



Ready for
Every Good Work

SACRED HEART COLLEGE (AUTONOMOUS)

Tirupattur – 635 601, Tamil Nadu, S.India

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A Don Bosco Institution of Higher Education, Founded in 1951 * Affiliated to Thiruvalluvar University, Vellore * Autonomous since 1987

Accredited by NAAC (4th Cycle – under RAF) with CGPA of 3.31 / 4 at 'A+' Grade

PG & Research Department of Mathematics

Sacred Heart College (Autonomous),

Tirupattur, Vellore District - 635 601

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Accredited by NAAC (4th Cycle – under RAF) with

CGPA of 3.31/4 at 'A+' Grade

UG Programme



(Mathematics)

2021-22 onwards

Program Outcomes – UG Programme

OUTCOME-BASED EDUCATION (OBE)

LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

OBE is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student should have achieved the goal. There is no single specified style of teaching or assessment in OBE; instead, classes, opportunities and assessments should all help the students achieve the specific outcomes

Outcome Based Education, as the name suggests depends on Outcomes and not Inputs. The outcomes in OBE are expected to be measurable. In fact each Educational Institute can state its own outcomes. The ultimate goal is to ensure that there is a correlation between education and employability

Outcome –Based Education (OBE): is a student-centric teaching and learning methodology in which the course delivery, assessment are planned to achieve, stated objectives and outcomes. It focuses on measuring student performance i.e. outcomes at different levels.

Some important aspects of the Outcome Based Education

Course: is defined as a theory, practical or theory cum practical subject studied in a semester.

Course Outcomes (COs): are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Generally three or more course outcomes may be specified for each course based on its weightage.

Programme: is defined as the specialization or discipline of a Degree.

Programme Outcomes (POs): Programme outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

Programme Specific Outcomes (PSOs):

PSOs are what the students should be able to do at the time of graduation with reference to a specific discipline.

Programme Educational Objectives (PEOs): The PEOs of a programme are the statements that describe the expected achievement of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after Graduation.

Programme Outcomes at SHC

Programme Outcomes at Undergraduate Level

Undergraduates will be able to:

- PO1:** Discuss their new knowledge and understanding; apply new ideas in order to acquire employability/self-employment
- PO2:** Pursue higher learning programmes and become entrepreneurs
- PO3:** Recognize moral and ethical values and be socially responsible citizens in the society
- PO4:** Apply analytical, technical, problem solving, critical thinking skills, and decision-making skills in solving real life problems in one's life and in the society.
- PO5:** Direct their own self-learning through MOOC courses, co-curricular activities, industrial exposures and field trainings
- PO6:** Develop their own broad conceptual background in Biological sciences, Computing sciences, Languages and culture, Management studies, Physical sciences, etc.
- PO7:** Demonstrate communication skills both oral and written in personal and academic pursuits

Programme Specific Outcomes - B.Sc Mathematics

PSO1: Solid Foundation in Knowledge: Bachelor Degree in Mathematics is the culmination of in-depth knowledge of many core branches of mathematics, viz. Algebra, Calculus, Geometry, Differential Equations, Mechanics, Real and Complex Analysis including some related areas like Numerical Methods, Mathematical modelling, Operation Research, Probability and Statistics. Thus, this programme helps students in building a solid foundation for further higher studies and research in Mathematics.

PSO2: Competency in Skills: The skills and knowledge gained has intrinsic beauty, which leads to proficiency in analytical reasoning, critical understanding, analysis and synthesis in order to solve theoretical and practical problems. This can orient students towards applications of mathematics in other disciplines and moreover, can also be utilized in modelling and solving real life problems.

PSO 3: Problem Solving: Students undergoing this programme learn to logically question assertions, to recognize patterns and to distinguish between essential and irrelevant aspects of problems. This helps them to learn behave responsibly in a rapidly changing interdependent society.

PSO4: Interdisciplinary and Research Skills: Students completing this programme will be able to present mathematics clearly and precisely, make vague ideas precise by formulating them in the language of mathematics, describe mathematical ideas from multiple perspectives and explain fundamental concepts of mathematics to non- mathematicians.

PSO 5: Proficiency in Employments: This programme will help students to enhance their employability for Government jobs, jobs in banking, insurance and investment sectors, data analysis jobs, and jobs in various other public and private enterprises.

Department of Mathematics
Proposed Internal Components
For the Batch 2021 – 22

Under Graduate Programme		
Components		Marks
I CA		15
II CA		15
Attendance		5
MCQ-30 questions- 60 minutes-online/offline	30	5
Problem Solving Session	15	5
Test Series(Unit Tests/Cycle Tests/Pre CA Tests)	15	5
Total		50

Pattern of CA Question Paper (UG)

Section A	
Answer ALL the Questions	$6 \times 2 = 12$ Marks
Section B	
Answer ALL the Questions Either or Type	$3 \times 6 = 18$ Marks
Section C	
Answer ANY TWO Questions Out of Three Questions	$2 \times 10 = 20$ Marks

Pattern of Semester Question Paper (UG)

Section A	
Answer ALL the Questions	$10 \times 2 = 20$ Marks
Section B	
Answer ALL the Questions Either or Type	$5 \times 7 = 35$ Marks
Section C	
Answer ANY THREE Questions Out of FIVE Questions	$3 \times 15 = 45$ Marks

Total Marks for Each Subject is

Continuous Internal Assessment 50 Marks + End Semester Examination 50

Total = 100 Marks

Common Programme Structure under CBCS B.A., B.Sc., Programmes

Part	Course		No. of Courses	Total No. of Hours	Total No. of Credits	Total
I	Tamil/Hindi/Urdu/French		4	20	12	20 (12)
II	General English		4	20	12	20 (12)
III	Main Core		16	86	86	124 (110)
	Main Electives		2	10	6	
	Allied		4	24	16	
	Non Major Elective		2	4	2	
IV	Life Education	Personal Skills Social Skills Employability Skills – I Employability Skills – II	4	8	4	16 (10)
		Value Education – I/ Christian Religion – I Value Education – II/ Christian Religion - II	2	4	2	
		Environmental Science	1	2	1	
		Human Rights	1	2	1	
		Communicative English	2		2	
V	Extension	Outreach Program			2	
		Groups and Movements			2	
VI	Extra Credit Course	Self Study Papers – I Self Study Paper - II	2		4*	
		Certificate Course	3		6*	
		Project Work/Internship			2*	
	Total			180	(148+6*)	180 (148+6*)

****Subject to the maximum of additional 6 credits**

PG & RESEARCH DEPARTMENT OF MATHEMATICS
SACRED HEART COLLEGE (AUTONOMOUS)
B. Sc., Mathematics Programme Structure 2021-22

Sem	Course Code	Course Title	Type	Hrs/Wk	Credits	Marks		
						Int	SE	Total
I	M116	Differential Calculus	MC	5	5	50	50	100
	M117	Algebra and Trigonometry	MC	5	5	50	50	100
	AP1XX	Allied - Physics - I	Allied	6	4	50	50	100
II	M214	Integral Calculus	MC	5	5	50	50	100
	M215	Differential Equations and Fourier Series	MC	5	5	50	50	100
	AP2XX	Allied Physics - II	Allied	6	4	50	50	100
III	M315	Vector Calculus	MC	5	5	50	50	100
	M316	Solid Geometry and Transforms	MC	5	5	50	50	100
	ACH3XX	Allied Chemistry -I	Allied	6	4	50	50	100
IV	M415	Numerical Methods	MC	5	5	50	50	100
	M416	Algebraic Structures - I	MC	5	5	50	50	100
	ACH4XX	Allied Chemistry - II	Allied	6	4	50	50	100
V	M541	Algebraic Structures - II	MC	6	6	50	50	100
	M542	Real Analysis - I	MC	6	6	50	50	100
	M543	Mechanics	MC	5	5	50	50	100
	M544	Probability and Statistics	MC	6	6	50	50	100
	M545A	Number Theory	DSE	5	3	50	50	100
	M545B	Mathematical Modeling with Difference and Differential Equations						
	M545C	Fuzzy Algebra						
NMA504	Mathematics for Competitive Examinations-I	NME	2	1	50	50	100	
VI	M643	Linear Algebra	MC	6	6	50	50	100
	M644	Real Analysis - II	MC	6	6	50	50	100
	M645	Complex Analysis	MC	6	6	50	50	100
	M646A	Resource Management Techniques	DSE	5	3	50	50	100
	M646B	Graph Theory						

	M646C	Discrete Mathematics						
	M647	Mathematical Statistics	MC	5	5	50	50	100
	NMA604	Mathematics for Competitive Examinations-II	NME	2	1	50	50	100
		Total		124	110+6*			

MC – Main Core

DSE – Discipline Specific Elective

NME – Non-Major Elective

Semester	III	V	VI	Credits
Title of the Certificate Course	Mathematical Logic	Mathematical Modeling with Spreadsheet	Scilab for Mathematical Computations	2*+2*+2*
Title of Self Study Course	Mathematical Aptitude - I Mathematical Competence Course	Mathematical Aptitude - II	-	2*+2*
	-	Individual Project/ Group project	-	2*
MOOC Courses	MOOC Courses are approved by the Department of Mathematics			Number of Credits awarded as per the recommendation of NPTEL

****Subject to the maximum of additional 6 credits**

Programme Structure – B.Sc. Mathematics (2021-22)

Semester I

Part	Type	Course Code	Title of the Course	Paper	Hours	Credit	CI A	Sem	Total
I	Language		Tamil/Hindi/Urdu/French	I	5	3	50	50	100
II	Language		General English	I	5	3	50	50	100
III	Main Core	M116	Differential Calculus	I	5	5	50	50	100
III	Main Core	M117	Algebra and Trigonometry	II	5	5	50	50	100
III	Allied		Allied Physics - I	I	6	4	50	50	100
IV	Life Education		Personal Skills	I	2	1	-	-	100*
			Christian Religion - I/Value Education – I	I	2	1	-	-	100*
			Communicative English	I		1	-	-	100*
Total					30	23			

*Internal Paper

Semester II

Part	Type	Course Code	Title of the Course	Paper	Hours	Credit	CI A	Sem	Total
I	Language		Tamil/Hindi/Urdu/French	II	5	3	50	50	100
II	Language		General English	II	5	3	50	50	100
III	Main Core	M214	Integral Calculus	III	5	5	50	50	100
III	Main Core	M215	Differential Equations and Fourier Series	IV	5	5	50	50	100
III	Allied		Allied Physics - II	II	6	4	50	50	100
IV	Life Education		Social Skills	II	2	1	-	-	100*
			Christian Religion – II/ Value Education – II	II	2	1	-	-	100*
			Communicative English	II		1	-	-	100*
Total					30	23			

*Internal Paper

Semester III

Part	Type	Course Code	Title of the Course	Paper	Hours	Credit	CIA	Sem	Total
I	Language		Tamil/Hindi/Urdu/French	III	5	3	50	50	100
II	Language		General English	III	5	3	50	50	100
III	Main Core	M315	Vector Calculus	V	5	5	50	50	100
III	Main Core	M316	Solid Geometry and Transforms	VI	5	5	50	50	100
III	Allied		Allied – III: Allied Chemistry - I	I	6	4	50	50	100
IV	Life Education		Employability Skills – I	III	2	1	-	-	100*
			Environmental Science	I	2	1	-	-	100*
VI	Extra Credit Course (Self Study Paper)		Mathematical Aptitude – I Mathematical Competence Course			2*			
VI	Extra Credit Course (Certificate Course)		Mathematical Logic			2*			
			Total		30	22+4*			

*Internal Paper

Semester IV

Part	Type	Course Code	Title of the Course	Paper	Hours	Credit	CIA	Sem	Total
I	Language		Tamil/Hindi/Urdu/French	IV	5	3	50	50	100
II	Language		General English	IV	5	3	50	50	100
III	Main Core	M415	Numerical Methods	VII	5	5	50	50	100
III	Main Core	M416	Algebraic Structures - I	VIII	5	5	50	50	100
III	Allied		Allied – IV: Allied Chemistry -II	II	6	4	50	50	100
IV	Life Education		Employability Skills – II	IV	2	1	-	-	100*
			Human Rights	I	2	1	-	-	100*
V	Extension		Outreach Program			2			
			Groups and Movements			2			
			Total		30	26+1*			

*Internal Paper

Semester V

Part	Type	Course Code	Course	Paper	Hours	Credit	CIA	Sem	Total
III	Main Core	M541	Algebraic Structures – II	IX	6	6	50	50	100
III	Main Core	M542	Real Analysis – I	X	6	6	50	50	100
III	Main Core	M543	Mechanics	XI	5	5	50	50	100
III	Main Core	M544	Probability and Statistics	XII	6	6	50	50	100
III	Main Elective	M545A M545B M545C	Number Theory Mathematical Modeling with Difference and Differential Equations Fuzzy Algebra	I	5	3	50	50	100
III	Non-Major Elective	NMA504	(Offered to other Departments) Mathematics for Competitive Examinations-I	I	2	1			100*
VI	Extra Credit Course (Self Study Paper)		Mathematical Aptitude – II			2*			
VI	Extra Credit Course		Individual Project/ Group project			2*			
VI	Extra Credit Course (Certificate Course)		Mathematical Modeling with Spreadsheet			2*			
			Total		30	27+6*			

*Internal Paper

Semester VI

Part	Type	Course Code	Title Of the Course	Paper	Hours	Credit	CIA	Sem	Total
III	Main Core	M643	Linear Algebra	XIII	6	6	50	50	100
III	Main Core	M644	Real Analysis – II	XIV	6	6	50	50	100
III	Main Core	M645	Complex Analysis	XV	6	6	50	50	100
III	Main Elective	M646A M646B M646C	Resource Management Techniques Graph Theory Discrete Mathematics	II	5	3	50	50	100
III	Main Core	M647	Mathematical Statistics	XVI	5	5	50	50	100
III	Non-Major Elective	NMA604	Mathematics for Competitive Examinations- II		2	1			100*
VI	Extra Credit Course (Certificate Course)		Scilab for Mathematical Computations			2*			
			Total		30	27+2*			

*Internal Paper

**Knowledge levels for assessment of Outcomes based on Blooms
Taxonomy**

S.No.	Level	Parameter	Description
1.	K1	Knowledge/Remembering	It is the ability to remember the previously learned.
2.	K2	Comprehension/Understanding	The learner explains ideas or concepts.
3.	K3	Application/Applying	The learner uses information in a new way.
4.	K4	Analysis/Analysing	The learner distinguishes among different
5.	K5	Evaluation/Evaluating	The learner justifies a stand or decision
6.	K6	Synthesis/Creating	The learner creates a new product or point of view.

Year/Semester: I Yr/ I SEM
Credits: 5

Code: M116
Hours/Week: 5

Differential Calculus

Objective: To develop problem solving skills in Calculus and provide base for higher mathematics.

Unit - I: Successive Differentiation

Successive differentiation - Leibnitz's Formula - Maxima and Minima (Problems Only).
(Chapter III: Sections 1.1 to 1.6, 2.1, 2.2; Chapter V: Sections 1.1 to 1.3)

Unit - II: Rolle's and Mean Value Theorems

Rolle's Theorem (Problems Only) - Mean Value Theorem (Problems Only) - Indeterminate forms.
(Chapter VI: Sections 1, 2.1, 4.1 to 4.6)

Unit - III: Partial Differentiations

Taylor's theorem - Cauchy's form of Remainder - Taylor's and Maclaurin's series - Partial differentiation - Euler's theorem on homogenous functions.
(Chapter VII: Sections 1.2 to 1.4; Chapter VIII: Sections 1.1, 1.2, 1.6)

Unit - IV: Curvature and Evolutes

Curvature - Radius of curvature - Centre of curvature - Evolutes and Involutives -
 $p-r$ equation.
(Chapter X: Sections 2.1 to 2.7)

Unit - V: Envelopes and Asymptotes

Envelopes - Asymptotes Parallel to the axis - Another method for finding asymptotes -
Asymptotes by inspection - Intersections of a curve with its asymptotes.
(Chapter X: Sections 1.1 to 1.4, Chapter XI: Sections 1 to 7)

Book for Study

1. S. Narayanan and T. K. Manicavachagom Pillay, Calculus, Volume I,
2. S. Viswanathan (Printers and Publishers), PVT Ltd, Chennai, 2011.

Books for Reference

1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc, 2002.
2. Dennis, D. Berkley, Calculus, Saunders College Publishing, New York, 1984.
3. Hilde Brand, Francis. B, Advanced Calculus for Applications, Prentice Hall Pvt. Ltd, New Delhi, 1977.
4. John. M. H, Ohm Steel, Advanced Calculus, Eurasia Publishing House, New Delhi, 1970.
5. P. Kandasamy and K. Thilagavathi, Mathematics for B. Sc Volume I & II, S. Chand & Co, New Delhi, 2004.
6. A. K. Sharma, Differential Calculus, Discovery Publishing House, New Delhi, 2004.
7. G. B. Thomas and R. L. Finney, Calculus, Pearson Education, 2007.

E-learning source: <http://www.learnerstv.com/Free-maths-Video-lectures-ltv295-Page1.htm>, <https://online.math.uh.edu/HoustonACT/videocalculus/>

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	classify the maxima and minima of the function.	K2
CO2	demonstrate mean value theorem for differentiable functions.	K3
CO3	developing the Euler's theorem of homogeneous function.	K6
CO4	finding the curvature and analyze evolutes of the curve in Cartesian and Polar coordinates.	K4, K5
CO5	identify and build the Envelopes and Asymptotes of the curve.	K1, K3

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	2	2	1	3	2	2	1	3	3	3	2	2	2.17
2	2	2	2	3	3	3	2	3	3	2	3	2	2.50
3	2	3	2	2	3	2	3	2	3	2	3	2	2.42
4	2	3	2	3	3	2	3	2	3	2	3	2	2.50
5	2	3	2	3	3	2	3	2	3	2	2	2	2.42
Mean Overall Score													2.40
Result													High

Year/Semester: I Yr /I SEM

Credits: 5

Code: M117

Hours/Week: 5

3.

Algebra and Trigonometry

Objective: To solve various types of algebraic equations, derive trigonometric identities and find real imaginary parts of complex trigonometric expression.

Unit - I: Summation of Series

Summation of Binomial Series, Exponential Series, Logarithmic Series and approximation problems (without proof of Theorems).

(Chapters 2, 3, and 4: Pages 2.1-2.16, 3.1-3.15, 4.1- 4.16).

Unit - II: Theory of Equations

Formation of an equation - Fundamental Theorem in the theory of equations- Relation between the roots and coefficients of an equation - Imaginary roots and irrational roots - Reciprocal equation.

(Chapter 6: Pages 6.1 - 6.37).

Unit - III: Theory of equations (contd...)

Transformation of Equation - Multiplication of roots by m - Diminishing the roots of an equation - Removal of a term - Descartes' Rule of signs - Descartes' rule of signs for negative roots of an equation - Horner's Method - Newton's Method. (Chapter 6: Pages 6.38 - 6.67).

Unit - IV: Trigonometry

Expansions for $\sin n\theta, \cos n\theta$ and $\tan n\theta$ - Expansions for $\cos^n \theta, \sin^n \theta$ and $\cos^m \theta \sin^n \theta$ in terms of sines and cosines of multiple of θ - Expansions of $\sin \theta, \cos \theta, \tan \theta$ in ascending powers of θ .

(Chapter 7: Pages 7.1 - 7.30).

Unit - V: Trigonometry (contd...)

Hyperbolic functions - Relations between circular and hyperbolic functions - Inverse hyperbolic functions.

(Chapter 7: Pages 7.31 - 7.60).

Book for Study

1. P.R. Vital and V. Malini, Algebra and Trigonometry - I, Margham Publications - Reprint 2015.

Books for Reference

1. S. Arumugam and A. Thangapandi Issac, Algebra and Trigonometry, New Gamma Publishing House, July 2011.
2. G. Britto Antony Xavier, V. Balaji, S.U. Vasantha Kumar, B. Govindan, Mathematical Sciences, Jayalakshmi publications, second Edition 2015.
3. W.S. Burnside and A.W. Panton, The Theory of Equations, Dublin University Press, 1954.
4. P. Duraipandiyan, S. Udayabaskaran Allied Maths, Vol.1, Muhil publishers, First Edition, 1997.
5. P. Kandasamy, K. Thilagavathy, Mathematics for B.Sc., First semester, volume - I, S. Chand and company Ltd, First Edition, 2004.

E -Learning source: <http://www.sosmath.com/trig/hyper/hyper03/hyper03.html>

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	list summation of various series.	K1
CO2	understand the importance of real and complex roots of the equation.	K2
CO3	finding the roots of the equation by various methods.	K5
CO4	formulate the Trigonometric series.	K6
CO5	determine and point out the relation between circular and hyperbolic function.	K3, K4

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
2	2	2	1	3	2	3	1	3	3	3	2	2	2.25
2	2	3	2	3	3	3	2	3	3	2	2	2	2.50
3	2	3	2	2	3	3	2	2	3	3	3	2	2.50
4	2	2	2	3	3	2	3	2	3	2	3	2	2.42
5	2	3	2	3	3	2	3	2	3	2	2	2	2.42
Mean Overall Score												2.42	
Result												High	

Year/Semester: I Yr/II SEM
Credits: 5

Code: M214
Hours/Week: 5

Integral Calculus

Objective: To develop problem solving skills in Calculus and provide base for higher mathematics.

Unit - I: Integration of Rational Functions

Integration by partial fractions - Integration of rational algebraic functions.
(Chapter 1, Sections 7.3 - 7.5)

Unit - II: Integration of Trigonometric Functions

Integration of Irrational functions - Integration of Trigonometric functions.
(Chapter 1: Sections 8 and 9)

Unit - III: Definite Integrals

Properties of definite integrals - Reduction Formulae - Bernoulli's Formula.
(Chapter 1: Sections 11, 13, 15.1)

Unit - IV: Double and Triple Integrals

Double and Triple integrals (Cartesian and Polar forms) - Changing the order of integration - Applications of double and triple integrals in finding area and volume.
(Chapter 5: Sections 2.1, 2.2, 3.1, 4, 5.1 - 5.4, 6.1 - 6.3 (Problems Only)).

Unit - V: Improper Integrals

Beta and Gamma functions- Applications of beta and gamma functions in evaluation of double and triple integrals.
(Chapter 7: Sections 2.1 - 2.3, 3 - 6 (Problems only))

Book for Study

1. S. Narayanan and T. K. Manicavachagom Pillay, Calculus, Volume II, S. Viswanathan (Printers and Publishers), PVT Ltd, Chennai, 2012.

Books for Reference

1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons (Asia) Pvt. Ltd, 2002.
2. Dennis, D. Berkley, Calculus, Saunders College Publishing, New York, 1984.
3. John. M. H, Ohm Steel, Advanced Calculus, Eurasia Publishing House, New Delhi, 1970.
4. P. Kandasamy and K. Thilagavathi, Mathematics for B. Sc Volume I & II, S. Chand & Co, New Delhi, 2004.
5. A. K. Sharma, Differential Calculus, Discovery Publishing House, New Delhi, 2004.
6. G. B. Thomas and R. L. Finney, Calculus, 9th edition, Pearson Education, Delhi, 2005.

E-learning source: <http://www.learnerstv.com/Free-maths-Video-lectures-ltv295-Page1.htm>, <https://online.math.uh.edu/HoustonACT/videocalculus/>

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	identify the techniques to solve the integration of Rational function.	K1
CO2	understand the techniques to solve the integration of Trigonometry function.	K2
CO3	applying the Bernoulli's formula to get the solution of the integral of the function.	K3
CO4	evaluate and deduce the concept of double and triple integrals.	K4, K5
CO5	integrate of double and triple integral by Beta and Gamma function.	K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
2	2	2	1	3	2	3	1	3	3	3	2	2	2.25
2	2	3	2	3	3	3	2	2	3	2	2	2	2.42
3	2	3	2	2	3	3	2	2	3	2	3	2	2.42
4	2	2	3	3	3	1	3	2	3	2	3	2	2.42
5	2	3	2	3	3	2	3	2	3	2	2	2	2.42
Mean Overall Score													2.38
Result													High

Year/Semester: I Yr / II SEM

Code: M215

Credits: 5

Hours / Week: 5

Differential Equations & Fourier Series

Objectives: To help the learners to solve standard types of ordinary and partial differential equations

Unit - I: Differential Equations of First Order

Exact differential equations- integrating factors-equations of first order but of higher degree - equations solvable for p , y and x - Clairaut equation.

(Book 1: Chapter 1, Sections 1.3, 1.4 and 1.7)

Unit - II: Linear Equations of Higher Order

Linear equations of higher degree with constant coefficients - homogeneous linear equations - variation of parameters - simultaneous linear differential equations. (Book 1: Chapter 2, Sections 2.1 - 2.4, Type D in 2.5, 2.6 and 2.7)

Unit - III: Partial Differential Equations

Partial differential equations - formation - solution - Lagrange's method - standard forms - Charpit's method.

(Book 1: Chapter 4, Sections 4.1-4.5)

Unit - IV: Applications of Differential Equations

Applications - orthogonal trajectories-growth and decay - dynamical problems with variable mass.

(Book 1: Chapter 6, Sections 6.1, 6.2 and 6.12)

Unit - V: Fourier Series

Definition - even and odd functions - half-range Fourier series - development in cosine series - development in sine series.

(Book 2: Chapter 6: Sections 6.1 - 6.5)

Books for Study

1. S. Arumugam, Issac, "Differential Equations and Applications", New Gamma Publishing House, Palayamkottai, 2011.
2. S. Narayanan and T.K. Manickavachagam Pillay, Calculus (Volume III), S. Viswanthan Publishers Pvt., Ltd., Chennai, 2011.

Books for Reference

1. Gupta, Malik and Mittal Differential Equations-Pragati Prakashan, Fourth Edition, 1997.
2. S. Narayanan and T. K. Manicavachagom, Differential Equations and its Applications - S. Viswanathan (printers & publishers) Pvt. Ltd., 1996
3. Richard Bronson, Differential Equations - Schaum's Outline Series, McGraw Hill, Second Edition, 1994

E - Learning source: <http://ovw.mit.edu/courses/mathematics/indexhtm>,

<http://tutorial.math.lamar.edu/Classes/DE/DE.aspx>,<https://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/>

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	understand the genesis of ordinary as well as partial differential equations and name the applications in real world.	K1, K2
CO2	apply various techniques of getting exact solutions of certain solvable first order differential equations and linear differential equations of second order.	K3
CO3	find solution of first order linear partial differential equations using Lagrange's method and eliminating constant and functions..	K4, K5
CO4	solve second order linear partial differential equations with constant coefficients.	K3
CO5	formulate mathematical models in the form of ordinary differential equations and to get the solution of the problem. Fourier Cosine and Fourier Sine series.	K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
2	2	2	1	3	3	3	1	3	3	3	2	2	2.33
2	2	3	2	3	3	3	2	3	3	2	2	2	2.50
3	3	2	2	2	3	3	2	3	2	3	3	2	2.50
4	2	2	2	3	3	2	3	2	3	2	3	2	2.42
5	3	3	2	3	3	2	3	2	3	2	2	2	2.50
Mean Overall Score													2.45
Result													High

Year/Semester: II Yr /III SEM
Credits: 5

Code: M315
Hours/Week: 5

Vector Calculus

Objective: To develop deep understanding of key concepts followed by problems of applied mathematics, which are essential tools of modern applied mathematics.

Unit - I: Vector Differentiation

Velocity of a particle - Examples - Scalar and Vector point functions - Level surfaces - Directional derivative of a scalar point function - Gradient of a scalar point function - Summation notation for gradient - Gradient of $f(r)$.

(Chapter 1: Sec 1.5 - 1.6 and Chapter 2: Sec 2.1 - 2.6, Chapter 2, Examples Section 2.13 - subsection 2.3 - 2.4).

Unit - II: Divergence and Curl

Divergence and curl of a vector point function - Scalar potential - Summation notation for divergence and curl - Divergence and curl of $f(r) \bar{r}$ - Laplacian differential operator - Other Differential operators - Divergence and curl of a gradient - Divergence and curl of a curl - Examples.

(Chapter 2: Sec 2.7 - 2.13, Chapter 2, Examples Section 2.13 - subsection 2.7 - 2.11).

Unit - III: Line, Surface and Volume Integrals

Line integrals - Line integral along an arc C - Surface integrals - Volume integrals - Examples.

(Chapter 3: Sec 3.1, 3.5, 3.6, 3.8, Omit Parabolic Cylinder type problems in Example 3.5).

Unit - IV: Integrals Theorems

Gauss divergence theorems without proof.

(Chapter 4: Sec 4.2, Examples 4.8).

Unit - V: Integrals Theorems (Contd...)

Green's theorems in plane without proof - Stoke's theorem without proof.

(Chapter 4: Sec 4.4, 4.5, Examples 4.8).

Book for Study

1. P. Duraipandian and Kayalal Pachaiyappa, Vector Analysis, S Chand and Company Limited, Ram Nagar, New Delhi, 2018.

Books for Reference

1. Abosos Ali Shaikh, Vector Analysis with Applications, Narosa publications, New Delhi, 2009.
2. M.L.Khanna, Vector Analysis, Jai PrakashNath and Co, 8th Edition, Meerut City, 1986.
3. Murray R. Spiegel, Seymour Lipschutz, Dennis Spellman, Vector Analysis, Tata McGraw Hill Education Private Limited, New Delhi, 2010.
4. M.D. Rajasinghania and others, Vector Algebra, S.Chand & Company Pvt.Ltd, Ram Nagar New Delhi, 1999.
5. P.R. Vittal, Vector Analysis, Margham publications, Chennai, 1997.

E- Learning source: <http://www.math.hmoedu/calculus/tutorials/vector> analysis

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	understand the definition of Scalar and Vector point's functions and find the directional derivative of a Scalar point function.	K2
CO2	find the solenoidal and irrotational of the vector point function.	K6
CO3	evaluate the line integrals, surface integrals and volume integrals.	K5
CO4	describe inter-relationship among the line integral, surface integral and triple integral formulation.	K1
CO5	apply and analyze Greens', Gauss and Stokes theorem.	K3, K4

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
2	2	2	1	3	2	3	1	3	3	3	2	2	2.25
2	3	3	2	3	3	3	2	3	3	2	3	2	2.67
3	2	3	2	3	3	3	2	3	2	3	3	2	2.58
4	2	3	2	3	3	2	3	2	3	2	3	2	2.50
5	2	3	2	3	3	2	3	2	3	3	2	2	2.50
Mean Overall Score												2.50	
Result												High	

Year/Semester: II Yr /III SEM
Credits: 5

Code: M316
Hours/Week: 5

Solid Geometry and Transforms

Objective: To make the students understand the basic concepts in two dimensional, three dimensional geometry, Laplace and Fourier transforms and to make them solve problems in these fields of study.

Unit - I: Plane

First degree equation - Determination of a plane - Plane perpendicular to a given direction - Planes parallel to given lines and through given points - Equation $P + \lambda P' = 0$ - Second degree homogeneous equation - Co planarity of the lines through a point - Perpendicular to a plane - positions of points with reference to a Plane - Sums .

(Book 1 : Chapter 3: Sections 3.1 to 3.9, 3.12)

Unit - II: Straight lines

Equation of a straight line - Conditions for various situations of a line - Angle between a plane and a line - Projection of a line - Perpendicular drawn to a line - Shortest distance between two skew lines.

(Book 1 : Chapter 4: Sections 4.1 to 4.6)

Unit - III: Straight lines (Continued)

Lines intersecting a given line - Lines of intersection of three planes - Equation of two given skew lines - Sums.

(Book 1 : Chapter 4: Sections 4.7 to 4.9, 4.11)

Unit - IV: Laplace Transforms

Laplace transforms - Inverse Laplace transforms - Solution of differential equations using Laplace transforms.

(Book 3 : Chapter 3, Sections 3.0-3.3)

Unit - V: Fourier Transforms

Infinite Fourier Transforms : Fourier sine transforms- Fourier cosine transforms-Linear property- Change of scale property-Shifting property-Modulation property-Convolution and Derivative theorems-Problems.

(Book-2 : Chapter 2 , Pages 158-185).

Books for Study

1. P. Duraipandian and KayalalPachaiyappa, Analytical Geometry 3D, Muhil Publishers, Revised Edition 2009..
2. J.K. Goyal and K.P.Gupta, Laplace and Fourier Transforms, PragatiPrakashan Publishers,1995.
3. S. Arumugam, Issac, "Differential Equations and Applications", New Gamma Publishing House, Palayamkottai, 2011.

Books for Reference:

1. P.K. Jain and Khalil Ahmed, Analytical Geometry of three dimensions, Wiley Eastern limited, 1991.
2. M. Pillai & others, Analytical Geometry, part II 3D, S.Viswanathan & co, Chennai, 1984.

E-learning Source: <http://mathworld.wolfram.com>

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	relate between plane and straight line in 2D and 3D.	K2
CO2	examine the two dimensional, three dimensional geometry and solve problems in these areas	K1, K3
CO3	analyze the uses of solid geometry in different scientific fields.	K4
CO4	find the solution of ODE using Laplace transforms.	K5
CO5	define the Fourier transform and its properties and convolution theorem and perform problems by Fourier transform.	K1, K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
2	3	2	1	2	2	3	1	3	3	3	2	2	2.25
2	2	3	2	3	3	3	2	3	3	2	2	2	2.50
3	2	3	2	2	3	3	2	2	2	3	3	3	2.50
4	2	3	3	2	3	2	3	3	3	2	3	2	2.58
5	2	3	2	3	3	2	3	2	3	2	2	2	2.42
Mean Overall Score													2.45
Result													High

Year/Semester: II Yr /IV SEM
Credits: 5

Code: M415
Hours/Week: 5

Numerical Methods

Objective: To introduce the scientific computation techniques to the students.

Unit - I: Transcendental and Polynomial Equations

Introduction - Bisection Method - Iteration methods based on first degree equation - Iteration methods based on second degree equation - Rate of convergence. (Without proof of formulae).

(Chapter 2: Sections 2.1 to 2.5)

Unit - II: System of linear Algebraic Equations

Introduction - Direct Methods - Error Analysis for Direct methods - Iteration Methods (Without proof of formulae).

(Chapter 3: Sections 3.1 to 3.4)

Unit - III: Interpolation and Approximation

Introduction - Lagrange and Newton interpolations - Finite difference operators - Interpolating polynomials using finite differences - Hermite interpolation - Piecewise and Spline interpolation - Bivariate interpolation (Without proof of formulae).

(Chapter 4: Sections 4.1 to 4.7)

Unit - IV: Numerical Differentiation

Introduction - Numerical Differentiation - Optimum choice for step-length - Extrapolation methods - Partial Differentiation (Without proof of formulae). (Chapter 5: Sections 5.1 to 5.5)

Unit - V: Numerical Integration

Numerical integration - Methods based on interpolation - Methods based on undetermined coefficients - Composite integration methods - Romberg Integration - Double integration (Without proof of formulae).

(Chapter: Sections 5.6 to 5.11)

Book for Study

1. M.K Jain, S.R.K Iyengar, and R.K Jain, Numerical Methods for Scientific and Engineering Computation, New age International Publisher, India, 2012.

Books for Reference

1. E. Balagurusamy, Numerical Methods, Tata McGraw Hill Publishing Company, New Delhi, 2004.
2. P. Kandasamy, K. Thilagavathi, K. Gunavathi, Numerical Methods, S. Chand & Company Ltd, New Delhi, 1997.
3. S.S. Sastry, Introductory methods of Numerical Analysis, 3-e, Prentice Hall Pvt Ltd, New Delhi, 2000.
4. A. Singaravelu, Numerical Methods, Meenakshi Publications, Chennai, 2002.

E-learning source: <http://nptel.ac.in/courses/122102009/>,
<http://www.math.ust.hk/~machas/numerical-methods.pdf>

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	find numerical solution to algebraic and transcendental equation.	K5
CO2	devise numerical solutions of system of linear equations and to check the accuracy of the solution.	K6
CO3	apply various interpolating and extrapolating methods to find numerical solution.	K3
CO4	understand the concept of numerical differentiation.	K2
CO5	define integration formulas and analyze the integrals by using Trapezoidal and Simpson's formula.	K1, K4

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
2	2	3	1	3	2	3	1	3	3	3	2	2	2.33
2	2	3	2	3	3	3	2	3	3	2	2	2	2.50
3	3	3	3	2	3	3	2	2	3	3	3	2	2.67
4	2	2	2	3	3	2	3	2	3	2	3	2	2.42
5	2	3	2	3	3	2	3	2	3	2	2	2	2.42
Mean Overall Score													2.47
Result													High

Year/Semester: II Yr /IV SEM
Credits: 5

Code: M416
Hours/Week: 5

Algebraic Structures - I

Objective: To acquire the knowledge of basic concept of some of the fundamental algebraic structures on Groups and Subgroups, Permutation Groups, Normal Subgroups and Factor Groups and Group Homomorphism's.

Unit - I: Groups, Finite Groups and Subgroups

Definition and Examples of Groups - Elementary Properties of Groups - Historical Note. Terminology and Notation - Subgroup Tests - Examples of Subgroups. (Chapters 2, 3)

Unit - II: Cyclic and Permutation Groups

Properties of Cyclic Groups - Classification of Subgroups of Cyclic Groups. Definition and Notation - Cycle Notation - Properties of Permutations - A Check Digit Scheme Based on D_5 . (Chapters 4, 5)

Unit - III: Isomorphism's, Cosets and Lagrange's Theorem

Motivation - Definition and Examples - Cayley's Theorem - Properties of Isomorphism's - Automorphism's - Properties of Cosets - Lagrange's Theorem and Consequences - An Application of Cosets to Permutation Groups - The Rotation Group of a Cube and a Soccer Ball. (Chapters 6, 7).

Unit - IV: External Direct Products, Normal Subgroups and Factor Groups

Definition and Examples - Properties of External Direct Products - The Group of Units Modulo n as an External Direct Product - Applications. Normal Subgroups- Factor Groups - Applications of Factor Groups - Internal Direct Products. (Chapters 8, 9).

Unit - V: Group Homomorphism's and Finite Abelian Groups

Definition and Examples - Properties of Homomorphism's - The First Isomorphism Theorem. The Fundamental Theorem - The Isomorphism Classes of Abelian Groups - Proof of the Fundamental Theorem. (Chapters 10, 11).

Book for Study

1. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, 1999.

Books for Reference

1. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
2. S.Arumugam and A.Thandapani, Modern Algebra, SciTech Publications Pvt. Ltd.
3. George E Andrews, Number Theory, Hindustan Publishing Corporation, 1984.
4. N. Herstein, Topics in Algebra, John Wiley and sons, 2-e, New Delhi, 2006.
5. John B. Fraleigh, A First Course in Abstract Algebra, 7-e, Pearson Education Publication, New Delhi 2003.
6. Saunders Maclane and Garrett Birkoff, Algebra, 2-e, Macmillan Publishing Co.inc, New York, 1979.
7. Serge Lang, Algebra, Addition Wesley Publishing Company, London 1965.

8. Surjeeth Singh and Quazi Zameeruddin, Modern Algebra 2-e, Vikas Publishing House Pvt. Ltd., New Delhi, 1975.

E - Learning source: <http://mathworld.wolfram.com>

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	understand the fundamental concept of groups, subgroups and related theorems.	K2
CO2	define cyclic and permutation groups and its properties.	K1
CO3	establish Lagrange's theorem.	K3
CO4	categorize internal and external direct products.	K4
CO5	consider finite abelian group and develop their properties of homomorphism	K5, K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
2	2	2	1	3	2	3	1	3	3	3	2	2	2.25
2	2	3	2	3	3	3	2	3	3	2	2	2	2.50
3	2	3	2	2	3	3	2	2	3	3	3	2	2.50
4	2	2	2	3	3	2	3	2	3	2	3	2	2.42
5	2	3	2	3	3	2	3	2	3	2	2	2	2.42
Mean Overall Score												2.42	
Result												High	

Year/Semester: III Yr/V SEM
Credits: 6

Code: M541
Hours/Week: 6

Algebraic Structures - II

Objective: To acquire the knowledge of basic concept of some of the fundamental algebraic structures on Rings and Integral Domains, Ideals, Factor Rings and Polynomials.

Unit - I: Rings and Integral Domains

Definition - Examples of Rings - Properties of Rings - Subrings. Definition and Examples - Fields - Characteristic of a Ring.

(Chapter 12, 13).

Unit - II: Ideals and Factor Rings

Ideals - Factor Rings - Prime Ideals and Maximal Ideals.

(Chapter 14).

Unit - III: Ring Homomorphism's and Polynomial Rings

Definition and Examples - Properties of Ring Homomorphism's - The Field of Quotients - The Division Algorithm and Consequences.

(Chapter 15, 16).

Unit - IV: Factorization of Polynomials

Reducibility Tests - Irreducibility Tests - Unique Factorization in $\mathbb{Z}[x]$ - Weird Dice: An Application of Unique Factorization.

(Chapter 17).

Unit - V: Divisibility in Integral Domains

Irreducible, Primes - Historical Discussion of Fermat's Last Theorem - Unique Factorization Domains - Euclidean Domains.

(Chapter 18).

Book for Study

1. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, 1999.

Books for Reference

1. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
2. S.Arumugam and A.Thandapani, Modern Algebra, SciTech Publications Pvt. Ltd.
3. George E Andrews, Number Theory, Hindustan Publishing Corporation, 1984.
4. N. Herstein, Topics in Algebra, John Wiley and sons, 2-e, New Delhi, 2006.
5. John B. Fraleigh, A First Course in Abstract Algebra, 7-e, Pearson Education Publication, New Delhi 2003.
6. Saunders MacLane and Garrett Birkhoff, Algebra, 2-e, Macmillan Publishing Co.inc, New York, 1979.
7. Serge Lang, Algebra, Addition Wesley Publishing Company, London 1965.
8. Surjeeth Singh and Quazi Zameeruddin, Modern Algebra 2-e, Vikas Publishing House Pvt. Ltd., New Delhi, 1975.

E - Learning source: <http://mathworld.wolfram.com>

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	analyze and demonstrate examples of ideals and factor rings.	K2, K4
CO2	define isomorphism and homomorphism for groups and rings.	K1
CO3	categorize various canonical types of groups and rings.	K4
CO4	apply and perform the reducibility and irreducibility tests for factorization of polynomials.	K3, K6
CO5	prove the divisibility of integral domain	K5

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	3	2	1	3	2	2	2	2	3	3	3	3	2.42
2	3	2	1	3	3	2	2	3	3	3	3	2	2.5
3	3	2	1	3	3	3	2	3	3	3	2	2	2.5
4	3	2	2	3	3	3	2	3	3	3	3	2	2.67
5	3	2	2	3	3	2	2	3	3	2	2	2	2.42
	Mean Overall Score												2.50
	Result												High

Year/Semester: III Yr/V SEM

Code: M542

Credits: 6

Hours/Week: 6

Real Analysis - I

Objective: To study the real number system, point set topology, limits and continuity, derivatives of real-valued functions.

Unit - I: Real Number System

Upper bounds, maximum element, 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 number with finite decimal representation - Finite decimal approximation to real numbers - Infinite decimal approximation to real numbers - Absolute values and the triangle inequality - The Cauchy-Schwarz inequality - Plus and minus infinity and the extended real number system \mathbb{R}^* - Finite and infinite sets - Countable and uncountable sets - Uncountability of the real number system - Set algebra - Countable collection of countable sets. (Chapter 1: Sections 1.10 to 1.20) (Chapter 2: Sections 2.11 to 2.15, Related Problems).

Unit - II: Point Set Topology

Introduction - Euclidean space in \mathbb{R}^n - Open balls and open sets in \mathbb{R}^n - Structure of open sets in \mathbb{R}^1 - Closed sets - Adherent points, Accumulation points - Closed sets and adherent points - Bolzano Weierstrass theorem (without proof) - Cantor intersection theorem. (Chapter 3: Sections 3.1 to 3.9, Related Problems).

Unit - III: Limits and Continuity

Introduction - Convergent sequences in a metric space - Cauchy sequences - Complete metric spaces - Limit of a function - Continuous functions - Continuity of composite functions - Examples of continuous functions. (Chapter 4: Sections 4.1 to 4.5, 4.8, 4.9, 4.11, Related Problems).

Unit - IV: Continuity

Continuity and inverse images of open or closed sets - Functions continuous on compact sets - Topological mappings - Bolzano's theorem - Uniform continuity - Uniform continuity and compact sets - Fixed point theorem for contractions. (Chapter 4: Sections 4.12 to 4.15, 4.19 to 4.21, Related Problems).

Unit - V: Derivatives

Introduction - Definition of derivative - Derivatives 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 - Intermediate Value theorem for derivatives - Taylor's formula with remainder. (Chapter 5: Sections 5.1 to 5.12, Related Problems).

Book for Study

1. Tom M. Apostol, Mathematical Analysis, Indian student second edition, Narosa Publishing House, Chennai, 20th Reprint, 2002.

Books for Reference

1. P. N. Arora and Ranjit Singh, First course in Real Analysis, Third edition, Sultan Chand and Sons Publishers, New Delhi, 1981.
2. S. Arumugam, Modern Analysis, New Gamma Publishers, Palayamkottai, 1993.
3. E. Fischer, Intermediate Real Analysis, Springer Verlag, 1983.
4. Robert G. Bartle and Donald R. Sherbert, Introduction to Real Analysis by 2-e John Wiley and Sons, 2000.
5. Richard R. Goldberg, Methods of Real Analysis, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi, 1970.

E-Learning source: mathworld.wolfram.com/Analysis.html.

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	understand and validate the basic properties of real number system such as least upper bound properties and Archimedean properties.	K2, K6
CO2	identify the continuity of a function.	K1
CO3	define and focus on open set, closed set, connected sets, continuous set, adherent points and accumulation points.	K1, K4
CO4	establish famous theorems such as Bolzano's theorem and Fixed point theorem.	K3
CO5	evaluate derivatives of real valued function using Rolle's theorem, Mean value theorem and Taylor's formula.	K5

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	3	2	2	3	2	2	2	2	3	3	3	3	2.5
2	3	2	1	2	3	2	2	3	2	3	2	2	2.25
3	3	2	2	3	3	3	2	2	3	3	2	2	2.5
4	2	2	1	2	3	3	2	3	3	3	2	2	2.33
5	3	2	1	3	3	2	2	3	3	2	2	2	2.33
Mean Overall Score												2.38	
Result												High	

Year/Semester: III Yr/VSEM
Credits: 5

Code: M543
Hours/Week: 5

Mechanics

Objective: To introduce the study of the motion of particles or bodies under the influence of forces and to provide a basic knowledge of behavior of objects in motion.

Unit - I: Kinematics

Velocity - Velocity of a particle describing a circle - Resultant velocity - Relative velocity - Acceleration - Rectilinear motion - Rectilinear motion with a constant acceleration - Coplanar motion - Velocity and Acceleration in a coplanar motion - Angular velocity - Relative Angular velocity.

(Chapter 1: Sections 1.2 to 1.4)

Unit - II: Forces on a particle and on a rigid body

Newton's laws of motion - Forces - Types of forces - Resultant of two forces on a particle - Resultant of three forces related to triangle acting at a point - Resultant of several forces acting on a particle - Equilibrium of a particle - Equilibrium of a particle under three forces - Equilibrium of a particle under several forces. (Chapter 2: Sections 2.1, 2.2 and Chapter 3: Section 3.1)

Unit - III: Frictional Forces

Friction - Laws of friction - Cone of friction and angle of friction - Limiting equilibrium of a particle on an inclined plane - Problems involving frictional forces. (Chapter 3: Section 3.2 and Chapter 5: Section 5.2 excluding 5.2.1)

Unit - IV: Simple Harmonic Motion

Simple harmonic motion - Projection of a particle having a uniform circular motion - Composition of two simple harmonic motions of same period - Simple harmonic motion along a horizontal line -- Motion under gravity in a resisting medium. Simple pendulum - Seconds pendulum.

(Chapter 12: Sections 12.1, 12.2, 12.4 and Chapter 15: Section 15.6).

Unit - V: Projectiles and Impact

Forces on a projectile - Displacement as a combination of vertical and horizontal displacements - Nature of trajectory - Results pertaining to the motion of a projectile - Maximum horizontal range for a given velocity - Two trajectories with a given speed and range - Projectile projected horizontally- Impulsive Force - Conservation of linear momentum- Impact of Spheres - Laws of Impact - Impact of Two Smooth Spheres - Direct impact of two smooth spheres.

(Chapter 13: Section 13.1 and Chapter 14: Sections 14.1, 14.2, 14.3).

Book for Study:

1. P.Duraipandian, LaxmiDuraipandian, MuthamizhJayapragasam, Mechanics, 6-e, S.Chand and Company Ltd., 2005.

Books for Reference:

1. V.Dharmapadam, Statics, S.Viswanathanpvt.Ltd. Madras, 1974.
2. A.V. Dharmapadam, Dynamics, S. Viswanathan Pvt. Ltd. 1981
3. R.C.Hibbler, Engineering Mechanics, Statics and Dynamics, Macmillan Publishing Company.

4. S.L.Loney, Principle of mechanics, Macmillan and Company Ltd, 1969
5. T.Natarajan, T.GovindaRajan, G. R.Venkataraman, K.Muthuswamy, Statics, Rochouse and sons, Madras, Chand and Company Ltd, New Delhi 1970.

E-Learning source:

<http://ecoursesonline.iasri.res.in/mod/page/view.php?id=3628>

Course Learning Outcomes:

By the end of the semester, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	bringout the fundamental concepts of Kinematics.	K1
CO2	understand Forces on a rigid body.	K2
CO3	solving the problems involving frictional forces and outline their applications.	K3, K4
CO4	prove rectilinear motion under varying forces.	K5
CO5	hypothesize projectile and impact.	K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	2	2	2	3	2	3	2	2	3	3	2	3	2.42
2	3	2	2	2	3	2	2	3	2	3	2	2	2.33
3	3	2	2	3	3	2	2	2	2	3	2	2	2.33
4	2	2	2	2	3	3	2	3	2	3	2	2	2.33
5	2	2	2	3	3	2	2	3	3	2	2	2	2.33
Mean Overall Score												2.35	
Result												High	

Year/Semester: III Yr/VSEM
Credits: 6

Code: M544
Hours/Week: 6

Probability and Statistics

Objective: To develop the statistical concepts and introduce the techniques of analysis and inference used for research in social and life sciences.

Unit - I: Probability

Basic Terminology - Mathematical probability - Axiomatic approach to probability - Some Theorems on Probability - Conditional Probability - Multiplication theorem of Probability - Independent events - Multiplication theorem of Probability for Independent events -- Pair wise independent events.

(Chapter 3: Sections 3.3, 3.4, 3.8 to 3.15: Omit section 3.14)

Unit - II: Random variables and Distribution functions

Introduction - Distribution Function - Discrete Random Variable - Continuous Random Variable - Two Dimensional Random Variables.

(Chapter 5: Sections 5.1 to 5.5 ; Omit Subsections 5.4.2, 5.5.6, 5.5.7)

Unit - III: Mathematical Expectation and Generating functions

Introduction - Mathematical Expectation - Expected value of Function of a Random Variable - Properties of Expectation - Properties of Variance - Covariance - Some Inequalities involving Expectation - Moment Generating Function - Cumulants - Characteristic Function - Chebychev's Inequality - Bernoulli Law of Large Numbers.

(Chapter 6: Sections 6.1 to 6.7; Chapter 7: Sections 7.1, 7.2, 7.3, 7.5, 7.7.1: Omit Subsections 7.3.2, 7.3.3)

Unit - IV: Discrete and Continuous Distributions

Bernoulli distribution - Binomial distribution - Poisson distribution - Normal distribution - Rectangular distribution - Gamma distribution.

(Chapter 8: Sections 8.3 to 8.5; Chapter 9: Sections 9.2, 9.3 & 9.5: Omit Subsections 9.2.12 to 9.2.15)

Unit - V: Correlation and Regression

Meaning of Correlation - Scatter diagram - Karl Pearson's Coefficient of Correlation - Calculation of the Correlation Co-efficient for a Bivariate Frequency Distribution - Probable Error of Correlation Co-efficient - Rank correlation - Linear Regression.

(Chapter 10: Sections 10.2 to 10.7; Chapter 11: Section 11.2)

Book for Study

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11-e, Sultan Chand & Sons, New Delhi, 2009.

Books for Reference

1. Murray R. Spiegel, Statistics, 2-e, McGraw Hill Book Company, New Delhi, 1992.
2. Richard A. Janson, Miller, Friends, Probability and statistics for engineers, 6-e Pearson Education Pvt. Ltd. Delhi, 2001.
3. Sheldon Ross, A First course in probability, 6-e Pearson Education Pvt. Ltd. Delhi, 2014.
4. William - Feller, An introduction to probability theory and its applications, 3-e, Wiley eastern limited, New Delhi, 1968.

E - Learning source: <http://mathword.wolfram.com>

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	understand the basic concepts of probability and various probabilities.	K2
CO2	classify and perform discrete and continuous random variable and their probability distribution.	K2, K6
CO3	define expectation and moment generating function and focus their properties.	K1, K4
CO4	establish discrete and continuous distributions such as Binomial, Poisson, normal, uniform and gamma distribution.	K3
CO5	find the correlation coefficient, rank correlation and fitting of regression lines by least square method.	K5

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	2	1	2	3	2	2	2	2	2	3	3	2	2.2
2	2	2	2	3	2	2	2	2	3	3	3	2	2.33
3	1	1	2	3	3	3	2	2	2	2	3	2	2.08
4	2	2	2	3	3	3	2	2	2	3	3	2	2.42
5	3	2	2	3	3	3	2	3	2	3	3	3	2.67
	Mean Overall Score												2.34
	Result												High

Year/Semester: III Yr /V SEM

Code: M545A

Credits: 3

Hours/Week: 5

Number Theory (Elective)

Objective: To study the divisibility, primes, congruence's and arithmetic functions in number theory.

Unit - I: Divisibility

Introduction - Divisibility, Greatest Common Divisor, Euclid's Algorithm, Greatest Common Divisor via Euclid's Algorithm - Least Common Multiple - Representation of Integers, Decimal Representations of Integers, Binary Representations of Integers.
(Chapter 2: Sections 2.1 to 2.4, Related Problems).

Unit - II: Primes

Introduction - Primes, Prime counting function, prime number theorem, Test of primality by trial division - Sieve of Eratosthenes, Canonical Factorization, Fundamental theorem of arithmetic, Sieve of Eratosthenes, Determining the canonical factorization of a natural number.
(Chapter 3: Sections 3.1 to 3.3, Related Problems).

Unit - III: Congruences

Introduction - Congruences and Equivalence Relations, Equivalence Relations - Linear Congruences - Linear Diophantine Equations and the Chinese Remainder Theorem.
(Chapter 4: Sections 4.1 to 4.4, Related Problems)

Unit - IV: Congruences (continued)

Polynomial Congruences - Modular Arithmetic: Fermat's Theorem - Wilson's Theorem and Fermat Numbers - Pythagorean Equation.
(Chapter 4: Sections 4.5 to 4.8, Related Problems)

Unit - V: Arithmetic Functions

Introduction - Sigma function, Tau function, Dirichlet product - Dirichlet Inverse, Mobius function, Euler's Function, Euler's Theorem, An application of algebra (Chapter 5: Sections 5.1 to 5.3, Related Problems).

Book for Study

1. Neville Robinns, Beginning Number Theory, 2nd Ed., Narosa Publishing House Pvt. Limited, Delhi, 2006.

Books for Reference

1. David M. Burton, Elementary Number Theory 6th Ed., Tata McGraw-Hill Edition, Indian reprint, 2007.
2. Neville Robinns, Beginning Number Theory, 2nd Ed., Narosa Publishing House Pvt. Limited Delhi, 2007.
3. Richard E. Klima, Neil Sigmon, Ernest Stitzinger, Applications of Abstract Algebra with Maple, CRC Press, Boca Raton, 2000.

E-Learning source: [mathworld.wolfram.com/topics/Number Theory.html](http://mathworld.wolfram.com/topics/Number%20Theory.html)

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	describe the basic concepts of divisibility	K1
CO2	perform equivalence relation	K6
CO3	establish Fermat's theorem	K3
CO4	Analyze and evaluate congruence relations	K4, K5
CO5	define arithmetic functions and illustrate applications	K1, K2

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	3	2	2	2	2	3	2	3	3	3	3	3	2.58
2	3	3	2	2	3	2	2	3	2	3	2	3	2.5
3	3	2	2	2	3	2	2	2	2	3	2	2	2.25
4	3	3	2	2	3	3	2	3	2	2	2	2	2.42
5	2	3	2	3	3	2	2	3	3	2	2	3	2.5
	Mean Overall Score												2.45
	Result												High

Year/Semester: III Yr / V SEM
Credits: 3

Code: M545B
Hours/Week: 5

Mathematical Modeling with Difference and Differential Equations (Elective)

Objective: To discuss the mathematical modeling through difference equations, differential equations, calculus of variations and dynamical programming.

Unit - I: Mathematically Modeling Discrete Processes

Difference Equations - Linear Difference equation with constant coefficients - Solution of Homogeneous Equations - Difference Equation: Equilibria and Stability - Introduction to Discrete Models - Linear Models - Population Model involving growth - Newton's Law of cooling - Bank Account problem - Drug delivery problem - Economic Model - Arms Race Model - Linear Prey Predator problem. (Book 1: Chapter 2: Sec 2.1 - 2.3).

Unit - II: Mathematically Modeling Discrete Processes (Contd...)

Non Linear Models - Density Dependent Growth Models - The Learning Model - Miscellaneous Examples.

(Book 1: Chapter 2: Sec 2.4 - 2.5).

Unit - III: Continuous Models using Ordinary Differential Equations

Formation of various continuous models - Carbon Dating - Drug distribution in the body - Growth and Decay of current in an L-R Circuit - Rectilinear Motion under Variable Force - Mechanical Oscillations - Dynamics of Rowing - Arms Race Models - Mathematical Model of Influenza Infection - Epidemic Models (Book 1: Chapter 3: Sec 3.2).

Unit - IV: Mathematical Models through Ordinary Differential Equations (Contd...)

Miscellaneous Examples

(Book 1: Chapter 3: Sec 3.7).

Unit - V: Mathematical Models through Ordinary Differential Equations of Second Order

Mathematical Modeling of Planetary Motions - Mathematical Modeling of Circular Motion and Motion of Satellites - Mathematical Modeling through Linear Differential Equations of Second Order - Rectilinear motion.

(Book 2: Chapter 4: Sec 4.1, 4.2 and 4.3.1).

Books for Study

1. Sandip Banerjee, Mathematical Modeling - Models, Analysis and Applications, CRC Press (Taylor & Francis Group), A Chapman & Hall Book.
2. J. N. Kapur, Mathematical Modeling, New Age International (P) Ltd., Publishers, Reprint 2018.

Books for Reference

1. Belinda Barnes, Glenn Robert Fulford, Mathematical Modelling with case studies, Chapman & Hall/CRC, 2009.
2. Brian Albright, Mathematical Modeling with Excel, Jones and Bartlet Publishers, LLC, First Indian Edition, 2010.
3. Dilwyn Edwards, Mike Hamson, Guide Mathematical Modelling, PALGRAVE, St.Martin's Press, LLC, Reprint 2007.

4. Glenn Fulford, Peter Forrester, Arthur Jones Modelling with Differential and Difference Equations, Cambridge University Press 1997.
5. R.Robert Huckfeldt, C.W.Kohfeld, Thomas W.Likens, Dynamic modeling An Introduction, SAGE Publications, 1982.
6. Elizabeth S. Allman and John A. Rhodes, Mathematical Models in Biology: An Introduction, Cambridge University Press, 2004.
7. Reinhard Illner, C. Sean Bohun, Samantha McCollum, Thea van Roode, Mathematical Modelling A Case Studies Approach, American Mathematical Society First Indian Edition, 2011.

E-Learning source: https://people.maths.bris.ac.uk/~madjl/course_text.pdf

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	create mathematical models of empirical or theoretical phenomena in domains such as the physical, natural or social science.	K6
CO2	understand the analytical approach to problems in their future endeavours.	K2
CO3	assess and articulate what type of modeling techniques are appropriate for a given physical system.	K5
CO4	make predictions of the behavior of a given physical system based on the analysis of its mathematical model.	K4
CO5	recognise the power of mathematical modelling and analysis and be able to apply their understanding to their further studies.	K1, K3

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	3	3	2	3	2	3	2	3	3	3	3	2	2.67
2	3	3	2	2	3	2	3	3	2	3	2	3	2.58
3	3	3	3	2	3	2	3	2	2	3	2	2	2.5
4	3	3	2	2	3	3	2	3	3	3	2	2	2.58
5	2	3	2	3	3	2	2	3	3	2	2	3	2.5
Mean Overall Score												2.57	
Result												High	

Year/Semester: III Yr/V SEM
Credits: 3

Code: M545C
Hours/Week: 5

Fuzzy Algebra (Elective)

Objective: This course aims to introduce fuzzy algebra, fuzzy graphs, fuzzy relations, fuzzy logic, fuzzy composition and initiate the learners into the application of these ideas.

Unit - I

Introduction- Fuzzy subsets-Lattices and Boolean Algebras- L fuzzy sets-operations on fuzzy α -level sets - properties of fuzzy subsets of a set - Algebraic product and sum of two fuzzy subsets-properties satisfied by Addition and product-Cartesian product of fuzzy subsets.

Text Book-1: Sections 1.1-1.13

Unit - II

Fuzzy relations on sets and fuzzy sets - compositions of fuzzy relations - properties of the min-max composition - fuzzy graphs.

Text Book-2: Sections 6.1-6.2

Unit - III

Introduction- Algebra of fuzzy relations-logic-connectives - Some more connectives.

Text Book-1: Sections 2.1-2.5

Unit - IV

Introduction-fuzzy subgroup-homomorphic image and Pre-image of subgroupoid - Fuzzy invariant subgroups-fuzzy subrings.

Text Book-1: Sections 3.1-3.5

Unit - V

Fuzzy subfields and Fuzzy subspaces - fuzzy subspace - fuzzy algebras over fuzzy field

Text Book-1: Sections 4.1-4.3

Book for Study

1. S.Nanda and N.R.Das "Fuzzy Mathematical concepts, Narosa Publishing House, New Delhi.
2. H.J. Zimmermann, "Fuzzy Set theory and its applications, Springer.

Books for Reference

1. George J. Klir and Yuan B, *Fuzzy Sets and Fuzzy Logic: Theory and Applications*, Prentice Hall India Private Ltd, 2007.
2. Pundir and Pundir, *Fuzzy sets and their Applications*, A Pragati Edition, 2006.
3. Timothy J. Ross, *Fuzzy logic with engineering Applications*, McGraw Hill Inc. New Delhi, 2004.
4. V. Novak, *Fuzzy Sets and their Applications*, Adam Hilger, Bristol, 1969.

E - Learning source:

<http://nptel.ac.in/courses/105108081/module9/lecture36/lecture.pdf>

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	describe the fuzzy set operations	K1
CO2	analyze and justify the fuzzy relations.	K4, K5
CO3	illustrate their knowledge on algebra and their extensions and applications	K2
CO4	formulate fuzzy graphs from fuzzy relations and would relate to ordinary graphs.	K6
CO5	establish fuzzy algebraic theorems over fuzzy field.	K3

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	2	2	1	3	2	2	2	2	2	3	3	2	2.17
2	3	2	1	3	2	3	2	3	2	3	3	2	2.42
3	3	2	1	3	3	3	2	3	3	3	2	2	2.5
4	3	3	2	3	3	3	2	3	3	3	3	2	2.75
5	3	2	2	3	3	2	2	3	3	2	2	2	2.42
	Mean Overall Score												2.45
	Result												High

Year/Semester: III Yr/VI SEM
Credits: 6

Code: M643
Hours/Week: 6

Linear Algebra

Objective: To study the transformations, Matrices, Systems of Linear Equations, Determinants and Diagonalization in Vector Space.

Unit-I: Vector Spaces

Introduction - Vector Spaces - Subspaces - Linear Combinations and Systems of Linear Equations - Linear Dependence and Linear Independence - Bases and Dimension.

(Chapter 1: Sections 1.1 to 1.6)

Unit-II: Linear Transformations and Matrices

Linear Transformations, Null Spaces and Ranges - The Matrix Representation of a Linear Transformation - Composition of Linear Transformations and Matrix Multiplication - Invertibility and Isomorphisms.

(Chapter 2: Sections 2.1 to 2.4)

Unit - III: Matrix Operations and Systems of Linear Equations

Elementary Matrix Operations and Elementary Matrices - The Rank of a Matrix and Matrix Inverses - Systems of Linear Equations-Theoretical Aspects - Systems of Linear Equations-Computational Aspects.

(Chapter 3, Sections 3.1 to 3.4)

Unit - IV: Diagonalization

Eigenvalues and Eigenvectors - Diagonalizability - Invariant Subspaces and the Cayley-Hamilton Theorem.

(Chapter 5, Sections: 5.1, 5.2 and 5.4)

Unit - V: Inner Product Spaces

Inner Products and Norms - The Gram-Schmidt Orthogonalization Process and Orthogonal Compliments - The Adjoint of a Linear Operator - Normal and Self-Adjoint Operators.

(Chapter 6, Sections: 6.1 to 6.4)

Book for Study

1. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, Fourth Edition, Pearson India Education Service Pvt Ltd, New Delhi(2007).

Books for Reference

1. S. Arumugam and A. Thandapani, Modern Algebra, SciTech Publications Pvt. Ltd.
2. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
3. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.
4. N. Herstein, Topics in Algebra, John Wiley and sons, 2-e, New Delhi, 2006.
5. John B. Fraleigh, A First Course in Abstract Algebra, 7-e, Pearson Education Publication, New Delhi 2003.
6. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
7. Saunders Maclane and Garrett Birkoff, Algebra, 2-e, Macmillan Publishing Co.inc, New York, 1979.
8. Santiago, Modern Algebra, Arul Publications, Madras, 1988.
9. Serge Lang, Algebra, Addition Wesley Publishing Company, London 1965.

10. Surjeeth Singh and QuaziZameeruddin, Modern Algebra 2-e, Vikas Publishing House Pvt. Ltd., New Delhi, 1975.

E - Learning source: <http://mathworld.wolfram.com>

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	understand the concept of vector spaces and its bases.	K2
CO2	analyze the matrix representation of the linear transformation.	K4
CO3	find the rank of the matrix	K5
CO4	establish Cayley Hamilton theorem	K3
CO5	define the orthonormal basis and develop Gram-Schmidt orthogonalization process.	K1, K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	3	2	2	3	2	3	2	3	3	3	3	2	2.58
2	3	3	2	2	3	2	3	2	2	2	2	3	2.42
3	2	2	2	2	2	2	3	2	2	3	2	2	2.17
4	3	2	2	2	3	3	2	3	3	3	2	2	2.5
5	2	2	2	3	3	2	2	3	3	2	2	3	2.42
Mean Overall Score												2.42	
Result												High	

Year/Semester: III Yr /VI SEM
Credits: 6

Code: M644
Hours/Week: 6

Real Analysis - II

Objectives: To study on infinite series, test of convergence, rearrangement of Series, sequence of functions, uniform convergence and power series.

Unit - I: Infinite Series

Introduction - Convergent and divergent sequences of complex numbers - Limit superior and limit inferior of a real valued sequence - Monotonic sequences of real numbers - Infinite series - Inserting and removing parentheses - Alternating series.
(Chapter 8: Sections 8.1 - 8.7, Related Problems)

Unit - II: Test of Convergence

Absolute and conditional convergence - Real and imaginary parts of a complex series - Test for convergence of series with positive terms - The geometric series - The integral test - The big oh and little oh notations - The ratio test and the root test - Dirichlet's test and Abel's test - Partial sums of the geometric series $\sum z^n$ on the unit circle $|z| = 1$.
(Chapter 8: Sections 8.8 - 8.16, Related Problems)

Unit - III: Rearrangement of Series

Rearrangements of series - Riemann's theorem on conditionally convergent series - Subseries - Double sequences - Double series - Rearrangement theorem for double series - A sufficient condition for equality of iterated series - Multiplication of series - Cesaro summability - Infinite products - Euler's product for the Riemann zeta function.
(Chapter 8: Sections: 8.17- 8.27)

Unit - IV: Sequence of Functions

Point wise convergence of sequences of functions - Examples of sequences of real-valued functions - Definition of uniform convergence - Uniform convergence and continuity - The Cauchy condition for uniform convergence - Uniform convergence of infinite series of functions- Uniform convergence and differentiation - Sufficient conditions for uniform convergence of a series - Uniform convergence and double sequences - Mean convergence.
(Chapter 9: Sections 9.1 - 9.6, 9.10-9.13, Related Problems)

Unit - V: Power Series

Power series - Multiplication of power series - The substitution theorem - Reciprocal of a power series - Real power series - The Taylor's series generated by a function - Bernstein's theorem.
(Chapter 9: Sections 9.14 - 9.20, Related Problems).

Book for Study

1. Tom M. Apostol, Mathematical Analysis, Indian student second edition, Narosa Publishing House, Chennai, 20th Reprint, 2002.

Books for Reference

1. P. N. Arora and Ranjit Singh, First course in Real Analysis, Third edition, Sultan Chand and Sons Publishers, New Delhi, 1981.
2. S. Arumugam, Modern Analysis, New Gamma Publishers, Palayamkottai, 1993.
3. E. Fischer, Intermediate Real Analysis, Springer Verlag, 1983.
4. Robert G. Bartle and Donald R. Sherbert, Introduction to Real Analysis by 2-e John Wiley and Sons, 2000.

5. Richard R. Goldberg, Methods of Real Analysis, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi, 1970.

E-Learning source: mathworld.wolfram.com/Analysis.html.

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	understand properties of the real line and that of sequence and infinite series.	K2
CO2	apply the ratio, root, alternating series and various tests to determine convergence and absolute convergence of an infinite series of real numbers.	K3
CO3	define the properties of rearrangement of series, and its infinite products.	K1
CO4	find the uniform convergence of a sequence of functions.	K5
CO5	outline the concept of power series and formulate related results.	K4, K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	3	2	2	3	2	3	2	3	3	3	3	2	2.58
2	2	2	2	2	3	3	3	2	2	2	2	3	2.33
3	2	3	2	2	2	3	3	3	2	3	2	3	2.5
4	2	3	2	3	3	3	2	3	3	3	3	2	2.67
5	3	2	2	3	3	2	2	3	3	2	2	3	2.5
	Mean Overall Score												2.52
	Result												High

Year/Semester: III Yr /VI SEM
Credits: 6

Code: M645
Hours/Week: 6

Complex Analysis

Objective: Upon completing this course the students will be able to use Cauchy's theorem to test for analyticity and compute a derivative, work with standard complex functions (mapping properties, derivatives), compute contour integrals using definition and Cauchy integral theorems, compute Taylor and Laurent series expansions of functions and apply the Residue theorem in the evaluation of integrals.

Unit -I: Analytic Functions

Functions of a complex variable - Limits - Theorems on limit - Continuous functions - Differentiability - The Cauchy-Riemann equations - Analytic functions - Harmonic functions.
(Chapter 2: Sections 2.1 - 2.8).

Unit-II: Conformal Mapping and Bilinear Transformations

Conformal mapping - Elementary transformations - Bilinear transformations - Cross ratio - Fixed points of bilinear transformations - The mapping $w = z^2$, $w = e^z$, $w = \sin z$.

(Chapter 2: Section 2.9, Chapter 3: Sections 3.1- 3.4, Chapter 5: Sections 5.1, 5.3, 5.4)

Unit-III: Complex Integration

Definite integral - Cauchy's theorem - Cauchy's integral formula - Higher derivatives.

(Chapter 6: Sections 6.1 - 6.4)

Unit-IV: Series Expansions

Taylor's series - Laurent's series - Zeros of an analytic function.

(Chapter 7: Sections 7.1 - 7.3)

Unit- V: Singularities and Calculus of Residues

Singularities - Residues - Cauchy's residue theorem

(Chapter 7: Section 7.4, Chapter 8: Section 8.1 - 8.2)

Book for Study

1. S.Arumugam, A.Thangapandi Isaac, A.Somasundaram, Complex Analysis, Scitech Publications (India) Pvt Ltd, Chennai, Reprint, May 2011.

Books for Reference

1. Goyal, Gupta, Functions of a Complex Variable, Pragati Prakashan, Meerut, 2003.
2. T.K. Manicavachagom Pillay, Dr. S.P. Rajagopalan, Dr. R. Sattanathan, Complex Analysis, S. Viswanathan Pvt., Ltd, Chennai, 2011.
3. S.Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, New Delhi, 2000.
4. Shanti Narayan, Theory of Functions of a Complex Variable, S. Chand & Company LTD, New Delhi, 2001.
5. Murray R. Spiegel, Seymour Lipschutz, John J. Schiller, Dennis Spellman, Complex Variables, Schaum's Outlines, Second Edition, New Delhi, 2010.

E-Learning source: <http://math.sfsu.edu/beck/papers/complex.pdf>,
<http://www.math.ku.dk/noter/filer/koman-12.pdf>

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	understand the significance of differentiability and analyzing of complex function leading to the Cauchy-Riemann equations.	K2, K4
CO2	define the concept of conformal mapping and cross ratio and fixed points of bilinear transformation.	K1
CO3	learn the role of Cauchy theorem and Cauchy integral form in evaluation of contour integrals, apply Liouville's theorem in fundamental theorem of algebra .	K3, K5
CO4	express the Taylor and Laurent series expansion of analytic function.	K2
CO5	categorize the nature of singularities, poles and residues and perform the application of Cauchy residue theorem.	K4,

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	2	3	2	3	3	3	3	3	3	3	2	2	2.67
2	3	2	2	2	3	3	3	2	2	2	2	3	2.42
3	2	2	2	2	3	3	3	3	3	3	2	3	2.58
4	3	2	2	3	3	3	2	3	3	3	3	2	2.67
5	3	2	2	3	3	2	2	3	3	2	2	3	2.5
	Mean Overall Score												2.57
	Result												High

Year/Semester: III Yr /VI SEM
Credits: 3

Code: M646A
Hours/Week: 5

Resource Management Techniques (Elective)

Objective: To develop the skill of formulation of LPP and different techniques to solve it. To know the applications of Transportation and Assignment problems. To study the optimizing problems in Sequencing, Networking and Inventory control.

Unit - I Linear Programming Problem

Introduction - Formulation of the Problem - Illustration on Mathematical Formulation of LPPs. Graphical Solution Method - Simplex method -- Duality theory.

(Book 1: Chapters 2, 3, 4, 6(6.1 - 6.3))

Unit - II Transportation Problem

Transportation -Balanced and Unbalanced problems - Assignment Problem - Balanced and Unbalanced problems.

(Book 2: Chapter 9, Sections: 9.1, 9.2, 9.3, 9.4, 9.5; Chapter 10, Sections -10.1, 10.2, 10.3, 10.4)

Unit - III Sequencing Problem

Problems with n jobs through 2 machines - Problems with n jobs through 3 machines- Problems with n jobs through m machines.

(Book 3: Chapter 12: Sections 12.1 -12.6)

Unit -IV Inventory Control

Inventory models: Introduction - Deterministic models- single item static models with and without shortages- Single item static model with single price break- Quantity discounts.(Problems only).

(Book 2: Chapter 14, Sections: 14.1 - 14.10)

Unit -V Network Scheduling by PERT/CPM

Introduction -Basic terms - Rules of Network Construction -Numbering the events - Time Analysis - Critical Path Method (CPM) - Programme Evaluation and Review Technique (PERT).

(Book 1: Chapter 15, Sections: 15.1-15.8)

Books for Study:

1. S. Kalavathy, Operations Research - Vikas Publishing House Pvt. Ltd., 4th Edition, Second Reprint 2018.
2. J. K. Sharma, Operations Research Theory & Applications - Trinity Press, India, Sixth edition, 2016.
3. KantiSwarup, P. K. Gupta, Man Mohan, Operations Research - Sultan Chand & Sons, Reprint 2013.

Books for Reference:

1. Hamdy A. Taha, Operations Research - An Introduction, Pearson, Seventh edition, 2014.
2. P. K Gupta, Problems in Operations Research, 2-e, S. Chand & Sons, New Delhi, 1983.
3. R. Pannerselvam, Operations Research, Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
4. S. D. Sharma, Operations Research, KedarNath Ram Nath and Co, Meerut, 1998.

E - Learning source: http://cs.bme.hu/fcs/operations_research.pdf

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	describe the concepts involved in solving linear programming problems which are widely used in business operations.	K1
CO2	apply mathematical techniques used in optimizing transportation and assignment problems.	K2
CO3	solve job sequencing problems.	K3
CO4	breakdown different inventory models	K4
CO5	evaluate PERT, CPM problems and develop applications	K5, K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	2	3	2	3	3	3	3	3	3	3	2	2	2.67
2	3	3	2	2	2	3	2	2	2	2	2	3	2.33
3	3	2	2	2	3	3	2	3	3	2	2	3	2.5
4	3	3	2	3	3	3	2	3	3	3	2	2	2.67
5	3	2	2	3	3	2	2	3	3	2	2	3	2.5
Mean Overall Score												2.53	
Result												High	

Year/Semester: III Yr /VI SEM

Code: M646B

Credits: 3

Hours/Week: 5

Graph Theory (Elective)

Objective: To study the basic concepts of Graph Theory such as Trees, planarity, Coloring, directed graphs and know the applications to Travelling Salesman Problem, teleprinter's problem, maximum network flow and arborescence.

Unit - I: Basic Concepts of Graph

What is a graph? - Application of graphs - Finite and Infinite graphs - Incidence and degree - Isolated Vertex, Pendant Vertex and Null graph - Isomorphism - Sub graphs - Walks, Paths and Circuits - Connected graphs, disconnected graphs and components - Euler graphs - Operations on graphs - More on Euler graphs - Hamiltonian Paths and Circuits - The Travelling Salesman Problem.

(Chapter 1: Except 1.6, Chapter 2: 2.1 - 2.10 (Except 2.3))

Unit - II: Trees

Trees - Some properties of trees - Pendant Vertices in a tree - distance and centers in a tree - Rooted and Binary tree - On Counting trees - Spanning trees.

(Chapter 3: 3.1 - 3.7)

Unit - III: Cut Sets and Planar Graph

Cut-Sets - Some properties of a cut set - All cut sets in a graph - Fundamental circuits and Cut - Sets - Connectivity and Separability - Network flows - Combinatorial Vs. Geometric graph - Planar graphs - Kuratowski's two graphs - Different Representation of a planar graph.

(Chapter 4: 4.1 - 4.6, Chapter 5: 5.1 - 5.4).

Unit - IV: Colouring and Matching

Incidence matrix - Submatrices of $A(G)$ - Chromatic number - Chromatic partitioning - Chromatic Polynomial - Matchings.

(Chapter 7: 7.1 - 7.2, Chapter 8: 8.1 - 8.4).

Unit - V: Digraphs

What is a directed graph? - Some types of digraphs - Digraphs and binary relations - Directed paths and Connectedness-Euler Digraphs-Trees with directed edges.

(Chapter 9: (9.1 - 9.6))

Book for Study

1. NarsinghDeo, Graph Theory with Applications to Engineering and Computer Science - Prentice-Hall of India, 2001.

Books for Reference

1. Douglas B. West, Introduction to Graph Theory - Prentice - Hall of India, 2001.
2. Gary Chartrand and Ping Zhang, Introduction to Graph Theory - Tata McGraw-Hill, 2006.
3. Harary F, Graph Theory - Addison -Wesley Publishing Company, 1989

E - Learning source: <http://cs.bme.hu/fcs/graphtheory.pdf>

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	define the graphs along with types and their examples .	K1
CO2	understand the types of tree.	K2
CO3	establish the coloring theorems for graphs and make graph matching.	K3, K6
CO4	classify and analyze types of digraphs.	K2, K4
CO5	assess the real world problems using graphs.	K5

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	3	3	2	2	2	3	2	3	3	3	2	2	2.5
2	3	2	2	2	3	3	3	3	3	2	2	3	2.58
3	3	3	2	2	2	2	3	3	2	2	2	3	2.42
4	3	3	2	3	2	3	2	3	3	2	3	2	2.58
5	3	2	2	3	3	2	2	3	3	2	2	3	2.5
	Mean Overall Score												2.52
	Result												High

Year/Semester: III Yr /VI SEM

Code: M646C

Credits: 3

Hours/Week: 5

Discrete Mathematics (Elective)

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

Unit - I:Mathematical logic

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.

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:Relations And Functions

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.

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:Formal Languages and Automata

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

Chapter 3- Sections 3-3.1, 3-3.2 Chapter 4- Section 4-6.2

Unit - IV: Lattices And Boolean Algebra

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

Chapter 4- Section 4-1.1, 4-2, 4-3, 4-4.2

Unit - V: Graph Theory

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

Chapter 5- Section 5-1.1, 5-1.2, 5-1.3, 5-1.4

Book for Study

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

Books for Reference

1. Oscar Levin, Discrete Mathematics, 3rd Edition,2016.
2. B. A. Davey & H. A. Priestley (2002). *Introduction to Lattices and Order* (2ndedition). Cambridge University Press.
3. Edgar G. Goodaire& Michael M. Parmenter (2018). *Discrete Mathematics withGraph Theory* (3rd edition). Pearson Education.
4. Rudolf Lidl& Günter Pilz (1998). *Applied Abstract Algebra* (2nd edition). Springer.
5. Kenneth H. Rosen (2012). *Discrete Mathematics and its Applications: WithCombinatorics and Graph Theory* (7th edition). McGraw-Hill.
6. C. L. Liu (1985). *Elements of Discrete Mathematics* (2nd edition). McGraw-Hill.

E - Learning source: <https://nptel.ac.in/courses/106/106/106106094/>
<https://nptel.ac.in/courses/111/107/111107058/>

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	analyze and perceive various graph theoretic concepts and familiarize with their applications.	K4, K5
CO2	describe about partially ordered sets, Boolean algebra, lattices and their types.	K1
CO3	apply Karnaugh map for simplifying the Boolean expression	K3
CO4	demonstrate the skill to construct simple mathematical proofs and to validate .	K2, K6
CO5	achieve greater accuracy , clarity of thought and language.	K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	2	3	2	3	3	3	3	3	3	3	2	2	2.67
2	3	2	2	2	3	3	3	2	2	2	2	3	2.42
3	2	2	2	2	3	3	3	3	3	3	2	3	2.58
4	3	2	2	3	3	3	2	3	3	3	3	2	2.67
5	3	2	2	3	3	2	2	3	3	2	2	3	2.5
	Mean Overall Score												2.57
	Result												High

Year/Semester: III Yr/VI SEM
 Credits : 5

Code: M647
 Hours/Week: 5

Mathematical Statistics

Objective: To apply statistical techniques for interpreting and drawing conclusion for business problem.

Unit - I: Multiple and Partial Correlation

Partial correlation - Partial correlation coefficient - Partial correlation in case of four variables - Multiple correlations - Multiple regression.

(Chapter 16: Pages 16.1 - 16.21)

Unit - II: Time Series

Components of time series - Secular trend - Seasonal variation - Cyclical variation - Irregular variation - Measures of trend - Graphic Method - Semi average method - Moving average method - Period of moving average - Method of least squares - Measures of seasonal variation - Method of averages - Moving average method - Ratio to a moving average method - Ratio to trend method - Deseasonalization.

(Chapter 37: Pages 37.1 - 37.22)

Unit-III: Sampling

Sampling: Sampling methods, sampling error and standard error - Relationship between sample size and standard error. Testing hypothesis: Testing of means and proportions - Large and small samples - z-test and t-test.

(Chapter 24: Pages 24.1 - 24.44, 26.1 - 26.45).

Unit- IV: F- Test

Testing equality of population variances - Analysis of variance - One way and two way classification.

(Chapter 27: Pages 27.1 - 27.29).

Unit-V: Chi square Test

Chi-square distribution - Characteristics and application - Test of goodness of fit and test of independence- Test of homogeneity.

(Chapter 28: Pages 28.1 - 28.44).

Note: The Proportion between theory and problem shall be 1:4.

Book for Study

1. P.R. Vittal and V. Malini, Statistical and Numerical Methods, Margham publications, Chennai, reprint 2017.

Books for Reference

1. S.C. Gupta and V.K. Kapoor, Fundamental of Mathematical Statistics, 11-e, Sultan Chand & Sons, New Delhi, 2004.
2. S.P. Gupta, Statistics Methods, Sultan Chand & Sons, New Delhi 2000.
3. Richard I Levin and David S. Rubit, Statistics for Management, Seventh edition, Pearson Education, New Delhi, 2001.
4. D.C. Sancheti and V.K. Kapoor, Business Statistics 2-e, Sultan Chand & Sons, New Delhi 1979.

E - Learning source:<http://www.collegestats.org/>

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	calculate the partial and multiple correlation coefficients for three variables.	K3
CO2	time series data, its applications to various field and components of time series, fitting of trend by moving average method, Measurement of seasonal indices by ratio and trend, ratio to moving average methods.	K6
CO3	define random sample from a distribution, sampling distribution..	K1
CO4	understand one way and two way analysis of variance.	K2
CO5	testing of goodness of fit and evaluate the test of independence.	K4, K5

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	2	3	2	3	2	3	2	3	3	3	2	2	2.5
2	2	3	2	3	3	2	2	3	3	2	3	3	2.59
3	3	3	2	3	2	2	3	3	2	2	2	3	2.25
4	3	3	2	3	2	3	2	3	3	2	3	2	2.58
5	3	3	3	3	2	3	1	3	3	3	2	3	2.67
	Mean Overall Score												2.52
	Result												High

1. J.K. Sharma, Operations Research, 2-e, Mcmillian India Ltd, 2003.
2. Sundaresan and Jayaseelan, An introduction to Business Mathematics, Sultan Chand and Company, New Delhi, 1988.

E - Learning source: [http://www.math.above.com/od/business math/](http://www.math.above.com/od/business%20math/)

Course Learning Outcomes:

This course will enable the students to:

CO Number	CO Statement	Knowledge Level
CO1	apply Cramer's rule to solve system of equations.	K3
CO2	classify maxima and minima of functions	K2
CO3	define definite integrals and solve by partial fraction method	K1
CO4	find basic feasible solution for LPP models using graphical and simplex method.	K5
CO5	focus and perform on Transportation and Assignment problems.	K4, K6

Mapping of CO with PO and PSO

CO	Programme Outcomes (PO)							Programme Specific Outcomes (PSO)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	
1	3	3	1	3	2	2	2	3	2	3	2	2	2.33
2	3	2	1	3	2	2	1	3	1	2	2	3	2.08
3	3	2	1	3	1	2	2	3	2	2	2	3	2.17
4	3	3	1	3	2	2	2	3	2	3	2	3	2.42
5	3	2	1	3	2	2	3	2	3	3	2	3	2.42
Mean Overall Score												2.28	
Result												High	