S	S	S	M	S	S
CO3	S	M	S	M	M	M	S	S	S	S
CO4	S	M	S	S	M	S	M	S	S	S
CO5	S	S	S	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		TRIGONOMETRY, VECTOR CALCULUS AND FOURIER SERIES	L	T	P	C
Core/Elective/Supportive		Core Paper – IV	5	-	-	4
Pre-requisite		Knowledge In Vector Algebra, Differentiation, Integration	Syllabus Version		2023 - 2024	

Course Objectives:

To enable the students to learn about the expansion of trigonometric, hyperbolic functions, vector calculus and the expansions of Fourier series .

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the expansion of trigonometric functions and hyperbolic functions .	K1
2	Acquire the basic knowledge of vector differentiation and vector integration.	K2
3	Determine and apply the important quantities associated with vector fields such as the divergence, curl and scalar potential.	K3
4	Understand and find Fourier series of a given periodic function.	K3
5	Examine line integral, surface integral ,volume integral and inter-relations among them .	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Expansion In Series	15 hours

Expansion in Series – Expansion of **cos^{n}θ, sin^{n}θ**in a series of cosines and sines of multiples of θ – Expansions of **cosnθ ,sinnθ and tannθ** in powers of sines , cosines and tangents – Expansion of sin θ, cos θ and tan θ in powers of θ – hyperbolic functions and inverse hyperbolic functions.

Unit:2	Logarithm Of Complex Quantities And Summation Of Series	15 hours

Logarithm of complex quantities - summation of series – when angles are in arithmetic progression – C + iS, method of summation – method of differences.

Unit:3	Vector Differentiation	15 hours

Scalar and vector fields –Differentiation of vectors – Gradient, Divergence and Curl-Solenoidal and irrotational vectors-Laplacian Operator.

Unit:4	Vector Integration	15 hours

Integration of vectors – line integral – surface integral – Green's theorem in the plane – Gauss divergence theorem – Stoke's theorem – (Statements only) - verification of the above said theorems.

Unit:5	Fourier Series	15 hours

Periodic functions – Fourier series of periodicity 2π – half range series.

	Total Lecture hours	**75 hours**

Text Book

1 Mathematics for B.Sc. Branch I, Volume I, II and IV - P.Kandasamy&K.Thilagavathi(S.Chand and Company Ltd, New Delhi, 2004.)

Reference Books

1 Vector Analysis -P. Duraipandian, Laxmiduraipandian (Revised Edition-Reprint 2005 Emerald Publishers)

2 Trigonometry -T.K. Manichavasagam Pillai and S.Narayanan(Viswanathan Publishers and Printers Pvt. Ltd 2009.)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1 http://www.math.odu.edu/~jhh/Volume-2.PDF
http://www-math.mit.edu/~djk/18_01/chapter20/section03.html
https://www.whitman.edu/mathematics/calculus_online/chapter16.html
http://www.mecmath.net/calc3book.pdf

2 http://www.nptelvideos.in/2012/11/mathematics-iii.html

3 https://nptel.ac.in/courses/111107108/1

Course Designed By 1.Dr.C.Janaki
2. Ms. S.Sobia

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	S	S	M	M	S	S
CO2	S	M	S	S	M	M	M	S	M	S
CO3	S	M	S	S	M	M	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	M
CO5	S	S	S	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Third Semester

Course code		DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS	L	T	P	C
Core/Elective/Supportive		Core Paper – V	3	-	-	4
Pre-requisite		Knowledge of Ordinary and Partial Derivatives	Syllabus Version		2023-2024	

Course Objectives:

To impart knowledge on the method of solving ordinary differential Equations of First Order and Second Order, Partial Differential equations, Laplace Transforms, its inverse and application of Laplace Transform to solve the first and second Order Differential Equations with constant coefficients.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquire knowledge to solve Differential and Partial Differential Equations.	K1
2	Solve higher order linear differential equations.	K2
3	Expose differential equation as a powerful tool in solving problems in Physical and Social sciences.	K3
4	Demonstrate competency to solve linear PDE by Lagrange's method	K3
5	Analyze the concepts of Laplace transform and inverse Laplace transforms to solve ODE with constant coefficients.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Differential Equation of First Order and Higher Degree.	9 hours

Ordinary Differential Equations: Equations of First Order and of Degree Higher than one – Solvable for p, x, y– Clairaut's Equation – Simultaneous Differential Equations with constant coefficients of the form

i) $f_1(D)x + g_1(D)y = \varphi_1(t)$

ii) $f_2(D)x + g_2(D)y = \varphi_2(t)$ where f_1, g_1, f_2 and g_2 are rational functions of $D=d/dt$ with constant coefficients and φ_1, φ_2 are explicit functions of t.

Unit:2	Higher Order Linear Differential Equation	9 hours

Finding the solution of Second and Higher Order with constant coefficients with Right Hand Side is of the form Ve^{ax} where V is a function of x – Euler's Homogeneous Linear Differential Equations.

Unit:3	Partial Differential Equations	9 hours

Partial Differential Equations: Formation of equations by eliminating arbitrary constants and arbitrary functions – Solutions of P.D Equations – Solutions of Partial Differential Equations by direct integration – Methods to solve the first order P.D. Equations in the standard forms – Lagrange's Linear Equations.

Unit:4	Laplace Transforms	9 hours

Laplace Transforms: Definition – Laplace Transforms of standard functions – Linearity property – First Shifting Theorem – Transform of $tf(t)$, , $f(t)/t$, $f'(t)$, $f''(t)$.

Unit:5	**Inverse Laplace Transforms**	**9 hours**
Inverse Laplace Transforms – Applications to solutions of First Order and Second Order Differential Equations with constant coefficients.		
	Total Lecture hours	**45 hours**

Text Book

1	Mathematics for B.Sc – Branch – I Volume III- P.Kandasamy & K.Thilagavathy (S. Chand and Company Ltd, New Delhi, 2004.)

Reference Books

1	Calculus Vol III -S. Narayanan and T.K. Manickavasagam Pillay, (S. Viswanathan Printers and Publishers Pvt. Ltd, Chennai 1991)
2	Differential Equations -N.P. Bali (Laxmi Publication Ltd, New Delhi, 2004)
3	Laplace and Fourier Transforms-Dr. J. K. Goyal and K.P. Gupta (Pragati Prakashan Publishers, Meerut, 2000)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://**nptel**.ac.in/courses/111105035/
2	http://www.nptelvideos.in/2012/11/mathematics-iii.html https://www.digimat.in/nptel/courses/video/111108081/L02.html
3	https://www.math.ust.hk/~machas/differential_equations.pdf. https://www.ijsr.net/archive/v2i1/ijsron2013331.pdf https://www.whitman.edu/mathematics/calculus_online/chapter17.html

Course Designed By: 1.Dr.E.Rameshkumar
2.Ms.S.Kavunthi

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	S	M	S	M	M	S	S
CO2	S	M	S	S	S	S	M	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	M	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low

`Course code		STATICS	L	T	P	C
Core/Elective/Supportive		Core Paper – VI	3	-		4
Pre-requisite		Basic Knowledge in Vector Algebra & Trigonometric Functions	Syllabus Version		2023-2024	

Course Objectives:

1.To enable the students to realize the nature of forces and resultant forces when more than one force acts on a particle.
2.To know about the conditions of equilibrium of couples and coplanar forces.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Remember the various laws.	K1
2	Understand the concepts of forces and moments.	K2
3	Understand the concepts of equilibrium.	K2
4	Apply the concepts of forces and moments.	K3
5	Analyze the basics of coplanar forces, equilibrium of forces acting on a rigid body and solve the problems.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Law of Forces**	**9 hours**

Forces acting at a point – Parallelogram law-triangle law –Converse of Triangle law- Polygon Law of Forces- Lami's Theorem. .

Unit:2	**Resolution and Components of Forces**	**9 hours**

(λ- μ) theorem –Resolution of forces- Components of a force- Resultant of any number of Coplanar forces acting at a point- Conditions of equilibrium.

Unit:3	**Parallel Forces, Moment and Couple**	**9 hours**

Parallel Forces and Moments –Resultant of two parallel forces (Like and unlike)-Conditions of equilibrium of three coplanar forces- Moment of a force- Geometrical representation- Sign of the moment- Unit of moment – Varignon's Theorem on couples-Equilibrium of two couples-Equivalence of two couples.

Unit:4	**Forces Acting on A Rigid Body**	**9 hours**

Coplanar forces acting on a rigid body – Theorem on three coplanar forces in equilibrium .

Unit:5	**General Conditions of Equilibrium of a System of Co-Planar Forces**	**9 hours**

Reduction of a system of coplanar forces to a single force and a couple - necessary & sufficient conditions of equilibrium only – Equation to the line of action of the resultant.

	Total Lecture hours	**45 hours**

Text Book

1	Statics -M.K.Venkataraman (Agasthiar Publications, Trichy, 1999.)

Reference Books

1	Statics -A.V.Dharmapadam.(S.Viswanathan Printers and Publishing Pvt., Ltd, 1993.)
2	Mechanics -P.Duraipandian and Laxmi Duraipandian.(S.Chand and Company Ltd, Ram Nagar, New Delhi -55, 1985.)
3	Statics -Dr.P.P.Gupta (Kedal Nath Ram Nath, Meerut, 1983-84)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/112/105/112105164/
2	https://nptel.ac.in/courses/122/102/122102004/
3	https://www.khanacademy.org/science/ap-physics-1

Course Designed By: 1.Ms.A.Karpagam
2.Dr.P.Rajarajeswari

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	S	S	M	M	S	S
CO2	S	M	S	S	M	M	M	M	M	S
CO3	S	M	S	S	M	M	M	S	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		Operations Research – Paper I	L	T	P	C
Core/Elective/Supportive		Skill Based Subject	3	-	-	2
Pre-requisite		Knowledge in Basic Mathematical Concepts	Syllabus Version	2023-2024		

Course Objectives:

To familiarize students with the basic concepts, models and techniques for effective decision making, model formulation and applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the basic concepts and application of operations research in various fields.	K1
2	Know principles of construction of mathematical models of conflicting situations.	K2
3	Analyze the relationship between a linear program and its dual.	K3
4	Apply techniques constructively to make effective decisions in business and solve problems in industry.	K3
5	Build and solve transportation problems.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Basics Of Operations Research and Formulation Of L.P.P	9 hours

Basics of O.R – Definition of O.R – Characteristics of O.R - Scientific methods in O.R – Necessary of O.R in Industry – O.R and Decision Making – Scope of O.R in Modern Management–Uses and limitations of O.R .Linear Programming Problem – Formulation of L.P.P.

Unit:2	Linear Programming Problem -Simplex method	9 hours

Graphical solutions of L.P.P – Problems. Simplex Method – Problems.

Unit:3	Big-M and Two-Phase Method	9 hours

Charne's Penalty Method (or) Big – M Method - Two Phase Simplex method – Problems.

Unit:4	Duality In L.P.P	9 hours

Duality in L.P.P – Concept of duality – Duality and Simplex Method – Problems.

Unit:5	Transportation Model	9 hours

The transportation Problems – Basic feasible solution by L.C.M – NWC- VAM- optimum solutions – unbalanced Transportation problems.

	Total Lecture hours	45 hours

Text Book

1	Operations Research – Kanti Swarup, P. K. Gupta, Man Mohan (S. Chand & Sons Education Publications, New Delhi, 12th Revised edition-2003)

Reference Books	
1	Operations Research – Prem Kumar Gupta D. S. Hira (S. Chand & Company Ltd, Ram Nagar, New Delhi ,2014)
2	Operations Research Principles and Problems- S. Dharani Venkata Krishnan(Keerthi publishing house PVT Ltd.1994)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/102/111102012/
2	https://nptel.ac.in/courses/111/104/111104027/
Course Designed By: 1. Dr.T.Narppasalai Arasu 2. Dr.P.Rajarajeswari	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	M	M	M	S	S
CO2	S	M	S	S	S	S	S	M	M	S
CO3	S	S	S	S	M	M	S	S	S	S
CO4	S	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Fourth Semester

Course code		DYNAMICS	L	T	P	C
Core/Elective/Supportive		Core Paper-VII	3	-	-	4
Pre-requisite		Knowledge in Forces and Vector Algebra	Syllabus Version		2023-2024	

Course Objectives:

To impart knowledge about the projectile, Simple Harmonic Motion and understanding the notions of impact between two smooth spheres.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Remember the basic kinematics and dynamic concepts.	K1
2	Describe the differential equation of Central Orbits.	K2
3	Apply the concepts of projectiles to solve problems relating to the motion of a projectile.	K3
4	To understand &apply the concepts of composition of simple harmonic motion in two directions.	K3
5	Understand impulsive forces and analyze loss of K.E due to direct and oblique impact.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Projectiles	9 hours

Path of a projectile-Greatest height-time of flight – Range -range on an inclined plane through the point of projection-Maximum range.

Unit:2	Central Orbits	9 hours

Radial and transverse components of velocity and acceleration – areal velocity of central orbits - Differential equation of central orbit in polar coordinates only.

Unit:3	Simple Harmonic Motion	9 hours

Amplitude, periodic time, phase-composition of two simple harmonic motions of the same period in a straight line and in two perpendicular lines.

Unit:4	Collision of Elastic Bodies-Direct Impact of Spheres	9 hours

Impulsive force – Newton's experimental law- Principle of conservation of momentum- Direct Impact on a smooth fixed plane -Direct impact of two smooth spheres- loss of kinetic energy during direct impact.

Unit:5	Oblique Impact of Spheres	9 hours

Oblique impact of a smooth sphere on fixed smooth plane – oblique impact of two smooth spheres - Loss of Kinetic energy during oblique impact.

	Total Lecture hours	**45 hours**
Text Book		
1	Dynamics -M.K.Venkataraman (11th Ed. Agasthiar Publications, Trichy, 1994.)	
Reference Books		
1	Dynamics -A.V.Dharamapadam (S.Viswanathan Printers and Publishers Pvt., Ltd, Chennai, 1998)	
2	Dynamics -K.Viswanatha Naik and M.S.Kasi (Emerald Publishers, 1992)	
3	Dynamics -Naryanamurthi (National Publishers, New Delhi, 1991)	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/115/106/115106119/	
2	https://www.askiitians.com/iit-jee-physics/mechanics/motion-of-projectile.aspx	
Course Designed By: 1. Dr.T.Nandhagopal 2. Mr.M.Balasankar		

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	S	S	S	S	S
CO2	M	M	M	M	M	S	M	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	M	M	M	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		PROGRAMMING IN C	L	T	P	C
Core/Elective/Supportive		Core Paper-VIII	2	-	-	3
Pre-requisite		Higher Secondary Level Mathematics	Syllabus Version		2023 – 2024	

Course Objectives:

To impart the importance of C language, its structure, Data types, Operators of C, Various control statements, Arrays, different types of functions and practical problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Remember the importance of C language and datatypes.	K1
2	Understand the basic structure, operators and statements of C language.	K2
3	Understand decision control statements, loop control statements.	K2
4	Apply the concepts of data types, operators, expressions, control statements, arrays, character arrays and strings to write the C code for a given algorithm.	K3
5	Read, understand and trace the execution of programs written in C language.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Constants, Variables and Data Types	6 hours

Introduction – Importance of C- Basic structure of C programme - Character set -Constants – Keywords and identifiers – Variables Data types – Declaration of variables – Assigning values to variables –Defining symbolic constants.

Unit:2	Operators and Expressions	6 hours

Arithmetic operators - Relational operators - logical operators – assignment operators – increment and decrement operators –Conditional operators – Special operators – Arithmetic expressions –Evaluation of expressions –Precedence of arithmetic operators – Some computational problems –Type conversion in expressions – operator precedence and associating mathematical functions.

Unit:3	Managing Input -Output Operations, Decision Making and Branching	6 hours

Reading and Writing character – formatted input and output. Decision making with IF statement – Simple IF statement – The IF ELSE statement - Nesting of IF ELSE statement – The ELSE IF ladder. The Switch statement –The ? Operator –The GOTO statement.

Unit:4	**Decision Making and Looping**	**6 hours**
The WHILE statement - the DO statement - the FOR statement –Jumps in loops .		
Unit:5	**Arrays and Strings**	**6 hours**
One, Two dimensional arrays – initializing two dimensional arrays – Multidimensional arrays –Declaring and initializing string variables – reading strings from terminal – Writing strings on the screen – Arithmetic operations on characters.		
	Total Lecture hours	**30 hours**

Text Book

1	Programming in ANSI C -E.Balagurusamy (Tata McGraw –Hill Publishing Company limited, New Delhi, Fifth Edition,2008)

Reference Books

1	Programming with C (Schaum's outline series)- Byron Gottfried (Tata McGraw Hill publishing company -1998.)
2	Programming with ANSI and Turbo C -Ashok N.Kamthane (Pearson Education publishers, 2002)
3	The spirit of 'C' -Henry Mullish and Herbert L cooper (Jaico publisher , 1996.)
4	The ANSI C- Brian W.Kernighan,Dennis M.Ritchie (Published by Prentice- Hall of India Private Limited, M-97,New Delhi- 110001 ,Second edition ,Ocober 1992)
5	ANSI C: With Microsoft C 5.1 and Quick C 2.0 -C.Balasubramanian.(Tata McGraw-Hill Publishing company limited, New Delhi.)
6	Programming In C - Kris A.Jamsa (Galgotia Publications Pvt.ltd. 1992)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/104/106104128/
2	https://nptel.ac.in/courses/106/105/106105171/

Course Designed By: 1. Dr.T.Narppasalai Arasu & 2. Dr.P.Rajarajeswari

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	M	M	M	S	S
CO2	S	S	M	M	S	M	M	S	M	S
CO3	S	M	M	M	S	S	M	S	S	S
CO4	S	S	S	S	S	M	S	S	S	M
CO5	S	S	S	S	S	M	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		PROGRAMMING IN C-(PRACTICAL)	L	T	P	C
Core/Elective/Supportive		Core Paper VIII (Practical)	-	-	1	1
Pre-requisite		Knowledge in C	Syllabus Version		2023-2024	

PRACTICAL LIST

1. Write a C program to generate 'N' Fibonacci number.
2. Write a C program to print all possible roots for a given quadratic equation.
3. Write a C program to calculate the statistical values of mean, median.
4. Write a C program to calculate the statistical values of Standard Deviation and variance of the given data.
5. Write a C program to sort a set of numbers.
6. Write a C program to sort the given set of names.
7. Write a C program to find factorial value of a given number 'N' using recursive function call.
8. Write a C program to find the product of two given matrix

Course code		OPERATIONS RESEARCH – PAPER II	L	T	P	C
Core/Elective/Supportive		SKILL BASED SUBJECT	3	-	-	2
Pre-requisite		Knowledge in Basic Mathematical Concepts	Syllabus Version		2023-2024	

Course Objectives:

To impart knowledge in Assignment Problems, Game theory, performance measures of queues and optimal use of Inventory.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify the importance of stocks the reasons for holding stock in an organization, determine the optimal order quantity for models.	K1
2	Explain the various costs related to inventory system.	K2
3	Apply game theory concepts to articulate real-world situations by identifying, analyzing and practicing strategic decisions.	K3
4	Apply and extend queueing models to analyze real world systems.	K4
5	Build and solve assignment model.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Assignment Model	9 hours

The Assignment Problems – Assignment algorithm – optimum solutions – Unbalanced Assignment Problems.

Unit:2	Game Theory	9 hours

Game Theory – Two-person zero sum game – The Maximin – Minimax principle – problems - Solution of 2 x 2 rectangular Games – Domination Property – (2 x n) and (m x 2) graphical method – Problems.

Unit:3	Queueing Model	9 hours

Queueing Theory – Introduction – Queueing system – Characteristics of Queueing system – Symbols and Notations – Classifications of queues – Problems in (M/M/1) : (∞/FIFO)

Unit:4	Multi-Channel Queueing Models	9 hours

Problems in (M/M/1):(N/FIFO); (M/M/C) : (∞/FIFO); (M/M/C) : (N/FIFO) Models.

Unit:5	Inventory Models	9 hours

Inventory control – Types of inventories – Inventory costs – EOQ Problem with no shortages – Production problem with no shortages – EOQ with shortages – Production problem with shortages – EOQ with price breaks.

	Total Lecture hours	45 hours

Text Book	
1	Operations Research – Kanti Swarup, P. K. Gupta, Man Mohan (S. Chand & Sons Education Publications, New Delhi, 12th Revised edition,2003)
Reference Books	
1	Operations Research – Prem Kumar Gupta D. S. Hira (S. Chand & Company Ltd, Ram Nagar, New Delhi,2014)
2	Operations Research Principles and Problems- S. Dharani Venkata Krishnan (Keerthi publishing house PVT Ltd.1994)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/102/111102012/
2	https://youtu.be/zADj0k0waFY https://youtu.be/xvDdrswAj8M https://www.youtube.com/watch?v=xVPoWkkQTrQ https://www.youtube.com/watch?v=7kDtTAnvuww https://www.youtube.com/watch?v=IfLsPHKk51w
3	https://nptel.ac.in/courses/109/103/109103021/
4	https://nptel.ac.in/courses/110/105/110105082/ https://nptel.ac.in/courses/110/106/110106045/
Course Designed By: 1. Dr.T.Narppasalai Arasu 2. Dr.P.Rajarajeswari	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	S	M	M	M	S	S
CO2	M	M	M	M	S	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	S	M	S	M	S	M

*S-Strong; M-Medium; L-Low


Fifth
Semester

Course code		REAL ANALYSIS - I	L	T	P	C
Core/Elective/Supportive		Core Paper – IX	5	-	-	4
Pre-requisite		Knowledge in the basic properties of real numbers	Syllabus Version	2023 - 2024		

Course Objectives:

Aimed at exposing the real number systems that underpin the development of real analysis and in understanding various physical phenomena.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Remember the basic topological properties of subsets of the real numbers.	K1
2	Understand the fundamental properties of the real numbers and analyze the real number system.	K2
3	Learn the concept of limits, sequence, continuity, convergent sequence in metric spaces appreciating the abstract ideas and their applicability.	K2
4	Have the proficiency in the formulation and construction of proofs of basic results in real analysis.	K3
5	Demonstrate skills in communicating Mathematics and learn basic techniques and examples in analysis to be well prepared for extended learning.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	The Real and Complex Number Systems	15 hours

Introduction -the field axioms, the order axioms –integers –the unique Factorization theorem for integers –Rational numbers –Irrational numbers –Upper bounds, maximum Elements, least upper bound –the completeness axiom –some properties of the supremum –properties of the integers deduced from the completeness axiom- The Archimedean property of the real number system –Rational numbers with finite decimal representation of real numbers –absolute values and the triangle inequality –the Cauchy-Schwarz inequality –plus and minus infinity and the extended real number system.

Unit:2	Basic Notions of a Set Theory.	15 hours

Notations –ordered pairs –Cartesian product of two sets – Relations and functions – further terminology concerning functions –one–one functions and inverse –composite functions – sequences –similar sets-finite and infinite sets –countable and uncountable sets –uncountability of the real number system –set algebra –countable collection of countable sets.

Unit:3	Elements of Point Set Topology	15 hours
Elements of point set topology: Euclidean space R^n –open balls and open sets in R^n. The structure of open sets in R^n –closed sets and adherent points –The Bolzano –Weierstrass theorem –the Cantor Intersection Theorem		
Unit:4	**Covering and Compactness**	**15 hours**
Covering –Lindelof covering theorem –the Heine- Borel covering theorem –Compactness in $\mathbf{R^n}$ –Metric Spaces –point set topology in metric spaces –compact subsets of a metric space –Boundary of a set.		
Unit:5	**Limits and Continuity in Metric Spaces**	**15 hours**
Convergent sequences in a metric space –Cauchy sequences –Completeness sequences – complete metric Spaces. Limit of a function –Continuous functions –continuity of composite functions. Continuous complex valued and vector valued functions.		
	Total Lecture hours	**75 hours**

Text Book

1	Mathematical Analysis-T.M.Apostol (2nd ed., Narosa Publishing Company, Chennai, 1990.) **Unit I :** Chapter 1 Sections 1.2, 1.3, 1.6 to 1.16, 1.18 to 1.20 **Unit II :** Chapter 2 Sections 2.2 to 2.15 **Unit III :** Chapter 3 Sections 3.2 to 3.9 **Unit IV :** Chapter 3 Sections 3.10 to 3.16 **Unit V :** Chapter 4 Sections 4.2 to 4.5, 4.8 to 4.10

Reference Books

1	Methods of Real Analysis -R.R.Goldberg.(NY, John Wiley, New York 1976.)
2	Introduction to Topology and Modern Analysis- G.F.Simmons.(McGraw – Hill, New York, 1963.)
3	A survey of Modern Algebra (3rd Edition)-G.Birkhoff and MacLane.(Macmillan, New York, 1965.)
4	Real Analysis -J.N.Sharma and A.R.Vasishtha.(Krishna Prakashan Media (P) Ltd, 1997)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/105/111105069/#
2	https://nptel.ac.in/courses/111/101/111101134/
3	https://www.digimat.in/nptel/courses/video/111105098/
4	https://nptel.ac.in/courses/111/106/111106053/

Course Designed By: 1. Dr.S.Palaniammal
2. Dr.E.Rameshkumar.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	M	M	S	S
CO2	S	S	M	M	M	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		COMPLEX ANALYSIS - I	L	T	P	C
Core/Elective/Supportive		Core Paper – X	6	-	-	4
Pre-requisite		Knowledge in Calculus	Syllabus Version	2023 – 2024		

Course Objectives:

To equip the students with the understanding of the fundamental concepts of complex functions, analyticity ,power series and complex integration.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Learn techniques of complex analysis effectively to establish mathematical results.	K1
2	Recognize the simple and multiple connected domains.	K2
3	Investigate a function for its analyticity and find it series development.	K3
4	Examine the relationship between conformal mapping and analytic functions	K4
5	Compute contour integrals directly and by the fundamental theorem.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Complex Plane	18 hours

Complex number system –Field of Complex numbers – Scalar multiplication of a complex number – Conjugation – Absolute value of a complex number-Inequalities in terms of moduli – Elementary Transformations i) $w=z+\alpha$ ii) $w = az$ iii) $w = 1/z$ .Fixed points -cross-ratio-invariance of cross-ratio under bilinear transformation –Definition of extended complex plane – Stereographic projection.

Unit:2	Analytic Functions	18 hours

Complex Functions- Limit of a function –continuity –differentiability – Analytical function defined in a region –necessary conditions for differentiability –sufficient conditions for differentiability –Cauchy-Riemann equation in polar coordinates –Definition of entire function.

Unit:3	Power Series and Elementary Functions	18 hours

Absolute convergence –circle of convergence –Analyticity of the sum of power series in the Circle of convergence (term by term differentiation of a series). Elementary functions: Exponential, Logarithmic, Trigonometric and Hyperbolic functions.

Unit:4	Harmonic Functions and Conformal Mapping	18 hours

Conjugate Harmonic functions: Definition and determination. Conformal Mapping: Isogonal mapping –Conformal Mapping-Mapping $z \rightarrow f(z)$, where f is analytic, particularly the mappings. $w = e^z$; $w = z^2$; $w = \sin z$; $w = \cos z$; $w = z + 1/z$.

Unit:5	**Complex Integration**	**18 hours**
Simply and multiply connected regions in the complex plane. Integration of f(z) from definition along a curve joining z_1 and z_2.. Proof of Cauchy's Theorem (using Goursat's lemma for a simply connected region). Statement of Cauchy's integral formula for higher derivatives - Morera's theorem.		
	Total Lecture hours	**90 hours**

Text Book

1	Complex Analysis (For Undergraduate Students of Mathematics, Physics and Engineering) -P.Duraipandian and Kayalal Pachaiyappa (S Chand Publishing, S Chand And Company Limited ,Reprint 2020) **Unit I** : Chapter 1 Sections 1.1 to 1.3, 1.6 to 1.9 Chapter 2 Sections 2.1 to 2.2, 2.6 to 2.10, Chapter 7 Section 7.1 **Unit II** : Chapter 4 Sections 4.1 to 4.10 **Unit III** : Chapter 6 Sections 6.1 to 6.11 **Unit IV** : Chapter 6 Sections 6.12 to 6.13 Chapter 7 Sections7.4,7.6 to 7.10 **Unit V** : Chapter 8 Sections 8.1 to 8.9

Reference Books

1	Complex Variable and Applications -Churchill and Others.(Tata McGraw Hill Publishing Company Ltd, 1974.)
2	Theory of functions of Complex Variable -Shanti Narayan (S.Chand and Company, Meerut, 1995.)
3	Functions of Complex Variable -Tyagi B.S(17th Edition, Pragati Prakasham Publishing Company Ltd, Meerut, 1992-93)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/103/111103070/
2	https://nptel.ac.in/courses/111/107/111107056/
3	https://nptel.ac.in/courses/122/103/122103012/

Course Designed By 1.Dr.T.Narppasalai Arasu
2.Ms.S.Kavunthi

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	S	M	M	M	S	S
CO2	S	M	M	M	M	S	M	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	S	M	S	M	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		MODERN ALGEBRA - I	L	T	P	C
Core/Elective/Supportive		Core Paper – XI	6	-	-	4
Pre-requisite		Higher Secondary Level Mathematics	Syllabus Version		2023 - 2024	

Course Objectives:

Focuses on the concepts of algebraic structures which is one of a pillar of modern Mathematics and emphasis on their properties and applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Recall the properties and extend group structure to finite permutation groups.	K1
2	Explain the concepts of homomorphism, isomorphism and automorphism.	K2
3	Demonstrate abstract thinking capacity and ability to prove theorems.	K3
4	Compare features of different algebraic structures.	K4
5	Examine the properties of algebraic structures and their role in applied contexts.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Groups and its Basic Properties	18 hours

Sets – mappings – Relations and binary operations – Groups: Abelian group, Symmetric group Definitions and Examples – Basic properties.

Unit:2	Subgroups and Normal Subgroups	18 hours

Subgroups – Cyclic subgroup - Index of a group – Order of an element – Fermat theorem - A Counting Principle - Normal Subgroups and Quotient Groups.

Unit:3	Automorphisms	18 hours

Homomorphisms (Applications 1 and 2 are omitted) -Automorphisms – Inner automorphism – Cayley's theorem, permutation groups.

Unit:4	Rings	18 hours

Definition and Examples –Some Special Classes of Rings – Commutative ring – Field – Integral domain - Homomorphisms of Rings.

Unit:5	Ideals and Quotient Rings	18 hours

Ideals and Quotient Rings – More Ideals and Quotient Rings – Maximal ideal - The field of Quotients of an Integral Domain.

	Total Lecture hours	90 hours

Text Book

1 Topics in Algebra -I.N. Herstein (John Wiley & Sons, New York, 2003.)

Unit I : Chapter 1 Sections 1.1 to 1.3,
Chapter 2 Sections 2.1 to 2.3

Unit II : Chapter 2 Sections 2.4 to 2.6

Unit III : Chapter 2 Sections 2.7 to 2.10

Unit IV : Chapter 3 Sections 3.1 to 3.3

Unit V : Chapter 3 Sections 3.4 to 3.6.

Reference Books

1 Modern Algebra -Surjeet Singh and Qazi Zameeruddin. (Vikas Publishing house, 1992.)

2 Modern Algebra- A.R.Vasishtha (Krishna Prakashan Mandir, Meerut, 1994 - 95.)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1 https://nptel.ac.in/courses/106/104/106104149/

2 https://nptel.ac.in/courses/111/106/111106113/

3 https://www.classcentral.com/course/swayam-modern-algebra-14201

Course Designed By: 1.Ms.A.Karpagam
2. Mr.M.Balasankar

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	M	S	S	M	S	S
CO2	M	M	S	S	M	S	S	S	S	S
CO3	S	M	M	S	S	S	S	S	S	S
CO4	S	M	M	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		DISCRETE MATHEMATICS	L	T	P	C
Core/Elective/Supportive		Core paper XII	5	-	-	4
Pre-requisite		Higher Secondary Level Mathematics	Syllabus Version	2023-2024		

Course Objectives:

Prepare students to develop mathematical foundations to understand, create mathematical arguments and focuses on the Formal languages, Automata, Lattices, Boolean Algebra and Graph Theory.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Assimilate various graph theoretic concepts and familiarize with their applications.	K1
2	Know and understand about partially ordered sets, Boolean algebra, lattices and their types.	K2
3	Apply Karnaugh map for simplifying the Boolean expression.	K3
4	Demonstrate the skill to construct simple mathematical proofs and to validate.	K4
5	To achieve greater accuracy, clarity of thought and language.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Mathematical logic	15 hours

Connectives, well-formed formulas, Tautology, Equivalence of formulas, Tautological implications, Duality law, Normal forms, Predicates, Variables, Quantifiers, Free and bound Variables. Theory of inference for predicate calculus.

Unit:2	Relations and Functions	15 hours

Composition of relations, Composition of functions, Inverse functions, one-to- one, onto, one-to-one& onto functions, Hashing functions, Permutation function, Growth of functions. Algebra structures: Semi groups, Free semi groups, Monoids.

Unit:3	Formal Languages and Automata	15 hours

Regular expressions, Types of grammar, Regular grammar and finite state automata, Context free and sensitive grammars.

Unit:4	Lattices and Boolean Algebra	15 hours

Partial ordering, Poset, Lattices, Boolean algebra, Boolean functions, Theorems, Minimization of Boolean functions(Karnaugh Method only).

Unit:5	Graph Theory	15 hours

Directed and undirected graphs, Paths, Reachability, Connectedness, Matrix representation, Euler paths, Hamiltonian paths, Trees, Binary trees - theorems, and applications.

	Total Lecture hours	75 hours

Text Book

1	Discrete Mathematical Structures with applications to computer science-J.P Tremblay and R.P Manohar (Mc.Graw Hill, 1975.) **Unit I** : Chapter 1. Sections - 1-2, 1-2.7. 1-2.9, 1-2.10, 1-2.11, 1-3, 1-5.1, 1-5.2, 1-5.4, 1-6.4 **Unit II** : Chapter 2- Sections - 2-3.5, 2-3.7, 2-4.2, 2-4.3, 2-4.6, Chapter 3- Sections-3-2, 3-5, 3-5.3, **Unit III** : Chapter 3- Sections 3-3.1, 3-3.2 Chapter 4- Section 4-6.2 **Unit IV** : Chapter 4- Section 4-1.1, 4-2, 4-3, 4-4.2 **Unit V** : Chapter 5- Section 5-1.1, 5-1.2, 5-1.3, 5-1.4

Reference Book

1	Discrete Mathematics-Oscar Levin (3rd Edition,2016)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/106/106106094/
2	https://nptel.ac.in/courses/111/107/111107058/

Course Designed By: 1. Ms.A.Karpagam
2. Ms.S.Kavunthi

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	S	M	S	M	M	S	S
CO2	S	M	S	S	M	S	S	S	S	S
CO3	S	M	S	S	M	S	M	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		OPERATIONS RESEARCH – PAPER III	L	T	P	C
Core/Elective/Supportive		Skill Based Subject	3	-	-	2
Pre-requisite		Knowledge in Basics of Operations Research	Syllabus Version	2023-2024		

Course Objectives:

Presents applications and method to solve Integer Programming Problems, Non-linear Programming Problems and Dynamic Programming problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the concept of simulation and simulate a queueing system	K1
2	Understand the overall approach of dynamic programming.	K2
3	Solve nonlinear programming problems using Lagrange multiplier and using Kuhn-Tucker conditions.	K2
4	Apply concepts in optimal scheduling	K3
5	To formulate a model for solving the intractable problems.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Simulation	9 hours

Introduction-simulation models-Event-Types of simulation- Generation of random numbers-Monte-Carlo simulation- simulation of queueing system.

Unit:2	Network Scheduling By PERT/CPM	9 hours

Introduction- Network and basic components- Rules of Network construction- Time calculation in Networks-CPM. Pert Calculations- Cost Analysis- crashing the network- Problems.

Unit:3	Integer Programming Problem	9 hours

Integer Programming Problem – Gomory's fractional cut Method – Branch and Bound Method.

Unit:4	Non-linear Programming Problems	9 hours

General NLPP – Lagrange multiplier – Hessian bordered Matrix – Kuhn Tucker Condition – Problems.

Unit:5	Dynamic Programming Problem	9 hours

Dynamic Programming Problem – Recursive equation approach – D.P.P Algorithm – Solution of L.P.P by D.P.P.

	Total Lecture hours	45 hours

Text Book

1. Operations Research – Kanti Swarup, P. K. Gupta, Man Mohan (S. Chand & Sons Education Publications, New Delhi, 12th Revised edition,2003)

Reference Books	
1	Operations Research – Prem Kumar Gupta& D. S. Hira (S. Chand & Company Ltd, Ram Nagar, New Delhi ,2014)
2	Operations Research Principles and Problems- S. Dharani Venkata Krishnan (Keerthi publishing house PVT Ltd ,1994)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/107/111107104/
2	https://nptel.ac.in/courses/111/102/111102012/
3	https://nptel.ac.in/courses/111/104/111104027/
4	https://nptel.ac.in/courses/111/105/111105039/
Course Designed By: 1. Dr.T.Narppasalai Arasu 2. Dr.P.Rajarajeswari	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	S	S	S	S	S	S	S
CO2	S	M	M	M	M	S	S	M	S	S
CO3	S	M	M	S	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Sixth Semester

Course code		REAL ANALYSIS - II	L	T	P	C
Core/Elective/Supportive		Core Paper – XIII	5	-	-	4
Pre-requisite		Knowledge in Mappings and Properties of Real Numbers	Syllabus Version		2023-2024	

Course Objectives:

To present a deeper and rigorous understanding of fundamental concepts like continuity, connectivity, derivative, monotonic functions with properties and Riemann - Stieltjes integral.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Demonstrate the understanding of continuity, uniform continuity, compactness, connectedness.	K1
2	Understand partitions and their refinement.	K2
3	Determine the Riemann integrability and the Riemann-Stieltjes integrability of a bounded function.	K2
4	Examine the derivatives of function.	K3
5	Acquire skills in writing and analyze the proofs that arise in the context of real analysis.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Topological Mappings	15 hours

Examples of continuous functions –continuity and inverse images of open or closed sets – functions continuous on compact sets –Topological mappings –Bolzano's theorem. .

Unit:2	Monotonic Functions	15 hours

Connectedness –components of a metric space – Uniform continuity - Uniform continuity and compact sets –fixed point theorem for contractions –monotonic functions.

Unit:3	Derivatives	15 hours

Definition of derivative –Derivative and continuity –Algebra of derivatives – the chain rule –one sided derivatives and infinite derivatives –functions with non-zero derivatives –zero derivatives and local extrema –Rolle's theorem –The mean value theorem for derivatives – Taylor's formula with remainder.

Unit:4	Functions of Bounded Variation	15 hours

Properties of monotonic functions –functions of bounded variation –total Variation –additive properties of total variation on (a, x) as a function of x – functions of bounded variation expressed as the difference of increasing functions –continuous functions of bounded variation.

Unit:5	The Riemann-Stieltjes Integral	15 hours

Introduction –Notation –The definition of Riemann –Stieltjes integral –linear properties – Integration by parts –change of variable in a Riemann –Stieltjes integral –Reduction to a Riemann integral.

	Total Lecture hours	**75 hours**

Text Book

1	Mathematical Analysis(2nded)-Tom. M. APOSTOL(Addison-Wisely. Narosa Publishing Company, Chennai, 1990.) **Unit I** : Chapter 4 Sections 4.11 to 4.15 **Unit II** : Chapter 4 Sections 4.16, 4.17, 4.19, 4.20, 4.21, 4.23 **Unit III** : Chapter 5 Sections 5.2 to 5.10 and 5.12 **Unit IV** : Chapter 6 Sections 6.2 to 6.8 **Unit V** : Chapter 7 Sections 7.1 to 7.7

Reference Books

1	Methods of Real Analysis -R.R.Goldberg (NY, John Wiley, New York 1976.)
2	Introduction to Topology and Modern Analysis -G.F.Simmons (McGraw – Hill, New York, 1963.)
3	A survey of Modern Algebra -G.Birkhoff and MacLane (3rd Edition, Macmillian, NewYork, 1965.)
4	Real Analysis -J.N.Sharma and A.R.Vasistha.(Krishna Prakashan Media (P) Ltd, 1997.)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/106/111106053/
2	https://www.math.ucdavis.edu/~emsilvia/math127/chapter7.pdf https://www.whitman.edu/Documents/Academics/Mathematics/grady.pdf
3	https://nptel.ac.in/courses/122/101/122101003/

Course Designed By: 1. Dr.S.Palaniammal 2. Dr.E.Rameshkumar

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	S	S	S	M	S	S
CO2	M	M	M	M	M	S	S	M	S	S
CO3	S	M	M	S	S	S	M	S	S	S
CO4	S	M	M	S	S	S	M	S	S	S
CO5	M	M	S	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		COMPLEX ANALYSIS - II	L	T	P	C
Core/Elective/Supportive		Core Paper – XIV	5	-	-	4
Pre-requisite		Knowledge in Analytic Functions, Complex Integration.	Syllabus Version		2023-2024	

Course Objectives:

To familiarize the students with some fundamental theorems, singularity, residues in complex functions, integrations of complex functions, meromorphic functions and their applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To recognize and apply the Liouville's theorem, the mean-value property of a function and the maximum modulus principle.	K1
2	Demonstrate understanding and appreciation of deeper aspects of complex analysis.	K2
3	Apply residue theorem to compute integrals.	K3
4	Ability to think critically by proving mathematical conjectures and establishing theorems from complex analysis.	K4
5	Classify the nature of singularity, poles and residues.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Integral Theorems	15 hours

Results based on Cauchy's theorem(I)-Zeros-Cauchy's Inequality – Liouville's theorem – Fundamental theorem of algebra –Maximum modulus theorem –Gauss mean value theorem – Gauss mean value theorem for a harmonic function on a circle.

Unit:2	Taylor's Series and Laurent's Series	15 hours

Results based on Cauchy's theorem(II)-Taylor's series –Laurent's series.

Unit:3	Singularities and Residues	15 hours

Isolated singularities (Removable Singularity, pole and essential singularity) –Residues –Residue theorem.

Unit:4	Real Definite Integrals	15 hours

Evaluation using the calculus of residues – Integration on the unit circle –Integral with - ∞ and + ∞ as lower and upper limits with the following integrals:

i) P(x) /Q(x) where the degree of Q(x) exceeds that of P(x) at least 2.

ii) (sin ax).f(x), (cos ax).f(x), where a>0 and f(z) →0 as z→∞ and f(z) does not have a pole on the real axis.

iii) f(x) where f(z) has a finite number of poles on the real axis.

Integral of the type $\int_0^\infty \frac{x^{a-1}}{1+x} dx$, 0< a <1.

Unit:5	Meromorphic Functions	15 hours
Theorem on number of zeros minus number of poles –Principle of argument-Rouche's theorem – Theorem that a function which is meromorphic in the extended plane is a rational function.		
	Total Lecture hours	**75 hours**

Text Book

1	Complex Analysis (For Undergraduate Students of Mathematics, Physics and Engineering) -P.Duraipandian and Kayalal Pachaiyappa (S Chand Publishing, S Chand And Company Limited ,Reprint 2020) **Unit I :** Chapter 8 Sections 8.10, 8.11 **Unit II :** Chapter 9 Sections 9.1 to 9.3, 9.13. **Unit III :** Chapter 9 Sections 9.5 to 9.12, 9.13. Chapter 10 Sections 10.1, 10.2 and 10.4. **Unit IV :** Chapter 10 Sections 10.3 and 10.4. **Unit V :** Chapter 11 Sections 11.1 to 11.3 **(Except theorems 11.5 and 11.6)**

Reference Books

1	Complex Variable and Applications -Churchill and Others(Tata Mc-graw Hill Publishing Company Ltd, 1974.)
2	Theory of functions of Complex Variable - Shanti Narayan (S.Chand and Company ,Meerut, 1995)
3	Functions of Complex Variable (17thEdition)- Tyagi B.S (Pragati Prakasham Publishing Company Ltd, Meerut, 1992-93.)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/103/111103070/
2	https://nptel.ac.in/courses/111/106/111106094/
4	https://nptel.ac.in/courses/122/103/122103012/

Course Designed By: 1.Dr.T.Narppasalai Arasu 2.Ms.S.Kavunthi

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	M	S	S	M	S	S
CO2	S	S	M	S	M	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	M	M	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		MODERN ALGEBRA - II	L	T	P	C
Core/Elective/Supportive		Core Paper – XV	5	-	-	4
Pre-requisite		Knowledge in Groups, Rings and Fields	Syllabus Version	2023-2024		

Course Objectives:

To develop understanding in the domain of matrix theory, vector spaces, linear transformations as well as the principles underlying the subject.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Communicate and understand mathematical ideas and results with the correct use of mathematical definitions, terminology and symbols.	K1
2	Explain the concepts of base and dimension of Vector space.	K2
3	To apply the Gram-Schmidt process to construct an orthonormal set of vectors in an inner product space.	K3
4	Demonstrate competence with the basic ideas of Matrix theory, Vector spaces, Dual spaces, Linear transformation.	K3
5	Have an insight to analyze a real life problem and solve it.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Matrices	15 hours

Introduction – Addition and Scalar Multiplication of Matrices – Product of Matrices –Transpose of a Matrix – Matrix Inverse – Symmetric and Skew - Symmetric Matrices.

Unit:2	Special Matrices	15 hours

Hermitian and Skew-Hermitian Matrices – Orthogonal and Unitary Matrices – Rank of a Matrix –Characteristic Roots and Characteristic Vectors of a Square Matrix.

Unit:3	Vector Spaces	15 hours

Elementary Basic Concepts – Subspace of a Vector space - Homomorphism – Isomorphism - Internal and External direct sums - Linear span - Linear Independence and Bases.

Unit:4	Dual Spaces	15 hours

Dual Spaces – Annihilator of a subspace - Inner Product Spaces – Norm of a Vector – Orthogonal Vectors - Orthogonal Complement of a subspace – Orthonormal set.

Unit:5	Linear Transformations	15 hours

Algebra of Linear Transformations – Regular, Singular Transformations – Range of T – Rank of T - Characteristic Roots – Characteristic Vectors – Matrices.

	Total Lecture hours	75 hours

Text Books	
1	Modern Algebra -R.Balakrishnan and M. Ramabadran.(Vikas Publishing House Pvt. Ltd, New Delhi, Second Revised Edition 1994) (For Units I & II) . **Unit I : Chapter 1 Sections 1.1 to 1.3, 1.5 to 1.7** **Unit II : Chapter 1 Sections 1.8 and 1.9 Chapter 2 Section 2.9 Chapter 3 Section 3.9**
2	Topics in Algebra -I.N. Herstein.(John Wiley & Sons, New York, 2003.) (For Units III, IV & V) **Unit III : Chapter 4 Sections 4.1 and 4.2** **Unit IV : Chapter 4 Sections 4.3 and 4.4** **Unit V : Chapter 6 Sections 6.1 , 6.2 and 6.3**
Reference Books	
1	Modern Algebra -Surjeet Singh and Qazi Zameeruddin (Vikas Publishing house, 1992.)
2	Modern Algebra -A.R.Vasishtha (Krishna Prakashan Mandir, Meerut, 1994 – 95.)
3	Linear Algebra -Seymour Lipschutz and Marc Lipson (3rd Edition, McGraw Hill, 2001.)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/106/111106135/
2	https://nptel.ac.in/courses/115/105/115105097/
3	https://nptel.ac.in/courses/111/101/111101115/
4	https://nptel.ac.in/courses/111/108/111108066/
Course Designed By: 1.Mrs.A.Karpagam 2. Mr.M.Balasankar	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	S	S	M	S	S
CO2	M	M	S	S	M	S	M	M	S	S
CO3	S	M	S	S	M	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		OPERATIONS RESEARCH - PAPER -IV	L	T	P	C
Core/Elective/Supportive		Skill Based Subject	3		-	2
Pre-requisite		Knowledge in Basics of Operations Research	Syllabus Version		2023-2024	

Course Objectives:

To enhance the students' knowledge in decision analysis, sequencing of the jobs to be carried out based on cost optimization, replacement policies and analyze the cases according to their categories.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the principles and applications of information theory.	K1
2	To understand sequencing, replacement problems.	K2
3	Demonstrate skills to achieve their objective using sequencing models.	K3
4	Apply decision making under different business environments.	K4
5	Determine a solution to a rectangular game using simplex method.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Decision Analysis	9 hours

Decision Making environment – Decisions under uncertainty – Decision under risk – Decision – Tree Analysis.

Unit:2	Sequencing Problems	9 hours

Introduction-problem of sequencing - basic terms used in sequencing- processing n-jobs through 2 machines - processing n –jobs through k machines - processing 2 jobs through k machines (Problems only).

Unit:3	Replacement Problems	9 hours

Introduction - Replacement of equipment / assets that deteriorates gradually - replacement of equipment that fails suddenly and problems.

Unit:4	Information Theory	9 hours

Introduction- A measure of Information-Axiomatic Approach to Information- Entropy-The expected information- Some properties of entropy function-Joint and conditional entropies

Unit:5	Applications	9 hours

General solution of (mxn) rectangular games using simplex method - Reliability and system failure rates using replacement problems.

	Total Lecture hours	45 hours

Text Book	
1	Operations Research -Kanti Swarup, P. K. Gupta , Man Mohan (S.Chand & sons education publications ; New Delhi,2003)
Reference Books	
1	Operations Research - P K Gupta & D S Hira (S. Chand and company ltd. Ram Nagar; New Delhi,2014.)
2	Operations Research principles problems - S Dharani Venkata Krishnan (keerthi publishing house Pvt. Ltd.1994)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/117/104/117104129/
2	https://nptel.ac.in/courses/110/105/110105082/
3	https://nptel.ac.in/courses/110/106/110106045/
Course Designed By: 1. Dr.T.Narppasalai Arasu 2. Dr.P.Rajarajeswari	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	S	S	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	M
CO5	S	M	M	S	S	S	S	S	M	S

*S-Strong; M-Medium; L-Low

Elective Courses

Course code		ASTRONOMY – I	L	T	P	C
Core/Elective/Supportive		ELECTIVE I – A	5	-	-	3
Pre-requisite		Knowledge in Physics and Mathematics	Syllabus Version		2023-2024	

Course Objectives:

To enable the students to understand the Astronomical aspects and about the laws governing the planet movements.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Define properties of physical systems that comprise the known universe	K1
2	Understand the Solar system, Celestial sphere, Dip-Twilight & Kepler's laws.	K2
3	Apply their physics and mathematical skills to problems in the areas of planetary science.	K3
4	Demonstrate the skill to infer valid scientific conclusions and communicate those conclusions in a clear and articulate manner.	K4
5	Analyze the astronomical concepts.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Solar system	15 hours

General description of the Solar system. Comets and meteorites – Spherical trigonometry.

Unit:2	Celestial sphere	15 hours

Celestial sphere – Celestial co – ordinates – Diurnal motion – Variation in length of the day.

Unit:3	Geocentric parallax	15 hours

Dip – Twilight – Geocentric parallax.

Unit:4	Refraction	15 hours

Refraction – Tangent formula – Cassini's formula.

Unit:5	Kepler's law	15 hours

Kepler's laws – Relation between true eccentric and mean anomalies.

	Total Lecture Hours	75 hours

Text Book	
1	Astronomy-S.Kumaravelu and Susheela Kumaravelu (Text*Publisher*: Sivakasi: Janki7th Edition 1986)
Course Designed By: 1. Ms. S.Sobia 2. Mr.M.Balasankar	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	S	S	M	S	S
CO2	M	M	M	S	S	S	S	M	S	M
CO3	M	M	M	M	M	S	M	S	S	S
CO4	S	S	M	S	S	S	S	S	S	S
CO5	S	M	M	S	S	S	M	S	M	S

*S-Strong; M-Medium; L-Low

Course code		NUMERICAL METHODS - I	L	T	P	C
Core/Elective/Supportive		ELECTIVE I – B	5	-	-	3
Pre-requisite		Knowledge in Higher Secondary Level Mathematics	Syllabus Version		2023-2024	

Course Objectives:

It exposes the students to study numerical techniques to find solutions of numerical, algebraic transcendental equations, solution of simultaneous linear algebraic equations and interpolation.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Remember the concepts of errors and its effect on computation.	K1
2	Obtain numerical solutions of algebraic and transcendental equations.	K2
3	Apply the finite difference and interpolation concepts.	K3
4	Develop skills in designing mathematical models for constructing polynomials to the given data and drawing inferences.	K4
5	Analyze the efficiency of iteration methods**.**	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	The Solution of Numerical Algebraic and Transcendental Equations	15 hours

Bisection method – Iteration Method – Convergence condition – Regula Falsi Method – Newton – Raphson method - Convergence Criteria – Order of Convergence.

Unit:2	Solution of Simultaneous Linear Algebraic Equations	15 hours

Gauss elimination method – Gauss Jordan method – Method of Triangularization – Gauss Jacobi method – Gauss Seidel method.

Unit:3	Finite Differences	15 hours

Differences – operators – forward and backward difference tables – Differences of a polynomial – Factorial polynomial – Error propagation in difference table.

Unit:4	Interpolation (for equal intervals)	15 hours

Newton's forward and backward formulae – equidistant terms with one or more missing values – Central differences and central difference table – Gauss forward and backward formulae – Stirling's formula.

Unit:5	Interpolation (for unequal intervals)	15 hours

Divided differences – Properties – Relations between divided differences and forward differences – Newton's divided differences formula – Lagrange's formula and inverse interpolation.

	Total Lecture hours	75 hours

Text Books	
1	Numerical methods -Kandasamy. P, Thilagavathy. K and Gunavathy. K (S. Chand and Company Ltd, New Delhi – Revised Edition 2007.)(Chapters: 3,4,5,6,7 and 8)
2	Introductory Methods of Numerical Analysis-S.S. Sastry (Prentice Hall of India Pvt. Ltd.New Delhi-110001Fourth Edition,2006)
Reference Books	
1	Numerical Methods in Science and Engineering -Venkataraman M. K.(National Publishing company V Edition 1999.)
2	Numerical Methods for Scientists and Engineers -Sankara Rao K .(2nd Edition Prentice Hall India 2004.)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://www.simumath.com/library/book.html?code=Alg_Equations_Examples
2	http://jupiter.math.nctu.edu.tw/~smchang/9602/NA_lecture_note.pdf http://www.iosrjournals.org/iosr-jm/papers/Vol6-issue6/J0665862.pdf
3	https://nptel.ac.in/courses/122/102/122102009/ https://nptel.ac.in/courses/111/107/111107105/
Course Designed By: 1. Dr.C.Janaki 2. Dr.P.Rajarajeswari	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	S	M	M	S	M	S	S
CO2	S	S	S	M	S	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	M	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code		ASTRONOMY II	L	T	P	C
Core/Elective/Supportive		ELECTIVE II – A	5	-		3
Pre-requisite		Knowledge in Physics & Mathematics	Syllabus Version		2023-2024	

Course Objectives:

To enable the students to learn about the interesting facts of Moon, Sun Planetary Motion.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts of precession and nutation.	K1
2	Describe the eclipse of the moon.	K2
3	Find equation of time.	K3
4	Demonstrate the ability to analyze the concepts.	K4
5	Describe the properties of stellar system.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Time**	**15 hours**

Equation of time – Conversion of time – Seasons – Calendar.

Unit:2	**Aberration**	**15 hours**

Annual Parallax – Aberration.

Unit:3	**Precession**	**15 hours**

Precession – Nutation.

Unit:4	**Eclipses**	**15 hours**

The Moon – Eclipses.

Unit:5	**The Stellar System**	**15 hours**

Planetary Phenomenon – The Stellar system.

	Total Lecture hours	**75 hours**

Text Book	
1	Astronomy-Mr.S.Kumaravelu and Susheela Kumaravelu**. (**Text *publisher*: Sivakasi: Janki,7th edition,1986)
Course Designed By: 1. Ms. S.Sobia 2. Mr.M.Balasankar	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	M	M	S	S
CO2	M	M	S	M	M	S	M	M	M	S
CO3	M	M	S	S	S	S	M	S	S	S
CO4	S	M	S	S	S	S	M	S	S	S
CO5	S	M	S	S	M	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code		Numerical Methods II	L	T	P	C
Core/Elective/Supportive		ELECTIVE II-B	5	-	-	3
Pre-requisite		Knowledge in Higher Secondary Level Mathematics	Syllabus Version		2023-2024	

Course Objectives:

1. To equip the learners with the powerful tool for numerical differentiation, numerical integration, difference equation, numerical solution to O.D.E.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Familiarize with numerical integration and differentiation, numerical solution of ordinary differential equations.	K1
2	Distinguish methods of Taylor series, Euler's, Modified Euler's and Runge Kutta methods to find solutions of differential equations.	K2
3	Apply the techniques for enormous application in the field of Science and some fields of Engineering.	K3
4	Compute the integrals and derivatives by using the appropriate technique.	K4
5	Find the numerical solution of second order O.D.E by finite difference method.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Numerical Differentiation**	**15 hours**

Newton's forward and backward formulae to compute the derivatives – Derivative using Stirling's formulae – to find maxima and minima of the function given the tabular values.

Unit:2	**Numerical Integration**	**15 hours**

Newton – Cote's formula – Trapezoidal rule – Simpson's 1/3 rd and 3/8 th rules.

Unit:3	**Difference Equation**	**15 hours**

Order and degree of a difference equation – solving homogeneous and non – homogeneous linear difference equations.

Unit:4	**Numerical Solution Of O.D.E**	**15 hours**

Taylor series method – Euler's method – improved and modified Euler method – Runge Kutta method (Second &fourth order Runge Kutta method only)

Unit:5	**Multi Step Methods**	**15 hours**

Milne's predictor corrector formulae – Adam-Bash forth predictor corrector formulae – solution of ordinary differential equations by finite difference method (for second order O.D.E).

	Total Lecture hours	**75 hours**

Text Books	
1	Numerical methods - Kandasamy. P, Thilagavathy. K and Gunavathy. K (S. Chand and Company Ltd, New Delhi – Revised Edition 2007.)(Chapters: 9,10,11,Appendix and Appendix E)
2	Introductory Methods of Numerical Analysis-S.S. Sastry (Prentice Hall of India Pvt. Ltd.NewDelhi-110001Fourth Edition,2006)
Reference Books	
1	Numerical Methods in Science and Engineering -Venkataraman M. K.(National Publishing company V Edition 1999.)
2	Numerical Methods for Scientists and Engineers -Sankara Rao K. (Prentice Hall India , 2nd Edition 2004)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://nptel.ac.in/courses/104101002/downloads/lecturenotes/module1/chapter6.pdf https://www.britannica.com/science/difference-equation
2	https://nptel.ac.in/courses/122/102/122102009/
3	https://nptel.ac.in/courses/111/107/111107063/
Course Designed By: 1. Dr.C.Janaki 2. Dr.P.Rajarajeswari	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	S	S	S	S	M	S	S
CO2	M	M	S	S	M	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	M	M	S	M	S	S	S
CO5	S	M	S	M	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		GRAPH THEORY	L	T	P	C
Core/Elective/Supportive		ELECTIVE III - A	5	-	-	4
Pre-requisite		Knowledge In Basic Mathematics	Syllabus Version	2023-2024		

Course Objectives:

Enables the students to learn the basic concepts of Graphs, sub-graphs, Eulerian graphs, Digraphs, tournaments, connectivity, graphs, matrix representation of graphs, trees, planar graphs.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify the properties of different types of graph and their application.	K1
2	Demonstrate knowledge of basic concepts in graph theory	K2
3	Understand cut graphs, cycle spaces	K2
4	Apply principles and concepts of graph theory in practical situations.	K3
5	Analyze the concepts of Planar graphs.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Graphs**	**15 hours**

Graphs –Sub graphs – Degree of a vertex walks, paths and cycles in a Graphs – connectedness cut vertex and cut edge.

Unit:2	**Euler and Hamiltonian Graphs**	**15 hours**

Euler and Hamiltonian Graphs – Algorithm for Euler circuits – Bipartite Graphs –Trees.

Unit:3	**Cut set graphs**	**15 hours**

Matrix representation of a graph – vector spaces, associated with a graph – cycle spaces and cut set graphs.

Unit:4	**Planar graphs**	**15 hours**

Planar graphs – Euler's theorem on planar graphs – characterization of planar graphs (no proofs) of the difficult part of the characterization.

Unit:5	**Directed graphs**	**15 hours**

Directed graphs – Connectivity – Euler Digraphs – Tournaments.

	Total Lecture hours	**75 hours**

Text Book	
1	A First Course in Graph Theory - A.*Choudum* (Macmillan,2001) Chapters 1 to 7.
Reference Books	
1	Graph theory with applications to Engineering and computer science-Narsingh Deo (Prentice Hall of India1979).
2	Graph Theory -Frank Harary (Narosa Publishing HQCK 2001 **).**
3	Introduction to Graph Theory- Dr. M. Murugan.(Muthali Publishing House,2005)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/106/111106102/
2	https://www.digimat.in/nptel/courses/video/106104170/L19.html
Course Designed By: 1. Dr.T.Narppasalai Arasu 2. Dr.C.Janaki	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	S	S	M	S	S
CO2	M	M	M	S	S	S	M	M	M	S
CO3	M	M	M	S	M	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	M	S	M	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code		AUTOMATA THEORY AND FORMAL LANGUAGES	L	T	P	C
Core/Elective/Supportive		ELECTIVE III - B	5	-	-	4
Pre-requisite		Knowledge in Mathematics	Syllabus Version	2023-2024		

Course Objectives:

To impart knowledge in Finite automata, regular languages, regular grammars, context free grammars, languages, and pushdown automata which play a crucial role to Identify different formal language classes and their relationship.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquire a fundamental understanding of the core concepts in automata theory and formal languages.	K1
2	Design grammars and automata for different language classes.	K2
3	Describe the types of grammar and derivation tree.	K2
4	To apply context-free languages, push-down automata.	K3
5	Design automata, regular expressions and context-free grammars accepting or generating a certain language.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Phrase Structure Languages.	15 hours

Introduction – phrase structure languages.

Unit:2	Closure Operations	15 hours

Closure operations.

Unit:3	Context Free Languages.	15 hours

Context free languages.

Unit:4	Finite State Automata	15 hours

Finite state automata.

Unit:5	Push Down Automata.	15 hours

Push down automata.

	Total Lecture hours	75 hours

Text Book	
1	Formal Languages and Automata- Rani Siromoney. (Revised edition 1984) (Published by the Christian Literary Society, Madras-3) Chapters 1 to 6.
Reference Books	
1	Formal languages and their relation automata-J.E. Hopcroft and D.Ullman (Addison Wesley1969)
2	Automata theory: Machines and Languages-Richard .Y.Kain (McGraw Hill1972)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/103/106103070/
2	https://www.digimat.in/nptel/courses/video/111103016/L02.html
Course Designed By: 1. Dr.T.Nandhagopal 2. Ms.S.Kavunthi	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	M	M	S	S
CO2	S	M	S	S	S	S	M	M	M	S
CO3	M	M	S	S	S	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		PROGRAMMING IN C++	L	T	P	C
Core/Elective/Supportive		ELECTIVE III - C	4	-		3
Pre-requisite		Knowledge in C Programming	Syllabus Version		2023-2024	

Course Objectives:

To enable the students to learn about the class structure, operators, inheritance, polymorphism, file handling.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know about class structure, member functions & data members, inheritance types and example problems.	K1
2	Understand how **C++** improves C with object-oriented features.	K2
3	Develop programming skills.	K2
4	To make use of objects and classes for developing programs.	K3
5	Build C++ classes.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Tokens, Expressions and Control Structures	12 hours

Evolution of C++ - applications of C++ - structure of C++ program. Tokens – keywords – identifiers and constants – basic data types – user-defined data types – constant pointers and pointers to constants – symbolic constants –type compatibility – declaration of variables – dynamic initialization of variables – reference variables – operators in C++ - scope resolution operator – memory management operators – manipulators – type cast operator – expressions and their types – special assignment expressions – implicit conversions – operator precedence.

Unit:2	Functions in C++	12 hours

The main function – function prototyping – call by reference – return by reference – inline functions – default arguments – const arguments – function overloading. Managing Console, I/O Operations: C++ streams – C++ stream classes – unformatted console I/O operations – formatted console I/O operations –managing output with manipulators.

Unit:3	Classes and Objects	12 hours

Specifying a class – defining member functions – making an outside function inline – nesting of member functions – private member functions – arrays within a class – memory allocation for objects –arrays of objects – objects as function arguments – friend functions – returning objects – const member functions. Constructors and Destructors: Introduction – constructors – parameterized constructors – multiple constructors in a class – constructors with default arguments – copy constructor.

Unit:4	**Operator Overloading**	**12 hours**
Introduction – defining operator overloading – overloading unary operators – overloading binary operators - overloading binary operators using friends – rules for overloading operators.		
Unit:5	**Inheritance**	**12 hours**
Introduction – defining derived classes – single inheritance – making a private member inheritable – multilevel inheritance – multiple inheritance – hierarchical inheritance – hybrid inheritance.		
	Total Lecture hours	**60 hours**

Text Books	
1	Object Oriented programming with C++- E.Balagurusamy (McGraw Hill 3rd Edition 2006.)
2	Object oriented programming in Turbo C++-Robert Lafore (Galgotia publications Pvt.Ltd, New Delhi- 110002,2002)
3	The C++ programming language- Bjarne Stroustrup (II Edition, Addison Wesley, 1991.)
Reference Books	
1	Programming with C++ - D. Ravi Chandran (Tata McGraw-Hill publishing company limited, New Delhi 1996)
2	Object Oriented Programming with ANSI and Turbo C++- Ashok N. Kamthane (Pearson Education publishers 2003)
3	Programming with C++ - John R.Hubbard (2nd Edition, TMH publishers 2002).
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/105/106105151/
2	https://nptel.ac.in/courses/106/101/106101208/
3	https://www.classcentral.com/course/swayam-programming-in-c-6704
Course Designed By: 1. Dr.T.Narppasalai Arasu 2.Dr.P.Rajarajeswari	

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	S	S	M	S	M	S	S
CO2	M	M	M	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	M	S	S	S
CO4	S	S	S	M	S	S	S	S	S	S
CO5	S	S	S	M	S	M	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		PROGRAMMING IN C++ (PRACTICAL)	L	T	P	C
Core/Elective/Supportive		ELECTIVE III - C(Practical)	-	-	1	1
Pre-requisite		Knowledge in C++	Syllabus Version		2023-2024	

PRACTICAL LIST

1. Write a function ‘power( )’to raise a number ‘m’ to a power ‘n’. The function takes a ‘double’ value for ‘m’ and ‘int’ value for ’n’, and returns the result correctly. Use a default vale of 2 for ‘n’ to make the function to calculate squares when this argument is omitted. Write a main( ) that gets the values of ‘m’ and ‘n’ from the user to test the function.

2. Write a program to compute compound interest of a given amount AMT for ‘n’ years. Use function overloading so that the program gets input of interest rate RATE in any of the data type ‘float’ or ‘int’

3. Create a class which consist of employee detail ENO, ENAME, DEPT, BASIC SALARY. Write a member function to get and display them. Derive a class PAY from the above class and write a member function to calculate DA, HRA and PF depending on the grade and display the pay slip in a neat format using console I/O

4. Define two classes POLAR and RECTANGLE to represent points in the polar and rectangle system. Write a program to convert from one system to another.

5. Create a class FLOAT that contains one float data member. Overload all the four arithmetic operators so that they operate on the objects of FLOAT.

Course code		NUMBER THEORY	L	T	P	C
Core/Elective/Supportive		ELECTIVE III – D	5	-	-	4
Pre-requisite		Knowledge in Algebra	Syllabus Version		2023–2024	

Course Objectives:

To impart knowledge in the basic concepts of number theory, fundamental definitions, theorems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts of divisibility and primes	K1
2	Solve congruence.	K2
3	Describe the fundamental theorem of Arithmetic.	K3
4	Understand the concepts and apply the theorems in areas of Mathematics.	K3
5	Compute powers of integers modulo prime numbers.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Early Number Theory	15 hours

Peano's Axiom - Mathematical Induction - The Binomial Theorem - Early Number Theory.

Unit:2	Divisibility Theory in Integers	15hours

Divisibility Theory in Integers - The Division Algorithm - The g.c.d. - Euclidean Algorithm - The Diophantine Equation ax + by = c

Unit:3	Primes and their Distributions	15 hours

Primes and their Distributions - The Fundamental Theorem of Arithmetic - The sieve of Eratosthenes - The Gull Conjecture.

Unit:4	The Theory of Congruence	15 hours

The Theory of Congruence - Basic Properties of Congruence - Special Divisibility test - Linear Congruence-Prime modulus- Power residues.

Unit:5	Fermat's Theorem	15 hours

Fermat's Theorem - Fermat's factorization method - The Little theorem - Wilson's theorem.

	Total Lecture hours	75 hours

Text Book	
1	Elementary Number theory -David M. Burton (W.M.C. Brown Publishers, Dubuque, Lawa, 1989.)
Reference Books	
1	An Introduction to theory of Numbers -Ivan Niven and H. Zuckerman (5th edition,Wiley 1991)
2	Elements of Number Theory - Prof. S.Kumaravelu and Susheela Kumaravelu (Raja Sankar offset Printers , Siva kasi, 2002)
3	Beginning Number Theory -Neville Robinns (2nd Ed., Narosa Publishing House Pvt. Ltd., Delhi, 2007)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/103/111103020/ https://nptel.ac.in/courses/111/101/111101137/
Course Designed By: 1.Dr.C.Janaki 2. Dr.M.Anandhi	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	M	M	S	S
CO2	S	S	S	M	S	S	S	M	M	S
CO3	M	M	M	M	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code		INTRODUCTION TO INDUSTRY 4.0	L	T	P	C
Core/Elective/Supportive		ELECTIVE III – E	5	-	-	4
Pre-requisite		Basic Knowledge of Computer and Internet	Syllabus Version		2023-2024	

Course Objectives:

To impart knowledge on Industry 4.0, need for digital transformation and the following Industry 4.0 tools:

1. Artificial Intelligence
2. Big Data and Data Analytics
3. Internet of Things

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the reason for adopting Industry 4.0 and Artificial Intelligence.	K1
2	Understand the need for digital transformation.	K2
3	Apply the industry 4.0 tools.	K3
4	Analyze the applications of Big Data	K4
5	Examine the applications and security of IoT Applications.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Industry 4.0	15 hours

Need – Reason for Adopting Industry 4.0 - Definition – Goals and Design Principles - Technologies of Industry 4.0 – Big Data – Artificial Intelligence (AI) – Industrial Internet of Things - Cyber Security – Cloud – Augmented Reality.

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Unit:2	Artificial Intelligence	15 hours

Artificial Intelligence: Artificial Intelligence (AI) – What & Why? - History of AI - Foundations of AI -The AI -environment - Societal Influences of AI - Application Domains and Tools - Associated Technologies of AI - Future Prospects of AI - Challenges of AI.

Unit:3	Big Data and IoT	15 hours

Big Data : Evolution - Data Evolution - Data : Terminologies - Big Data Definitions - Essential of Big Data in Industry 4.0 - Big Data Merits and Advantages - Big Data Components : Big Data Characteristics - Big Data Processing Frameworks - Big Data Applications - Big Data Tools - Big Data Domain Stack : Big Data in Data Science - Big Data in IoT - Big Data in Machine Learning - Big Data in Databases - Big Data Use cases Big Data in Social Causes - Big Data for Industry -Big Data Roles and Skills -Big Data Roles - Learning Platforms; Internet of Things (IoT) : Introduction to IoT - Architecture of IoT - Technologies for IoT - Developing IoT Applications - Applications of IoT - Security in IoT .

Unit:4	**Applications and Tools of Industry 4.0**	**15 hours**
Applications of IoT – Manufacturing – Healthcare – Education – Aerospace and Defense – Agriculture – Transportation and Logistics – Impact of Industry 4.0 on Society: Impact on Business, Government, People. Tools for Artificial Intelligence, Big Data and Data Analytics, Virtual Reality, Augmented Reality, IoT, Robotics.		
Unit:5	**Jobs 2030**	**15 hours**
Industry 4.0 – Education 4.0 – Curriculum 4.0 – Faculty 4.0 – Skills required for Future - Tools for Education – Artificial Intelligence Jobs in 2030 – Jobs 2030 - Framework for aligning Education with Industry 4.0 .		
	Total Lecture hours	**75 hours**

Text Book

1	Higher Education for Industry 4.0 and Transformation to Education 5.0 (2021) - P.Kaliraj & T. Devi

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/105/106105195/

Course Designed By: 1.Dr.C.Janaki
2 Dr.T.Nandhagopal

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	S	S	M	S	S
CO2	M	M	M	S	S	S	S	M	M	S
CO3	S	S	S	S	S	S	S	S	S	M
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	M	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

B. Sc.MATHEMATICS

Syllabus

(2022-2023)

Program Code : 22A

DEPARTMENT OF MATHEMATICS

(Affiliated Colleges)

Bharathiar University

(A State University, Accredited with "A" Grade by NAAC and 13th Rank among Indian Universities by MHRD-NIRF)

Coimbatore 641 046, INDIA

Program Educational Objectives (PEOs)	
The **B. Sc. Mathematics** program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	Acquire knowledge in functional areas of Mathematics and apply in all the fields of learning.
PEO2	Recognise the need for life long learning and demonstrate the ability to explore some mathematical content independently.
PEO3	Employ mathematical ideas encompassing logical reasoning ,analytical, numerical ability , theoretical skills to model real-world problems and solve them.
PEO4	Develop critical thinking ,creative thinking, self confidence for eventual success in career.
PEO5	Analyze , interpret solutions and to enhance their Entrepreneurial skills, Managerial skill and leadership
PEO6	To prepare the students to communicate mathematical ideas effectively and develop their ability to collaborate both intellectually and creatively in diverse contexts.
PEO7	Rewarding careers in Education, Industry, Banks, MNCs and pursue higher studies

Program Specific Outcomes (PSOs)	
After the successful completion of **B. Sc. Mathematics** program, the students are expected to	
PSO1	Maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for extended learning.
PSO2	Identify the applications of Mathematics in other disciplines and society.
PSO3	Develop an in-depth knowledge in Mathematics appreciating the connections between theory and its applications .
PSO4	Demonstrate their mathematical modeling ability, problem solving skills, creative talent and power of communication necessary for various kinds of employment.
PSO5	Develop mathematical aptitude and the ability to think abstractly.
PSO6	Learn independently and improve ones performance.
PSO7	Students are equipped to appear competitive examinations.

Program Outcomes (POs)	
On successful completion of the **B. Sc. Mathematics** program	
PO1	Students are empowered with analytical and logical skills-to formulate results and construct mathematical argument.
PO2	Ability to organize, analyze and interpret data accurately in both academic and non -academic context.
PO3	Demonstrate effective communication of mathematical ideas and creative thinking skills to facilitate solving real world problems as a team and independently.
PO4	Appreciate and identify the connections between Mathematics and other disciplines.
PO5	Competency to obtain employment in education , public and private sectors..
PO6	Identify the area of interest for extended learning from the understanding gained from the domain and allied areas of Mathematics.
PO7	Develop mathematical aptitude and make critical observations.
PO8	Garner innovative ideas to face global challenges.
PO9	Instill a sense of responsibility in tackling professional and social issues ethically.
PO10	Trigger their passion for research in unexplored areas of Mathematics.

BHARATHIAR UNIVERSITY:COIMBATORE 641 046

B. Sc. Mathematics Curriculum (Affiliated Colleges)
(CBCS PATTERN)

(*For the students admitted from the academic year **2022-2023**and onwards*)

Scheme of Examination

Part	Title of the Course	Hours/ Week	Examination				Credits
			Duration in Hours	Maximum Marks			
				CIA	CEE	Total	
	Semester I						
I	Language - I	6	3	50	50	100	4
II	English - I	6	3	50	50	100	4
III	Core Paper I - Classical Algebra	4	3	50	50	100	4
III	Core Paper II-Calculus	5	3	50	50	100	4
III	Allied A : Paper I Chosen by the college	7	3	50	50	100	4
IV	Environmental Studies*	2	3	-	50	50	2
	Total	**30**		**250**	**300**	**550**	**22**
	Semester II						
I	Language – II	6	3	50	50	100	4
II	English – II	4	3	25	25	50@@	2
II	Effective English :Language Proficiency for Employability http://kb.naanmudhalvan.in/Special:Filepath/Cambridge_Course_Details.pdf	2	-	25	25	50##	2
III	Core Paper III - Analytical Geometry	4	3	50	50	100	4
III	Core Paper IV-Trigonometry, Vector Calculus and Fourier Series	5	3	50	50	100	4
III	Allied A: Paper II Chosen by the College	7	3	50	50	100	4
IV	Value Education – Human Rights*	2	3	-	50	50	2
	Total	**30**		**250**	**300**	**550**	**22**
	Semester III						
I	Language – III	6	3	50	50	100	4
II	English – III	6	3	50	50	100	4
III	Core Paper V- Differential Equations and Laplace Transforms.	3	3	50	50	100	4
III	Core Paper VI- Statics	3	3	50	50	100	4

III	Allied B : Paper I – Chosen by the college	7	3	30	45	75	3
IV	Skill based Subject - Operations Research -I	3	3	25	25	50@@	2
IV	Digital Skills for Employability	-	-	25	75	100	2
IV	Tamil** / Advanced Tamil* (OR) Non-major elective - I (Yoga for Human Excellence)* / Women's Rights*	2	3		50	50	2
	Total	**30**		**280**	**395**	**675**	**25**
	Semester IV						
I	Language – IV	5	3	50	50	100	4
II	English – IV	5	3	50	50	100	4
III	Core Paper VII-Dynamics	3	3	50	50	100	4
III	Core Paper VIII- Programming in C	2	3	30	45	75	3
III	Core Paper VIII -Programming in C Practical	1	3	10	15	25	1
III	Allied B - Paper II Chosen by the college	5	3	30	45	75	3
III	Allied B - Paper II Chosen by the college (For Practical Paper)	2	3	25	25	50	2
IV	Skill based Subject - Operations Research – Paper II	3	3	25	25	50@@	2
IV	Office Fundamentals :Digital Skills for Employability http://kb.naanmudhalvan.in/Special:Filepath/Microsoft_Course_Details.xlsx	2	-	25	25	50##	2
IV	Tamil**/Advanced Tamil* (OR) Non-major elective -II (General Awareness*)	2	3		50	50	2
	Total	**30**		**295**	**380**	**675**	**27**
	Semester V						
III	Core Paper IX-Real Analysis-I	5	3	50	50	100	4
III	Core Paper X- Complex Analysis-I	6	3	50	50	100	4
III	Core Paper XI- Modern Algebra-I	6	3	50	50	100	4
III	Core Paper XII- Discrete Mathematics	5	3	50	50	100	4
III	Elective I	5	3	30	45	75	3
IV	Skill based Subject - Operations Research - Paper III	3	3	25	25	50@@	2

IV	Computational Intelligence for Employability	-	-	25	75	100	2
	Total	**30**		**280**	**345**	**625**	**23**
	Semester VI						
III	Core Paper XIII - Real Analysis-II	5	3	50	50	100	4
III	Core Paper XIV - Complex Analysis-II	5	3	50	50	100	4
III	Core Paper XV -Modern Algebra-II	5	3	50	50	100	4
III	Elective II	5	3	30	45	75	3
III	Elective III	5	3	50	50	100	4
IV	Skill Based Subject - Operations Research- Paper IV	3	3	25	25	50@@	2
IV	Project Based learning 2-Advanced Platform Technology -(Govt(auto) & Govt (Non-Auto)) / Data Analytics & Visualization - Aided (Non-auto) & SF(Non-Auto) http://kb.naanmudhalvan.in/Bharathiar_University_(BU)	2	-	25	25	50##	2
V	Extension Activities ** / Swachh Bharath @			50		50	2
	Total	**30**		**330**	**295**	**625**	**25**
	Grand Total	**180**		**1685**	**2015**	**3700**	**144**
#All computer papers have theory and practical exams							
	Theory			**30**	**45**	**75**	**100**
	Practicals			**10**	**15**	**25**	

Note

Naan Mudhalvan –Courses- external 25 marks will be assessed by Industry and internal will be offered by respective course teacher.

* No Continuous Internal Assessment (CIA). Only University Examinations

** No University Examinations. Only Continuous Internal Assessment (CIA).

@Swachh Bharath Internship Scheme (SBIS) is to be added for 2 credits in the extension activities.

@@University semester examination will be conducted for 50 marks (As per existing pattern of Examination) and it will be converted for 25 marks.

Allied Subjects(Colleges can choose any two subjects)

1.Physics 2. Chemistry3.Accountancy 4.Statistics.

List of Elective papers

(Colleges can choose any one of the paper as electives)

Elective – I	**A**	Astronomy- I
	B	Numerical -Methods-I

Elective – II	**A**	Astronomy—II
	B	Numerical Methods-II
Elective – III	**A**	Graph Theory
	B	Automata Theory & Formal Languages
	C	Programming in C++ #
	D	Number Theory
	E	Introduction to Industry 4.0

First Semester

Course code		CLASSICAL ALGEBRA	L	T	P	C
Core/Elective/Supportive		Core Paper – I	4	-	-	4
Pre-requisite		Knowledge of Limits	Syllabus Version		2022 - 2023	

Course Objectives:

1.To enable the students to learn Binomial ,Exponential , Logarithmic series and their application to summation of series.
2.To study intensively the convergence and divergence of different types of series.
3. To demonstrate the standard methods to solve both polynomial and transcendental type equations.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the concept of Binomial ,Exponential , Logarithmic series and their application to summation of series.	K1
2	Acquire a clear knowledge regarding methods to find an approximate roots of the equations .	K2
3	Apply the appropriate tests to find the convergence or divergence of an infinite series.	K3
4	ApplyDescartes's rule of signs to find the number of positive and negative roots if any in a polynomial equation .	K3
5	Analyze the relation between roots and coefficients of the polynomial equations.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Summation Of Series Using Binomial And Exponential Theorem	12hours

Binomial, exponential theorems-their statements only- their immediate application to summation and approximation only.

Unit:2	Logarithmic Series, Convergence And Divergence Of Series	12 hours

Logarithmic series theorem-statement and proof-Immediate application to summation and approximation only. Convergency and divergency of series –definitions, elementary results- comparison tests-De -Alembert's and Cauchy's tests.

Unit:3	Absolute Convergence Of Series	12 hours

Absolute convergence-series of positive terms-Cauchy's condensation test-Raabe's test.

Unit:4	Theory Of Equations	12 hours

Roots of an equation- Relations connecting the roots and coefficients- transformations of equations-character and position of roots-Descarte's rule of signs-symmetric function of roots-Reciprocal equations.

Unit:5	**Multiple Roots**	**12 hours**
Multiple roots-Rolle's theorem - position of real roots of f(x) =0 – Newton's method of approximation to a root – Horner's method.		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Algebra-T.K .Manicavachasam Pillai, T.Natarajan& K.S Ganapathy , (S.Viswanatham Printers & Publishers Private Ltd-2006)

Reference Books

1	Mathematics for B.Sc. Branch I -Vol. I- P. Kandasamy and K.Thilagavathy (For B.Sc-I semester) (S. Chand and Company Ltd, New Delhi, 2004.)
2	Algebra - N.P.Bali(Publisher: Laxmi Publications-New Delhi Edition 2010) .

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.brainkart.com/article/Introduction-to-Binomial,-Exponential-and-Logarithmic-series_35107/
2	http://www.jjernigan.com/172/ConvergenceDivergenceNotes.pdf
3	http://home.iitk.ac.in/~psraj/mth101/lecture_notes/Lecture11-13.pdf https://maths4uem.files.wordpress.com/2015/09/1028-infinite-series.pdf https://ocw.mit.edu/high-school/mathematics/exam-prep/concept-of-series/series-convergence-divergence/

Course Designed By: 1.Dr.T.Narppasalai Arasu
2.Dr.M.Anandhi

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	S	S	S	M	S	S
CO2	S	M	M	M	S	S	S	M	M	S
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		CALCULUS	L	T	P	C
Core/Elective/Supportive		Core Paper – II	5	-	-	4
Pre-requisite		Higher Secondary Level Mathematics.	Syllabus Version		2022 - 2023	

Course Objectives:

To orient the students to get an idea of curvatures, Integration of different types of functions, its geometrical applications, double, triple and improper integrals.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify areas in Mathematics and other fields where Calculus is useful.	K1
2	Understand the concepts of Evolutes and Envelopes, methods to find curvature and evolutes.	K2
3	Apply the concept of change of variables in double and triple integrals.	K3
4	Apply double , triple integral to find the area and volume respectively.	K3
5	Apply the Beta and gamma function to solve the multiple integrals.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Curvature	15hours

Curvature-radius of curvature in Cartesian and polar forms-evolutes and envelopes- Pedal equations- total differentiation- Euler's theorem on homogeneous functions.

.

Unit:2	Integration	15 hours

Integration of $f'(x)/f(x)$, $f'(x)\sqrt{f(x)}$,$[(px+q)/\sqrt{(ax^2+bx+c)}]$, $[\sqrt{(x-a)/(b-x)}]$, $[\sqrt{(x-a)(b-x)}]$,$1/[\sqrt{(x-a)(b-x)}$,$1/(a\cos x+b\sin x+c)$, $1/(a\cos^2 x+b\sin^2 x+c)$,Integration by parts-Bernoulli's Formula.

Unit:3	Evaluation Of Double And Triple Integrals	15 hours

Reduction formulae- problems- evaluation of double and triple integrals- applications to calculations of areas and volumes-areas in polar coordinates.

Unit:4	Change Of Variables In Double And Triple Integrals	15 hours

Change of order of integration in double integral- Jacobians- Change of variables in double and triple integrals.

Unit:5	Beta And Gamma Functions	15 hours

Beta and Gamma integrals-their properties, relation between them- evaluation of multiple integrals using Beta and Gamma functions - Improper Integrals.

	Total Lecture hours	75 hours

Text Book(s)

1	Calculus Vol 1 - S. Narayanan and T.K.M. Pillai. (Viswanathan Publishers 2008)
2	Calculus Vol 2- S. Narayanan and T.K.M. Pillai.(Viswanathan Publishers 2008)

Reference Books	
1	Mathematics for BSc – Vol I and. II - P. Kandasamy &K.Thilagarathy(S.Chand and Co-2004)
2	A Text book of calculus- Shanthi Narayanan &J.N.Kapoor(S.Chand& Co.2014)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://ocw.mit.edu/resources/res-18-006-calculus-revisited-single-variable-calculus-fall-2010/study-materials/ https://www.whitman.edu/mathematics/calculus_online/chapter15.html
2	https://www.khanacademy.org/math/calculus-home
3	https://www.sac.edu/FacultyStaff/HomePages/MajidKashi/PDF/MATH_150/Bus_Calculus.pdf
4	http://nptel.ac.in/courses/111104085/29
5	http://www.math.odu.edu/~jhh/Volume-1.PDF http://www.math.odu.edu/~jhh/Volume-2.PDF https://www.math.cmu.edu/~wn0g/2ch6a.pdf
6	https://nptel.ac.in/courses/111/105/111105122/http://www.staff.ttu.ee/~lpallas/multipleintegrals.pdf
Course Designed By: 1.Dr.C.Janaki 2.Dr.M.Anandhi	

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	S	S	S	S	S	S
CO2	S	M	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Second Semester

Course code		ANALYTICAL GEOMETRY	L	T	P	C
Core/Elective/Supportive		Core Paper – III	4	-	-	4
Pre-requisite		Basic Knowledge In Trigonometry &Vector Algebra.	Syllabus Version		2022 - 2023	

Course Objectives:

Emphasis to enhance student knowledge in three dimensional analytical geometry and the geometrical aspects of three dimensional figs, viz, sphere, cone and cylinder.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Gain knowledge about the regular geometrical figures and their properties.	K1
2	Describe the geometric concepts.	K2
3	Find equation to tangent, normal at a point on a conic	K3
4	Analyze condition of tangency and find the tangent plane to the central conicoid	K4
5	Analyze conics to explain natural phenomenon	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Straight Lines	12 hours

Analytical Geometry 3D-Straight lines-coplanarity of straight line-shortest distance (S.D) and equation of S.D between two lines-simple problems.

Unit:2	Sphere	12 hours

Sphere: standard equation of sphere-results based on the properties of a sphere-tangent plane to a sphere- equation of a circle.

Unit:3	System Of Spheres	12 hours

Tangency of spheres- coaxial system of spheres- radical planes- Orthogonal spheres.

Unit:4	Cone And Cylinder	12 hours

Cone whose vertex is at the origin- envelope cone of a sphere-right circular cone-equation of a cylinder-right circular cylinder.

Unit:5	Conicoid	12 hours

Nature of a conicoid- standard equation of central conicoid –enveloping cone- tangent plane-condition for tangency –director Sphere- director plane .

	Total Lecture hours	60 hours

Text Book(s)

1	Analytical Geometry - P. Durai Pandian & others (Emerald Publishers 1998).
2	Solid Geometry- N.P. Bali(Laxmi Publications (P) Ltd,2015)

Reference Books

1	Solid Geometry- M.L. Khanna(Jainath& Co Publishers, Meerut)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://www.brainkart.com/article/Three-Dimensional-Analytical-Geometry_6453/
2	http://egyankosh.ac.in/bitstream/123456789/11990/1/Unit-2.pdf
Course Designed By: 1.Dr.C.Janaki 2.Dr.M.Anandhi	

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	S	S	M	S	S	S	S	S
CO2	S	M	S	S	S	S	S	M	S	S
CO3	S	M	S	M	M	M	S	S	S	S
CO4	S	M	S	S	M	S	M	S	S	S
CO5	S	S	S	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		TRIGONOMETRY, VECTOR CALCULUS AND FOURIER SERIES	L	T	P	C
Core/Elective/Supportive		Core Paper – IV	5	-	-	4
Pre-requisite		Knowledge In Vector Algebra, Differentiation, Integration	Syllabus Version		2022 - 2023	

Course Objectives:

To enable the students to learn about the expansion of trigonometric, hyperbolic functions, vector calculus and the expansions of Fourier series .

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the expansion of trigonometric functions and hyperbolic functions .	K1
2	Acquire the basic knowledge of vector differentiation and vector integration.	K2
3	Determine and apply the important quantities associated with vector fields such as the divergence, curl and scalar potential.	K3
4	Understand and find Fourier series of a given periodic function.	K3
5	Examine line integral, surface integral ,volume integral and inter-relations among them .	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Expansion In Series	15 hours

Expansion in Series – Expansion of $\cos^n\theta$, $\sin^n\theta$ in a series of cosines and sines of multiples of θ – Expansions of $\cos n\theta$, $\sin n\theta$ and $\tan n\theta$ in powers of sines , cosines and tangents – Expansion of sin θ, cos θ and tan θ in powers of θ – hyperbolic functions and inverse hyperbolic functions.

Unit:2	Logarithm Of Complex Quantities And Summation Of Series	15 hours

Logarithm of complex quantities - summation of series – when angles are in arithmetic progression – C + iS, method of summation – method of differences.

Unit:3	Vector Differentiation	15 hours

Scalar and vector fields –Differentiation of vectors – Gradient, Divergence and Curl-Solenoidal and irrotational vectors-Laplacian Operator.

Unit:4	Vector Integration	15 hours

Integration of vectors – line integral – surface integral – Green's theorem in the plane – Gauss divergence theorem – Stoke's theorem – (Statements only) - verification of the above said theorems.

Unit:5	Fourier Series	15 hours

Periodic functions – Fourier series of periodicity 2π – half range series.

	Total Lecture hours	**75 hours**

Text Book

1	Mathematics for B.Sc. Branch I, Volume I, II and IV - P.Kandasamy&K.Thilagavathi(S.Chand and Company Ltd, New Delhi, 2004.)

Reference Books

1	Vector Analysis -P. Duraipandian, Laxmiduraipandian (Revised Edition-Reprint 2005 Emerald Publishers)
2	Trigonometry -T.K. Manichavasagam Pillai and S.Narayanan(Viswanathan Publishers and Printers Pvt. Ltd 2009.)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	http://www.math.odu.edu/~jhh/Volume-2.PDF http://www-math.mit.edu/~djk/18_01/chapter20/section03.html https://www.whitman.edu/mathematics/calculus_online/chapter16.html http://www.mecmath.net/calc3book.pdf
2	http://www.nptelvideos.in/2012/11/mathematics-iii.html
3	https://nptel.ac.in/courses/111107108/1

Course Designed By 1.Dr.C.Janaki
2. Ms. S.Sobia

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	S	S	M	M	S	S
CO2	S	M	S	S	M	M	M	S	M	S
CO3	S	M	S	S	M	M	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	M
CO5	S	S	S	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Third Semester

Course code		DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS	L	T	P	C
Core/Elective/Supportive		Core Paper – V	3	-	-	4
Pre-requisite		Knowledge of Ordinary and Partial Derivatives	Syllabus Version		2022-2023	

Course Objectives:

To impart knowledge on the method of solving ordinary differential Equations of First Order and Second Order, Partial Differential equations, Laplace Transforms, its inverse and application of Laplace Transform to solve the first and second Order Differential Equations with constant coefficients.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquire knowledge to solve Differential and Partial Differential Equations.	K1
2	Solve higher order linear differential equations.	K2
3	Expose differential equation as a powerful tool in solving problems in Physical and Social sciences.	K3
4	Demonstrate competency to solve linear PDE by Lagrange's method	K3
5	Analyze the concepts of Laplace transform and inverse Laplace transforms to solve ODE with constant coefficients.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Differential Equation of First Order and Higher Degree.	9 hours

Ordinary Differential Equations: Equations of First Order and of Degree Higher than one – Solvable for p, x, y– Clairaut's Equation – Simultaneous Differential Equations with constant coefficients of the form

i) $f_1(D)x + g_1(D)y = \varphi_1(t)$

ii) $f_2(D)x + g_2(D)y = \varphi_2(t)$ where f_1 , g_1 , f_2 and g_2 are rational functions of $D=d/dt$ with constant coefficients and φ_1 , φ_2 are explicit functions of t.

Unit:2	Higher Order Linear Differential Equation	9 hours

Finding the solution of Second and Higher Order with constant coefficients with Right Hand Side is of the form Ve^{ax} where V is a function of x – Euler's Homogeneous Linear Differential Equations.

Unit:3	Partial Differential Equations	9 hours

Partial Differential Equations: Formation of equations by eliminating arbitrary constants and arbitrary functions – Solutions of P.D Equations – Solutions of Partial Differential Equations by direct integration – Methods to solve the first order P.D. Equations in the standard forms – Lagrange's Linear Equations.

Unit:4	Laplace Transforms	9 hours

Laplace Transforms: Definition – Laplace Transforms of standard functions – Linearity property – First Shifting Theorem – Transform of $tf(t)$, , $f(t)/t$, $f'(t)$, $f''(t)$.

Unit:5	**Inverse Laplace Transforms**	**9 hours**
Inverse Laplace Transforms – Applications to solutions of First Order and Second Order Differential Equations with constant coefficients.		
	Total Lecture hours	**45 hours**

Text Book

1	Mathematics for B.Sc – Branch – I Volume III- P.Kandasamy & K.Thilagavathy (S. Chand and Company Ltd, New Delhi, 2004.)

Reference Books

1	Calculus Vol III -S. Narayanan and T.K. Manickavasagam Pillay, (S. Viswanathan Printers and Publishers Pvt. Ltd, Chennai 1991)
2	Differential Equations -N.P. Bali (Laxmi Publication Ltd, New Delhi, 2004)
3	Laplace and Fourier Transforms-Dr. J. K. Goyal and K.P. Gupta (Pragati Prakashan Publishers, Meerut, 2000)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://**nptel**.ac.in/courses/111105035/
2	http://www.nptelvideos.in/2012/11/mathematics-iii.html https://www.digimat.in/nptel/courses/video/111108081/L02.html
3	https://www.math.ust.hk/~machas/differential_equations.pdf. https://www.ijsr.net/archive/v2i1/ijsron2013331.pdf https://www.whitman.edu/mathematics/calculus_online/chapter17.html

Course Designed By: 1.Dr.E.Rameshkumar
2.Ms.S.Kavunthi

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	S	M	S	M	M	S	S
CO2	S	M	S	S	S	S	M	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	M	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low

`Course code		STATICS	L	T	P	C
Core/Elective/Supportive		Core Paper – VI	3	-		4
Pre-requisite		Basic Knowledge in Vector Algebra & Trigonometric Functions	Syllabus Version		2022-2023	

Course Objectives:

1.To enable the students to realize the nature of forces and resultant forces when more than one force acts on a particle.

2.To know about the conditions of equilibrium of couples and coplanar forces.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Remember the various laws.	K1
2	Understand the concepts of forces and moments.	K2
3	Understand the concepts of equilibrium.	K2
4	Apply the concepts of forces and moments.	K3
5	Analyze the basics of coplanar forces, equilibrium of forces acting on a rigid body and solve the problems.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Law of Forces**	**9 hours**

Forces acting at a point – Parallelogram law-triangle law –Converse of Triangle law- Polygon Law of Forces- Lami's Theorem. .

Unit:2	**Resolution and Components of Forces**	**9 hours**

(λ- μ) theorem –Resolution of forces- Components of a force- Resultant of any number of Coplanar forces acting at a point- Conditions of equilibrium.

Unit:3	**Parallel Forces, Moment and Couple**	**9 hours**

Parallel Forces and Moments –Resultant of two parallel forces (Like and unlike)-Conditions of equilibrium of three coplanar forces- Moment of a force- Geometrical representation- Sign of the moment- Unit of moment – Varignon's Theorem on couples-Equilibrium of two couples-Equivalence of two couples.

Unit:4	**Forces Acting on A Rigid Body**	**9 hours**

Coplanar forces acting on a rigid body – Theorem on three coplanar forces in equilibrium .

Unit:5	**General Conditions of Equilibrium of a System of Co-Planar Forces**	**9 hours**

Reduction of a system of coplanar forces to a single force and a couple - necessary & sufficient conditions of equilibrium only – Equation to the line of action of the resultant.

	Total Lecture hours	**45 hours**

Text Book

1	Statics -M.K.Venkataraman (Agasthiar Publications, Trichy, 1999.)

Reference Books

1	Statics -A.V.Dharmapadam.(S.Viswanathan Printers and Publishing Pvt., Ltd, 1993.)
2	Mechanics -P.Duraipandian and Laxmi Duraipandian.(S.Chand and Company Ltd, Ram Nagar, New Delhi -55, 1985.)
3	Statics -Dr.P.P.Gupta (Kedal Nath Ram Nath, Meerut, 1983-84)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/112/105/112105164/
2	https://nptel.ac.in/courses/122/102/122102004/
3	https://www.khanacademy.org/science/ap-physics-1

Course Designed By: 1.Ms.A.Karpagam
2.Dr.P.Rajarajeswari

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	M	S	S	M	M	S	S
CO2	S	M	S	S	M	M	M	M	M	S
CO3	S	M	S	S	M	M	M	S	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		Operations Research – Paper I	L	T	P	C
Core/Elective/Supportive		Skill Based Subject	3	-	-	2
Pre-requisite		Knowledge in Basic Mathematical Concepts	Syllabus Version	2022-2023		

Course Objectives:

To familiarize students with the basic concepts, models and techniques for effective decision making, model formulation and applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the basic concepts and application of operations research in various fields.	K1
2	Know principles of construction of mathematical models of conflicting situations.	K2
3	Analyze the relationship between a linear program and its dual.	K3
4	Apply techniques constructively to make effective decisions in business and solve problems in industry.	K3
5	Build and solve transportation problems.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Basics Of Operations Research and Formulation Of L.P.P	9 hours

Basics of O.R – Definition of O.R – Characteristics of O.R - Scientific methods in O.R – Necessary of O.R in Industry – O.R and Decision Making – Scope of O.R in Modern Management–Uses and limitations of O.R .Linear Programming Problem – Formulation of L.P.P.

Unit:2	Linear Programming Problem -Simplex method	9 hours

Graphical solutions of L.P.P – Problems. Simplex Method – Problems.

Unit:3	Big-M and Two-Phase Method	9 hours

Charne's Penalty Method (or) Big – M Method - Two Phase Simplex method – Problems.

Unit:4	Duality In L.P.P	9 hours

Duality in L.P.P – Concept of duality – Duality and Simplex Method – Problems.

Unit:5	Transportation Model	9 hours

The transportation Problems – Basic feasible solution by L.C.M – NWC- VAM- optimum solutions – unbalanced Transportation problems.

	Total Lecture hours	45 hours

Text Book

1	Operations Research – Kanti Swarup, P. K. Gupta, Man Mohan (S. Chand & Sons Education Publications, New Delhi, 12th Revised edition-2003)

Reference Books	
1	Operations Research – Prem Kumar Gupta D. S. Hira (S. Chand & Company Ltd, Ram Nagar, New Delhi ,2014)
2	Operations Research Principles and Problems- S. Dharani Venkata Krishnan(Keerthi publishing house PVT Ltd.1994)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/102/111102012/
2	https://nptel.ac.in/courses/111/104/111104027/
Course Designed By: 1. Dr.T.Narppasalai Arasu 2. Dr.P.Rajarajeswari	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	M	M	M	S	S
CO2	S	M	S	S	S	S	S	M	M	S
CO3	S	S	S	S	M	M	S	S	S	S
CO4	S	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Fourth Semester

Course code		DYNAMICS	L	T	P	C
Core/Elective/Supportive		Core Paper-VII	3	-	-	4
Pre-requisite		Knowledge in Forces and Vector Algebra	Syllabus Version		2022-2023	

Course Objectives:

To impart knowledge about the projectile, Simple Harmonic Motion and understanding the notions of impact between two smooth spheres.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Remember the basic kinematics and dynamic concepts.	K1
2	Describe the differential equation of Central Orbits.	K2
3	Apply the concepts of projectiles to solve problems relating to the motion of a projectile.	K3
4	To understand &apply the concepts of composition of simple harmonic motion in two directions.	K3
5	Understand impulsive forces and analyze loss of K.E due to direct and oblique impact.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Projectiles	9 hours

Path of a projectile-Greatest height-time of flight – Range -range on an inclined plane through the point of projection-Maximum range.

Unit:2	Central Orbits	9 hours

Radial and transverse components of velocity and acceleration – areal velocity of central orbits - Differential equation of central orbit in polar coordinates only.

Unit:3	Simple Harmonic Motion	9 hours

Amplitude, periodic time, phase-composition of two simple harmonic motions of the same period in a straight line and in two perpendicular lines.

Unit:4	Collision of Elastic Bodies-Direct Impact of Spheres	9 hours

Impulsive force – Newton's experimental law- Principle of conservation of momentum- Direct Impact on a smooth fixed plane -Direct impact of two smooth spheres- loss of kinetic energy during direct impact.

Unit:5	Oblique Impact of Spheres	9 hours

Oblique impact of a smooth sphere on fixed smooth plane – oblique impact of two smooth spheres - Loss of Kinetic energy during oblique impact.

	Total Lecture hours	45 hours

Text Book

1	Dynamics -M.K.Venkataraman (11th Ed. Agasthiar Publications, Trichy, 1994.)
Reference Books	
1	Dynamics -A.V.Dharamapadam (S.Viswanathan Printers and Publishers Pvt., Ltd, Chennai, 1998)
2	Dynamics -K.Viswanatha Naik and M.S.Kasi (Emerald Publishers, 1992)
3	Dynamics -Naryanamurthi (National Publishers, New Delhi, 1991)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/115/106/115106119/
2	https://www.askiitians.com/iit-jee-physics/mechanics/motion-of-projectile.aspx
Course Designed By: 1. Dr.T.Nandhagopal 2. Mr.M.Balasankar	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	S	S	S	S	S
CO2	M	M	M	M	M	S	M	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	M	M	M	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		PROGRAMMING IN C	L	T	P	C
Core/Elective/Supportive		Core Paper-VIII	2	-	-	3
Pre-requisite		Higher Secondary Level Mathematics	Syllabus Version		2022 – 2023	

Course Objectives:

To impart the importance of C language, its structure, Data types, Operators of C, Various control statements, Arrays, different types of functions and practical problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Remember the importance of C language and datatypes.	K1
2	Understand the basic structure, operators and statements of C language.	K2
3	Understand decision control statements, loop control statements.	K2
4	Apply the concepts of data types, operators, expressions, control statements, arrays, character arrays and strings to write the C code for a given algorithm.	K3
5	Read, understand and trace the execution of programs written in C language.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Constants, Variables and Data Types	6 hours

Introduction – Importance of C- Basic structure of C programme - Character set -Constants – Keywords and identifiers – Variables Data types – Declaration of variables – Assigning values to variables –Defining symbolic constants.

Unit:2	Operators and Expressions	6 hours

Arithmetic operators - Relational operators - logical operators – assignment operators – increment and decrement operators –Conditional operators – Special operators – Arithmetic expressions –Evaluation of expressions –Precedence of arithmetic operators – Some computational problems –Type conversion in expressions – operator precedence and associating mathematical functions.

Unit:3	Managing Input -Output Operations, Decision Making and Branching	6 hours

Reading and Writing character – formatted input and output. Decision making with IF statement – Simple IF statement – The IF ELSE statement - Nesting of IF ELSE statement – The ELSE IF ladder. The Switch statement –The ? Operator –The GOTO statement.

Unit:4	Decision Making and Looping	6 hours

The WHILE statement - the DO statement - the FOR statement –Jumps in loops

.

Unit:5	**Arrays and Strings**	**6 hours**
One, Two dimensional arrays – initializing two dimensional arrays – Multidimensional arrays –Declaring and initializing string variables – reading strings from terminal – Writing strings on the screen – Arithmetic operations on characters.		
	Total Lecture hours	**30 hours**

Text Book

1	Programming in ANSI C -E.Balagurusamy (Tata McGraw –Hill Publishing Company limited, New Delhi, Fifth Edition,2008)

Reference Books

1	Programming with C (Schaum's outline series)- Byron Gottfried (Tata McGraw Hill publishing company -1998.)
2	Programming with ANSI and Turbo C -Ashok N.Kamthane (Pearson Education publishers, 2002)
3	The spirit of 'C' -Henry Mullish and Herbert L cooper (Jaico publisher , 1996.)
4	The ANSI C- Brian W.Kernighan,Dennis M.Ritchie (Published by Prentice- Hall of India Private Limited, M-97,New Delhi- 110001 ,Second edition ,Ocober 1992)
5	ANSI C: With Microsoft C 5.1 and Quick C 2.0 -C.Balasubramanian.(Tata McGraw-Hill Publishing company limited, New Delhi.)
6	Programming In C - Kris A.Jamsa (Galgotia Publications Pvt.ltd. 1992)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/104/106104128/
2	https://nptel.ac.in/courses/106/105/106105171/

Course Designed By: 1. Dr.T.Narppasalai Arasu

2. Dr.P.Rajarajeswari

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	M	M	M	S	S
CO2	S	S	M	M	S	M	M	S	M	S
CO3	S	M	M	M	S	S	M	S	S	S
CO4	S	S	S	S	S	M	S	S	S	M
CO5	S	S	S	S	S	M	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		PROGRAMMING IN C-(PRACTICAL)	L	T	P	C
Core/Elective/Supportive		Core Paper VIII (Practical)	-	-	1	1
Pre-requisite		Knowledge in C	Syllabus Version		2022-2023	

PRACTICAL LIST

1. Write a C program to generate 'N' Fibonacci number.
2. Write a C program to print all possible roots for a given quadratic equation.
3. Write a C program to calculate the statistical values of mean, median.
4. Write a C program to calculate the statistical values of Standard Deviation and variance of the given data.
5. Write a C program to sort a set of numbers.
6. Write a C program to sort the given set of names.
7. Write a C program to find factorial value of a given number 'N' using recursive function call.
8. Write a C program to find the product of two given matrix

Course code		OPERATIONS RESEARCH – PAPER II	L	T	P	C
Core/Elective/Supportive		SKILL BASED SUBJECT	2	-	-	2
Pre-requisite		Knowledge in Basic Mathematical Concepts	Syllabus Version		2022-2023	

Course Objectives:

To impart knowledge in Assignment Problems, Game theory, performance measures of queues and optimal use of Inventory.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify the importance of stocks the reasons for holding stock in an organization, determine the optimal order quantity for models.	K1
2	Explain the various costs related to inventory system.	K2
3	Apply game theory concepts to articulate real-world situations by identifying, analyzing and practicing strategic decisions.	K3
4	Apply and extend queueing models to analyze real world systems.	K4
5	Build and solve assignment model.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Assignment Model	6 hours

The Assignment Problems – Assignment algorithm – optimum solutions – Unbalanced Assignment Problems.

Unit:2	Game Theory	6 hours

Game Theory – Two-person zero sum game – The Maximin – Minimax principle – problems - Solution of 2 x 2 rectangular Games – Domination Property – (2 x n) and (m x 2) graphical method – Problems.

Unit:3	Queueing Model	6 hours

Queueing Theory – Introduction – Queueing system – Characteristics of Queueing system – Symbols and Notations – Classifications of queues – Problems in (M/M/1) : (∞/FIFO)

Unit:4	Multi-Channel Queueing Models	6 hours

Problems in (M/M/1):(N/FIFO); (M/M/C) : (∞/FIFO); (M/M/C) : (N/FIFO) Models.

Unit:5	Inventory Models	6 hours

Inventory control – Types of inventories – Inventory costs – EOQ Problem with no shortages – Production problem with no shortages – EOQ with shortages – Production problem with shortages – EOQ with price breaks.

	Total Lecture hours	**30 hours**

Text Book

1	Operations Research – Kanti Swarup, P. K. Gupta, Man Mohan (S. Chand & Sons Education Publications, New Delhi, 12th Revised edition,2003)

Reference Books

1	Operations Research – Prem Kumar Gupta D. S. Hira (S. Chand & Company Ltd, Ram Nagar, New Delhi,2014)
2	Operations Research Principles and Problems- S. Dharani Venkata Krishnan (Keerthi publishing house PVT Ltd.1994)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/102/111102012/
2	https://youtu.be/zADj0k0waFY https://youtu.be/xvDdrswAj8M https://www.youtube.com/watch?v=xVPoWkkQTrQ https://www.youtube.com/watch?v=7kDtTAnvuww https://www.youtube.com/watch?v=IfLsPHKk51w
3	https://nptel.ac.in/courses/109/103/109103021/
4	https://nptel.ac.in/courses/110/105/110105082/ https://nptel.ac.in/courses/110/106/110106045/

Course Designed By: 1. Dr.T.Narppasalai Arasu

2. Dr.P.Rajarajeswari

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	S	M	M	M	S	S
CO2	M	M	M	M	S	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	S	M	S	M	S	M

*S-Strong; M-Medium; L-Low

Fifth Semester

Course code		REAL ANALYSIS - I	L	T	P	C
Core/Elective/Supportive		Core Paper – IX	5	-	-	4
Pre-requisite		Knowledge in the basic properties of real numbers	Syllabus Version	2022 - 2023		

Course Objectives:

Aimed at exposing the real number systems that underpin the development of real analysis and in understanding various physical phenomena.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Remember the basic topological properties of subsets of the real numbers.	K1
2	Understand the fundamental properties of the real numbers and analyze the real number system.	K2
3	Learn the concept of limits, sequence, continuity, convergent sequence in metric spaces appreciating the abstract ideas and their applicability.	K2
4	Have the proficiency in the formulation and construction of proofs of basic results in real analysis.	K3
5	Demonstrate skills in communicating Mathematics and learn basic techniques and examples in analysis to be well prepared for extended learning.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	The Real and Complex Number Systems	15 hours

Introduction -the field axioms, the order axioms –integers –the unique Factorization theorem for integers –Rational numbers –Irrational numbers –Upper bounds, maximum Elements, least upper bound –the completeness axiom –some properties of the supremum –properties of the integers deduced from the completeness axiom- The Archimedean property of the real number system –Rational numbers with finite decimal representation of real numbers –absolute values and the triangle inequality –the Cauchy-Schwarz inequality –plus and minus infinity and the extended real number system.

Unit:2	Basic Notions of a Set Theory.	15 hours

Notations –ordered pairs –Cartesian product of two sets – Relations and functions – further terminology concerning functions –one–one functions and inverse –composite functions – sequences –similar sets-finite and infinite sets –countable and uncountable sets –uncountability of the real number system –set algebra –countable collection of countable sets.

Unit:3	Elements of Point Set Topology	15 hours

Elements of point set topology: Euclidean space R^n –open balls and open sets in R^n. The structure of open sets in R^n –closed sets and adherent points –The Bolzano –Weierstrass theorem –the Cantor Intersection Theorem

Unit:4	**Covering and Compactness**	**15 hours**

Covering –Lindelof covering theorem –the Heine- Borel covering theorem –Compactness in $\mathbf{R^n}$ –Metric Spaces –point set topology in metric spaces –compact subsets of a metric space –Boundary of a set.

Unit:5	**Limits and Continuity in Metric Spaces**	**15 hours**

Convergent sequences in a metric space –Cauchy sequences –Completeness sequences – complete metric Spaces. Limit of a function –Continuous functions –continuity of composite functions. Continuous complex valued and vector valued functions.

	Total Lecture hours	**75 hours**

Text Book

1. Mathematical Analysis-T.M.Apostol (2nd ed., Narosa Publishing Company, Chennai, 1990.)
   - **Unit I :** Chapter 1 Sections 1.2, 1.3, 1.6 to 1.16, 1.18 to 1.20
   - **Unit II :** Chapter 2 Sections 2.2 to 2.15
   - **Unit III :** Chapter 3 Sections 3.2 to 3.9
   - **Unit IV :** Chapter 3 Sections 3.10 to 3.16
   - **Unit V :** Chapter 4 Sections 4.2 to 4.5, 4.8 to 4.10

Reference Books

1. Methods of Real Analysis -R.R.Goldberg.(NY, John Wiley, New York 1976.)
2. Introduction to Topology and Modern Analysis- G.F.Simmons.(McGraw – Hill, New York, 1963.)
3. A survey of Modern Algebra (3rd Edition)-G.Birkhoff and MacLane.(Macmillan, New York, 1965.)
4. Real Analysis -J.N.Sharma and A.R.Vasishtha.(Krishna Prakashan Media (P) Ltd, 1997)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://nptel.ac.in/courses/111/105/111105069/#
2. https://nptel.ac.in/courses/111/101/111101134/
3. https://www.digimat.in/nptel/courses/video/111105098/
4. https://nptel.ac.in/courses/111/106/111106053/

Course Designed By: 1. Dr.S.Palaniammal
2. Dr.E.Rameshkumar.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	M	M	S	S
CO2	S	S	M	M	M	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		COMPLEX ANALYSIS - I	L	T	P	C
Core/Elective/Supportive		Core Paper – X	6	-	-	4
Pre-requisite		Knowledge in Calculus	Syllabus Version	2022 – 2023		

Course Objectives:

To equip the students with the understanding of the fundamental concepts of complex functions, analyticity ,power series and complex integration.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Learn techniques of complex analysis effectively to establish mathematical results.	K1
2	Recognize the simple and multiple connected domains.	K2
3	Investigate a function for its analyticity and find it series development.	K3
4	Examine the relationship between conformal mapping and analytic functions	K4
5	Compute contour integrals directly and by the fundamental theorem.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Complex Plane	18 hours

Complex number system –Field of Complex numbers – Scalar multiplication of a complex number – Conjugation – Absolute value of a complex number-Inequalities in terms of moduli – Elementary Transformations i) $w=z+\alpha$ ii) $w = az$ iii) $w = 1/z$ .Fixed points -cross-ratio-invariance of cross-ratio under bilinear transformation –Definition of extended complex plane – Stereographic projection.

Unit:2	Analytic Functions	18 hours

Complex Functions- Limit of a function –continuity –differentiability – Analytical function defined in a region –necessary conditions for differentiability –sufficient conditions for differentiability –Cauchy-Riemann equation in polar coordinates –Definition of entire function.

Unit:3	Power Series and Elementary Functions	18 hours

Absolute convergence –circle of convergence –Analyticity of the sum of power series in the Circle of convergence (term by term differentiation of a series). Elementary functions: Exponential, Logarithmic, Trigonometric and Hyperbolic functions.

Unit:4	Harmonic Functions and Conformal Mapping	18 hours

Conjugate Harmonic functions: Definition and determination. Conformal Mapping: Isogonal mapping –Conformal Mapping-Mapping $z \rightarrow f(z)$, where f is analytic, particularly the mappings. $w = e^z$; $w = z^2$; $w = \sin z$; $w = \cos z$; $w = z + 1/z$.

Unit:5	**Complex Integration**	**18 hours**
Simply and multiply connected regions in the complex plane. Integration of f(z) from definition along a curve joining z_1 and z_2.. Proof of Cauchy's Theorem (using Goursat's lemma for a simply connected region). Statement of Cauchy's integral formula for higher derivatives - Morera's theorem.		
	Total Lecture hours	**90 hours**

Text Book	
1	Complex Analysis (For Undergraduate Students of Mathematics, Physics and Engineering) -P.Duraipandian and Kayalal Pachaiyappa (S Chand Publishing, S Chand And Company Limited ,Reprint 2020) **Unit I :** Chapter 1 Sections 1.1 to 1.3, 1.6 to 1.9 Chapter 2 Sections 2.1 to 2.2, 2.6 to 2.10, Chapter 7 Section 7.1 **Unit II :** Chapter 4 Sections 4.1 to 4.10 **Unit III :** Chapter 6 Sections 6.1 to 6.11 **Unit IV :** Chapter 6 Sections 6.12 to 6.13 Chapter 7 Sections7.4,7.6 to 7.10 **Unit V :** Chapter 8 Sections 8.1 to 8.9
Reference Books	
1	Complex Variable and Applications -Churchill and Others.(Tata McGraw Hill Publishing Company Ltd, 1974.)
2	Theory of functions of Complex Variable -Shanti Narayan (S.Chand and Company, Meerut, 1995.)
3	Functions of Complex Variable -Tyagi B.S(17th Edition, Pragati Prakasham Publishing Company Ltd, Meerut, 1992-93)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/103/111103070/
2	https://nptel.ac.in/courses/111/107/111107056/
3	https://nptel.ac.in/courses/122/103/122103012/

Course Designed By 1.Dr.T.Narppasalai Arasu
2.Ms.S.Kavunthi

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	S	M	M	M	S	S
CO2	S	M	M	M	M	S	M	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	S	M	S	M	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		MODERN ALGEBRA - I	L	T	P	C
Core/Elective/Supportive		Core Paper – XI	6	-	-	4
Pre-requisite		Higher Secondary Level Mathematics	Syllabus Version		2022 - 2023	

Course Objectives:

Focuses on the concepts of algebraic structures which is one of a pillar of modern Mathematics and emphasis on their properties and applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Recall the properties and extend group structure to finite permutation groups.	K1
2	Explain the concepts of homomorphism, isomorphism and automorphism.	K2
3	Demonstrate abstract thinking capacity and ability to prove theorems.	K3
4	Compare features of different algebraic structures.	K4
5	Examine the properties of algebraic structures and their role in applied contexts.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Groups and its Basic Properties	18 hours

Sets – mappings – Relations and binary operations – Groups: Abelian group, Symmetric group Definitions and Examples – Basic properties.

Unit:2	Subgroups and Normal Subgroups	18 hours

Subgroups – Cyclic subgroup - Index of a group – Order of an element – Fermat theorem - A Counting Principle - Normal Subgroups and Quotient Groups.

Unit:3	Automorphisms	18 hours

Homomorphisms (Applications 1 and 2 are omitted) -Automorphisms – Inner automorphism – Cayley's theorem, permutation groups.

Unit:4	Rings	18 hours

Definition and Examples –Some Special Classes of Rings – Commutative ring – Field – Integral domain - Homomorphisms of Rings.

Unit:5	Ideals and Quotient Rings	18 hours

Ideals and Quotient Rings – More Ideals and Quotient Rings – Maximal ideal - The field of Quotients of an Integral Domain.

	Total Lecture hours	**90 hours**

Text Book

1	Topics in Algebra -I.N. Herstein (John Wiley & Sons, New York, 2003.) **Unit I :** Chapter 1 Sections 1.1 to 1.3, Chapter 2 Sections 2.1 to 2.3 **Unit II :** Chapter 2 Sections 2.4 to 2.6 **Unit III :** Chapter 2 Sections 2.7 to 2.10 **Unit IV :** Chapter 3 Sections 3.1 to 3.3 **Unit V :** Chapter 3 Sections 3.4 to 3.6.

Reference Books

1	Modern Algebra -Surjeet Singh and Qazi Zameeruddin. (Vikas Publishing house, 1992.)
2	Modern Algebra- A.R.Vasishtha (Krishna Prakashan Mandir, Meerut, 1994 - 95.)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/104/106104149/
2	https://nptel.ac.in/courses/111/106/111106113/
3	https://www.classcentral.com/course/swayam-modern-algebra-14201

Course Designed By: 1.Ms.A.Karpagam

2. Mr.M.Balasankar

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	M	S	S	M	S	S
CO2	M	M	S	S	M	S	S	S	S	S
CO3	S	M	M	S	S	S	S	S	S	S
CO4	S	M	M	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		DISCRETE MATHEMATICS	L	T	P	C
Core/Elective/Supportive		Core paper XII	5	-	-	4
Pre-requisite		Higher Secondary Level Mathematics	Syllabus Version		2022-2023	

Course Objectives:

Prepare students to develop mathematical foundations to understand, create mathematical arguments and focuses on the Formal languages, Automata, Lattices, Boolean Algebra and Graph Theory.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Assimilate various graph theoretic concepts and familiarize with their applications.	K1
2	Know and understand about partially ordered sets, Boolean algebra, lattices and their types.	K2
3	Apply Karnaugh map for simplifying the Boolean expression.	K3
4	Demonstrate the skill to construct simple mathematical proofs and to validate.	K4
5	To achieve greater accuracy, clarity of thought and language.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Mathematical logic	15 hours

Connectives, well-formed formulas, Tautology, Equivalence of formulas, Tautological implications, Duality law, Normal forms, Predicates, Variables, Quantifiers, Free and bound Variables. Theory of inference for predicate calculus.

Unit:2	Relations and Functions	15 hours

Composition of relations, Composition of functions, Inverse functions, one-to- one, onto, one-to-one& onto functions, Hashing functions, Permutation function, Growth of functions. Algebra structures: Semi groups, Free semi groups, Monoids.

Unit:3	Formal Languages and Automata	15 hours

Regular expressions, Types of grammar, Regular grammar and finite state automata, Context free and sensitive grammars.

Unit:4	Lattices and Boolean Algebra	15 hours

Partial ordering, Poset, Lattices, Boolean algebra, Boolean functions, Theorems, Minimization of Boolean functions(Karnaugh Method only).

Unit:5	Graph Theory	15 hours

Directed and undirected graphs, Paths, Reachability, Connectedness, Matrix representation, Euler paths, Hamiltonian paths, Trees, Binary trees - theorems, and applications.

	Total Lecture hours	**75 hours**

Text Book

1 Discrete Mathematical Structures with applications to computer science-J.P Tremblay and R.P Manohar (Mc.Graw Hill, 1975.)

Unit I : Chapter 1. Sections - 1-2, 1-2.7. 1-2.9, 1-2.10, 1-2.11, 1-3, 1-5.1, 1-5.2, 1-5.4, 1-6.4

Unit II : Chapter 2- Sections - 2-3.5, 2-3.7, 2-4.2, 2-4.3, 2-4.6,
Chapter 3- Sections-3-2, 3-5, 3-5.3,

Unit III : Chapter 3- Sections 3-3.1, 3-3.2
Chapter 4- Section 4-6.2

Unit IV : Chapter 4- Section 4-1.1, 4-2, 4-3, 4-4.2

Unit V : Chapter 5- Section 5-1.1, 5-1.2, 5-1.3, 5-1.4

Reference Book

1 Discrete Mathematics-Oscar Levin (3rd Edition,2016)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1 https://nptel.ac.in/courses/106/106/106106094/

2 https://nptel.ac.in/courses/111/107/111107058/

Course Designed By: 1. Ms.A.Karpagam
2. Ms.S.Kavunthi

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	S	M	S	M	M	S	S
CO2	S	M	S	S	M	S	S	S	S	S
CO3	S	M	S	S	M	S	M	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		OPERATIONS RESEARCH – PAPER III	L	T	P	C
Core/Elective/Supportive		Skill Based Subject	3	-	-	2
Pre-requisite		Knowledge in Basics of Operations Research	Syllabus Version		2022-2023	

Course Objectives:

Presents applications and method to solve Integer Programming Problems, Non-linear Programming Problems and Dynamic Programming problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the concept of simulation and simulate a queueing system	K1
2	Understand the overall approach of dynamic programming.	K2
3	Solve nonlinear programming problems using Lagrange multiplier and using Kuhn-Tucker conditions.	K2
4	Apply concepts in optimal scheduling	K3
5	To formulate a model for solving the intractable problems.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Simulation	9 hours

Introduction-simulation models-Event-Types of simulation- Generation of random numbers-Monte-Carlo simulation- simulation of queueing system.

Unit:2	Network Scheduling By PERT/CPM	9 hours

Introduction- Network and basic components- Rules of Network construction- Time calculation in Networks-CPM. Pert Calculations- Cost Analysis- crashing the network- Problems.

Unit:3	Integer Programming Problem	9 hours

Integer Programming Problem – Gomory's fractional cut Method – Branch and Bound Method.

Unit:4	Non-linear Programming Problems	9 hours

General NLPP – Lagrange multiplier – Hessian bordered Matrix – Kuhn Tucker Condition – Problems.

Unit:5	Dynamic Programming Problem	9 hours

Dynamic Programming Problem – Recursive equation approach – D.P.P Algorithm – Solution of L.P.P by D.P.P.

	Total Lecture hours	45 hours

Text Book

1	Operations Research – Kanti Swarup, P. K. Gupta, Man Mohan (S. Chand & Sons

	Education Publications, New Delhi, 12th Revised edition,2003)
Reference Books	
1	Operations Research – Prem Kumar Gupta& D. S. Hira (S. Chand & Company Ltd, Ram Nagar, New Delhi ,2014)
2	Operations Research Principles and Problems- S. Dharani Venkata Krishnan (Keerthi publishing house PVT Ltd ,1994)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/107/111107104/
2	https://nptel.ac.in/courses/111/102/111102012/
3	https://nptel.ac.in/courses/111/104/111104027/
4	https://nptel.ac.in/courses/111/105/111105039/
Course Designed By: 1. Dr.T.Narppasalai Arasu 2. Dr.P.Rajarajeswari	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	S	S	S	S	S	S	S
CO2	S	M	M	M	M	S	S	M	S	S
CO3	S	M	M	S	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Sixth Semester

Course code		REAL ANALYSIS - II	L	T	P	C
Core/Elective/Supportive		Core Paper – XIII	5	-	-	4
Pre-requisite		Knowledge in Mappings and Properties of Real Numbers	Syllabus Version		2022-2023	

Course Objectives:

To present a deeper and rigorous understanding of fundamental concepts like continuity, connectivity, derivative, monotonic functions with properties and Riemann - Stieltjes integral.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Demonstrate the understanding of continuity, uniform continuity, compactness, connectedness.	K1
2	Understand partitions and their refinement.	K2
3	Determine the Riemann integrability and the Riemann-Stieltjes integrability of a bounded function.	K2
4	Examine the derivatives of function.	K3
5	Acquire skills in writing and analyze the proofs that arise in the context of real analysis.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Topological Mappings	15 hours

Examples of continuous functions –continuity and inverse images of open or closed sets – functions continuous on compact sets –Topological mappings –Bolzano's theorem. .

Unit:2	Monotonic Functions	15 hours

Connectedness –components of a metric space – Uniform continuity - Uniform continuity and compact sets –fixed point theorem for contractions –monotonic functions.

Unit:3	Derivatives	15 hours

Definition of derivative –Derivative and continuity –Algebra of derivatives – the chain rule –one sided derivatives and infinite derivatives –functions with non-zero derivatives –zero derivatives and local extrema –Rolle's theorem –The mean value theorem for derivatives – Taylor's formula with remainder.

Unit:4	Functions of Bounded Variation	15 hours

Properties of monotonic functions –functions of bounded variation –total Variation –additive properties of total variation on (a, x) as a function of x – functions of bounded variation expressed as the difference of increasing functions –continuous functions of bounded variation.

Unit:5	The Riemann-Stieltjes Integral	15 hours

Introduction –Notation –The definition of Riemann –Stieltjes integral –linear properties – Integration by parts –change of variable in a Riemann –Stieltjes integral –Reduction to a Riemann integral.

	Total Lecture hours	**75 hours**

Text Book

1 Mathematical Analysis(2nd ed)-Tom. M. APOSTOL(Addison-Wisely. Narosa Publishing Company, Chennai, 1990.)

Unit I : Chapter 4 Sections 4.11 to 4.15

Unit II : Chapter 4 Sections 4.16, 4.17, 4.19, 4.20, 4.21, 4.23

Unit III : Chapter 5 Sections 5.2 to 5.10 and 5.12

Unit IV : Chapter 6 Sections 6.2 to 6.8

Unit V : Chapter 7 Sections 7.1 to 7.7

Reference Books

1	Methods of Real Analysis -R.R.Goldberg (NY, John Wiley, New York 1976.)
2	Introduction to Topology and Modern Analysis -G.F.Simmons (McGraw – Hill, New York, 1963.)
3	A survey of Modern Algebra -G.Birkhoff and MacLane (3rd Edition, Macmillian, NewYork, 1965.)
4	Real Analysis -J.N.Sharma and A.R.Vasistha.(Krishna Prakashan Media (P) Ltd, 1997.)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/106/111106053/
2	https://www.math.ucdavis.edu/~emsilvia/math127/chapter7.pdf https://www.whitman.edu/Documents/Academics/Mathematics/grady.pdf
3	https://nptel.ac.in/courses/122/101/122101003/

Course Designed By: 1. Dr.S.Palaniammal

2. Dr.E.Rameshkumar

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	S	S	S	M	S	S
CO2	M	M	M	M	M	S	S	M	S	S
CO3	S	M	M	S	S	S	M	S	S	S
CO4	S	M	M	S	S	S	M	S	S	S
CO5	M	M	S	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		COMPLEX ANALYSIS - II	L	T	P	C
Core/Elective/Supportive		Core Paper – XIV	5	-	-	4
Pre-requisite		Knowledge in Analytic Functions, Complex Integration.	Syllabus Version		2022-2023	

Course Objectives:

To familiarize the students with some fundamental theorems, singularity, residues in complex functions, integrations of complex functions, meromorphic functions and their applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To recognize and apply the Liouville's theorem, the mean-value property of a function and the maximum modulus principle.	K1
2	Demonstrate understanding and appreciation of deeper aspects of complex analysis.	K2
3	Apply residue theorem to compute integrals.	K3
4	Ability to think critically by proving mathematical conjectures and establishing theorems from complex analysis.	K4
5	Classify the nature of singularity, poles and residues.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Integral Theorems	15 hours

Results based on Cauchy's theorem(I)-Zeros-Cauchy's Inequality – Liouville's theorem – Fundamental theorem of algebra –Maximum modulus theorem –Gauss mean value theorem – Gauss mean value theorem for a harmonic function on a circle.

Unit:2	Taylor's Series and Laurent's Series	15 hours

Results based on Cauchy's theorem(II)-Taylor's series –Laurent's series.

Unit:3	Singularities and Residues	15 hours

Isolated singularities (Removable Singularity, pole and essential singularity) –Residues –Residue theorem.

Unit:4	Real Definite Integrals	15 hours

Evaluation using the calculus of residues – Integration on the unit circle –Integral with - ∞ and + ∞ as lower and upper limits with the following integrals:

i) P(x) /Q(x) where the degree of Q(x) exceeds that of P(x) at least 2.

ii) (sin ax).f(x), (cos ax).f(x), where a>0 and f(z) $\rightarrow$0 as z$\rightarrow\infty$ and f(z) does not have a pole on the real axis.

iii) f(x) where f(z) has a finite number of poles on the real axis.

Integral of the type $\int_0^\infty \frac{x^{a-1}}{1+x} dx$, 0< a <1.

Unit:5	Meromorphic Functions	15 hours

Theorem on number of zeros minus number of poles –Principle of argument-Rouche's theorem – Theorem that a function which is meromorphic in the extended plane is a rational function.		
	Total Lecture hours	**75 hours**
Text Book		
1	Complex Analysis (For Undergraduate Students of Mathematics, Physics and Engineering) -P.Duraipandian and Kayalal Pachaiyappa (S Chand Publishing, S Chand And Company Limited ,Reprint 2020) **Unit I :** Chapter 8 Sections 8.10, 8.11 **Unit II :** Chapter 9 Sections 9.1 to 9.3, 9.13. **Unit III :** Chapter 9 Sections 9.5 to 9.12, 9.13. Chapter 10 Sections 10.1, 10.2 and 10.4. **Unit IV :** Chapter 10 Sections 10.3 and 10.4. **Unit V :** Chapter 11 Sections 11.1 to 11.3 **(Except theorems 11.5 and 11.6)**
Reference Books		
1	Complex Variable and Applications -Churchill and Others(Tata Mc-graw Hill Publishing Company Ltd, 1974.)
2	Theory of functions of Complex Variable - Shanti Narayan (S.Chand and Company ,Meerut, 1995)
3	Functions of Complex Variable (17th Edition)- Tyagi B.S (Pragati Prakasham Publishing Company Ltd, Meerut, 1992-93.)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/111/103/111103070/
2	https://nptel.ac.in/courses/111/106/111106094/
4	https://nptel.ac.in/courses/122/103/122103012/
Course Designed By: 1.Dr.T.Narppasalai Arasu 2.Ms.S.Kavunthi		

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	M	S	S	M	S	S
CO2	S	S	M	S	M	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	M	M	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		MODERN ALGEBRA - II	L	T	P	C
Core/Elective/Supportive		Core Paper – XV	5	-	-	4
Pre-requisite		Knowledge in Groups, Rings and Fields	Syllabus Version	2022-2023		

Course Objectives:

To develop understanding in the domain of matrix theory, vector spaces, linear transformations as well as the principles underlying the subject.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Communicate and understand mathematical ideas and results with the correct use of mathematical definitions, terminology and symbols.	K1
2	Explain the concepts of base and dimension of Vector space.	K2
3	To apply the Gram-Schmidt process to construct an orthonormal set of vectors in an inner product space.	K3
4	Demonstrate competence with the basic ideas of Matrix theory, Vector spaces, Dual spaces, Linear transformation.	K3
5	Have an insight to analyze a real life problem and solve it.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Matrices	15 hours

Introduction – Addition and Scalar Multiplication of Matrices – Product of Matrices –Transpose of a Matrix – Matrix Inverse – Symmetric and Skew - Symmetric Matrices.

Unit:2	Special Matrices	15 hours

Hermitian and Skew-Hermitian Matrices – Orthogonal and Unitary Matrices – Rank of a Matrix –Characteristic Roots and Characteristic Vectors of a Square Matrix.

Unit:3	Vector Spaces	15 hours

Elementary Basic Concepts – Subspace of a Vector space - Homomorphism – Isomorphism - Internal and External direct sums - Linear span - Linear Independence and Bases.

Unit:4	Dual Spaces	15 hours

Dual Spaces – Annihilator of a subspace - Inner Product Spaces – Norm of a Vector – Orthogonal Vectors - Orthogonal Complement of a subspace – Orthonormal set.

Unit:5	Linear Transformations	15 hours

Algebra of Linear Transformations – Regular, Singular Transformations – Range of T – Rank of T - Characteristic Roots – Characteristic Vectors – Matrices.

	Total Lecture hours	**75 hours**

Text Books

1	Modern Algebra -R.Balakrishnan and M. Ramabadran.(Vikas Publishing House Pvt. Ltd, New Delhi, Second Revised Edition 1994) (For Units I & II) . **Unit I** **:** Chapter 1 Sections 1.1 to 1.3, 1.5 to 1.7 **Unit II** **:** Chapter 1 Sections 1.8 and 1.9 Chapter 2 Section 2.9 Chapter 3 Section 3.9
2	Topics in Algebra -I.N. Herstein.(John Wiley & Sons, New York, 2003.) (For Units III, IV & V) **Unit III** **:** Chapter 4 Sections 4.1 and 4.2 **Unit IV** **:** Chapter 4 Sections 4.3 and 4.4 **Unit V** **:** Chapter 6 Sections 6.1 , 6.2 and 6.3

Reference Books

1	Modern Algebra -Surjeet Singh and Qazi Zameeruddin (Vikas Publishing house, 1992.)
2	Modern Algebra -A.R.Vasishtha (Krishna Prakashan Mandir, Meerut, 1994 – 95.)
3	Linear Algebra -Seymour Lipschutz and Marc Lipson (3rd Edition, McGraw Hill, 2001.)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/106/111106135/
2	https://nptel.ac.in/courses/115/105/115105097/
3	https://nptel.ac.in/courses/111/101/111101115/
4	https://nptel.ac.in/courses/111/108/111108066/

Course Designed By: 1.Mrs.A.Karpagam

2. Mr.M.Balasankar

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	M	M	S	S	M	S	S
CO2	M	M	S	S	M	S	M	M	S	S
CO3	S	M	S	S	M	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		OPERATIONS RESEARCH - PAPER -IV	L	T	P	C
Core/Elective/Supportive		Skill Based Subject	2		-	2
Pre-requisite		Knowledge in Basics of Operations Research	Syllabus Version		2022-2023	

Course Objectives:

To enhance the students' knowledge in decision analysis, sequencing of the jobs to be carried out based on cost optimization, replacement policies and analyze the cases according to their categories.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the principles and applications of information theory.	K1
2	To understand sequencing, replacement problems.	K2
3	Demonstrate skills to achieve their objective using sequencing models.	K3
4	Apply decision making under different business environments.	K4
5	Determine a solution to a rectangular game using simplex method.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Decision Analysis	6 hours

Decision Making environment – Decisions under uncertainty – Decision under risk – Decision – Tree Analysis.

Unit:2	Sequencing Problems	6 hours

Introduction-problem of sequencing - basic terms used in sequencing- processing n-jobs through 2 machines - processing n –jobs through k machines - processing 2 jobs through k machines (Problems only).

Unit:3	Replacement Problems	6 hours

Introduction - Replacement of equipment / assets that deteriorates gradually - replacement of equipment that fails suddenly and problems.

Unit:4	Information Theory	6 hours

Introduction- A measure of Information-Axiomatic Approach to Information- Entropy-The expected information- Some properties of entropy function-Joint and conditional entropies

Unit:5	Applications	6 hours

General solution of (mxn) rectangular games using simplex method - Reliability and system failure rates using replacement problems.

	Total Lecture hours	30 hours

Text Book

1	Operations Research -Kanti Swarup, P. K. Gupta , Man Mohan (S.Chand & sons education publications ; New Delhi,2003)
Reference Books	
1	Operations Research - P K Gupta & D S Hira (S. Chand and company ltd. Ram Nagar; New Delhi,2014.)
2	Operations Research principles problems - S Dharani Venkata Krishnan (keerthi publishing house Pvt. Ltd.1994)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/117/104/117104129/
2	https://nptel.ac.in/courses/110/105/110105082/
3	https://nptel.ac.in/courses/110/106/110106045/
Course Designed By: 1. Dr.T.Narppasalai Arasu 2. Dr.P.Rajarajeswari	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	S	S	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	M
CO5	S	M	M	S	S	S	S	S	M	S

*S-Strong; M-Medium; L-Low

Elective Courses

Course code		ASTRONOMY – I	L	T	P	C
Core/Elective/Supportive		ELECTIVE I – A	5	-	-	3
Pre-requisite		Knowledge in Physics and Mathematics	Syllabus Version		2022-2023	

Course Objectives:

To enable the students to understand the Astronomical aspects and about the laws governing the planet movements.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Define properties of physical systems that comprise the known universe	K1
2	Understand the Solar system, Celestial sphere, Dip-Twilight & Kepler's laws.	K2
3	Apply their physics and mathematical skills to problems in the areas of planetary science.	K3
4	Demonstrate the skill to infer valid scientific conclusions and communicate those conclusions in a clear and articulate manner.	K4
5	Analyze the astronomical concepts.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Solar system	15 hours

General description of the Solar system. Comets and meteorites – Spherical trigonometry.

Unit:2	Celestial sphere	15 hours

Celestial sphere – Celestial co – ordinates – Diurnal motion – Variation in length of the day.

Unit:3	Geocentric parallax	15 hours

Dip – Twilight – Geocentric parallax.

Unit:4	Refraction	15hours

Refraction – Tangent formula – Cassini's formula.

Unit:5	Kepler's law	15 hours

Kepler's laws – Relation between true eccentric and mean anomalies.

	Total Lecture Hours	75 hours

Text Book

1	Astronomy-S.Kumaravelu and Susheela Kumaravelu (Text*Publisher*: Sivakasi: Janki7th Edition 1986)

Course Designed By: 1. Ms. S.Sobia

2. Mr.M.Balasankar

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	S	S	M	S	S
CO2	M	M	M	S	S	S	S	M	S	M
CO3	M	M	M	M	M	S	M	S	S	S
CO4	S	S	M	S	S	S	S	S	S	S
CO5	S	M	M	S	S	S	M	S	M	S

*S-Strong; M-Medium; L-Low

Course code		NUMERICAL METHODS - I	L	T	P	C
Core/Elective/Supportive		ELECTIVE I – B	5	-	-	3
Pre-requisite		Knowledge in Higher Secondary Level Mathematics	Syllabus Version		2022-2023	

Course Objectives:

It exposes the students to study numerical techniques to find solutions of numerical, algebraic transcendental equations, solution of simultaneous linear algebraic equations and interpolation.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Remember the concepts of errors and its effect on computation.	K1
2	Obtain numerical solutions of algebraic and transcendental equations.	K2
3	Apply the finite difference and interpolation concepts.	K3
4	Develop skills in designing mathematical models for constructing polynomials to the given data and drawing inferences.	K4
5	Analyze the efficiency of iteration methods**.**	K4

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6 -** Create

Unit:1	The Solution of Numerical Algebraic and Transcendental Equations	15 hours

Bisection method – Iteration Method – Convergence condition – Regula Falsi Method – Newton – Raphson method - Convergence Criteria – Order of Convergence.

Unit:2	Solution of Simultaneous Linear Algebraic Equations	15 hours

Gauss elimination method – Gauss Jordan method – Method of Triangularization – Gauss Jacobi method – Gauss Seidel method.

Unit:3	Finite Differences	15 hours

Differences – operators – forward and backward difference tables – Differences of a polynomial – Factorial polynomial – Error propagation in difference table.

Unit:4	Interpolation (for equal intervals)	15 hours

Newton's forward and backward formulae – equidistant terms with one or more missing values – Central differences and central difference table – Gauss forward and backward formulae – Stirling's formula.

Unit:5	Interpolation (for unequal intervals)	15 hours

Divided differences – Properties – Relations between divided differences and forward differences – Newton's divided differences formula – Lagrange's formula and inverse interpolation.

	Total Lecture hours	75 hours

Text Books	
1	Numerical methods -Kandasamy. P, Thilagavathy. K and Gunavathy. K (S. Chand and Company Ltd, New Delhi – Revised Edition 2007.)(Chapters: 3,4,5,6,7 and 8)
2	Introductory Methods of Numerical Analysis-S.S. Sastry (Prentice Hall of India Pvt. Ltd.New Delhi-110001Fourth Edition,2006)
Reference Books	
1	Numerical Methods in Science and Engineering -Venkataraman M. K.(National Publishing company V Edition 1999.)
2	Numerical Methods for Scientists and Engineers -Sankara Rao K .(2nd Edition Prentice Hall India 2004.)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://www.simumath.com/library/book.html?code=Alg_Equations_Examples
2	http://jupiter.math.nctu.edu.tw/~smchang/9602/NA_lecture_note.pdf http://www.iosrjournals.org/iosr-jm/papers/Vol6-issue6/J0665862.pdf
3	https://nptel.ac.in/courses/122/102/122102009/ https://nptel.ac.in/courses/111/107/111107105/
Course Designed By: 1. Dr.C.Janaki 2. Dr.P.Rajarajeswari	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	S	M	M	S	M	S	S
CO2	S	S	S	M	S	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	M	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code		ASTRONOMY II	L	T	P	C
Core/Elective/Supportive		ELECTIVE II – A	5	-		3
Pre-requisite		Knowledge in Physics & Mathematics	Syllabus Version		2022-2023	

Course Objectives:

To enable the students to learn about the interesting facts of Moon, Sun Planetary Motion.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts of precession and nutation.	K1
2	Describe the eclipse of the moon.	K2
3	Find equation of time.	K3
4	Demonstrate the ability to analyze the concepts.	K4
5	Describe the properties of stellar system.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Time	15 hours

Equation of time – Conversion of time – Seasons – Calendar.

Unit:2	Aberration	15 hours

Annual Parallax – Aberration.

Unit:3	Precession	15 hours

Precession – Nutation.

Unit:4	Eclipses	15 hours

The Moon – Eclipses.

Unit:5	The Stellar System	15 hours

Planetary Phenomenon – The Stellar system.

	Total Lecture hours	75 hours

Text Book

1	Astronomy-Mr.S.Kumaravelu and Susheela Kumaravelu**. (**Text *publisher*: Sivakasi: Janki,7th edition,1986)

Course Designed By: 1. Ms. S.Sobia

2. Mr.M.Balasankar

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	M	M	S	S
CO2	M	M	S	M	M	S	M	M	M	S
CO3	M	M	S	S	S	S	M	S	S	S
CO4	S	M	S	S	S	S	M	S	S	S
CO5	S	M	S	S	M	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code		Numerical Methods II	L	T	P	C
Core/Elective/Supportive		ELECTIVE II-B	5	-	-	3
Pre-requisite		Knowledge in Higher Secondary Level Mathematics	Syllabus Version		2022-2023	

Course Objectives:

1. To equip the learners with the powerful tool for numerical differentiation, numerical integration, difference equation, numerical solution to O.D.E.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Familiarize with numerical integration and differentiation, numerical solution of ordinary differential equations.	K1
2	Distinguish methods of Taylor series, Euler's, Modified Euler's and Runge Kutta methods to find solutions of differential equations.	K2
3	Apply the techniques for enormous application in the field of Science and some fields of Engineering.	K3
4	Compute the integrals and derivatives by using the appropriate technique.	K4
5	Find the numerical solution of second order O.D.E by finite difference method.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Numerical Differentiation**	**15 hours**

Newton's forward and backward formulae to compute the derivatives – Derivative using Stirling's formulae – to find maxima and minima of the function given the tabular values.

Unit:2	**Numerical Integration**	**15 hours**

Newton – Cote's formula – Trapezoidal rule – Simpson's 1/3 rd and 3/8 th rules.

Unit:3	**Difference Equation**	**15 hours**

Order and degree of a difference equation – solving homogeneous and non – homogeneous linear difference equations.

Unit:4	**Numerical Solution Of O.D.E**	**15 hours**

Taylor series method – Euler's method – improved and modified Euler method – Runge Kutta method (Second &fourth order Runge Kutta method only)

Unit:5	**Multi Step Methods**	**15 hours**

Milne's predictor corrector formulae – Adam-Bash forth predictor corrector formulae – solution of ordinary differential equations by finite difference method (for second order O.D.E).

	Total Lecture hours	**75 hours**

Text Books

1	Numerical methods - Kandasamy. P, Thilagavathy. K and Gunavathy. K (S. Chand and Company Ltd, New Delhi – Revised Edition 2007.)(Chapters: 9,10,11,Appendix and Appendix E)
2	Introductory Methods of Numerical Analysis-S.S. Sastry (Prentice Hall of India Pvt. Ltd.NewDelhi-110001Fourth Edition,2006)
Reference Books	
1	Numerical Methods in Science and Engineering -Venkataraman M. K.(National Publishing company V Edition 1999.)
2	Numerical Methods for Scientists and Engineers -Sankara Rao K. (Prentice Hall India , 2nd Edition 2004)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://nptel.ac.in/courses/104101002/downloads/lecturenotes/module1/chapter6.pdf https://www.britannica.com/science/difference-equation
2	https://nptel.ac.in/courses/122/102/122102009/
3	https://nptel.ac.in/courses/111/107/111107063/
Course Designed By: 1. Dr.C.Janaki 2. Dr.P.Rajarajeswari	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	S	S	S	S	M	S	S
CO2	M	M	S	S	M	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	M	M	S	M	S	S	S
CO5	S	M	S	M	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		GRAPH THEORY	L	T	P	C
Core/Elective/Supportive		ELECTIVE III - A	5	-	-	4
Pre-requisite		Knowledge In Basic Mathematics	Syllabus Version	2022-2023		

Course Objectives:

Enables the students to learn the basic concepts of Graphs, sub-graphs, Eulerian graphs, Digraphs, tournaments, connectivity, graphs, matrix representation of graphs, trees, planar graphs.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify the properties of different types of graph and their application.	K1
2	Demonstrate knowledge of basic concepts in graph theory	K2
3	Understand cut graphs, cycle spaces	K2
4	Apply principles and concepts of graph theory in practical situations.	K3
5	Analyze the concepts of Planar graphs.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Graphs	15 hours

Graphs –Sub graphs – Degree of a vertex walks, paths and cycles in a Graphs – connectedness cut vertex and cut edge.

Unit:2	Euler and Hamiltonian Graphs	15 hours

Euler and Hamiltonian Graphs – Algorithm for Euler circuits – Bipartite Graphs –Trees.

Unit:3	Cut set graphs	15 hours

Matrix representation of a graph – vector spaces, associated with a graph – cycle spaces and cut set graphs.

Unit:4	Planar graphs	15 hours

Planar graphs – Euler's theorem on planar graphs – characterization of planar graphs (no proofs) of the difficult part of the characterization.

Unit:5	Directed graphs	15 hours

Directed graphs – Connectivity – Euler Digraphs – Tournaments.

	Total Lecture hours	75 hours

Text Book

1. A First Course in Graph Theory - A.*Choudum* (Macmillan,2001) Chapters 1 to 7.

Reference Books

1. Graph theory with applications to Engineering and computer science-Narsingh Deo (Prentice Hall of India1979).

2	Graph Theory -Frank Harary (Narosa Publishing HQCK 2001 **).**
3	Introduction to Graph Theory- Dr. M. Murugan.(Muthali Publishing House,2005)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/106/111106102/
2	https://www.digimat.in/nptel/courses/video/106104170/L19.html
Course Designed By: 1. Dr.T.Narppasalai Arasu 2. Dr.C.Janaki	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	S	S	M	S	S
CO2	M	M	M	S	S	S	M	M	M	S
CO3	M	M	M	S	M	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	M	S	M	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code		AUTOMATA THEORY AND FORMAL LANGUAGES	L	T	P	C
Core/Elective/Supportive		ELECTIVE III - B	5	-	-	4
Pre-requisite		Knowledge in Mathematics	Syllabus Version	2022-2023		

Course Objectives:

To impart knowledge in Finite automata, regular languages, regular grammars, context free grammars, languages, and pushdown automata which play a crucial role to Identify different formal language classes and their relationship.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquire a fundamental understanding of the core concepts in automata theory and formal languages.	K1
2	Design grammars and automata for different language classes.	K2
3	Describe the types of grammar and derivation tree.	K2
4	To apply context-free languages, push-down automata.	K3
5	Design automata, regular expressions and context-free grammars accepting or generating a certain language.	K4

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6** – Create

Unit:1	**Phrase Structure Languages.** .	**15 hours**

Introduction – phrase structure languages.

Unit:2	**Closure Operations**	**15 hours**

Closure operations.

Unit:3	**Context Free Languages.**	**15 hours**

Context free languages.

Unit:4	**Finite State Automata**	**15 hours**

Finite state automata.

Unit:5	**Push Down Automata.**	**15 hours**

Push down automata.

	Total Lecture hours	**75 hours**

Text Book	
1	Formal Languages and Automata- Rani Siromoney. (Revised edition 1984) (Published by the Christian Literary Society, Madras-3) Chapters 1 to 6.
Reference Books	
1	Formal languages and their relation automata-J.E. Hopcroft and D.Ullman (Addison Wesley1969)
2	Automata theory: Machines and Languages-Richard .Y.Kain (McGraw Hill1972)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/103/106103070/
2	https://www.digimat.in/nptel/courses/video/111103016/L02.html
Course Designed By: 1. Dr.T.Nandhagopal 2. Ms.S.Kavunthi	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	M	M	S	S
CO2	S	M	S	S	S	S	M	M	M	S
CO3	M	M	S	S	S	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		PROGRAMMING IN C++	L	T	P	C
Core/Elective/Supportive		ELECTIVE III - C	4	-		3
Pre-requisite		Knowledge in C Programming	Syllabus Version		2022-2023	

Course Objectives:

To enable the students to learn about the class structure, operators, inheritance, polymorphism, file handling.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know about class structure, member functions & data members, inheritance types and example problems.	K1
2	Understand how **C++** improves C with object-oriented features.	K2
3	Develop programming skills.	K2
4	To make use of objects and classes for developing programs.	K3
5	Build C++ classes.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Tokens, Expressions and Control Structures	12 hours

Evolution of C++ - applications of C++ - structure of C++ program. Tokens – keywords – identifiers and constants – basic data types – user-defined data types – constant pointers and pointers to constants – symbolic constants –type compatibility – declaration of variables – dynamic initialization of variables – reference variables – operators in C++ - scope resolution operator – memory management operators – manipulators – type cast operator – expressions and their types – special assignment expressions – implicit conversions – operator precedence.

Unit:2	Functions in C++	12 hours

The main function – function prototyping – call by reference – return by reference – inline functions – default arguments – const arguments – function overloading. Managing Console, I/O Operations: C++ streams – C++ stream classes – unformatted console I/O operations – formatted console I/O operations –managing output with manipulators.

Unit:3	Classes and Objects	12 hours

Specifying a class – defining member functions – making an outside function inline – nesting of member functions – private member functions – arrays within a class – memory allocation for objects –arrays of objects – objects as function arguments – friend functions – returning objects – const member functions. Constructors and Destructors: Introduction – constructors – parameterized constructors – multiple constructors in a class – constructors with default arguments – copy constructor.

Unit:4	Operator Overloading	12 hours
Introduction – defining operator overloading – overloading unary operators – overloading binary operators - overloading binary operators using friends – rules for overloading operators.		
Unit:5	**Inheritance**	**12 hours**
Introduction – defining derived classes – single inheritance – making a private member inheritable – multilevel inheritance – multiple inheritance – hierarchical inheritance – hybrid inheritance.		
	Total Lecture hours	**60 hours**

Text Books

1	Object Oriented programming with C++- E.Balagurusamy (McGraw Hill 3rd Edition 2006.)
2	Object oriented programming in Turbo C++-Robert Lafore (Galgotia publications Pvt.Ltd, New Delhi- 110002,2002)
3	The C++ programming language- Bjarne Stroustrup (II Edition, Addison Wesley, 1991.)

Reference Books

1	Programming with C++ - D. Ravi Chandran (Tata McGraw-Hill publishing company limited, New Delhi 1996)
2	Object Oriented Programming with ANSI and Turbo C++- Ashok N. Kamthane (Pearson Education publishers 2003)
3	Programming with C++ - John R.Hubbard (2nd Edition, TMH publishers 2002).

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/105/106105151/
2	https://nptel.ac.in/courses/106/101/106101208/
3	https://www.classcentral.com/course/swayam-programming-in-c-6704

Course Designed By: 1. Dr.T.Narppasalai Arasu

2. Dr.P.Rajarajeswari

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	M	S	M	S	S
CO2	M	M	M	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	M	S	S	S
CO4	S	S	S	M	S	S	S	S	S	S
CO5	S	S	S	M	S	M	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		PROGRAMMING IN C++ (PRACTICAL)	L	T	P	C
Core/Elective/Supportive		ELECTIVE III - C(Practical)	-	-	1	1
Pre-requisite		Knowledge in C++	Syllabus Version		2022-2023	

PRACTICAL LIST

1. Write a function ‘power( )’to raise a number ‘m’ to a power ‘n’. The function takes a ‘double’ value for ‘m’ and ‘int’ value for ’n’, and returns the result correctly. Use a default vale of 2 for ‘n’ to make the function to calculate squares when this argument is omitted. Write a main( ) that gets the values of ‘m’ and ‘n’ from the user to test the function.

2. Write a program to compute compound interest of a given amount AMT for ‘n’ years. Use function overloading so that the program gets input of interest rate RATE in any of the data type ‘float’ or ‘int’

3. Create a class which consist of employee detail ENO, ENAME, DEPT, BASIC SALARY. Write a member function to get and display them. Derive a class PAY from the above class and write a member function to calculate DA, HRA and PF depending on the grade and display the pay slip in a neat format using console I/O

4. Define two classes POLAR and RECTANGLE to represent points in the polar and rectangle system. Write a program to convert from one system to another.

5. Create a class FLOAT that contains one float data member. Overload all the four arithmetic operators so that they operate on the objects of FLOAT.

Course code		NUMBER THEORY	L	T	P	C
Core/Elective/Supportive		ELECTIVE III – D	5	-	-	4
Pre-requisite		Knowledge in Algebra	Syllabus Version		2022 – 2023	

Course Objectives:

To impart knowledge in the basic concepts of number theory, fundamental definitions, theorems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts of divisibility and primes	K1
2	Solve congruence.	K2
3	Describe the fundamental theorem of Arithmetic.	K3
4	Understand the concepts and apply the theorems in areas of Mathematics.	K3
5	Compute powers of integers modulo prime numbers.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Early Number Theory	15 hours

Peano's Axiom - Mathematical Induction - The Binomial Theorem - Early Number Theory.

Unit:2	Divisibility Theory in Integers	15hours

Divisibility Theory in Integers - The Division Algorithm - The g.c.d. - Euclidean Algorithm - The Diophantine Equation ax + by = c

Unit:3	Primes and their Distributions	15 hours

Primes and their Distributions - The Fundamental Theorem of Arithmetic - The sieve of Eratosthenes - The Gull Conjecture.

Unit:4	The Theory of Congruence	15 hours

The Theory of Congruence - Basic Properties of Congruence - Special Divisibility test - Linear Congruence-Prime modulus- Power residues.

Unit:5	Fermat's Theorem	15 hours

Fermat's Theorem - Fermat's factorization method - The Little theorem - Wilson's theorem.

	Total Lecture hours	75 hours

Text Book	
1	Elementary Number theory -David M. Burton (W.M.C. Brown Publishers, Dubuque, Lawa, 1989.)
Reference Books	
1	An Introduction to theory of Numbers -Ivan Niven and H. Zuckerman (5^{th} edition,Wiley 1991)
2	Elements of Number Theory - Prof. S.Kumaravelu and Susheela Kumaravelu (Raja Sankar offset Printers , Siva kasi, 2002)
3	Beginning Number Theory -Neville Robinns (2^{nd} Ed., Narosa Publishing House Pvt. Ltd., Delhi, 2007)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/103/111103020/ https://nptel.ac.in/courses/111/101/111101137/
Course Designed By: 1.Dr.C.Janaki 2. Dr.M.Anandhi	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	M	M	S	S
CO2	S	S	S	M	S	S	S	M	M	S
CO3	M	M	M	M	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code		INTRODUCTION TO INDUSTRY 4.0	L	T	P	C
Core/Elective/Supportive		ELECTIVE III – E	5	-	-	4
Pre-requisite		Basic Knowledge of Computer and Internet	Syllabus Version		2022-2023	

Course Objectives:

To impart knowledge on Industry 4.0, need for digital transformation and the following Industry 4.0 tools:

1. Artificial Intelligence
2. Big Data and Data Analytics
3. Internet of Things

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the reason for adopting Industry 4.0 and Artificial Intelligence.	K1
2	Understand the need for digital transformation.	K2
3	Apply the industry 4.0 tools.	K3
4	Analyze the applications of Big Data	K4
5	Examine the applications and security of IoT Applications.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Industry 4.0	15 hours

Need – Reason for Adopting Industry 4.0 - Definition – Goals and Design Principles - Technologies of Industry 4.0 – Big Data – Artificial Intelligence (AI) – Industrial Internet of Things - Cyber Security – Cloud – Augmented Reality.

.

Unit:2	Artificial Intelligence	15 hours

Artificial Intelligence: Artificial Intelligence (AI) – What & Why? - History of AI - Foundations of AI -The AI -environment - Societal Influences of AI - Application Domains and Tools - Associated Technologies of AI - Future Prospects of AI - Challenges of AI.

Unit:3	Big Data and IoT	15 hours

Big Data : Evolution - Data Evolution - Data : Terminologies - Big Data Definitions - Essential of Big Data in Industry 4.0 - Big Data Merits and Advantages - Big Data Components : Big Data Characteristics - Big Data Processing Frameworks - Big Data Applications - Big Data Tools - Big Data Domain Stack : Big Data in Data Science - Big Data in IoT - Big Data in Machine Learning - Big Data in Databases - Big Data Use cases Big Data in Social Causes - Big Data for Industry -Big Data Roles and Skills -Big Data Roles - Learning Platforms; Internet of Things (IoT) : Introduction to IoT - Architecture of IoT - Technologies for IoT - Developing IoT Applications - Applications of IoT - Security in IoT .

Unit:4	**Applications and Tools of Industry 4.0**	**15 hours**
Applications of IoT – Manufacturing – Healthcare – Education – Aerospace and Defense – Agriculture – Transportation and Logistics – Impact of Industry 4.0 on Society: Impact on Business, Government, People. Tools for Artificial Intelligence, Big Data and Data Analytics, Virtual Reality, Augmented Reality, IoT, Robotics.		
Unit:5	**Jobs 2030**	**15 hours**
Industry 4.0 – Education 4.0 – Curriculum 4.0 – Faculty 4.0 – Skills required for Future - Tools for Education – Artificial Intelligence Jobs in 2030 – Jobs 2030 - Framework for aligning Education with Industry 4.0 .		
	Total Lecture hours	**75 hours**

Text Book

1	Higher Education for Industry 4.0 and Transformation to Education 5.0 (2021) - P.Kaliraj & T. Devi

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/105/106105195/

Course Designed By: 1.Dr.C.Janaki
2 Dr.T.Nandhagopal

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	S	S	M	S	S
CO2	M	M	M	S	S	S	S	M	M	S
CO3	S	S	S	S	S	S	S	S	S	M
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	M	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

B. Sc.MATHEMATICS

Syllabus

(2021-2022)

Program Code : 22A

DEPARTMENT OF MATHEMATICS

(Affiliated Colleges)

Bharathiar University

(A State University, Accredited with "A" Grade by NAAC and 13th Rank among Indian Universities by MHRD-NIRF)

Coimbatore 641 046, INDIA

Program Educational Objectives (PEOs)	
The **B. Sc. Mathematics** program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	Acquire knowledge in functional areas of Mathematics and apply in all the fields of learning.
PEO2	Recognise the need for life long learning and demonstrate the ability to explore some mathematical content independently.
PEO3	Employ mathematical ideas encompassing logical reasoning ,analytical, numerical ability , theoretical skills to model real-world problems and solve them.
PEO4	Develop critical thinking ,creative thinking, self confidence for eventual success in career.
PEO5	Analyze , interpret solutions and to enhance their Entrepreneurial skills, Managerial skill and leadership
PEO6	To prepare the students to communicate mathematical ideas effectively and develop their ability to collaborate both intellectually and creatively in diverse contexts.
PEO7	Rewarding careers in Education, Industry, Banks, MNCs and pursue higher studies

Program Specific Outcomes (PSOs)	
After the successful completion of **B. Sc. Mathematics** program, the students are expected to	
PSO1	Maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for extended learning.
PSO2	Identify the applications of Mathematics in other disciplines and society.
PSO3	Develop an in-depth knowledge in Mathematics appreciating the connections between theory and its applications .
PSO4	Demonstrate their mathematical modeling ability, problem solving skills, creative talent and power of communication necessary for various kinds of employment.
PSO5	Develop mathematical aptitude and the ability to think abstractly.
PSO6	Learn independently and improve ones performance.
PSO7	Students are equipped to appear competitive examinations.

Program Outcomes (POs)	
On successful completion of the **B. Sc. Mathematics** program	
PO1	Students are empowered with analytical and logical skills-to formulate results and construct mathematical argument.
PO2	Ability to organize, analyze and interpret data accurately in both academic and non -academic context.
PO3	Demonstrate effective communication of mathematical ideas and creative thinking skills to facilitate solving real world problems as a team and independently.
PO4	Appreciate and identify the connections between Mathematics and other disciplines.
PO5	Competency to obtain employment in education , public and private sectors..
PO6	Identify the area of interest for extended learning from the understanding gained from the domain and allied areas of Mathematics.
PO7	Develop mathematical aptitude and make critical observations.
PO8	Garner innovative ideas to face global challenges.
PO9	Instill a sense of responsibility in tackling professional and social issues ethically.
PO10	Trigger their passion for research in unexplored areas of Mathematics.

BHARATHIAR UNIVERSITY:COIMBATORE 641 046

B. Sc. Mathematics Curriculum (Affiliated Colleges)
(CBCS PATTERN)

(*For the students admitted from the academic year **2021-2022** and onwards*)

Scheme of Examination

Part	Title of the Course	Hours/ Week	Examination				Credits
			Duration in Hours	Maximum Marks			
				CIA	CEE	Total	
	Semester I						
I	Language - I	6	3	50	50	100	4
II	English - I	6	3	50	50	100	4
III	Core Paper I - Classical Algebra	4	3	50	50	100	4
III	Core Paper II-Calculus	5	3	50	50	100	4
III	Allied A : Paper I Chosen by the college	7	3	50	50	100	4
IV	Environmental Studies*	2	3	-	50	50	2
	Total	**30**		**250**	**300**	**550**	**22**
	Semester II						
I	Language – II	6	3	50	50	100	4
II	English – II	6	3	50	50	100	4
III	Core Paper III - Analytical Geometry	4	3	50	50	100	4
III	Core Paper IV-Trigonometry, Vector Calculus and Fourier Series	5	3	50	50	100	4
III	Allied A: Paper II Chosen by the College	7	3	50	50	100	4
IV	Value Education – Human Rights*	2	3	-	50	50	2
	Total	**30**		**250**	**300**	**550**	**22**
	Semester III						
I	Language – III	6	3	50	50	100	4
II	English – III	6	3	50	50	100	4
III	Core Paper V- Differential Equations and Laplace Transforms.	3	3	50	50	100	4
III	Core Paper VI- Statics	3	3	50	50	100	4
III	Allied B : Paper I – Chosen by the college	7	3	30	45	75	3
IV	Skill based Subject - Operations Research -I	3	3	30	45	75	3

IV	Tamil** / Advanced Tamil* (OR) Non-major elective - I (Yoga for Human Excellence)* / Women's Rights*	2	3		50	50	2
	Total	**30**		**260**	**340**	**600**	**24**
	Semester IV						
I	Language – IV	5	3	50	50	100	4
II	English – IV	5	3	50	50	100	4
III	Core Paper VII-Dynamics	3	3	30	45	75	3
III	Core Paper VIII- Programming in C	2	3	30	45	75	3
III	Core Paper VIII -Programming in C Practical	1	3	10	15	25	1
III	Allied B - Paper II Chosen by the college	5	3	30	45	75	3
III	Allied B - Paper II Chosen by the college (For Practical Paper)	2	3	25	25	50	2
IV	Skill based Subject - Operations Research – Paper II	2	3	25	25	50@@	2
IV	Office Fundamentals :Digital Skills for Employability http://kb.naanmudhalvan.in/Special:Filepath/Microsoft_Course_Details.xlsx	3	-	25	25	50##	2
IV	Tamil**/Advanced Tamil* (OR) Non-major elective -II (General Awareness*)	2	3		50	50	2
	Total	**30**		**275**	**375**	**650**	**26**
	Semester V						
III	Core Paper IX-Real Analysis-I	5	3	50	50	100	4
III	Core Paper X- Complex Analysis-I	6	3	50	50	100	4
III	Core Paper XI- Modern Algebra-I	6	3	50	50	100	4
III	Core Paper XII- Discrete Mathematics	5	3	50	50	100	4
III	Elective I	5	3	30	45	75	3
IV	Skill based Subject - Operations Research - Paper III	3	3	25	25	50@@	2
IV	Computational Intelligence for Employability	-	-	25	75	100	2
	Total	**30**		**280**	**345**	**625**	**23**
	Semester VI						
III	Core Paper XIII - Real Analysis-II	5	3	50	50	100	4
III	Core Paper XIV - Complex Analysis-II	5	3	50	50	100	4

III	Core Paper XV -Modern Algebra-II	5	3	50	50	100	4
III	Elective II	5	3	30	45	75	3
III	Elective III	5	3	50	50	100	4
IV	Skill Based Subject - Operations Research- Paper IV	2	3	25	25	50@@	2
IV	Project Based learning 2-Advanced Platform Technology -(Govt(auto) & Govt (Non-Auto)) / Data Analytics & Visualization - Aided (Non-auto) & SF(Non-Auto) http://kb.naanmudhalvan.in/Bharathiar_University_(BU)	3	-	25	25	50##	2
V	Extension Activities ** / Swachh Bharath @			50		50	2
	Total	**30**		**330**	**295**	**625**	**25**
	Grand Total	**180**		**1645**	**1955**	**3600**	**142**
# All computer papers have theory and practical exams							
	Theory			30	45	75	**100**
	Practicals			10	15	25	

Note

@@ University semester examination will be conducted for 50 marks (As per existing pattern of Examination) and it will be converted for 25 marks.

Naan Mudhalvan –Courses- external 25 marks will be assessed by Industry and internal will be offered by respective course teacher.

* No Continuous Internal Assessment (CIA). Only University Examinations

** No University Examinations. Only Continuous Internal Assessment (CIA).

@Swachh Bharath Internship Scheme (SBIS) is to be added for 2 credits in the extension activities.

Allied Subjects(Colleges can choose any two subjects)

1.Physics 2.Chemistry 3.Accountancy 4.Statistics.

List of Elective papers

(Colleges can choose any one of the paper as electives)

Elective – I	**A**	Astronomy- I
	B	Numerical -Methods-I
Elective – II	**A**	Astronomy—II
	B	Numerical Methods-II
Elective – III	**A**	Graph Theory
	B	Automata Theory & Formal Languages
	C	Programming in C++ #
	D	Number Theory
	E	Introduction to Industry 4.0

First Semester

Course code		CLASSICAL ALGEBRA	L	T	P	C
Core/Elective/Supportive		Core Paper – I	4	-	-	4
Pre-requisite		Knowledge of Limits	Syllabus Version		2021 - 2022	

Course Objectives:

1.To enable the students to learn Binomial ,Exponential , Logarithmic series and their application to summation of series.
2.To study intensively the convergence and divergence of different types of series.
3. To demonstrate the standard methods to solve both polynomial and transcendental type equations.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the concept of Binomial ,Exponential , Logarithmic series and their application to summation of series.	K1
2	Acquire a clear knowledge regarding methods to find an approximate roots of the equations .	K2
3	Apply the appropriate tests to find the convergence or divergence of an infinite series.	K3
4	ApplyDescartes's rule of signs to find the number of positive and negative roots if any in a polynomial equation .	K3
5	Analyze the relation between roots and coefficients of the polynomial equations.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Summation Of Series Using Binomial And Exponential Theorem	12hours

Binomial, exponential theorems-their statements only- their immediate application to summation and approximation only.

Unit:2	Logarithmic Series, Convergence And Divergence Of Series	12 hours

Logarithmic series theorem-statement and proof-Immediate application to summation and approximation only. Convergency and divergency of series –definitions, elementary results- comparison tests-De -Alembert's and Cauchy's tests.

Unit:3	Absolute Convergence Of Series	12 hours

Absolute convergence-series of positive terms-Cauchy's condensation test-Raabe's test.

Unit:4	Theory Of Equations	12 hours

Roots of an equation- Relations connecting the roots and coefficients- transformations of equations-character and position of roots-Descarte's rule of signs-symmetric function of roots-Reciprocal equations.

Unit:5	**Multiple Roots**	**12 hours**
Multiple roots-Rolle's theorem - position of real roots of f(x) =0 – Newton's method of approximation to a root – Horner's method.		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Algebra-T.K .Manicavachasam Pillai, T.Natarajan& K.S Ganapathy , (S.Viswanatham Printers & Publishers Private Ltd-2006)

Reference Books

1	Mathematics for B.Sc. Branch I -Vol. I- P. Kandasamy and K.Thilagavathy (For B.Sc-I semester) (S. Chand and Company Ltd, New Delhi, 2004.)
2	Algebra - N.P.Bali(Publisher: Laxmi Publications-New Delhi Edition 2010) .

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.brainkart.com/article/Introduction-to-Binomial,-Exponential-and-Logarithmic-series_35107/
2	http://www.jjernigan.com/172/ConvergenceDivergenceNotes.pdf
3	http://home.iitk.ac.in/~psraj/mth101/lecture_notes/Lecture11-13.pdf https://maths4uem.files.wordpress.com/2015/09/1028-infinite-series.pdf https://ocw.mit.edu/high-school/mathematics/exam-prep/concept-of-series/series-convergence-divergence/

Course Designed By: 1.Dr.C.Janaki
2.Mrs .B.Thenmozhi

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	S	S	S	M	S	S
CO2	S	M	M	M	S	S	S	M	M	S
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		CALCULUS	L	T	P	C
Core/Elective/Supportive		Core Paper – II	5	-	-	4
Pre-requisite		Higher Secondary Level Mathematics.	Syllabus Version		2021 - 2022	

Course Objectives:

To orient the students to get an idea of curvatures, Integration of different types of functions, its geometrical applications, double, triple and improper integrals.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify areas in Mathematics and other fields where Calculus is useful.	K1
2	Understand the concepts of Evolutes and Envelopes, methods to find curvatureand evolutes.	K2
3	Apply the concept of change of variables in double and triple integrals.	K3
4	Apply double , triple integral to find the area and volume respectively.	K3
5	Apply the Beta and gamma function to solve the multiple integrals.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Curvature	15hours

Curvature-radius of curvature in Cartesian and polar forms-evolutes and envelopes- Pedal equations- total differentiation- Euler's theorem on homogeneous functions.

.

Unit:2	Integration	15 hours

Integration of $f'(x)/f(x)$, $f'(x)\sqrt{f(x)}$,$[(px+q)/\sqrt{(ax^2+bx+c)}]$, $[\sqrt{(x-a)/(b-x)}]$, $[\sqrt{(x-a)(b-x)}]$,$1/[\sqrt{(x-a)(b-x)}$,$1/(a\cos x+b\sin x+c)$, $1/(a\cos^2 x+b\sin^2 x+c)$,Integration by parts-Bernoulli's Formula.

Unit:3	Evaluation Of Double And Triple Integrals	15 hours

Reduction formulae- problems- evaluation of double and triple integrals- applications to calculations of areas and volumes-areas in polar coordinates.

Unit:4	Change Of Variables In Double And Triple Integrals	15 hours

Change of order of integration in double integral- Jacobians- Change of variables in double and triple integrals.

Unit:5	Beta And Gamma Functions	15 hours

Beta and Gamma integrals-their properties, relation between them- evaluation of multiple integrals using Beta and Gamma functions - Improper Integrals.

	Total Lecture hours	75 hours

Text Book(s)

1	Calculus Vol 1 - S. Narayanan and T.K.M. Pillai. (Viswanathan Publishers 2008)
2	Calculus Vol 2- S. Narayanan and T.K.M. Pillai.(Viswanathan Publishers 2008)
Reference Books	
1	Mathematics for BSc – Vol I and. II - P. Kandasamy &K.Thilagarathy(S.Chand and Co-2004)
2	A Text book of calculus- Shanthi Narayanan &J.N.Kapoor(S.Chand& Co.2014)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://ocw.mit.edu/resources/res-18-006-calculus-revisited-single-variable-calculus-fall-2010/study-materials/ https://www.whitman.edu/mathematics/calculus_online/chapter15.html
2	https://www.khanacademy.org/math/calculus-home
3	https://www.sac.edu/FacultyStaff/HomePages/MajidKashi/PDF/MATH_150/Bus_Calculus.pdf
4	http://nptel.ac.in/courses/111104085/29
5	http://www.math.odu.edu/~jhh/Volume-1.PDF http://www.math.odu.edu/~jhh/Volume-2.PDF https://www.math.cmu.edu/~wn0g/2ch6a.pdf
6	https://nptel.ac.in/courses/111/105/111105122/http://www.staff.ttu.ee/~lpallas/multipleintegrals.pdf
Course Designed By: 1.Dr.C.Janaki 2.Mr.R.Subramanian	

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	S	S	S	S	S	S
CO2	S	M	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Second Semester

Course code		ANALYTICAL GEOMETRY	L	T	P	C
Core/Elective/Supportive		Core Paper – III	4	-	-	4
Pre-requisite		Basic Knowledge In Trigonometry &Vector Algebra.	Syllabus Version		2021 - 2022	

Course Objectives:

Emphasis to enhance student knowledge in three dimensional analytical geometry and the geometrical aspects of three dimensional figs, viz, sphere, cone and cylinder.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Gain knowledge about the regular geometrical figures and their properties.	K1
2	Describe the geometric concepts.	K2
3	Find equation to tangent, normal at a point on a conic	K3
4	Analyze condition of tangency and find the tangent plane to the central conicoid	K4
5	Analyze conics to explain natural phenomenon	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Straight Lines	12 hours

Analytical Geometry 3D-Straight lines-coplanarity of straight line-shortest distance (S.D) and equation of S.D between two lines-simple problems.

Unit:2	Sphere	12 hours

Sphere: standard equation of sphere-results based on the properties of a sphere-tangent plane to a sphere- equation of a circle.

Unit:3	System Of Spheres	12 hours

Tangency of spheres- coaxial system of spheres- radical planes- Orthogonal spheres.

Unit:4	Cone And Cylinder	12 hours

Cone whose vertex is at the origin- envelope cone of a sphere-right circular cone-equation of a cylinder-right circular cylinder.

Unit:5	Conicoid	12 hours

Nature of a conicoid- standard equation of central conicoid –enveloping cone- tangent plane-condition for tangency –director Sphere- director plane .

	Total Lecture hours	60 hours

Text Book(s)

1	Analytical Geometry - P. Durai Pandian & others (Emerald Publishers 1998).
2	Solid Geometry- N.P. Bali(Laxmi Publications (P) Ltd,2015)

Reference Books

1	Solid Geometry- M.L. Khanna(Jainath& Co Publishers, Meerut)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://www.brainkart.com/article/Three-Dimensional-Analytical-Geometry_6453/
2	http://egyankosh.ac.in/bitstream/123456789/11990/1/Unit-2.pdf
Course Designed By: 1.Dr.C.Janaki 2.Mrs .B.Thenmozhi	

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	S	S	M	S	S	S	S	S
CO2	S	M	S	S	S	S	S	M	S	S
CO3	S	M	S	M	M	M	S	S	S	S
CO4	S	M	S	S	M	S	M	S	S	S
CO5	S	S	S	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		TRIGONOMETRY, VECTOR CALCULUS AND FOURIER SERIES	L	T	P	C
Core/Elective/Supportive		Core Paper – IV	5	-	-	4
Pre-requisite		Knowledge In Vector Algebra, Differentiation, Integration	Syllabus Version		2021 - 2022	

Course Objectives:

To enable the students to learn about the expansion of trigonometric, hyperbolic functions, vector calculus and the expansions of Fourier series .

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the expansion of trigonometric functions and hyperbolic functions .	K1
2	Acquire the basic knowledge of vector differentiation and vector integration.	K2
3	Determine and apply the important quantities associated with vector fields such as the divergence,curl and scalar potential.	K3
4	Understand and find Fourier series of a given periodic function.	K3
5	Examine line integral, surface integral ,volume integral and inter-relations among them .	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Expansion In Series	15 hours

Expansion in Series – Expansion of $\cos^n\theta$, $\sin^n\theta$ in a series of cosines and sines of multiples of θ – Expansions of $\cos n\theta$, $\sin n\theta$ and $\tan n\theta$ in powers of sines , cosines and tangents – Expansion of sin θ, cos θ and tan θ in powers of θ – hyperbolic functions and inverse hyperbolic functions.

Unit:2	Logarithm Of Complex Quantities And Summation Of Series	15 hours

Logarithm of complex quantities - summation of series – when angles are in arithmetic progression – C + iS,method of summation – method of differences.

Unit:3	Vector Differentiation	15 hours

Scalar and vector fields –Differentiation of vectors – Gradient, Divergence and Curl-Solenoidal and irrotational vectors-Laplacian Operator.

Unit:4	Vector Integration	15 hours

Integration of vectors – line integral – surface integral – Green's theorem in the plane – Gauss divergence theorem – Stoke's theorem – (Statements only) - verification of the above said theorems.

Unit:5	Fourier Series	15 hours

Periodic functions – Fourier series of periodicity 2π – half range series.

	Total Lecture hours	**75 hours**

Text Book

1	Mathematics for B.Sc. Branch I, Volume I, II and IV - P.Kandasamy&K.Thilagavathi(S.Chand and Company Ltd, New Delhi, 2004.)

Reference Books

1	Vector Analysis -P. Duraipandian, Laxmiduraipandian (Revised Edition-Reprint 2005 Emerald Publishers)
2	Trigonometry -T.K. Manichavasagam Pillai and S.Narayanan(Viswanathan Publishers and Printers Pvt. Ltd 2009.)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	http://www.math.odu.edu/~jhh/Volume-2.PDF http://www-math.mit.edu/~djk/18_01/chapter20/section03.html https://www.whitman.edu/mathematics/calculus_online/chapter16.html http://www.mecmath.net/calc3book.pdf
2	http://www.nptelvideos.in/2012/11/mathematics-iii.html
3	https://nptel.ac.in/courses/111107108/1

Course Designed By: 1.Dr.C.Janaki
2.Mr.R.Subramanian

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	S	S	M	M	S	S
CO2	S	M	S	S	M	M	M	S	M	S
CO3	S	M	S	S	M	M	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	M
CO5	S	S	S	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Third Semester

Course code		DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS	L	T	P	C
Core/Elective/Supportive		Core Paper – V	3	-	-	4
Pre-requisite		Knowledge Of Ordinary And Partial Derivatives	Syllabus Version		2021 - 2022	

Course Objectives:

To impart knowledge on the method of solving ordinary differential Equations of First Order and Second Order, Partial Differential equations, Laplace Transforms, its inverse and application of Laplace Transform to solve the first and second Order Differential Equations with constant coefficients.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquire knowledge to solve Differential and Partial Differential Equations.	K1
2	Solve higher order linear differential equations.	K2
3	Expose differential equation as a powerful tool in solving problems in Physical and Social sciences.	K3
4	Demonstrate competency to solve linear PDE by Lagrange's method	K3
5	Analyze the concepts of Laplace transforms and inverse Laplace transforms to solve ODE with constant coefficients.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Differential Equation Of First Order And Higher Degree.	9hours

Ordinary Differential Equations: Equations of First Order and of Degree Higher than one – Solvable for p, x, y– Clairaut's Equation – Simultaneous Differential Equations with constant coefficients of the form

i) $f_1(D)x + g_1(D)y = \varphi_1(t)$

ii) $f_2(D)x + g_2(D)y \ \varphi_2(t)$ where f_1 , g_1 , f_2 and g_2 are rational functions D=d/dt with constant coefficients and φ_1 , φ_2 explicit functions of tand explicit functions of t.

Unit:2	Higher Order Linear Differential Equation	9hours

Finding the solution of Second and Higher Order with constant coefficients with Right Hand Side is of the form Ve^{ax} where V is a function of x – Euler's Homogeneous Linear Differential Equations.

Unit:3	Partial Differential Equations	9 hours

Partial Differential Equations: Formation of equations by eliminating arbitrary constants and arbitrary functions – Solutions of P.D Equations – Solutions of Partial Differential Equations by direct integration – Methods to solve the first order P.D. Equations in the standard forms – Lagrange's Linear Equations.

Unit:4	Laplace Transforms	9 hours

Laplace Transforms: Definition – Laplace Transforms of standard functions – Linearity property – First Shifting Theorem – Transform of tf(t), , f (t)/t, $f^{'}(t)$, $f^{''}(t)$.		
Unit:5	**Inverse Laplace Transforms**	**9 hours**
Inverse Laplace Transforms – Applications to solutions of First Order and Second Order Differential Equations with constant coefficients.		
	Total Lecture hours	**45 hours**

Text Book

1	Mathematics for B.Sc – Branch – I Volume III-P.Kandasamy&K.Thilagavathi (S. Chand and Company Ltd, New Delhi, 2004.)

Reference Books

1	Calculus Vol III -S. Narayanan and T.K. Manickavasagam Pillai, (S. Viswanathan Printers and Publishers Pvt. Ltd, Chennai 1991)
2	Differential Equations -N.P. Bali(Laxmi Publication Ltd, New Delhi, 2004)
3	Laplace and Fourier Transforms-Dr. J. K. Goyal and K.P. Gupta(PragatiPrakashan Publishers, Meerut, 2000)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://**nptel**.ac.in/courses/111105035/
2	http://www.nptelvideos.in/2012/11/mathematics-iii.html https://www.digimat.in/nptel/courses/video/111108081/L02.html
3	https://www.math.ust.hk/~machas/differential_equations.pdf. https://www.ijsr.net/archive/v2i1/ijsron2013331.pdf https://www.whitman.edu/mathematics/calculus_online/chapter17.html

Course Designed By: 1.Dr.C.Janaki
2.Mr.R.Subramanian

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	S	M	S	M	M	S	S
CO2	S	M	S	S	S	S	M	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	M	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		STATICS	L	T	P	C
Core/Elective/Supportive		Core Paper – VI	3	-		4
Pre-requisite		Basic Knowledge In Vector Algebra &Trigonometric Functions	Syllabus Version		2021 - 2022	

Course Objectives:

1.To enable the students to realize the nature of forces and resultant forces when more than one force acts on a particle.

2.To know about the conditions of equilibrium of couples and coplanar forces.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Remember the various laws.	K1
2	Understand the concepts of forces and moments.	K2
3	Understand the concepts of equilibrium .	K2
4	Apply the concepts of forces and moments.	K3
5	Analyze the basics of coplanar forces , equilibrium of forces acting on a rigid body and solve the problems.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Law Of Forces	9 hours

Forces acting at a point – Parallelogram law-triangle law –Converse of Triangle law-Polygon Law of Forces- Lami's Theorem. .

Unit:2	Resolution And Components Of Forces	9 hours

(λ- μ) theorem –Resolution of forces- Components of a force- Resultant of any number of Coplanar forces acting at a point- Conditions of equilibrium.

Unit:3	Parallel Forces ,Moment And Couple	9 hours

Parallel Forces and Moments –Resultant of two parallel forces (Like and unlike)-Conditions of equilibrium of three coplanar forces- Moment of a force- Geometrical representation-Sign of the moment- Unit of moment – Varignon's Theorem on couples-Equilibrium of two couples- Equivalence of two couples.

Unit:4	Forces Acting On A Rigid Body	9 hours

Moment of a force about a point-Varignon's Theorem - Coplanar forces acting on a rigid body – Theorem on three coplanar forces in equilibrium .

Unit:5	General Conditions of Equilibrium Of A System Of Co-planar Forces	9 hours

Reduction of a system of coplanar forces to a single force and a couple - necessary & sufficient conditions of equilibrium only – Equation to the line of action of the resultant.

	Total Lecture hours	**45 hours**

Text Book

1	Statics -M.K.Venkataraman(Agasthiar Publications, Trichy, 1999.)

Reference Books

1	Statics -A.V.Dharmapadam.(S.Viswanathan Printers and Publishing Pvt., Ltd, 1993.)
2	Mechanics -P.Duraipandian and Laxmi Duraipandian.(S.Chand and Company Ltd, Ram Nagar, New Delhi -55, 1985.)
3	Statics -Dr.P.P.Gupta(Kedal Nath Ram Nath, Meerut, 1983-84)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/112/105/112105164/
2	https://nptel.ac.in/courses/122/102/122102004/
3	https://www.khanacademy.org/science/ap-physics-1

Course Designed By: 1.Dr.C.Janaki
2.Dr. Renu Thomas

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	M	M	M	S	S	M	M	S	S
CO2	S	M	S	S	M	M	M	M	M	S
CO3	S	M	S	S	M	M	M	S	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		Operations Research – Paper I	L	T	P	C
Core/Elective/Supportive		Skill Based Subject	3	-	-	3
Pre-requisite		Knowledge In Basic Mathematical Concepts	Syllabus Version	2021 - 2022		

Course Objectives:

To familiarize students with the basic concepts ,models and techniques for effective decision making ,model formulation and applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the basic concepts and application of operations researchin various fields.	K1
2	Know principles of construction of mathematical models of conflicting situations.	K2
3	Analyze the relationship between a linear program and its dual.	K3
4	Apply techniques constructively to make effective decisions in business and solve problems in industry.	K3
5	Build and solve transportation problems.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Basics Of Operations Research &Formulation Of L.P.P	9 hours

Basics of O.R – Definition of O.R – Characteristics of O.R - Scientific methods in O.R – Necessary of O.R in Industry – O.R and Decision Making – Scope of O.R in Modern Management–Uses and limitations of O.R. Linear Programming Problem – Formulation of L.P.P.

Unit:2	Linear Programming Problem -Simplex method	9 hours

Graphical solutions of L.P.P – Problems. Simplex Method – Problems.

Unit:3	Big-M &Two Phase Method	9 hours

Charne's Penality Method (or) Big – M Method - Two Phase Simplex method – Problems.

Unit:4	Duality In L.P.P	9 hours

Duality in L.P.P – Concept of duality – Duality and Simplex Method – Problems .

Unit:5	Transportation Model	9 hours

The transportation Problems – Basic feasible solution by L.C.M – NWC- VAM- optimum solutions – unbalanced Transportation problems.

	Total Lecture hours	45 hours

Text Book

1	Operations Research – Kantiswarup, P. K. Gupta, Man Mohan(S. Chand & Sons Education Publications, New Delhi, 12th Revised edition-2003)
Reference Books	
1	Operations Research – Prem Kumar Gupta D. S. Hira(S. Chand & Company Ltd, Ram Nagar, New Delhi ,2014)
2	Operations Research Principles and Problems- S. Dharani Venkata Krishnan(Keerthi publishing house PVT Ltd.1994)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/102/111102012/
2	https://nptel.ac.in/courses/111/104/111104027/
Course Designed By: 1.Dr.C.Janaki 2.Dr.M.S. Annie Christi	

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	M	M	M	S	S
CO2	S	M	S	S	S	S	S	M	M	S
CO3	S	S	S	S	M	M	S	S	S	S
CO4	S	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Fourth Semester

Course code		DYNAMICS	L	T	P	C
Core/Elective/Supportive		Core Paper-VII	3	-	-	3
Pre-requisite		Knowledge In Forces And Vector Algebra	Syllabus Version	2021 – 2022		

Course Objectives:

To impart knowledge about the projectile, Simple Harmonic Motion and understanding the notions of impact between two smooth spheres.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Remember the basic kinematics and dynamic concepts.	K1
2	Describe the differential equation of Central Orbits .	K2
3	Apply the concepts of projectiles to solve problems relating to the motion of a projectile .	K3
4	To understand &apply the concepts of composition of simple harmonic motion in two directions .	K3
5	Understand impulsive forces and analyze loss of K.E due to direct and oblique impact.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Projectiles	9hours

Path of a projectile-Greatest height-time of flight – Range -range on an inclined plane through the point of projection-Maximum range.

Unit:2	Central Orbits	9 hours

Radial and transverse components of velocity and acceleration – areal velocity of central orbits - Differential equation of central orbit in polar coordinates only.

Unit:3	Simple Harmonic Motion	9 hours

Amplitude, periodic time, phase-composition of two simple harmonic motions of the same period in a straight line and in two perpendicular lines.

Unit:4	Collision Of Elastic Bodies-Direct Impact Of Spheres	9 hours

Impulsive force – Newton's experimental law- Principle of conservation of momentum- Direct Impact on a smooth fixed plane -Direct impact of two smooth spheres- loss of kinetic energy during direct impact.

Unit:5	Oblique Impact Of Spheres	9 hours

Oblique impact of a smooth sphere on fixed smooth plane – oblique impact of two smooth spheres - Loss of Kinetic energy during oblique impact.

	Total Lecture hours	45 hours

Text Book	
1	Dynamics -M.K.Venkataraman(11th Ed. Agasthiar Publications, Trichy, 1994.)
Reference Books	
1	Dynamics -A.V.Dharamapadam(S.Viswanathan Printers and Publishers Pvt., Ltd, Chennai, 1998)
2	Dynamics -K.Viswanatha Naik and M.S.Kasi(Emerald Publishers, 1992)
3	Dynamics -Naryanamurthi(National Publishers, New Delhi, 1991)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/115/106/115106119/
2	https://www.askiitians.com/iit-jee-physics/mechanics/motion-of-projectile.aspx
Course Designed By: 1.Dr.C.Janaki 2. Dr. Renu Thomas	

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	S	S	S	S	S
CO2	M	M	M	M	M	S	M	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	M	M	M	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		PROGRAMMING IN C	L	T	P	C
Core/Elective/Supportive		Core Paper-VIII	2	-	-	3
Pre-requisite		Higher Secondary level Mathematics	Syllabus Version		2021 – 2022	

Course Objectives:

To impart the importance of C language, its structure, Data types, Operators of C, Various control statements, Arrays, different types of functions and practical problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Remember the importance of C language and datatypes.	K1
2	Understand the basic structure, operators and statements of C language.	K2
3	Understand decision control statements, loop control statements .	K2
4	Apply the concepts of data types, operators, expressions, control statements , arrays, character arrays and strings to write the C code for a given algorithm.	K3
5	Read, understand and trace the execution of programs written in C language.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Constants, Variables &Data Types	6 hours

Introduction – Importance of C- Basic structure of C programme - Character set -Constants – Keywords and identifiers – Variables Data types – Declaration of variables – Assigning values to variables –Defining symbolic constants.

Unit:2	Operators &Expressions	6 hours

Arithmetic operators - Relational operators - logical operators – assignment operators – increment and decrement operators –Conditional operators – Special operators – Arithmetic expressions –Evaluation of expressions –Precedence of arithmetic operators – Some computational problems –Type conversion in expressions – operator precedence and associating mathematical functions.

Unit:3	Managing Input -Output Operations , Decision Making And Branching	6 hours

Reading and Writing character – formatted input and output. Decision making with IF statement – Simple IF statement – The if ELSE statement - Nesting of IF ELSE statement – The ELSE IF ladder. The Switch statement –The ? Operator –The GOTO statement.

Unit:4	Decision Making And Looping	6 hours

The WHILE statement - the DO statement the FOR statement –Jumps in loops.

Unit:5	Arrays And Strings	6 hours

One, Two dimensional arrays – initializing two dimensional arrays – Multidimensional arrays – Declaring and initializing string variables –reading strings from terminal – Writing strings on the screen – Arithmetic operations on characters.		
	Total Lecture hours	**30 hours**
Text Book		
1	Programming in ANSI C -E.Balagurusamy(Tata McGraw –Hill Publishing Company limited, New Delhi,Fifth Edition,2008)	
Reference Books		
1	Programming with C (Schaum's outline series)- Byron Gottfried (TataMcGrawHill publishing company -1998.)	
2	Programming with Ansi and Turbo C -Ashok N.Kamthane(Pearson Education publishers, 2002)	
3	The spirit of C -HentryMullish and Herbert L cooper (Jaico publisher , 1996.)	
4	The Ansi C- Brian W.Kernighan,DennisM.Ritchie(Published by Prentice- Hall of India Private Limited, M-97,New Delhi- 110001 ,Second edition ,Ocober 1992)	
5	Ansi C: With Microsoft C 5.1 and Quick C 2.0 -C.Balasubramanian.(Tata McGraw-Hill Publishing company limited, New Delhi.)	
6	Programming In C - Kris A.Jamsa(Galgotia Publications Pvt.ltd. 1992)	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/106/104/106104128/	
2	https://nptel.ac.in/courses/106/105/106105171/	
Course Designed By: 1.Dr.C.Janaki 2.Dr.K.Malar		

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	M	M	M	S	S
CO2	S	S	M	M	S	M	M	S	M	S
CO3	S	M	M	M	S	S	M	S	S	S
CO4	S	S	S	S	S	M	S	S	S	M
CO5	S	S	S	S	S	M	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		PROGRAMMING IN C-(PRACTICAL)	L	T	P	C
Core/Elective/Supportive		Core Paper VIII (Practical)	-	-	1	1
Pre-requisite		Knowledge in C	Syllabus Version		2021-2022	

PRACTICAL LIST

1. Write a C program to generate 'N' Fibonacci number.
2. Write a C program to print all possible roots for a given quadratic equation.
3. Write a C program to calculate the statistical values of mean, median.
4. Write a C program to calculate the statistical values of Standard Deviation and variance of the given data .
5. Write a C program to sort a set of numbers.
6. Write a C program to sort the given set of names.
7. Write a C program to find factorial value of a given number 'N' using recursive function call.
8. Write a C program to find the product of two given matrix

Course code		OPERATIONS RESEARCH – PAPER II	L	T	P	C
Core/Elective/Supportive		SKILL BASED SUBJECT	2	-	-	2
Pre-requisite		Knowledge In Basic Mathematical Concepts	Syllabus Version		2021 – 2022	

Course Objectives:

To impart knowledge in Assignment Problems, Game theory, performance measures of queues and optimal use of Inventory.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify the importance of stocks, the reasons for holding stockin an organization ,determine the optimal order quantity for models .	K1
2	Explain the various costs related to inventory system.	K2
3	Apply game theory concepts to articulate real-world situations by identifying, analyzing and practicing strategic decisions .	K3
4	Apply and extend queueing models to analyze real world systems.	K4
5	Build and solve assignment model.	K4

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6** – Create

Unit:1	Assignment Model	6 hours

The Assignment Problems – Assignment algorithm – optimum solutions – Unbalanced Assignment Problems.

Unit:2	Game Theory	6 hours

Game Theory – Two person zero sum game – The Maximin – Minimax principle – problems - Solution of 2 x 2 rectangular Games – Domination Property – (2 x n) and (m x 2) graphical method – Problems.

Unit:3	Queueing Model	6 hours

Queueing Theory – Introduction – Queueing system – Characteristics of Queueing system – Symbols and Notations – Classifications of queues – Problems in (M/M/1) : (∞/FIFO)

Unit:4	Multi Channel Queueing Models	6 hours

Problems in (M/M/1):(N/FIFO); (M/M/C) : (∞/FIFO); (M/M/C) : (N/FIFO) Models.

Unit:5	Inventory Models	-6 hours

Inventory control – Types of inventories – Inventory costs – EOQ Problem with no shortages – Production problem with no shortages – EOQ with shortages – Production problem with shortages – EOQ with price breaks.

	Total Lecture hours	**30 hours**
Text Book		
1	Operations Research – Kantiswarup, P. K. Gupta, Man Mohan(S. Chand & Sons Education Publications, New Delhi, 12th Revised edition,2003)	
Reference Books		
1	Operations Research – Prem Kumar Gupta D. S. Hira(S. Chand & Company Ltd, Ram Nagar, New Delhi,2014)	
2	Operations Research Principles and Problems- S. Dharani Venkata krishnan(Keerthi publishing house PVT Ltd.1994)	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/111/102/111102012/	
2	https://youtu.be/zADj0k0waFY https://youtu.be/xvDdrswAj8M https://www.youtube.com/watch?v=xVPoWkkQTrQ https://www.youtube.com/watch?v=7kDtTAnvuww https://www.youtube.com/watch?v=IfLsPHKk51w	
3	https://nptel.ac.in/courses/109/103/109103021/	
4	https://nptel.ac.in/courses/110/105/110105082/ https://nptel.ac.in/courses/110/106/110106045/	
Course Designed By: 1.Dr.C.Janaki 2. .Dr.M.S. Annie Christi		

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	S	M	M	M	S	S
CO2	M	M	M	M	S	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	S	M	S	M	S	M

*S-Strong; M-Medium; L-Low

Fifth Semester

Course code		REAL ANALYSIS - I	L	T	P	C
Core/Elective/Supportive		Core Paper – IX	5	-	-	4
Pre-requisite		Knowledge in the basic properties of real numbers	Syllabus Version	2021 - 2022		

Course Objectives:

Aimed at exposing the real number systems that underpin the development of real analysis and in understanding various physical phenomena .

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Remember the basic topological properties of subsets of the real numbers .	K1
2	Understand the fundamental properties of the real numbers and analyze the real number system.	K2
3	Learn the concept of limits, sequence, continuity, convergent sequence in metric spaces appreciating the abstract ideas and their applicability .	K2
4	Have the proficiency in the formulation and construction of proofs of basic results in real analysis.	K3
5	Demonstrate skills in communicating Mathematics and learn basic techniques and examples in analysis to be well prepared for extended learning .	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	The Real And Complex Number Systems	15 hours

Introduction -the field axioms, the order axioms –integers –the unique Factorization theorem for integers –Rational numbers –Irrational numbers –Upper bounds, maximum Elements, least upper bound –the completeness axiom –some properties of the supremum – properties of the integers deduced from the completeness axiom- The Archimedean property of the real number system –Rational numbers with finite decimal representation of real numbers –absolute values and the triangle inequality –the Cauchy-Schwarz inequality –plus and minus infinity and the extended real number system.

Unit:2	Basic Notions Of A Set Theory.	15 hours

Notations –ordered pairs –Cartesian product of two sets – Relations and functions – further terminology concerning functions –one–one functions and inverse –composite functions –sequences –similar sets-finite and infinite sets –countable and uncountable sets – uncountability of the real number system –set algebra –countable collection of countable sets.

Unit:3	Elements Of Point Set Topology	15 hours

Elements of point set topology: Euclidean space R^n –open balls and open sets in R^n. The structure of open sets in R^n –closed sets and adherent points –The Bolzano –Weierstrass theorem –the Cantor intersection Theorem

Unit:4	Covering &Compactness	15 hours

Covering –Lindelof covering theorem –the Heine Borel covering theorem –Compactness in $\mathbf{R^n}$

–Metric Spaces –point set topology in metric spaces –compact subsets of a metric space – Boundary of a set.

Unit:5	**Limits And Continuity In Metric Spaces**	**15 hours**

Convergent sequences in a metric space –Cauchy sequences –Completeness sequences – complete metric Spaces. Limit of a function –Continuous functions –continuity of composite functions. Continuous complex valued and vector valued functions.

	Total Lecture hours	**75 hours**

Text Book(s)

1 Mathematical Analysis-T.M.Apostol(2nd ed., Narosa Publishing Company, Chennai, 1990.)

Unit I	Chapter 1 Sections 1.2, 1.3, 1.6 to 1.16, 1.18 to 1.20
Unit II	Chapter 2 Sections 2.2 to 2.15
Unit III	Chapter 3 Sections 3.2 to 3.9
Unit IV	Chapter 3 Sections 3.10 to 3.16
Unit V	Chapter 4 Sections 4.2 to 4.5, 4.8 to 4.10

Reference Books

1 Methods of Real Analysis -R.R.Goldberg.(NY, John Wiley, New York 1976.)

2 Introduction to Topology and Modern Analysis- G.F.Simmons.(McGraw – Hill, New York, 1963.)

3 A survey of Modern Algebra(3rd Edition)-G.Birkhoff and MacLane.(Macmillian, New York, 1965.)

4 Real Analysis -J.N.Sharma and A.R.Vasistha.(Krishna Prakashan Media (P) Ltd, 1997)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1 https://nptel.ac.in/courses/111/105/111105069/#

2 https://nptel.ac.in/courses/111/101/111101134/

3 https://www.digimat.in/nptel/courses/video/111105098/

4 https://nptel.ac.in/courses/111/106/111106053/

Course Designed By: 1.Dr.C.Janaki
2. .Dr.M.S. Annie Christi

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	M	M	S	S
CO2	S	S	M	M	M	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		COMPLEX ANALYSIS - I	L	T	P	C
Core/Elective/Supportive		Core Paper – X	6	-	-	4
Pre-requisite		Knowledge in Calculus	Syllabus Version		2021 -2022	

Course Objectives:

To equip the students with the understanding of the fundamental concepts of complex functions, analyticity ,power series and complex integration.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Learn techniques of complex analysis effectively to establish mathematical results.	K1
2	Recognize thesimple and multiple connected domains.	K2
3	Investigate a function for its analyticity and find it series development.	K3
4	Examine the relationship between conformal mapping and analytic functions	K4
5	Compute contour integrals directly and by the fundamental theorem.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Complex Plane	18 hours

Complex number –Field of Complex numbers – Conjugation – Absolute value -Argument – Elementary Transformations i) $w=z+\alpha$ ii) $w = az$ iii) $w =1/z$ .Fixed points -cross-ratio- invariance of cross-ratio under bilinear transformation –Definition of extended complex plane – Stereographic projection.

Unit:2	Analytic Functions	18 hours

Complex Functions- Limit of a function –continuity –differentiability – Analytical function defined in a region –necessary conditions for differentiability –sufficient conditions for differentiability –Cauchy-Riemann equation in polar coordinates –Definition of entire function.

Unit:3	Power Series And Elementary Functions	18 hours

Absolute convergence –circle of convergence –Analyticity of the sum of power series in the Circle of convergence (term by term differentiation of a series) Elementary functions : Exponential, Logarithmic, Trigonometric and Hyperbolic functions.

Unit:4	Harmonic Functions And Conformal Mapping	18 hours

Definition and determination. Conformal Mapping: Isogonal mapping –Conformal mapping-Mapping z-->>f(z), where f is analytic, particularly the mappings.

$w= e^{z}$; $w= z^{2}$; w=sin z ; w =cosz ; w=z+ 1/z .		
Unit:5	**Complex Integration**	**18 hours**
Simply and multiply connected regions in the complex plane. Integration of f(z) from definition along a curve joining $\mathbf{z}_1$ and $\mathbf{z}_2$. Proof of Cauchy's Theorem (using Goursat's lemma for a simply connected region). Statement of Cauchy's integral formula for higher derivatives -Morera's theorem.		
	Total Lecture hours	**90 hours**

Text Book(s)

1	Complex Analysis -P.Duraipandian and Laxmi Duraipandian.(Emerald Publishers, Chennai –2, 1986.) Unit I Chapter 1 Sections 1.1 to 1.3, 1.6 to 1.9 Chapter 2 Sections 2.1 to 2.2, 2.6 to 2.9, Chapter 7 Section 7.1 Unit II Chapter 4 Sections 4.1 to 4.10 Unit III Chapter 6 Sections 6.1 to 6.11 Unit IV Chapter 6 Sections 6.12 to 6.13 Chapter 7 Sections7.4,7.6 to 7.9 Unit V Chapter 8 Sections 8.1 to 8.9

Reference Books

1	Complex Variable and Applications -Churchill and Others.(Tata McGraw Hill Publishing Company Ltd, 1974.)
2	Theory of functions of Complex Variable -Santhinarayan(S.Chand and Company, Meerut, 1995.)
3	Functions of Complex Variable -Tyagi B.S(17th Edition, Pragati Prakasham Publishing Company Ltd, Meerut, 1992-93)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/103/111103070/
2	https://nptel.ac.in/courses/111/107/111107056/
3	https://nptel.ac.in/courses/122/103/122103012/

Course Designed By 1.Dr.C.Janaki
2.Mr.R.Subramanian

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	S	M	M	M	S	S
CO2	S	M	M	M	M	S	M	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	S	M	S	M	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		MODERN ALGEBRA - I	L	T	P	C
Core/Elective/Supportive		Core Paper – XI	6	-	-	4
Pre-requisite		Higher Secondary level Mathematics	Syllabus Version	2021 - 2022		

Course Objectives:

Focuses on the concepts of algebraic structures which is one of a pillar of modern Mathematics and emphasis on their properties and applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Recall the properties and extend group structure to finite permutation groups .	K1
2	Explain the concepts of homomorphism, isomorphism and automorphism.	K2
3	Demonstrate abstract thinking capacity and ability to prove theorems.	K3
4	Compare features of different algebraic structures .	K4
5	Examine the properties of algebraic structures and their role in applied contexts.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Groups & its Basic Properties	18 hours

Sets – mappings – Relations and binary operations – Groups: Abelian group, Symmetric group Definitions and Examples – Basic properties.

Unit:2	Subgroups& Normal Subgroups	18 hours

Subgroups – Cyclic subgroup - Index of a group – Order of an element – Fermat theorem - A Counting Principle - Normal Subgroups and Quotient Groups.

Unit:3	Automorphisms	18 hours

Homomorphisms (Applications 1 and 2 are omitted) -Automorphisms – Inner automorphism – Cayley's theorem, permutation groups.

Unit:4	Rings	18 hours

Definition and Examples –Some Special Classes of Rings – Commutative ring – Field – Integral domain - Homomorphisms of Rings.

Unit:5	Ideals & Quotient Rings	18 hours

Ideals and Quotient Rings – More Ideals and Quotient Rings – Maximal ideal - The field of Quotients of an Integral Domain .

	Total Lecture hours	90 hours

Text Book

1 Topics in Algebra -I.N. Herstein(John Wiley & Sons, New York, 2003.)

	Unit I Chapter 1 Sections 1.1 to 1.3, Chapter 2 Sections 2.1 to 2.3 Unit II Chapter 2 Sections 2.4 to 2.6 Unit III Chapter 2 Sections 2.7 to 2.10 Unit IV Chapter 3 Sections 3.1 to 3.3 Unit V Chapter 3 Sections 3.4 to 3.6.
Reference Books	
1	Modern Algebra -Surjeet Singh and Qazi Zameeruddin.(Vikas Publishing house, 1992.)
2	Modern Algebra- A.R.Vasishtha(Krishna Prakashan Mandir, Meerut, 1994 - 95.)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/104/106104149/
2	https://nptel.ac.in/courses/111/106/111106113/
3	https://www.classcentral.com/course/swayam-modern-algebra-14201
Course Designed By: 1.Dr.C.Janaki 2. Dr. G.V. Chandrasekar	

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	M	S	S	M	S	S
CO2	M	M	S	S	M	S	S	S	S	S
CO3	S	M	M	S	S	S	S	S	S	S
CO4	S	M	M	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		DISCRETE MATHEMATICS	L	T	P	C
Core/Elective/Supportive		CORE PAPER XII	5	-	-	4
Pre-requisite		Higher Secondary level Mathematics	Syllabus Version	2021 - 2022		

Course Objectives:

Prepare students to develop mathematical foundations to understand , create mathematical arguments and focuses on the Formal languages , Automata, Lattices, Boolean Algebra and Graph Theory.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Assimilate various graph theoretic concepts and familiarize with their applications.	K1
2	Know and understand about partially ordered sets, Boolean algebra, lattices and their types.	K2
3	Apply Karnaugh map for simplifying the Boolean expression.	K3
4	Demonstrate the skill to construct simple mathematical proofs and to validate .	K4
5	To achieve greater accuracy , clarity of thought and language.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Mathematical logic	15 hours

Connectives ,well formed formulas, Tautology, Equivalence of formulas, Tautological implications, Duality law, Normal forms, Predicates, Variables, Quantifiers, Free and bound Variables. Theory of inference for predicate calculus.

Unit:2	Relations And Functions	15 hours

Composition of relations, Composition of functions, Inverse functions, one-to- one, onto, one-to-one& onto functions, Hashing functions, Permutation function, Growth of functions. Algebra structures: Semi groups, Free semi groups, Monoids.

Unit:3	Formal Languages And Automata	15 hours

Regular expressions, Types of grammar, Regular grammar and finite state automata, Context free and sensitive grammars.

Unit:4	Lattices And Boolean Algebra	15 hours

Partial ordering, Poset, Lattices, Boolean algebra, Boolean functions, Theorems, Minimization of Boolean functions(Karnaugh Method only).

Unit:5	Graph Theory	15 hours
Directed and undirected graphs, Paths, Reachability, Connectedness, Matrix representation, Euler paths, Hamiltonian paths, Trees, Binary trees - theorems, and applications.		
	Total Lecture hours	**75 hours**

Text Book

1 Discrete Mathematical Structures with applications to computer science-J.P Tremblay and R.P Manohar (Mc.Graw Hill, 1975.)
Unit 1: Chapter 1. Sections - 1-2, 1-2.7. 1-2.9, 1-2.10, 1-2.11, 1-3, 1-5.1, 1-5.2, 1-5.4, 1-6.4
Unit 2: Chapter 2- Sections - 2-3.5, 2-3.7, 2-4.2, 2-4.3, 2-4.6,
Chapter 3- Sections-3-2, 3-5, 3-5.3,
Unit 3: Chapter 3- Sections 3-3.1, 3-3.2
Chapter 4- Section 4-6.2
Unit4: Chapter 4- Section 4-1.1, 4-2, 4-3, 4-4.2
Unit 5: Chapter 5- Section 5-1.1, 5-1.2, 5-1.3, 5-1.4

Reference Book

1 Discrete Mathematics-Oscar Levin(3rd Edition,2016)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1 https://nptel.ac.in/courses/106/106/106106094/

2 https://nptel.ac.in/courses/111/107/111107058/

Course Designed By: 1.Dr.C.Janaki
2.Mr.R.Subramanian

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	S	M	S	M	M	S	S
CO2	S	M	S	S	M	S	S	S	S	S
CO3	S	M	S	S	M	S	M	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		OPERATIONS RESEARCH – PAPER III	L	T	P	C
Core/Elective/Supportive		Skill Based Subject	3	-	-	2
Pre-requisite		Knowledge In Basics of O.R	Syllabus Version	2021 - 2022		

Course Objectives:

Presents applications and method to solve Integer Programming Problems, Non-linear Programming Problems and Dynamic Programming problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the concept of simulation and simulate a queueing system	K1
2	Understand the overall approach of dynamic programming.	K2
3	Solve nonlinear programming problems using Lagrange multiplier and using Kuhn-Tucker conditions.	K2
4	Apply concepts in optimal scheduling	K3
5	To formulate a model for solving the intractable problems.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Simulation	9 hours

Introduction-simulation models-Event-Types of simulation- Generation of random numbers-Monte-Carlo simulation- simulation of queueing system.

Unit:2	Network Scheduling By PERT/CPM	9 hours

Introduction- Network and basic components- Rules of Network construction- Time calculation in Networks-CPM. Pert Calculations- Cost Analysis- crashing the network-Problems.

Unit:3	Integer Programming Problem	9 hours

Integer Programming Problem – Gomory's fractional cut Method – Branch and Bound Method.

Unit:4	Non-linear Programming Problems	9 hours

General NLPP – Lagrange multiplier – Hessian bordered Matrix – Kuhn Tucker Condition – Problems.

Unit:5	Dynamic Programming Problem	9 hours

Dynamic Programming Problem – Recursive equation approach – D.P.P Algorithm – Solution of L.P.P by D.P.P.

	Total Lecture hours	**45 hours**

Text Book

1	Operations Research – Kantiswarup, P. K. Gupta, Man Mohan(S. Chand & Sons Education Publications, New Delhi, 12th Revised edition,2003)

Reference Books

1	Operations Research – Prem Kumar Gupta& D. S. Hira(S. Chand & Company Ltd, Ram Nagar, New Delhi ,2014)
2	Operations Research Principles and Problems- S. Dharani Venkatakrishnan(Keerthi publishing house PVT Ltd ,1994)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/107/111107104/
2	https://nptel.ac.in/courses/111/102/111102012/
3	https://nptel.ac.in/courses/111/104/111104027/
4	https://nptel.ac.in/courses/111/105/111105039/

Course Designed By: 1.Dr.C.Janaki
2.Dr.M.S. Annie Christi

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	S	S	S	S	S	S	S
CO2	S	M	M	M	M	S	S	M	S	S
CO3	S	M	M	S	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	M	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Sixth Semester

Course code		REAL ANALYSIS - II	L	T	P	C
Core/Elective/Supportive		Core Paper – XIII	5	-	-	4
Pre-requisite		Knowledge in Mappings &Properties of Real Numbers	Syllabus Version		2021 - 2022	

Course Objectives:

To present a deeper and rigorous understanding of fundamental concepts like continuity, connectivity, derivative, monotonic functions with properties and Riemann - Stieltjes integral.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Demonstrate the understanding of continuity, uniform continuity ,compactness ,connectedness.	K1
2	Understand partitions and their refinement.	K2
3	Determine the Riemann integrability and the Riemann-Stieltjes integrability of a bounded function.	K2
4	Examine the derivatives of function.	K3
5	Acquire skills in writing and analyze the proofs that arise in the context of real analysis.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Topological Mappings	15hours

Examples of continuous functions –continuity and inverse images of open or closed sets – functions continuous on compact sets –Topological mappings –Bolzano's theorem. .

Unit:2	Monotonic Functions	15 hours

Connectedness –components of a metric space – Uniform continuity - Uniform continuity and compact sets –fixed point theorem for contractions –monotonic functions.

Unit:3	Derivatives	15 hours

Definition of derivative –Derivative and continuity –Algebra of derivatives – the chain rule –one sided derivatives and infinite derivatives –functions with non-zero derivatives –zero derivatives and local extrema –Rolle's theorem –The mean value theorem for derivatives – Taylor's formula with remainder.

Unit:4	Functions Of Bounded Variation	15 hours

Properties of monotonic functions –functions of bounded variation –total Variation –additive properties of total variation on (a, x) as a function of x – functions of bounded variation expressed as the difference of increasing functions –continuous functions of bounded variation.

Unit:5	The Riemann-Stieltjes Integral	15 hours
Introduction –Notation –The definition of Riemann –Stieltjes integral –linear properties – Integration by parts –change of variable in a Riemann –Stieltjes integral –Reduction to a Riemann integral.		
	Total Lecture hours	**75 hours**

Text Book

1	Mathematical Analysis(2nd ed)-Tom. M. APOSTOL(Addison-Wisely. Narosa Publishing Company, Chennai, 1990.) Unit I :Chapter 4 Sections 4.11 to 4.15 Unit II :Chapter 4 Sections 4.16, 4.17, 4.19, 4.20, 4.21, 4.23 Unit III: Chapter 5 Sections 5.2 to 5.10 and 5.12 Unit IV :Chapter 6 Sections 6.2 to 6.8 Unit V :Chapter 7 Sections 7.1 to 7.7

Reference Books

1	Methods of Real Analysis -R.R.Goldberg(NY, John Wiley, New York 1976.)
2	Introduction to Topology and Modern Analysis -G.F.Simmons(McGraw – Hill, New York, 1963.)
3	A survey of Modern Algebra -G.Birkhoff and MacLane(3rd Edition, Macmillian, NewYork, 1965.)
4	Real Analysis -J.N.Sharma and A.R.Vasistha.(Krishna Prakashan Media (P) Ltd, 1997.)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/106/111106053/
2	https://www.math.ucdavis.edu/~emsilvia/math127/chapter7.pdf https://www.whitman.edu/Documents/Academics/Mathematics/grady.pdf
3	https://nptel.ac.in/courses/122/101/122101003/

Course Designed By: 1.Dr.C.Janaki
2.Dr. M.S. Annie Christi

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	S	S	S	M	S	S
CO2	M	M	M	M	M	S	S	M	S	S
CO3	S	M	M	S	S	S	M	S	S	S
CO4	S	M	M	S	S	S	M	S	S	S
CO5	M	M	S	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		COMPLEX ANALYSIS - II	L	T	P	C
Core/Elective/Supportive		Core Paper – XIV	5	-	-	4
Pre-requisite		Knowledge In Analytic Functions, Complex Integration .	Syllabus Version		2021-2022	

Course Objectives:

To familiarize the students with some fundamental theorems, singularity , residues in complex functions, integrations of complex functions , meromorphic functions and their applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To recognize and apply the Liouville's theorem, the mean-value property of a function and the maximum modulus principle.	K1
2	Demonstrate understanding and appreciation of deeper aspects of complex analysis.	K2
3	Apply residue theorem to compute integrals.	K3
4	Ability to think critically by proving mathematical conjectures and establishing theorems from complex analysis.	K4
5	Classify the nature of singularity, poles and residues .	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Integral Theorems	15 hours

Results based on Cauchy's theorem(I)-Zeros-Cauchy's Inequality – Liouville's theorem – Fundamental theorem of algebra –Maximum modulus theorem –Gauss mean value theorem – Gauss mean value theorem for a harmonic function on a circle.

Unit:2	Taylor's Series &Laurent's Series	15 hours

Results based on Cauchy's theorem(II)-Taylor's series –Laurent's series .

Unit:3	Singularities And Residues	15 hours

Isolated singularities (Removable Singularity, pole and essential singularity) –Residues –Residue theorem.

Unit:4	Real Definite Integrals	15 hours

Evaluation using the calculus of residues – Integration on the unit circle –Integral with $-\infty$ and $+\infty$ as lower and upper limits with the following integrals:

i) $P(x)/Q(x)$ where the degree of $Q(x)$ exceeds that of $P(x)$ at least 2.

ii) $(\sin ax).f(x)$, $(\cos ax).f(x)$, where $a>0$ and $f(z) \rightarrow 0$ as $z \rightarrow \infty$ and $f(z)$ does not have a pole on the real axis.

iii) $f(x)$ where $f(z)$ has a finite number of poles on the real axis.

Integral of the type $\int_0^\infty x^{a-1}/(1+x)\,dx$; $0< a <1$.

Unit:5	**Meromorphic Functions**	**15 hours**

Theorem on number of zeros minus number of poles –Principle of argument- Rouche's theorem – Theorem that a function which is meromorphic in the extended plane is a rational function.

	Total Lecture hours	**75 hours**

Text Book

1. Complex analysis -P. Duraipandian and Laxmi Duraipandian(Emerald Publishers, Chennai – 2, 1997.)

   Unit I :Chapter 8 Sections 8.10, 8.11

   Unit II :Chapter 9 Sections 9.1 to 9.3, 9.13.

   Unit III: Chapter 9 Sections 9.5 to 9.12, 9.13. Chapter 10 Sections 10.1, 10.2 and 10.4.

   Unit IV: Chapter 10 Sections 10.3 and 10.4.

   Unit V: Chapter 11 Sections 11.1 to 11.3 **(Except theorems 11.5 and 11.6)**

Reference Books

1. Complex Variable and Applications -Churchill and Others(Tata Mc-graw Hill Publishing Company Ltd, 1974.)
2. Theory of functions of Complex Variable -Santhinarayan(S.Chand and Company ,Meerut, 1995)
3. Functions of Complex Variable (17th Edition)- Tyagi B.S (PragatiPrakasham Publishing Company Ltd, Meerut, 1992-93.)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://nptel.ac.in/courses/111/103/111103070/
2. https://nptel.ac.in/courses/111/106/111106094/
4. https://nptel.ac.in/courses/122/103/122103012/

Course Designed By: 1.Dr.C.Janaki
2.Mr.R.Subramanian

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	M	S	S	M	S	S
CO2	S	S	M	S	M	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	M	M	S	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		MODERN ALGEBRA - II	L	T	P	C
Core/Elective/Supportive		Core Paper – XV	5	-	-	4
Pre-requisite		Knowledge in Groups, Rings and Fields	Syllabus Version	2021 - 2022		

Course Objectives:

To develop understanding in the domain of matrix theory ,vector spaces, linear transformations as well as the principles underlying the subject.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Communicate and understand mathematical ideas and results with the correct use of mathematical definitions, terminology and symbols.	K1
2	Explain the concepts of base and dimension of Vector space.	K2
3	To apply the Gram-Schmidt process to construct an orthonormal set of vectors in an inner product space.	K3
4	Demonstrate competence with the basic ideas of Matrix theory ,Vector spaces, Dual spaces, Linear transformation.	K3
5	Have an insight to analyze a real life problem and solve it.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Matrices	15 hours

Introduction – Addition and Scalar Multiplication of Matrices – Product of Matrices –Transpose of a Matrix – Matrix Inverse – Symmetric and Skew - Symmetric Matrices.

Unit:2	Special Matrices	15 hours

Hermitian and Skew-Hermitian Matrices – Orthogonal and Unitary Matrices – Rank of a Matrix –Characteristic Roots and Characteristic Vectors of a Square Matrix.

Unit:3	Vector Spaces	15 hours

Elementary Basic Concepts – Subspace of a Vector space - Homomorphism – Isomorphism - Internal and External direct sums - Linear span - Linear Independence and Bases.

Unit:4	Dual Spaces	15 hours

Dual Spaces – Annihilator of a subspace - Inner Product Spaces – Norm of a Vector – Orthogonal Vectors - Orthogonal Complement of a subspace – Orthonormal set.

Unit:5	Linear Transformations	15 hours

Algebra of Linear Transformations – Regular, Singular Transformations – Range of T – Rank of T - Characteristic Roots – Characteristic Vectors – Matrices.		
	Total Lecture hours	**75 hours**
Text Book(s)		
1	Modern Algebra -R.Balakrishnan and M. Ramabadran.(Vikas Publishing House Pvt. Ltd, New Delhi, Second Revised Edition 1994) (For Units I & II) . Unit I :Chapter 1 Sections 1.1 to 1.3, 1.5 to 1.7 Unit II :Chapter 1 Sections 1.8 and 1.9 Chapter 2 Section 2.9 Chapter 3 Section 3.9	
2	Topics in Algebra -I.N. Herstein.(John Wiley & Sons, New York, 2003.) (For Units III, IV & V) Unit III: Chapter 4 Sections 4.1 and 4.2 Unit IV :Chapter 4 Sections 4.3 and 4.4 Unit V :Chapter 6 Sections 6.1 , 6.2 and 6.3	
Reference Books		
1	Modern Algebra -Surjeet Singh and Qazi Zameeruddin(Vikas Publishing house, 1992.)	
2	Modern Algebra -A.R.Vasishtha(Krishna Prakashan Mandir, Meerut, 1994 – 95.)	
3	Linear Algebra -Seymour Lipschutz and Marc Lipson(3rd Edition, McGraw Hill, 2001.)	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/111/106/111106135/	
2	https://nptel.ac.in/courses/115/105/115105097/	
3	https://nptel.ac.in/courses/111/101/111101115/	
4	https://nptel.ac.in/courses/111/108/111108066/	
Course Designed By: 1.Dr.C.Janaki 2.Dr. G.V. Chandrasekar		

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	S	S	M	S	S
CO2	M	M	S	S	M	S	M	M	S	S
CO3	S	M	S	S	M	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		OPERATIONS RESEARCH - PAPER -IV	L	T	P	C
Core/Elective/Supportive		Skill Based Subject	2		-	2
Pre-requisite		Knowledge in Basics of O.R	Syllabus Version		2021 - 2022	

Course Objectives:

To enhance the students knowledge in decision analysis, sequencing of the jobs to be carried out based on cost optimization, replacement policies and analyze the cases according to their categories.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the principles and applications of information theory.	K1
2	To understand sequencing, replacement problems.	K2
3	Demonstrate skills to achieve their objective using sequencing models.	K3
4	Apply decision making under different business environments .	K4
5	Determine a solution to a rectangular game using simplex method.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Decision Analysis	6 hours

Decision Making environment – Decisions under uncertainty – Decision under risk – Decision – Tree Analysis.

Unit:2	Sequencing Problems	6 hours

Introduction-problem of sequencing - basic terms used in sequencing- processing n-jobs through 2 machines - processing n –jobs through k machines - processing 2 jobs through k machines(Problems only).

Unit:3	Replacement Problems	6 hours

Introduction - Replacement of equipment / assets that deteriorates gradually - replacement of equipment that fails suddenly and problems.

Unit:4	Information Theory	6 hours

Introduction- A measure of Information-Axiomatic Approach to Information- Entropy-The expected information- Some properties of entropy function-Joint and conditional entropies

Unit:5	Applications	6 hours

General solution of (mxn) rectangular games using simplex method - Reliability and system failure rates using replacement problems.

	Total Lecture hours	**30 hours**
Text Book		
1	Operations Research -Kantiswarup, P. K. Gupta , Man Mohan (S.Chand&sons education publications ; New Delhi,2003)	
Reference Books		
1	Operations Research - P K Gupta & D S Hira (S. Chand and company ltd. Ram Nagar; New Delhi,2014.)	
2	Operations Research principles problems - S Dharani Venkatakrishnan(keerthi publishing house Pvt. Ltd.1994)	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/117/104/117104129/	
2	https://nptel.ac.in/courses/110/105/110105082/	
3	https://nptel.ac.in/courses/110/106/110106045/	
Course Designed By: 1.Dr.C.Janaki 2.Dr.M.S. Annie Christi		

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	S	S	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	M
CO5	S	M	M	S	S	S	S	S	M	S

*S-Strong; M-Medium; L-Low

Elective Courses

Course code		ASTRONOMY – I	L	T	P	C
Core/Elective/Supportive		ELECTIVE I – A	5	-	-	3
Pre-requisite		Knowledge In Physics and Mathematics	Syllabus Version		2021-2022	

Course Objectives:

To enable the students to understand the Astronomical aspects and about the laws governing the planet movements.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Define properties of physical systems that comprise the known universe	K1
2	Understand the Solar system, Celestial sphere, Dip-Twilight & Kepler's laws.	K2
3	Apply their physics and mathematical skills to problems in the areas of planetary science.	K3
4	Demonstrate the skill to infer valid scientific conclusions and communicate those conclusions in a clear and articulate manner.	K4
5	Analyze the astronomical concepts.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Solar system	15 hours

General description of the Solar system. Comets and meteorites – Spherical trigonometry..

Unit:2	Celestial sphere	15 hours

Celestial sphere – Celestial co – ordinates – Diurnal motion – Variation in length of the day.

Unit:3	Geocentric parallex	15 hours

Dip – Twilight – Geocentric parallex.

Unit:4	Refraction	15hours

Refraction – Tangent formula – Cassinis formula.

Unit:5	Kepler's law	15 hours

Kepler's laws – Relation between true eccentric and mean anamolies.

	Total Lecture Hours	75 hours

Text Book

1	Astronomy-S.Kumaravelu and SusheelaKumaravelu(Text*Publisher*: Sivakasi: Janki7th Edition 1986)

Course Designed By: 1.Dr.C.Janaki
2.Dr. A.Pushpalatha

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	S	S	M	S	S
CO2	M	M	M	S	S	S	S	M	S	M
CO3	M	M	M	M	M	S	M	S	S	S
CO4	S	S	M	S	S	S	S	S	S	S
CO5	S	M	M	S	S	S	M	S	M	S

*S-Strong; M-Medium; L-Low

Course code		NUMERICAL METHODS – I	L	T	P	C
Core/Elective/Supportive		ELECTIVE I – B	5	-	-	3
Pre-requisite		Knowledge In Higher Secondary Level Mathematics	Syllabus Version		2021-2022	

Course Objectives:

It exposes the students to study numerical techniques to find solutions of numerical, algebraic transcendental equations, solution of simultaneous linear algebraic equations and interpolation.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Remember the concepts of errors and its effect on computation.	K1
2	Obtain numerical solutions of algebraic and transcendental equations.	K2
3	Apply the finite difference and interpolation concepts .	K3
4	Develop skills in designing mathematical models for constructing polynomials to the given data and drawing inferences.	K4
5	Analyze the efficiency of iteration methods**.**	K4

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6 -** Create

Unit:1	The Solution Of Numerical Algebraic And Transcendental Equations	15 hours

Bisection method – Iteration Method – Convergence condition – Regula Falsi Method – Newton – Raphson method - Convergence Criteria – Order of Convergence.

Unit:2	Solution Of Simultaneous Linear Algebraic Equations	15 hours

Gauss elimination method – Gauss Jordan method – Method of Triangularization – Gauss Jacobi method – Gauss Seidel method.

Unit:3	Finite Differences	15 hours

Differences – operators – forward and backward difference tables – Differences of a polynomial – Factorial polynomial – Error propagation in difference table.

Unit:4	Interpolation (for equal intervals)	15 hours

Newton's forward and backward formulae – equidistant terms with one or more missing values – Central differences and central difference table – Gauss forward and backward formulae – Stirling's formula.

Unit:5	Interpolation (for unequal intervals)	15 hours

Divided differences – Properties – Relations between divided differences and forward differences – Newton's divided differences formula – Lagrange's formula and inverse interpolation.

	Total Lecture hours	75 hours

Text Book

1	Numerical methods -Kandasamy. P, Thilagavathi. K and Gunavathi. K (S. Chand and Company Ltd, New Delhi – Revised Edition 2007.)(Chapters: 3,4,5,6,7 and 8)
2	Introductory Methods of Numerical Analysis-S.S. Sastry(Prentice Hall of India Pvt. Ltd.New Delhi-110001Fourth Edition,2006)
Reference Books	
1	Numerical Methods in Science and Engineering -Venkataraman M. K.(National Publishing company V Edition 1999.)
2	Numerical Methods for Scientists and Engineers -Sankara Rao K.(2nd Edition Prentice Hall India 2004.)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://www.simumath.com/library/book.html?code=Alg_Equations_Examples
2	http://jupiter.math.nctu.edu.tw/~smchang/9602/NA_lecture_note.pdf http://www.iosrjournals.org/iosr-jm/papers/Vol6-issue6/J0665862.pdf
3	https://nptel.ac.in/courses/122/102/122102009/ https://nptel.ac.in/courses/111/107/111107105/
Course Designed By: 1.Dr.C.Janaki 2.Mr.R.Subramanian	

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	S	M	M	S	M	S	S
CO2	S	S	S	M	S	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	M	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code		ASTRONOMY II	L	T	P	C
Core/Elective/Supportive		ELECTIVE II – A	5	-		3
Pre-requisite		Knowledge In Physics& Mathematics	Syllabus Version		2021-2022	

Course Objectives:

To enable the students to learn about the interesting facts of Moon, Sun Planetary Motion .

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts of precession and nutation.	K1
2	Describe the eclipse of the moon.	K2
3	Find equation of time .	K3
4	Demonstrate the ability to analyze the concepts.	K4
5	Describe the properties of stellar system.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Time**	**15 hours**

Equation of time – Convertion of time – Seasons – Calendar.

Unit:2	**Abberation**	**15 hours**

Annual Parallax – Abberation.

Unit:3	**Precession**	**15 hours**

Precession – Nutation.

Unit:4	**Eclipses**	**15 hours**

The Moon – Eclipses.

Unit:5	**The Stellar System**	**15 hours**

Planetary Phenomenon – The Stellar system.

	Total Lecture hours	**75 hours**

Text Book(s)

1	**Astronomy-Mr.S.Kumaravelu and SusheelaKumaravelu.(**Text*publisher*: Sivakasi: Janki,7th edition,1986)

Course Designed By: 1.Dr.C.Janaki
2A.Pushpalatha

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	M	M	S	S
CO2	M	M	S	M	M	S	M	M	M	S
CO3	M	M	S	S	S	S	M	S	S	S
CO4	S	M	S	S	S	S	M	S	S	S
CO5	S	M	S	S	M	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code		Numerical Methods II	L	T	P	C
Core/Elective/Supportive		ELECTIVE II-B	5	-	-	3
Pre-requisite		Knowledge In Higher Secondary Level Mathematics	Syllabus Version		2021 – 2022	

Course Objectives:

1. To equip the learners with the powerful tool for numerical differentiation, numerical integration ,difference equation, numerical solution to O.D.E.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Familiarize with numerical integration and differentiation, numerical solution of ordinary differential equations.	K1
2	Distinguish methods of Taylor series, Euler's, Modified Euler's and Runge Kutta methods to find solutions of differential equations.	K2
3	Apply the techniques for enormous application in the field of Science and some fields of Engineering.	K3
4	Compute the integrals and derivatives by using the appropriate technique.	K4
5	Find the numerical solution of second order O.D.E by finite difference method.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Numerical Differentiation	15 hours

Newton's forward and backward formulae to compute the derivatives – Derivative using Stirling's formulae – to find maxima and minima of the function given the tabular values.

Unit:2	Numerical Integration	15 hours

Newton – Cote's formula – Trapezoidal rule – Simpson's 1/3 rd and 3/8 th rules.

Unit:3	Difference Equation	15 hours

Order and degree of a difference equation – solving homogeneous and non – homogeneous linear difference equations.

Unit:4	Numerical Solution Of O.D.E	15hours

Taylor series method – Euler's method – improved and modified Euler method – Runge Kutta method(Second &fourth order Runge Kutta method only)

Unit:5	Multi Step Methods	15 hours

Milne's predictor corrector formulae – Adam-Bashforth predictor corrector formulae – solution of ordinary differential equations by finite difference method (for second order O.D.E).

	Total Lecture hours	75 hours

Text Book	
1	Numerical methods -Kandasamy. P, Thilagavathi. K and Gunavathi. K (S. Chand and Company Ltd, New Delhi – Revised Edition 2007.)(Chapters: 9,10,11,Appendix and Appendix E)
2	Introductory Methods of Numerical Analysis-S.S. Sastry(Prentice Hall of India Pvt. Ltd.NewDelhi-110001Fourth Edition,2006)
Reference Books	
1	Numerical Methods in Science and Engineering -Venkataraman M. K.(National Publishing company V Edition 1999.)
2	Numerical Methods for Scientists and Engineers -Sankara Rao K. (Prentice Hall India , 2nd Edition2004)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://nptel.ac.in/courses/104101002/downloads/lecturenotes/module1/chapter6.pdf https://www.britannica.com/science/difference-equation
2	https://nptel.ac.in/courses/122/102/122102009/
3	https://nptel.ac.in/courses/111/107/111107063/
Course Designed By: 1.Dr.C.Janaki 2.Mr.R.Subramanian	

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	S	S	S	S	S	M	S	S
CO2	M	M	S	S	M	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	M	M	S	M	S	S	S
CO5	S	M	S	M	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		GRAPH THEORY	L	T	P	C
Core/Elective/Supportive		ELECTIVE III - A	5	-	-	4
Pre-requisite		Knowledge In Basic Mathematics	Syllabus Version	2021-2022		

Course Objectives:

Enables the students to learn the basic concepts of Graphs, sub-graphs, Eulerian graphs, Digraphs, tournaments ,connectivity, graphs, matrix representation of graphs, trees, planar graphs.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Identify the properties of different types of graph and their application.	K1
2	Demonstrate knowledge of basic concepts in graph theory .	K2
3	Understand cut graphs ,cycle spaces	K2
4	Apply principles and concepts of graph theory in practical situations.	K3
5	Analyze the concepts of Planar graphs.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Graphs	15 hours

Graphs –Sub graphs – Degree of a vertex walks, paths and cycles in a Graphs – connectedness cut vertex and cut edge.

Unit:2	Euler and Hamiltonian Graphs	15 hours

Euler and Hamiltonian Graphs – Algorithm for Euler circuits – Bipartite Graphs –Trees.

Unit:3	Cut set graphs	15 hours

Matrix representation of a graph – vector spaces, associated with a graph – cycle spaces and cut set graphs.

Unit:4	Planar graphs	15hours

Planar graphs – Euler's theorem on planar graphs – characterization of planar graphs (no proofs) of the difficult part of the characterization.

Unit:5	Directed graphs	15 hours

Directed graphs – Connectivity – Euler Digraphs – Tournaments.

	Total Lecture hours	75 hours

Text Book

1	A First Course in Graph Theory - A.*Choudum* (Macmillan,2001) Chapters 1 to 7.

Reference Books

1	Graph theory with applications to Engineering and computer science-Narasingh Deo (Prentice Hall of India1979).

2	Graph Theory -Frank Harary (Narosa Publishing HQCK 2001 **).**
3	Introduction to Graph Theory- Dr. M. Murugan.(Muthali Publishing House,2005)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/106/111106102/
2	https://www.digimat.in/nptel/courses/video/106104170/L19.html
Course Designed By: 1.Dr.C.Janaki 2.Mr.R.Subramanian	

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	S	S	M	S	S
CO2	M	M	M	S	S	S	M	M	M	S
CO3	M	M	M	S	M	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	M	S	M	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code		AUTOMATA THEORY AND FORMAL LANGUAGES	L	T	P	C
Core/Elective/Supportive		ELECTIVE III - B	5	-	-	4
Pre-requisite		Knowledge in Mathematics	Syllabus Version	2021-2022		

Course Objectives:

To impart knowledge in Finite automata, regular languages, regular grammars, context free grammars, languages, and pushdown automata which play a crucial role to Identify different formal language classes and their relationship.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquire a fundamental understanding of the core concepts in automata theory and formal languages.	K1
2	Design grammars and automata for different language classes.	K2
3	Describe the types of grammar and derivation tree.	K2
4	To apply context-free languages, push-down automata.	K3
5	Design automata, regular expressions and context-free grammars accepting or generating a certain language.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Phrase Structure Languages.** .	**15 hours**

Introduction – phrase structure languages.

Unit:2	**Closure Operations**	**15 hours**

Closure operations.

Unit:3	**Context Free Languages.**	**15 hours**

Context free languages.

Unit:4	**Finite State Automata**	**15 hours**

Finite state automata.

Unit:5	**Push Down Automata.**	**15 hours**

Push down automata.

	Total Lecture hours	**75 hours**

Text Book

1	Formal Languages and Automata- Rani Siromoney. (Revised edition 1984)(Published by the Christian Literary Society, Madras-3)Chapters 1 to 6.

Reference Books	
1	Formal languages and their relation automata-J.E. Hopcroft and D.Ullman(Addision Wesley1969)
2	Automata theory:Machines and Languages-Richard .Y.Kain(McGraw Hill1972)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/103/106103070/
2	https://www.digimat.in/nptel/courses/video/111103016/L02.html
Course Designed By: 1.Dr.C.Janaki 2.Dr.A.Pushpalatha	

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	M	M	S	S
CO2	S	M	S	S	S	S	M	M	M	S
CO3	M	M	S	S	S	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code		PROGRAMMING IN C++	L	T	P	C
Core/Elective/Supportive		ELECTIVE III - C	4	-		3
Pre-requisite		Knowledge in C Programming	Syllabus Version		2021 – 2022	

Course Objectives:

To enable the students to learn about the class structure, operators, inheritance, polymorphism, file handling.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know about class structure, member functions & data members, inheritance types and example problems .	K1
2	Understand how **C++** improves C with object-oriented features.	K2
3	Develop programming skills.	K2
4	To make use of objects and classes for developing programs.	K3
5	Build C++ classes.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Tokens, Expressions And Control Structures	12 hours

Evolution of C++ - applications of C++ - structure of C++ program. Tokens – keywords – identifiers and constants – basic data types – user-defined data types – constant pointers and pointers to constants – symbolic constants –type compatibility – declaration of variables – dynamic initialization of variables – reference variables – operators in C++ - scope resolution operator – memory management operators – manipulators – type cast operator – expressions and their types – special assignment expressions – implicit conversions – operator precedence.

Unit:2	Functions In C++	12 hours

The main function – function prototyping – call by reference – return by reference – inline functions – default arguments – const arguments – function overloading. Managing Console I/O Operations: C++ streams – C++ stream classes – unformatted console I/O operations – formatted console I/O operations –managing output with manipulators.

Unit:3	Classes And Objects	12 hours

Specifying a class – defining member functions – making an outside function inline – nesting of member functions – private member functions – arrays within a class – memory allocation for objects –arrays of objects – objects as function arguments – friend functions – returning objects – const member functions. Constructors and Destructors: Introduction – constructors – parameterized constructors – multiple constructors in a class – constructors with default arguments – copy constructor.

Unit:4	Operator Overloading	12 hours
Introduction – defining operator overloading – overloading unary operators – overloading binary operators - overloading binary operators using friends – rules for overloading operators.		
Unit:5	**Inheritance**	**12 hours**
Introduction – defining derived classes – single inheritance – making a private member inheritable – multilevel inheritance – multiple inheritance – hierarchical inheritance – hybrid inheritance.		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	Object Oriented programming with C++- E.Balagurusamy(McGraw Hill 3rd Edition 2006.)
2	Object oriented programming in Turbo C++-Robert Lafore(Galgotia publications Pvt.Ltd, New Delhi- 110002,2002)
3	The C++ programming language- Bjarne Stroutstrup(II Edition, Addision Wesley, 1991.)

Reference Books	
1	Programming with C++ -D.Ravi Chandran (Tata McGraw-Hill publishing company limited, New Delhi 1996)
2	Object Oriented Programming with ANSI and Turbo C++-AshokN.Kamthane(Pearson Education publishers 2003)
3	Programming with C++ -John R.Hubbard(2nd Edition, TMH publishers2002).

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/105/106105151/
2	https://nptel.ac.in/courses/106/101/106101208/
3	https://www.classcentral.com/course/swayam-programming-in-c-6704

Course Designed By: 1.Dr.C.Janaki
2.Dr. K. Malar

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	M	S	M	S	S
CO2	M	M	M	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	M	S	S	S
CO4	S	S	S	M	S	S	S	S	S	S
CO5	S	S	S	M	S	M	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code		PROGRAMMING IN C++ (PRACTICAL)	L	T	P	C
Core/Elective/Supportive		ELECTIVE III - C(Practical)	-	-	1	1
Pre-requisite		Knowledge in C++	Syllabus Version		2021-2022	

PRACTICAL LIST

1. Write a function ‘power( )’to raise a number ‘m’ to a power ‘n’. The function takes a ‘double’ value for ‘m’and ‘int’ value for ’n’, and returns the result correctly. Use a default vale of 2 for ‘n’ to make the function to calculate squares when this argument is omitted. Write a main( ) that gets the values of ‘m’ and ‘n’ from the user to test the function.

2. Write a program to compute compound interest of a given amount AMT for ‘n’ years. Use function overloading so that the program gets input of interest rate RATE in any of the data type ‘float’ or ‘int’

3. Create a class which consist of employee detail ENO, ENAME, DEPT, BASIC SALARY. Write a member function to get and display them. Derive a class PAY from the above class and write a member function to calculate DA, HRA and PF depending on the grade and display the pay slip in a neat format using console I/O

4. Define two classes POLAR and RECTANGLE to represent points in the polar and rectangle system. Write a program to convert from one system to another.

5. Create a class FLOAT that contains one float data member. Overload all the four arithmetic operators so that they operate on the objects of FLOAT.

Course code		NUMBER THEORY	L	T	P	C
Core/Elective/Supportive		ELECTIVE III – D	5	-	-	4
Pre-requisite		Knowledge in Algebra	Syllabus Version		2021 – 2022	

Course Objectives:

To impart knowledge in the basic concepts of number theory , fundamental definitions , theorems .

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the concepts of divisibility and primes	K1
2	Solve congruence.	K2
3	Describe the fundamental theorem of Arithmetic.	K3
4	Understand the concepts and apply the theorems in areas of Mathematics.	K3
5	Compute powers of integers modulo prime numbers.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Early Number Theory	15 hours

Peano's Axiom - Mathematical Induction - The Binomial Theorem - Early Number Theory .

Unit:2	Divisibility Theory in Integers	15hours

Divisibility Theory in Integers - The Division Algorithm - The g.c.d. - Euclidean Algorithm - The Diophontine Equation ax + by = c

Unit:3	Primes and their Distributions	15 hours

Primes and their Distributions - The fundamental Theorem of Arithmetic - The seive of Eratosthenes - The Gull Conjecture.

Unit:4	The Theory of Congruence	15 hours

The Theory of Congruence - Basic Properties of Congruence - Special Divisibility test - Linear Congruence-Prime modulus- Power residues.

Unit:5	Fermat's Theorem	15 hours

Fermat's Theorem - Fermat's factorization method - The Little theorem - Wilson's theorem.

	Total Lecture hours	75 hours

Text Book

1 Elementary Number theory -David M. Burton (W.M.C. Brown Publishers, Dubuque, Lawa, 1989.)

Reference Books	
1	An Introduction to theory of Numbers -Ivan Nivan and H. Zuckerman (5th edition,Wiley 1991)
2	Elements of Number Theory - Prof. S.Kumaravelu and SusheelaKumaravelu(Raja Sankar offset Printers ,Sivakasi, 2002)
3	Beginning Number Theory -Neville Robinns(2nd Ed., Narosa Publishing House Pvt.Ltd.,Delhi, 2007)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/103/111103020/ https://nptel.ac.in/courses/111/101/111101137/
Course Designed By: 1.Dr.C.Janaki 2.Mr.R.Subramanian	

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	M	M	S	S
CO2	S	S	S	M	S	S	S	M	M	S
CO3	M	M	M	M	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code		INTRODUCTION TO INDUSTRY 4.0	L	T	P	C
Core/Elective/Supportive		ELECTIVE III – E	5	-	-	4
Pre-requisite		Basic Knowledge Of Computer And Internet	Syllabus Version		2021-2022	

Course Objectives:

To impart knowledge on Industry 4.0, need for digital transformation and the following Industry 4.0 tools:

1. Artificial Intelligence
2. Big Data and Data Analytics
3. Internet of Things

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the reason for adopting Industry 4.0 and Artificial Intelligence.	K1
2	Understand the need for digital transformation.	K2
3	Apply the industry 4.0 tools.	K3
4	Analyze the applications of Big Data .	K4
5	Examine the applications and security of IoT Applications.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Industry 4.0	15 hours

Need – Reason for Adopting Industry 4.0 - Definition – Goals and Design Principles - Technologies of Industry 4.0 – Big Data – Artificial Intelligence (AI) – Industrial Internet of Things - Cyber Security – Cloud – Augmented Reality. .

Unit:2	Artificial Intelligence	15 hours

Artificial Intelligence : Artificial Intelligence (AI) – What & Why? - History of AI - Foundations of AI -The AI -environment - Societal Influences of AI - Application Domains and Tools - Associated Technologies of AI - Future Prospects of AI - Challenges of AI .

Unit:3	Big Data And IoT	15 hours

Big Data : Evolution - Data Evolution - Data : Terminologies - Big Data Definitions - Essential of Big Data in Industry 4.0 - Big Data Merits and Advantages - Big Data Components : Big Data Characteristics - Big Data Processing Frameworks - Big Data Applications - Big Data Tools - Big

Data Domain Stack : Big Data in Data Science - Big Data in IoT - Big Data in Machine Learning - Big Data in Databases - Big Data Use cases Big Data in Social Causes - Big Data for Industry - Big Data Roles and Skills -Big Data Roles - Learning Platforms; Internet of Things (IoT) : Introduction to IoT - Architecture of IoT - Technologies for IoT - Developing IoT Applications - Applications of IoT - Security in IoT .		
Unit:4	**Applications And Tools Of Industry 4.0**	**15 hours**
Applications of IoT – Manufacturing – Healthcare – Education – Aerospace and Defense – Agriculture – Transportation and Logistics – Impact of Industry 4.0 on Society: Impact on Business, Government, People. Tools for Artificial Intelligence, Big Data and Data Analytics, Virtual Reality, Augmented Reality, IoT, Robotics.		
Unit:5	**Jobs 2030**	**15 hours**
Industry 4.0 – Education 4.0 – Curriculum 4.0 – Faculty 4.0 – Skills required for Future - Tools for Education – Artificial Intelligence Jobs in 2030 – Jobs 2030 - Framework for aligning Education with Industry 4.0 .		
	Total Lecture hours	**75 hours**

Text Book

1	Higher Education for Industry 4.0 and Transformation to Education 5.0(2021)-P.Kaliraj & T. Devi

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/105/106105195/

Course Designed By:1.Dr.C.Janaki
2.Mr.R.Subramanian

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	S	S	S	M	S	S
CO2	M	M	M	S	S	S	S	M	M	S
CO3	S	S	S	S	S	S	S	S	S	M
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	M	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low