M.Sc. MATHEMATICS

SYLLABUS - 2018

SCHOOL OF EXCELLENCE
with
CHOICE BASED CREDIT SYSTEM (CBCS)

SCHOOL OF COMPUTING SCIENCES
St. JOSEPH'S COLLEGE (Autonomous)
Special Heritage Status Awarded by UGC
Accredited at 'A' Grade (3rd cycle) by NAAC
College with Potential for Excellence Conferred by UGC
DBT-STAR & DST-FIST Sponsored College
TIRUCHIRAPPALLI - 620 002, INDIA

SCHOOLS OF EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS)

POSTGRADUATE COURSES

St. Joseph's College (Autonomous), a pioneer in higher education in India, strives to work towards the academic excellence. In this regard, it has initiated the implementation of five "Schools of Excellence" from the academic year 2014-15, to standup to the challenges of the 21st century.

Each School integrates related disciplines under one roof. The school system allows the enhanced academic mobility and enriched employability of the students. At the same time this system preserves the identity, autonomy and uniqueness of every department and reinforces their efforts to be student centric in curriculum designing and skill imparting. These five schools will work concertedly to achieve and accomplish the following objectives.

- Optimal utilization of resources both human and material for the academic flexibility leading to excellence.
- Students experience or enjoy their choice of courses and credits for their horizontal mobility.
- The existing curricular structure as specified by TANSCHE and other higher educational institutions facilitate the Credit-Transfer Across the Disciplines (CTAD) - a uniqueness of the choice-based credit system.
- Human excellence in specialized areas
- Thrust in internship and / or projects as a lead towards research and
- The multi-discipline nature of the newly evolved structure (School System) caters to the needs of stake-holders, especially the employers.

What is Credit system?

Weightage to a course is given in relation to the hours assigned for the course. Generally, one hour per week has one credit. For viability and conformity to the guidelines credits are awarded irrespective of the teaching hours. The following Table shows the correlation between credits and hours. However, there could be some flexibility because of practical, field visits, tutorials and nature of project work.

For PG courses, a student must earn a minimum of 110 credits as mentioned in the table below. The total number of minimum courses offered by a department are given in the course pattern.

POSTGRADUATE COURSE PATTERN (June 2018 onwards)

Part	Semester	Specification	No. of Courses	Hours	Credits	Total Credits
1	I-IV	**Core Courses** Theory Practical	 12-14 3-6	84	68	81
	II	**Self-Paced Learning**	1	-	2	
	III	**Interdisciplinary Core**	1	6	5	
	IV	**Comprehensive Examination** **Project Work**	1 1	- 6	2 4	
2	I-III	**Core Electives**	3	12	12	12
3	II	**IDC (Soft Skills)**	1	4	4	**12**
	III	**IDC (WS)** **IDC (BS)**	1 1	4 4	4 4	
4	I	**Extra Credit Courses-1 (MOOC)**	1	-	(2)	(4)
	III	**Extra Credit Courses-2 (MOOC)**	1	-	(2)	
5	IV	Outreach Programme (SHEPHERD)	1	-	5	**5**
		TOTAL		**120**		**110 (+4 extra credits)**

Note: IDC: Inter-Departmental Courses, BS: Between School, WS: Within School

However, there could be some flexibility because of practical, field visits, tutorials and nature of project work. For PG courses, a student must earn a minimum of 110 credits. The total number of courses offered by a department is given above.

Course Pattern

The Post-Graduate degree course consists of five vital components. They are core course, core electives, IDCs, Extra credit courses, and the Outreach Programme.

Core Courses

A core course is the course offered by the parent department related to the major subjects, components like theories, practicals, Inter disciplinary core, self paced learning, comprehensive examination, Project work, field visits, library record and etc.

Inter-disciplinary Core

Inter-disciplinary Core should be shared by the various Departments of every School. This course should be opted by all the students belonging to the particular school. Each department of the respective school should allocate themselves the schedule and the units of the course.

Core Elective

The core elective course is also offered by the parent department. The objective is to provide choice and flexibility within the department. There are three core electives. They are offered in different semesters according to the choice of the school.

Extra Credit Courses

In order to facilitate the students gaining extra credits, the extra credit courses are given. According to the guidelines of UGC, the students are encouraged to avail this option of enriching by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTEL etc.

Inter-Departmental Courses (IDC)

IDC is an interdepartmental course offered by a department / School for the students belonging to other departments / school. The objective is to provide mobility and flexibility outside the parent department / School. This is introduced to make every course multi-disciplinary in nature. It is to be chosen from a list of courses offered by various departments.

There are three IDCs. Among three, one is the Soft-Skill course offered by the JASS in the II Semester for the students of all the Departments. The other one is offered "With-in the school" (WS) and the third one is offered "Between the school" (BS). The IDCs are of application oriented and inter disciplinary in nature.

Subject Code Fixation

The following code system (9 characters) is adopted for Post Graduate courses:

Year of Revision	PG Code of the Dept	Semester	Specification of Part	Running number in the part
↓	↓	↓	↓	↓
18	P##	*x*	*x*	*xx*
18	**PMA**	**1**	**1**	**01**

For Example :

MSc - Mathematics, first semester **'Real Analysis-I'**
The code of the paper is **18PMA1101**.
Thus, the subject code is fixed for other subjects.

Specification of the Part

I - Core Courses: (Theory, Practical, Self paced Learning, Inter-disciplinary Core, Core, Comprehensive Examination, Project work)
II - Core Electives
III - Inter Departmental Courses (WS, Soft Skill & BS)
IV - Extra credit courses
V - Outreach Programme (Shepherd)

EXAMINATION

Continuous Internal Assessment (CIA):

PG - Distribution of CIA Marks	
Passing Minimum: 50 Marks	
Library Referencing	5
3 Components	35
Mid-Semester Test	30
End-Semester Test	30
CIA	**100**

Mid-Semster & End-Semester Tests

Centralised – Conducted by the office of Controller of Examinations

1. Mid-Semester Test & End-Semester Test: (2 Hours each); will have Objective + Descriptive elements; with the existing question pattern PART-A; PART-B; and PART-C
2. CIA Component III for UG & PG will be of 15 marks and compulsorily objective multiple choice question type.
3. The CIA Component III must be conducted by the department / faculty concerned at a suitable computer centres.
4. The 10 marks of PART-A of Mid-Semester and End-Semester Tests will comprise only: OBJECTIVE MULTIPLE CHOICE QUESTIONS; TRUE / FALSE; and FILL-IN BLANKS.
5. The number of hours for the 5 marks allotted for Library Referencing/ work would be 30 hours per semester. The marks scored out of 5 will be given to all the courses (Courses) of the Semester.
6. English Composition once a fortnight will form one of the components for UG General English

SEMESTER EXAMINATION

Testing with Objective and Descriptive questions

Part-A: Objective MCQs only (30 Marks)

Answers are to be marked on OMR score-sheet. The OMR score-sheets will be supplied along with the Main Answer Book. 40 minutes after the start of the examination the OMR score-sheets will be collected

Part-B & C: Descriptive (70 Marks)

Part-B: 5 x 5 = 25 marks; inbuilt choice;

Part-C: 3 x 15 = 45 marks; 3 out of 5 questions, open choice.

The Accounts Paper of Commerce will have

Part-A: Objective = 25 marks

Part-B: 25 x 3 = 75 marks

Duration of Examination must be rational; proportional to teaching hours 90 minute-examination / 50 Marks for courses of 2/3 hours/week (all Part IV UG Courses) 3-hours examination for courses of 4-6 hours/week.

GRADING SYSTEM

1. Grading

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added. The marks thus obtained, will then be graded as per the scheme provided in the following Table-1.

From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by Semester **Grade Point Average (GPA)** and **Cumulative Grade Point Average (CGPA)** respectively. These two are calculated by the following formulae:

GPA = $\frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}$ **WAM** (Weighted Averag Marks) = $\frac{\sum_{i=1}^{n} C_i M_i}{\sum_{i=1}^{n} C_i}$

where,

'C_i' is the Credit earned for the Course-*i,*
'G_i' is the Grade Point obtained by the student for the Course '*i*',
'M' is the marks obtained for the course '*i*', and
'*n*' is the number of Courses **Passed** in that semester.

CGPA: Average GPA of all the Courses starting from the first semester to the current semester.

2. Classification of Final Results

i) The classification of final results shall be based on the CGPA, as indicated in the following Table-2.

ii) For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as 'Outstanding'. Similarly, the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99, and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective programmes as 'Excellent', 'Very Good', 'Good', and 'Above Average' respectively.

iii) Absence from an examination shall not be taken as an attempt.

Table-1: Grading of the Courses

Marks Range	Grade Point	Corresponding Grade
90 and above	10	O
80 and above but below 90	9	A+
70 and above but below 80	8	A
60 and above but below 70	7	B+
50 and above but below 60	6	B
Below 50	NA	RA

Table-2: Final Result

CGPA	Classification of Final Results	Corresponding Grade
9.00 and above	O	Outstanding
8.00 to 8.99	A+	Excellent
7.00 to 7.99	A	Very Good
6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average
Below 5.00	RA	Re-appearance

Credit based weighted Mark System is to be adopted for individual semesters and cumulative semesters in the column 'Marks Secured' (for 100).
A Pass in Outreach Programme (SHEPHERD) will continue to be mandatory although the marks will not count for the calculation of the CGPA.

Declaration of Result:

Mr./Ms. _____ has successfully completed the Post Graduate in _____ programme. The candidate's Cumulative Grade Point Average (CGPA) is _____ and the class secured _____ by completing the minimum of 110 credits.
The candidate has also acquired _____ (if any) extra credits offered by the parent department courses.

M. Sc. MATHEMATICS

Course Pattern - 2018 Set

Sem	Code	Courses	Hr	Cr
I	18PMA1101	Real Analysis I	7	5
	18PMA1102	Algebra	7	5
	18PMA1103	Graph Theory	6	5
	18PMA1104	Classical Dynamics	6	5
	18PMA1201A	Core Elective: Stochastic Processes (or)	4	4
	18PMA1201B	Core Elective: Differential Geometry		
	18PMA1401	Extra credit course-1 (MOOC)	-	(2)
		Total for semester -I	**30**	**24+(2)**
II	18PMA2105	Linear algebra	6	5
	18PMA2106	Real Analysis II	4	4
	18PMA2107	Complex Analysis	6	5
	18PMA2108	Ordinary Differential Equations	6	5
	18PMA2109	Self- Paced Learning-History of Mathematics	-	2
	18PMA2301	IDC-WS: Numerical solutions using MATLAB	4	4
	18PSS2301	IDC-1: Soft Skill	4	4
		Total for semester -II	**30**	**29**
III	18PMA3110	Measure and Integration	6	5
	18PMA3111	Topology	6	5
	18SCS3101A	Inter-disciplinary Core: Design and Analysis of Algorithms	6	5
	18PMA3202A	Core Elective: Algebraic Number Theory (or)	4	4
	18PMA3202B	Core Elective: Optimization Techniques		
	18PMA3203A	Core Elective: Automata Theory (or)	4	4
	18PMA3203B	Core Elective: Fuzzy Analysis		
	18PMA3302	IDC-BS: Operations Research	4	4
	18PMA3402	Extra credit course-II (MOOC)	-	(2)
		Total for Semester -III	**30**	**27+(2)**
IV	18PMA4112	Functional Analysis	6	5
	18PMA4113	Partial Differential Equations	6	5
	18PMA4114	Calculus of Variation Integral Equation and Transforms	6	5
	18PMA4115	Skill Based: Problem Solving in Advanced Mathematics	4	4
	18PMA4116	Comprehensive Examination	-	2
	18PMA4117	Project Work	8	4
		Total for Semester -IV	**30**	**25**
	18PCW4501	Outreach Programme (SHEPHERD)	-	**5**
		Total Hours & Credits for all Semesters (I-IV)	**120**	**110 +(4)**

Programme Outcomes (POs):

1. Graduates are prepared to be creators of new knowledge leading to innovation and **entrepreneurship employable** in various sectors such as private, government, and research organizations.
2. Graduates are trained to evolve new technologies in their own discipline.
3. Graduates are groomed to engage in lifelong learning process by exploring their knowledge independently.
4. Graduates are framed to design and conduct experiments /demos/create models to analyze and interpret data.
5. Graduates ought to have the ability of effectively communicating the findings of Biological sciences incorporating with existing knowledge.

Programme Specific Outcomes (PSOs):

1. Analytic skills and Critical thinking.
2. Computational and Data Analysis skills
3. Aptitude skills that will help to take up research in pure and applied mathematics
4. Reasoning skills required to learn advance mathematics
5. Probing attitude and a search for deeper knowledge in science
6. The relevance and applications of Mathematics in scientific phenomenon
7. Positive approach towards Higher Education in Mathematics
8. Employability Skills that will enable the students to explore career in Teaching and Research in Mathematics.

_____

Semester I **Hours/Week: 7**

18PMA1101 **Credits : 5**

REAL ANALYSIS

Course Outcomes:

1. Construction of Real Numbers
2. Fundamentals of Pure Mathematics.
3. Inherit the knowledge of Set Theoretic approach.
4. Techniques in sequences
5. Sufficient conditions for convergence of series
6. Basic Knowledge of Topology
7. Properties of Real valued continuous functions
8. Fundamentals of Differentiable functions

Unit-I: Basic Topology

Introduction-Ordered Sets-Finite, Countable and Uncountable Sets - Metric Spaces - Compact Sets -Perfect Sets - Connected Sets (Ch. 1[1.0-1.11], Ch. 2)

Unit-II: Numerical Sequences and Series

Convergent Sequences - Subsequences - Cauchy Sequences - Upper and Lower Limits - Some Special Sequences - Series - Series of non-negative terms - the number e. (Ch. 3 [3.1-3.32])

Unit-III: Convergence of Series

The Root and Ratio Tests - Power Series - Summation by parts - Absolute convergence - Addition and Multiplication of Series - Rearrangements. (Ch.3 [3.33-3.54])

Unit-IV: Continuity

Limits of Functions - Continuous functions - Continuity and Compactness- Continuity and Connectedness - Discontinuities - Monotonic functions - Infinite Limits and Limits at Infinity. (Ch.4)

Unit-V: Differentiation

The Derivative of a Real Function - Mean Value Theorems - The Continuity of Derivatives - L'Hospital's Rule.- Derivatives of Higher Order - Taylor's Theorem (Ch.5 [5.1- 5.15])

Textbook

1. Walter Rudin, Principles of Mathematical Analysis, Third Edition, McGraw-Hill International Book Company, New York, 1976.

References

1. Tom M Apostol, Mathematical Analysis, Addison-Wesley Publishing Company, London, 1974.
2. Richard R Goldberg, Methods of Real Analysis, Oxford & IBH Publishing Company, New Delhi, 1970.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PMA1101					Title of the Paper REAL ANALYSIS - I								Hours 7	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	3	4	3	4	2	3	4	3	3	4	3		3.23
CO2	3	3	3	3	4	5	4	3	3	3	2	3	3		3.23
CO3	3	2	3	3	4	4	3	5	3	3	2	2	4		3.15
CO4	3	4	4	4	3	3	3	5	3	4	3	3	2		3.38
CO5	3	4	3	3	4	4	4	3	4	3	3	2	3		3.30
CO6	3	4	4	3	3	4	3	4	3	3	2	3	2		3.15
CO7	3	3	2	2	3	3	3	2	3	3	2	3	3		2.69
CO8	3	2	2	3	2	3	3	4	4	3	3	2	2		2.77
														Overall Mean Score for COs	3.11

Result: The Score for this Course is 3.1 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester I **Hours/Week: 7**
18PMA1102 **Credits : 5**

ALGEBRA

Course Outcomes:

1. To introduce the Algebraic Structures like Ring and Field
2. To study Polynomial Rings and its effect in Galois Theory
3. Properties of Finite Field
4. To give foundation in group theory
5. To train the students in problem-solving as a preparatory to NET/SET
6. Theoretic Background of Algebraic concepts
7. Problem solving techniques in algebra
8. Introduction to advance concepts in algebra

Unit-I:

Normal subgroups and Quotient groups - Homomorphism - Conjugacy - Sylow's theorem. (Chapter 2: 2.6, 2.7, 2.11 and 2.12)

Unit-II:

Ideals and quotient rings - More Ideals and quotient rings - The field of quotients of an Integral Domain - Euclidean rings - A particular Euclidean ring. (Chapter 3: 3.4, 3.5, 3.6, 3.7 and 3.8)

Unit-III:

Polynomial Rings - Polynomials over the Rational Field - Polynomial Rings over commutative rings. (Chapter 3: 3.9, 3.10 and 3.11)

Unit-IV:

Field Extension - Extension Fields - Roots of Polynomials - More about roots. (Chapter 5: 5.1, 5.3, 5.5)

Unit-V:

The elements of Galois Theory - Finite Fields. (Chapter 5: 5.6 and Chapter 7: 7.1)

Textbook

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, New Delhi, 1992.

References

1. Serge Lang, Algebra, Third Edition, Springer Graduate Texts in Mathematics, New York, 2002.
2. N.S. Gopala Krishnan, University Algebra, Second Edition, John Wiley & Sons (Asia) Pvt. Ltd., 1986.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PMA1102					Title of the Paper ALGEBRA								Hours 7	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	3	2	2	4	4	4	3	3	3	3	4		3.15
CO2	3	3	2	2	3	4	4	3	3	3	2	2	4		2.92
CO3	3	3	2	3	2	4	4	3	3	4	2	3	3		3.00
CO4	3	3	2	3	2	3	4	3	4	4	2	3	4		3.07
CO5	3	3	3	2	3	3	3	4	4	2	2	4	3		3.00
CO6	3	3	3	2	3	3	3	4	4	5	4	3	3		3.30
CO7	3	4	3	3	3	4	4	4	3	4	4	2	3		3.38
CO8	3	3	3	2	3	4	4	3	3	3	4	3	3		3.15
													Overall Mean Score for COs		3.12

Result: The Score for this Course is 3.1 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester I **Hours/Week: 6**
18PMA1103 **Credits : 5**

GRAPH THEORY

Course Outcomes:

1. To study the concepts of Connectivity and vertex and edge connectivity and its applications
2. To introduce the concept of colouring and its implication in planar graphs
3. To introduce the notion of Eulerian and Hamiltonian graphs
4. To give a rigorous introduction to the basic concepts of Graph Theory.
5. To give applications of Graph Theory in other disciplines
6. Applications to real life problems
7. Introduction to advance topics in graph theory
8. Algorithms in graph theory

Note: Theorems, Propositions and results which are starred are to be omitted.

Unit-I: Basic Results

Basic Concepts - Subgraphs - Degrees of Vertices - Paths and Connectedness - Operations on Graphs - Directed Graphs: Basic Concepts - Tournaments. (Chapter I: 1.1 to 1.4, 1.7, Chapter II: 2.1, 2.2)

Unit-II: Connectivity

Vertex Cuts and Edge Cuts - Connectivity and Edge - Connectivity, Trees: Definitions, Characterization and Simple Properties - Counting the Number of Spanning Trees - Cayley's Formula. (Chapter III: 3.1, 3.2, Chapter IV: 4.1, 4.3.1 to 4.4) Counting the Number of Spanning Trees - Cayley's Formula. (Chapter III: 3.1, 3.2, Chapter IV: 4.1, 4.3.1 to 4.4)

Unit-III: Independent Sets and Matchings

Vertex Independent Sets and Vertex Coverings - Edge Independent Sets - Matchings and Factors - Eulerian Graphs - Hamiltonian Graphs. (Chapter V: 5.1 to 5.4, Chapter VI: 6.1, 6.2)

Unit-IV: Graph Colourings

Vertex Colouring - Critical Graphs - Triangle - Free Graphs - Edge Colourings of Graphs - Chromatic Polynomials. (Chapter VII: 7.1 to 7.4, 7.7)

Unit-V: Planarity

Planar and Nonplanar Graphs - Euler Formula and its Consequences - K5 and K3,3 are Nonplanar Graphs - Dual of a Plane Graph - The Four-Colour Theorem and the Heawood Five-Colour Theorem-Kuratowski's Theorem. (Chapter VIII: 8.1 to 8.6)

Textbook

1. R. Balakrishnan, K. Ranganathan, A Textbook of Graph Theory, Springer International Edition, New Delhi, 2008.

References

1. J.A. Bondy, U.S.R. Murty, Graph Theory with Applications, Mac Milan Press Ltd., 1976.
2. F. Harary, Graph Theory, Addison - Wesley, Reading, Mass., 1969.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PMA1103				Title of the Paper GRAPH THEORY									Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	3	4	3	4	4	3	3	4	5	3	3	3.46	
CO2	3	3	2	2	3	4	3	4	3	4	4	4	3	3.23	
CO3	3	3	4	4	3	4	3	3	4	4	3	4	4	3.54	
CO4	4	3	3	4	4	5	3	4	4	5	3	4	4	3.85	
CO5	3	3	3	3	3	4	4	3	3	4	4	4	4	3.50	
CO6	3	3	3	2	3	4	4	3	3	4	4	3	4	3.31	
CO7	4	4	3	3	3	4	5	4	3	3	2	2	3	3.31	
CO8	3	3	3	3	3	4	3	4	3	4	4	3	3	3.31	
													Overall Mean Score for COs	3.45	

Result: The Score for this Course is 3.4 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester I **Hours/Week: 6**
18PMA1104 **Credits : 5**

CLASSICAL DYNAMICS

Course Outcomes:

1. To give a detailed knowledge about the mechanical system of particles.
2. To study the applications of Lagrange's equations and Hamilton's equations as well as the theory of Hamilton-Jacobi Theory
3. Understanding Separable Theory.
4. Integrals of Motion.
5. Understanding the theory of Variational principles.
6. Hamilton Jacobi Theory
7. Applications into Practical problems
8. Abstract Physical concepts

Unit-I: Introductory Concepts
The mechanical system - Generalized coordinates - Constraints- Virtual work - Energy and momentum. (Chapter I: Sections 1.1 to 1.5)

Unit-II: Lagrange's Equations
Derivation of Lagrange's equations - examples - Integrals of motion. (Chapter II: Sections 2.1 to 2.3)

Unit-III: Special Applications of Lagrange's Equations
Rayleigh's Dissipation function - Impulsive motion - Velocity dependent potentials. (Chapter III: Sections 3.1, 3.2 & 3.4)

Unit-IV: Hamilton's Equations
Hamilton's principle, Hamilton equations, other variational principles. (Chapter IV: Sections 4.1 to 4.3)

Unit-V: Hamilton - Jacobi Theory
Hamilton's Principal function - The Hamilton - Jacobi equation, separability. (Chapter V: Sections 5.1 to 5.3)

Textbook

1. Donald T. Greenwood, Classical Dynamics, Prentice Hall of India Pvt. Ltd, New Delhi, 1985.

References

1. John L. Synge, Byron A. Griffith, Principles of Mechanics, Third Edition, McGraw-Hill Book, New York, 1959.
2. Herbert Goldstein, Charles P. Poole, John L. Safko, Classical Mechanics, Addison-Wesley Press Inc., 2002.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PMA1104				Title of the Paper CLASSICAL DYNAMICS									Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	3	2	3	4	4	3	4	3	3	3	2	3.08	
CO2	3	3	2	3	3	4	4	3	3	3	2	3	4	3.08	
CO3	3	2	2	3	3	3	4	4	3	3	3	3	3	3.00	
CO4	3	3	3	3	3	4	4	4	4	3	3	3	3	3.31	
CO5	3	2	3	2	3	4	4	3	3	4	3	3	4	3.15	
CO6	3	3	3	4	3	4	3	4	3	3	3	2	3	3.15	
CO7	3	3	3	4	3	4	3	4	3	3	3	2	3	3.15	
CO8	3	3	2	3	3	4	3	3	3	4	5	3	4	3.31	
													Overall Mean Score for COs	3.15	

Result: The Score for this Course is 3.15 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No.of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester I **Hours/Week: 4**
18PMA1201A **Credits : 4**

Core Elective:
STOCHASTIC PROCESSES

Course Outcomes:

1. To understand the stochastic models for many real life probabilistic situations.
2. To learn the well known models like birth-death and queueing to reorient their knowledge of stochastic analysis.
3. To learn the transition probabilities and its classifications.
4. To understand the random walk associated with real life situation to solve.
5. To learn the real life queueing problems by comparing the conventional queueing models.
6. Applications into real life problems

Unit-I: Elements of Stochastic processes and Markov chains

Stochastic processes - Specification of Stochastic processes -Stationary processes - Markov chain - Transition probabilities - Random walk (Chapter 2: Sections 2.1, 2.2, 2.3 and Chapter 3: Section 3.1)

Unit-II: Higher transition probabilities and classification of states

Higher transition probabilities - Classification of states - Transient and recurrent states. (Chapter 3: Sections 3.2 and 3.4)

Unit-III: Markov process with discrete state space

Poisson process - Generalizations of Poisson process - Pure birth process - Yule-Furry process - Birth-Immigration process.
(Chapter 4: Sections 4.1, 4.3 (omit 4.3.5 - 4.3.7)

Unit-IV: Renewal processes

Renewal process in discrete time - Renewal process in continuous time - Renewal equation - Renewal theorems. (Chapter 6: Sections 6.1.1 - 6.1.3, 6.2(omit example 2(b)), 6.3, 6.5(omit 6.5.2))

Unit-V: Stochastic processes in queueing

Queueing processes - Steady state behaviour of M/M/1 queueing model - Non-Markovianqueueing models - Queues with Poisson input (M/G/1) (Chapter 10: Sections 10.1 (omit 10.1.4), 10.2 (omit 10.2.3.1), 10.7 (omit examples 7(a), 7(b) and Sections 10.7.3, 10.7.4).

Textbook

1. J. Medhi, Stochastic Processes, New Age International Publishers, Second Edition, New Delhi, 1994.

References

1. U. Narayan Bhat, Elements of Applied Stochastic Processes, Second Edition, John Wiley & Sons, New York, 1972.
2. N.V. Prabhu, Stochastic Processes, Macmillan, New York

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PMA1201A					Title of the Paper Core Elective: STOCHASTIC PROCESSES								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	3	2	3	4	4	4	3	3	3	3	3	3.15	
CO2	3	3	3	2	3	4	3	4	4	3	3	4	4	3.54	
CO3	3	3	3	2	3	4	4	3	4	4	3	4	4	3.62	
CO4	3	3	3	3	3	4	3	3	3	4	3	4	3	3.23	
CO5	3	3	3	3	3	4	4	3	4	4	4	3	3	3.38	
CO6	3	3	3	4	3	3	3	4	3	3	3	2	3	3.08	
Overall Mean Score for COs														3.33	

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\textbf{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \textbf{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester I **Hours/Week: 4**
18PMA1201B **Credits : 4**

Core Elective:
DIFFERENTIAL GEOMETRY

Course Outcomes:

1. To explain the various intrinsic concepts of Differential Geometry.
2. To understand the theory of Differential Geometry.
3. To introduce difference surfaces and their uses.
4. To study Euler's theorem in Differential Geometry.
5. To appreciate the application of the Gauss equation
6. Applications into real life problems

Unit-I:

Analytical representation - Arc length - Tangent - Oscillating plane - Torsion - Formulae for Frenet contact. (Chapter I: sections 1.1 - 1.7)

Unit-II:

Natural equations - Helices - General solution of natural equations - Evolutes and involutes - Imaginary curves - Ovals. (Chapter I: sections 1.8 - 1.13)

Unit-III:

Analytical representation - First fundamental theorem - Normal, tangent plane - Developable surfaces- Second fundamental form - Meusrier's theorem - Euler's theorem. (Chapter 2: sections 2.1 - 2.6)

Unit-IV:

Dupin's indicatrix - Some surfaces - A geometrical interpretation of asymptotic and curvature lines conjugate directions - Triply orthogonal system of surfaces. (Chapter 2: sections 2.7 - 2.11)

Unit-V:

Gauss - The equations of Gauss-Weingarten - The theorem of Gauss and the equations of Codazzi curvilinear coordinates in space - Some applications of the Gauss and the Codazzi equations - The fundamental theorem of surface theory. (Chapter 3: Sections 3.1 - 3.6)

Textbook

1. Dirk J. Struik, Lectures on Classical Differential Geometry, Addison Wesley Publishing Company, 1950.

References

1. T.J. Willmore, An introduction to Differential Geometry, Oxford University Press, New York, 1959.
2. Barrett O'Neill, Elementary Differential Geometry, Second Edition, Academic Press, 2006

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18PMA1201B					Title of the Paper Core Elective: DIFFERENTIAL GEOMETRY								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	3	2	3	4	4	3	3	4	4	3	3	3.23	
CO2	3	2	3	3	3	4	3	3	4	4	3	3	4	3.23	
CO3	3	3	2	2	3	3	4	4	3	3	4	3	4	3.15	
CO4	3	3	4	3	4	4	3	3	5	4	3	4	4	3.62	
CO5	3	3	3	3	3	4	4	3	4	3	4	3	3	3.31	
CO6	3	2	3	3	3	4	3	3	3	4	5	3	3	3.23	
													Overall Mean Score for COs		3.30

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 6**
18PMA2105 **Credits : 5**

LINEAR ALGEBRA

Course Outcomes:

1. To give the students a thorough knowledge of the various aspects of Linear Transformations.
2. Understanding Relation between Matrices and Linear Transformation
3. Understanding Elementary operations
4. Polynomials of Matrices
5. To train the students in problem-solving as a preparatory to NET/SET
6. Advance concepts in Linear Algebra
7. Knowledge of Matrix theory
8. Techniques of Diaganalisation

Unit-I: Matrices

Systems of linear Equations - Matrices and Elementary Row operations - Row-reduced echelon Matrices - Matrix Multiplication - Invertible Matrices- Bases and Dimension.(Only revision of Vector spaces and subspaces). (Chapter 1 [1.2-1.6] and Chapter 2 [2.3])

Unit-II: Linear transformations

The algebra of linear transformations - Isomorphism of Vector Spaces - Representations of Linear Transformations by Matrices - Linear Functionals - The Double Dual - The Transpose of a Linear Transformation. (Chapter 3)

Unit-III: Algebra of polynomials

The algebra of polynomials - Lagrange Interpolation - Polynomial Ideals - The prime factorization of a polynomial - Commutative rings - Determinant functions. (Chapter 4 [4.1 - 4.5] and Chapter 5 [5.1 - 5.2])

Unit-IV: Determinants

Permutations and the uniqueness of determinants - Classical Adjoint of a (square) matrix - Inverse of an invertible matrix using determinants - Characteristic values - Annihilating polynomials. (Chapter 5 [5.3,5.4] and Chapter 6 [6.1 - 6.3])

Unit-V: Diagonalization

Invariant subspaces - Simultaneous triangulation and simultaneous Diagonalization Direct-sum Decompositions - Invariant Direct sums - Primary Decomposition theorem. (Chapter 6 [6.4 - 6.8])

Textbook

1. Kenneth Hoffman and Ray Alden Kunze, Linear Algebra, Second Edition, Prentice Hall of India Private Limited, New Delhi, 1975.

References

1. Kumaresan, Linear Algebra: A Geometric Approach, Prentice-Hall of India Ltd, 2004.
2. V. Krishnamurthy, V.P. Mainra, J.L. Arora, Introduction to Linear Algebra, East West Press Ltd, 1985.
3. A.R. Rao, P. Bhimashankaram, Linear Algebra, Second Edition, Tata McGraw Hill, 2000.
4. Charles W. Curtis, Linear Algebra: an introductory approach, Springer Verlag, 1984

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PMA2105				Title of the Paper LINEAR ALGEBRA								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	3	3	4	2	3	4	5	4	3	4	4	3	4	3.54
CO2	3	3	3	2	3	4	4	5	3	3	4	4	4	3.46
CO3	4	4	3	3	4	5	5	4	3	3	4	4	4	3.85
CO4	4	3	3	3	3	5	4	4	3	4	3	3	4	3.54
CO5	3	3	3	2	4	4	4	3	3	3	4	4	3	3.31
CO6	3	3	3	2	3	4	4	4	4	3	4	4	3	3.38
CO7	3	3	4	3	3	4	4	5	4	4	4	3	4	3.69
CO8	3	4	3	3	3	4	4	4	3	3	4	4	4	3.54
													Overall Mean Score for COs	**3.54**

Result: The Score for this Course is 3.5 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester II **Hours/Week: 4**
18PMA2106 **Credits : 4**

REAL ANALYSIS - II

Course Outcomes:

1. Knowledge of Riemann integrals and its properties
2. Give knowledge for any advanced learning in Pure Mathematics.
3. Convergence of a sequences and series of functions
4. Basics of special functions
5. To train the students in problem-solving as a preparatory to NET/SET
6. Multivariate analysis

Unit-I: R-S Integral

Definition and Existence of the Integral- Properties of the integral - Integration and Differentiation - Integration of Vector-valued functions - Rectifiable curves. (Ch. 6 [6.1 - 6.27])

Unit-II: Sequence and Series of Functions

Discussion of Main Problem- Uniform Convergence - Uniform Convergence and Continuity - Uniform Convergence and Integration - Uniform Convergence and Differentiation. (Ch. 7 [7.1 - 7.18])

Unit-III: Some Special functions

Power series -The Exponential and Logarithmic Functions - The Trigonometric Functions - The Algebraic Completeness of the Complex Field (Ch. 8 [8.1 - 8])

Unit-IV: Triginometric Series

Fourier series – Parseval's theorem- The Gamma function. (Ch. 8 [8.9 - 8.22])

Unit-V: Functions of Several Variables

LinearTransformations - Differentiation - The Contraction Principle - The Inverse Function Theorem - The Implicit Function Theorem. (Ch. 9 [9.1 - 9.29])

Textbook

1. Walter Rudin, Principles of Mathematical Analysis, Third Edition, McGraw-Hill International Book Company, New York, 1976.

References

1. Tom M Apostol, Mathematical Analysis, Addison-Wesley Publishing Company, London, 1974.
2. Richard R Goldberg, Methods of Real Analysis, Oxford & IBH Publishing Company, New Delhi, 1970.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PMA2106					Title of the Paper REAL ANALYSIS - II								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	4	3	4	4	4	5	4	3	4	3	3	3.62	
CO2	3	3	4	2	3	4	3	3	4	4	4	3	3	3.31	
CO3	3	3	4	2	4	4	3	3	4	4	3	4	4	3.46	
CO4	4	3	3	2	3	3	4	4	4	4	3	3	3	3.31	
CO5	3	3	3	2	3	4	4	3	4	4	4	4	4	3.46	
CO6	3	3	3	3	3	3	4	4	4	4	3	3	4	3.38	
													Overall Mean Score for COs	3.42	

Result: The Score for this Course is ____ (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester II | **Hours/Week: 6**
18PMA2107 | **Credits : 5**

COMPLEX ANALYSIS

Course Outcomes:

1. To be familiar with Cauchy's Integral Formula to apply Contour Integration.
2. To learn the various intrinsic concepts and the theory of Complex Analysis.
3. To study the concept of Analyticity, Complex Integration..
4. To be familiar with the concept of Complex Integration so as to apply Cauchy's Theorem.
5. Knowledge of Infinite Products
6. Knowledge of Residues
7. Advance concepts in complex analysis
8. Knowledge of Harmonic functions

Unit-I:

Concept of Analytic Function, Elementary Theory of Power Series: Limits and Continuity –Analytic Functions-Polynomials –Rational Functions-Sequences –Series- Uniform Convergence. Power series- Abel's Limit Theorem (Chapter: 2 Section 1.1-1.4, 2.1-2.5 Pages 21-42)

Unit-II:

Fundamental Theorems: Line Integrals - Rectifiable arcs - Line integrals as Functions of Arcs - Cauchy's Theorem for a Rectangle - Cauchy's Theorem in a Disk. -The index of a point with respect to a closed curve (Chapter: 4 sections 1.1 - 1.5 & 2.1 Pages 101 - 117)

Unit-III:

Cauchy's Integral Formula & Local Properties of Analytical Functions: The integral formula - Higher Derivatives - Removable Singularities Taylor's Theorem - Zeroes and Poles. The Local mapping (Chapter: 4 sections 2.2 - 2.3, 3.1-3.3 Pages 118 - 133)

Unit-IV:

The Calculus of Residues: The Maximum principle - The Residue theorem - The argument principle - Evaluation of Definite Integrals.- Definitions and Basic prosperities of Harmonic functions - The Mean Value Property (Chapter: 4 sections 3.4, 5.1 - 5.3, 6.1-6.2 Pages 133 - 137, 148 - 166)

Unit-V:

Harmonic functions, Power Series expansion: Poisson's Formula - Schwarz's Theorem-Weierstrass's Theorem - The Taylor series - The Laurent series (Chapter: 4 sections 6.3 - 6.4 Chapter: 5 sections 1.1 - 1.3 Pages 166-172, 175 - 186)

Textbook

1. Lars V. Ahlfors, Complex Analysis: An Introduction to the Theory of Analytic Functions of One Complex Variable, Third Edition, McGraw-Hill Book Company, New York, 1979.

References

1. John B. Conway, Functions of one Complex Variable, Second Edition, Springer Graduate Texts in Mathematics, New York, 1978.
2. S. Ponnusamy, Foundations of Complex Analysis, Second Edition, Narosa Publishing House, India,2005

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PMA2107					Title of the Paper COMPLEX ANALYSIS								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	3	3	2	4	4	4	4	4	3	3	4		3.38
CO2	3	3	3	3	3	4	4	3	5	4	3	4	3		3.46
CO3	3	3	3	2	3	4	3	4	4	4	3	4	4		3.38
CO4	3	3	3	3	3	4	3	3	4	4	3	4	3		3.30
CO5	3	3	3	3	3	4	4	3	3	4	3	4	4		3.38
CO6	3	3	3	3	3	4	4	3	4	3	3	4	3		3.30
CO7	3	3	3	3	4	4	4	4	3	4	3	3	3		3.38
CO8	3	3	3	2	4	3	4	4	4	3	4	4	3		3.38
													Overall Mean Score for COs		3.37

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Totalof Values}}{\text{Total No.of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 6**
18PMA2108 **Credits : 5**

ORDINARY DIFFERENTIAL EQUATIONS

Course Outcomes:

1. To study the method of solving Bessel's and Legendre differential equations.
2. To introduce the motion of stability of a solution of ODE.
3. To study the Boundary Value Problems.
4. Knowledge of oscillation theory and Boundary value problems.
5. To introduce existence and uniqueness theorems in Differential equations.
6. Problem solving techniques in Differential equations
7. Application of power series
8. Stability of Differential equations

Unit-I

The general solution of the homogeneous equation – The use of one known solution to find another – The method of variation of parameters – Power Series solutions. A review of power series – Series solutions of first order equations – Second order linear equations ; Ordinary points.(Chapter 3 Sec 14,15,16,19 & Chapter 5 Sec 26,27,28)

Unit-II

Regular Singular Points – Gauss's hypergeometric equation – The Point at infinity – Legendre Polynomials – Bessel functions – Properties of Legendre Polynomials and Bessel functions.(Chapter 5 29,30,31,32 & Chapter 8 Sec 44,45,46,47)

Unit-III

Linear Systems of First Order Equations – Homogeneous equations with constant coefficients – The Existence and uniqueness of solutions of Initial Value Problems for First Order Ordinary Differential Equations – The method of solutions of successive approximations and Picard's theorem.(Chapter 10 55,56 & Chapter 13 Sec 68,69)

Unit-IV

Oscillation theory and Boundary Value Problems – Qualitative properties of solutions – Oscillations and the Sturm separation theorem, Sturm Comparison Theorems – Eigenvalues, Eigen functions and the Vibrating String.(Chapter 4 Sec 24,25 and Chapter 7 Sec 40)

Unit-V

Nonlinear equations : Autonomous Systems ; the phase plane and its phenomena – Types of critical points ; Stability – Critical points and stability for linear systems – Stability by Liapunov's direct method – Simple critical points of nonlinear systems. (Chapter 11 Sec 58,59,60,61,62)

Text Book

1. George F. Simmons, Differential Equations with Applications and Historical Notes, Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition 2003.

References

1. W.T. Reid, Ordinary Differential Equations, John Wiley & Sons, New York, 1971.
2. Earl A. Coddington, An Introduction to Ordinary Differential Equations, Prentice-Hall of India, New Delhi, 1992.
3. William E. Boyce, Richard C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 10th Edition, John Wiley and Sons, NY., 2012.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PMA2108		Title of the Paper ORDINARY DIFFERENTIAL EQUATIONS										Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	3	3	3	2	3	4	4	4	4	3	4	4	3	3.38
CO2	3	3	3	3	3	4	4	3	4	4	4	4	3	3.46
CO3	3	3	3	3	3	3	4	4	4	3	4	4	4	3.46
CO4	3	2	3	3	3	4	4	4	3	4	5	3	4	3.46
CO5	3	2	3	3	3	3	4	4	4	3	4	4	3	3.30
CO6	3	3	3	4	3	4	4	5	3	3	3	4	4	3.53
CO7	3	3	3	3	3	4	4	4	3	4	3	4	3	3.38
CO8	3	3	3	2	3	4	4	4	3	4	4	4	3	3.38
										Overall Mean Score for COs				**3.42**

Result: The Score for this Course is 3.4 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	**1**	**2**	**3**	**4**	**5**
Relation	**0.0-1.0**	**1.1-2.0**	**2.1-3.0**	**3.1-4.0**	**4.1-5.0**
Quality	**Very poor**	**Poor**	**Moderate**	**High**	**Very High**

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester II — **Hours/Week: -**

18PMA2109 — **Credits : 2**

Self-paced Learning:
HISTORY OF MATHEMATICS

Course Outcomes:

1. Knowledge of History of Decimals and Limits.
2. Acquaintance with the development of Algebra.
3. Familiarity of Invention of Differential Calculus.
4. The life of Eratosthenes and Dirichlet .
5. The life of Henri Poincare
6. The life of EmmyNoether.

Unit-I

The Ancient Greeks - Pythagoras - Introduction to Pythagorean Ideas - Euclid - Introduction to Euclid - Archimedes - The Genius of Archimedes-Zeno's Paradox and the Concept of Limit - The Context of the Paradox? - Consideration of the Paradoxes - Decimal Notation and Limits - Infinite Sums and Limits - Finite Geometric Series.

Sections: 1.1,1.1.1,1.2,1.2.1,1.3,1.3.1, 2.1, 2.3, 2.4-2.6

Unit-II

The Arabs and the Development of Algebra - The Development of AlgebraAl-Khowarizmi and the Basics of Algebra - The Life of Al-Khwarizmi - Omar Khayyam and the Resolution of the Cubic - Cardano, Abel, Galois, and the Solving of Equations - A Particular Equation - The General Case - The Brief and Tragic Lives of Abel and Galois - The Work of Abel and Galois in Context - Rene Descartes and the Idea of Coordinates - Introductory Remarks -The Life of Rene Descartes - The Real Number Line - The Cartesian Plane -Coordinates in Three-Dimensional Space.

Sections: 4.2, 4.2.1, 4.2.2, 4.2.4, 5.6, 5.7, 5.7.1, 5.7.2, 5.8.1, 5.9, 6.0-6.3, 6.5

Unit-III

The Invention of Differential Calculus - The Life of Fermat - Fermat's Method - Fermat's Lemma and Maximum/Minimum Problems - Complex Numbers and Polynomials - Progenitors of the Complex Number System - Cardano - Argand - Cauchy - Riemann - Complex Number Basics - The Fundamental Theorem of Algebra - Finding the Roots of a Polynomial - Cauchy and the Foundations of Analysis - Why Do We Need the Real Numbers?

Sections: 7.1, 7.2, 7.4, 8.2, 8.2.1-8.2.5, 8.3, 8.4, 8.5, 10.1, 10.2

Unit-IV

The Prime Numbers - The Sieve of Eratosthenes - The Infinitude of the Primes - Dirichlet and How to Count - The Life of Dirichlet - The Pigeonhole Principle - Riemann and the Geometry of Surfaces - Introduction - Georg Cantor and the Orders of Infinity - Introductory Remarks - An Uncountable Set - Countable and Uncountable - The Existence of Transcendental Numbers.
Sections: 11.1, 11.2, 12.1, 12.2, 13.0, 14.1, 14.2.1, 14.2.2, 14.3

Unit-V

Henri Poincare, Child Prodigy - Introductory Remarks - Emmy Noether and Algebra - The Life of Emmy Noether - Emmy Noether and Abstract Algebra: Groups - Emmy Noether and Abstract Algebra: Rings - The Idea of an Ideal - Cryptography - What is Cryptography?
Sections: 16.1, 18.1, 18.2, 18.3, 18.3.1, 20.3

Textbook

1. Steven G. Krantz, An Episodic History of Mathematics, Mathematical Association of America, 2010.

References

1. C.B. Boyer and U. Merzbach, History of Mathematics, John Wiley & Sons, New York, 1988.
2. E.T. Bell, Men of Mathematics, Penguin Books Ltd., Hardmondsworth, Middlesex, UK, 1953.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PMA2109					Title of the Paper Self-Paced Learning: HISTORY OF MATHEMATICS								Hours -	Credits 2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	4	2	4	3	4	4	2	3	4	2	2	3		3.1
CO2	4	4	2	4	4	4	4	2	3	4	3	2	2		3.2
CO3	3	3	2	4	3	4	3	2	3	4	3	2	3		3.0
CO4	4	3	2	4	4	4	4	3	2	4	3	2	2		3.2
CO5	4	3	3	5	4	4	4	3	2	4	3	2	2		3.3
CO6	3	3	3	4	4	3	3	3	3	4	3	3	3		3.2
														Overall Mean Score for COs	3.2

Result: The Score for this Course is 3.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester II **Hours/Week: 4**
18PMA2301 **Credits : 4**

IDC-II (WS):
NUMERICAL METHODS USING MATLAB

Course Outcomes:

1. To introduce the Mathematical software MATLAB for high-performance numerical computations and visualization.
2. To learn MATLAB built-in functions provided to solve all type of scientific problems.
3. Drawing 2D and 3D Plots
4. Solving Matrix Problems
5. Solving Linear systems
6. Solving Differential equations

Unit-I: Basics of MATLAB - Matrix functions

Basics, windows, Variables, File types, Matrices and Vectors, Matrix manipulation, Matrix and Array Operations, Arithmetic operations, Relational operations, Logical operations, Elementary math functions, Matrix functions, Manipulating character strings, Array Operations, Vectorization.

Unit-II: Built-in functions

Inline functions, Anonymous functions, Built-in functions, Complex Arithmetic, Solving linear systems, Eigen Values and Vectors, Calculus.

Unit-III: Graphics

Basic 2-D Plots, Specialized 2-D plots, 3-D Plots, 3-D Surface Graphics.

Unit-IV: MATLAB Algorithms and Programs

The Solution of Non-linear Equations f(x) = 0 : Bracketing Methods for Locating a Root

Newton-Raphson and Secant Methods, The Solution of Linear Systems AX = Â : Gaussian elimination and Pivoting, Iteration for Nonlinear Systems: Seidel and Newton's Methods (Optional). (Algorithms and Programs only, No derivations and Theorems) (Chapter 2.2, 2.4, 3.4, 3.7)

Unit-V: : MATLAB Algorithms and Programs

Curve Fitting : Least-squares Line, Numerical Integration : Composite Trapezoidal and Simpson's Rule, Solution of Differential Equations : Euler's Method - Taylor Series Method - Runge-Kutta Methods - Predictor-Corrector Methods (Algorithms and Programs only, No derivations and Theorems) (Chapter 5.1, 7.2, 9.2, 9.4, 9.5, 9.6)

Textbook

1. Rudra Pratap, Getting started with MATLAB 7, Oxford University Press, 2008.
2. John H. Mathews and Kurds D. Fink, Numerical Methods using MATLAB, Third Edition, Prentice Hall, Upper Saddle River, NJ, 1999.

References

1. Brain R Hunt, Ronald L Lipsman, Jonathan M Rosenberg, A Guide to MATLAB for Beginners and Experienced Users, Cambridge University Press, 2003.
2. C. Woodford and C. Phillips, Numerical Methods with Worked Examples, Matlab Edition, Springer, Netherlands, 2012.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester II	Code 18PMA2301					Title of the Paper IDC (WS) - II: NUMERICAL SOLUTIONS USING MATLAB								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	2	3	3	3	3	4	3	3	3	3	3	3	3	3.00	
CO2	2	3	3	2	3	4	4	4	3	3	3	3	3	3.08	
CO3	3	3	3	3	3	3	3	3	3	4	3	3	3	3.08	
CO4	3	3	3	3	3	4	4	3	3	4	3	3	3	3.23	
CO5	3	3	3	3	3	4	4	3	3	3	3	3	3	3.15	
CO6	4	3	3	3	4	4	4	4	3	4	3	3	3	3.46	
										Overall Mean Score for COs				**3.17**	

Result: The Score for this Course is 3.1 (High Relationship)

Note:

Mapping	**1-20%**	**21-40%**	**41-60%**	**61-80%**	**81-100%**
Scale	**1**	**2**	**3**	**4**	**5**
Relation	**0.0-1.0**	**1.1-2.0**	**2.1-3.0**	**3.1-4.0**	**4.1-5.0**
Quality	**Very poor**	**Poor**	**Moderate**	**High**	**Very High**

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No.of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester II **Hours/Week: 4**
18PSS2301 **Credits : 4**

IDC: SOFT SKILLS

Course Outcomes:

1. Students are taught the various nuances of grooming such as, good manners and etiquettes and they are trained to practice them in the class rooms.
2. Students are empowered with public speaking skills via extempore speeches and prepared speeches, presented before the class and assessed by the trainer as well as the companions which eventually helps build self confidence of the students.
3. Students learn the different types of resumes and different types of interview skills and write and print their own resumes and present before the interview panel for their mock interview.
4. Students actively learn the ten parameters of group discussion, perform on the stage with their colleagues, which is videotaped, reviewed and evaluated.
5. As students go through their teenage, self discovery becomes a tool to develop their personality facilitated with scientific psychological personality tests.
6. Students are guided to knowing their SWOT (Strengths, Weaknesses, Opportunities and Threats)and setting their short term and long term goals for their lives.

Module 1: Basics of Communication: Definition of communication, Process of Communication, Barriers of Communication, Non-verbal Communication,

Effective Communication: The Art of Listening, Exercises in Kinesthetics, Production of Speech, Organization of Speech, Modes of delivery, Conversation Techniques, Dialogue, Good manners and Etiquettes, Politeness markers & Listening links.

Module II: Resume Writing: What is Resume? Types of Resume? Chronological, Functional and Mixed Resume, Steps in preparation of Resume, structure and framework for writing resume, Intensive training / personalized training on resume writing. **Interview Skills**: Common interview questions, Attitude, Body Language, The mock interviews, Phone interviews, Behavioral interviews.

Module III: Group Discussion: Group Discussion Basics, GD Topics for Practice, Points for GD Topics, Case-Based and Article based Group Discussions, Points for Case Studies, and Notes on Current Issues for GDS & Practicum with video coverage. **Team Building:** Team Vs Group – Synergy,

Stages of Team Formation, Broken Square-Exercise, Win as much as you win- Exercise, Leadership – Styles, Work ethics.

Module IV: Personal Effectiveness: Self Discovery, Self Esteem, Goal setting, Problem-solving, Conflict and Stress Management

Module V: Numerical Ability: Average, Percentage, Profit and Loss, Problems on ages, Simple Interest, Compound Interest, Area, Volume and Surface Area,Time and Work, Pipes and Cisterns, Time and Distance, Problems on Trains, Boats and Streams, Calendar, Clocks, Permutations and Combinations, Probability.

Module VI: Test of Reasoning: Series Completion, Analogy, Data Sufficiency, Blood Relations, Assertion and Reasoning, Logical Deduction, Direction. **Non-Verbal Reasoning**: Series, Classification

Text Book

1. Melchias, G., Balaiah John., John Love Joy (Eds) 2015. *Winners in the making*. St.Joseph's College, Trichy-2

References

1. Aggarwal, R. S. *Quantitative Aptitude, S.Chand & Sons*
2. Aggarwal, R.S. (2010). *A Modern Approach to Verbal and Non Verbal Reasoning*. S. Chand & Co, Revised Edition.
3. Covey, Stephen. (2004). *7 Habits of Highly effective people,* Free Press.
4. Egan Gerard (1994). *The Skilled Helper* (5th Ed). Pacific Grove, Brooks/ Cole.
5. Khera, Shiv (2003). *You Can Win.* Macmillan Books, Revised Edition.
6. Murphy, Raymond. (1998). *Essential English Grammar*. 2nd ed., Cambridge University Press.
7. Prasad, L. M. (2000). *Organizational Behaviour, S.Chand & Sons.*
8. Schuller, Robert. (2010). *Positive Attitudes*. Jaico Books.
9. Trishna's (2006). *How to do well in GDs & Interviews*, Trishna Knowledge Systems.
10. Yate, Martin. (2005). H*iring the Best: A Manager's Guide to Effective Interviewing and Recruiting*.

Modules	Topics	Examination Pattern	
		CIA	Online
I	Basics of Communication	15	5
II	Resume Writing & Interview Skills	15	5
III	Group Discussion & Team Building	10	5
IV	Personal Effectiveness	10	5
V	Numerical Ability (Common Session)	5	10
VI	Test of Reasoning (Common Session)	5	10
Total		**60**	**40**

Semester III **Hours/Week: 6**
18PMA3110 **Credits : 5**

MEASURE AND INTEGRATION

Course Outcomes:

1. To generalize the concept of integration using measures.
2. To develop the concept of analysis in abstract situations.
3. To learn measure theory
4. To understand the concepts of measurable function
5. To connect integral of derivative with differentiation of an integral.
6. Advance concepts in measure theory
7. Knowledge of decomposition theorems
8. Knowledge of Absolute continuity

Unit-I: Lebesgue Measure

Outer measure - measurable sets and Lebesgue measure - - properties - A non-measurable set - measurable functions - Little wood's three principles. (Proofs of Egoroff 's theorem and Lusin's theorem to be omitted)

(Chapter 3 Sec. 1 - 6)

Unit-II: Lebesgue Integral

Lebesgue Integral of simple function - bounded measurable function - of a nonnegative function - Fatou's lemma - Monotone convergence theorem - General Lebesgue integral - Lebesgue convergence theorem – Convergence in measure.

(Chapter 4 Sec. 1 - 5)

Unit-III: Differentiation and Integration

Differentiation of monotone functions - Vitali's lemma - Integral of derivative - Functions of bounded variation - Differentiation of an integral - absolute continuity-Convex functions-Jensen's inequality.

(Chapter 5 Sec. 1 - 5)

Unit-IV: General measure and Integration

Measure spaces - Measurable functions - Integration - Signed measure - Hahn decomposition theorem - Jordan decomposition theorem - Radon-Nikodym theorem- Lebesgue decomposition theorem (Chapter 11 Sec.1- 6)

Unit-V: Measure and outer measure

Outer measure and Measurability - Extension theorem – product measures-Fubini's theorem – Tonelli's theorem.

(Chapter 12 Sec. 1, 2,4)

Textbook

1. H.L. Royden, Real Analysis, Third Edition, Prentice Hall of India, New Delhi, 2007.

References

1. G. de Barra, Measure Theory and Integration, New Age International Publishers, New Delhi, 2008.
2. Walter Rudin, Real and Complex Analysis, Mc-Graw Hill Book Company, New York, 1970.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PMA3110					Title of the Paper MEASURE AND INTEGRATION								Hours 7	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	3	2	3	3	4	3	4	4	3	4	3		3.23
CO2	3	3	3	2	3	4	3	3	4	4	3	4	3		3.23
CO3	3	3	4	3	3	4	3	4	4	3	3	3	4		3.38
CO4	3	3	3	3	3	4	4	3	3	4	4	3	3		3.30
CO5	3	3	3	3	3	3	4	4	4	3	3	4	3		3.30
CO6	3	3	2	2	3	4	4	3	3	3	3	4	3		3.07
CO7	3	3	2	3	3	4	4	3	3	3	4	4	3		3.23
CO8	3	3	3	2	3	4	4	3	3	4	4	3	3		3.23
													Overall Mean Score for COs		3.25

Result: The Score for this Course is 3.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\textbf{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \textbf{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 6**
18PMA3111 **Credits : 5**

TOPOLOGY

Course Outcomes:

1. Understanding metric spaces as a motivation to topology
2. Continuous functions and their properties in topological spaces
3. Understanding Basis as a collection of basic open sets
4. Understand compactness and connectedness in topological spaces
5. Understand separation axioms.
6. Problem solving techniques in topology
7. Advance concepts in topology
8. Sufficient conditions for metrizability of a topological space

Unit-I: Topological Spaces

Topological spaces - Basis for a topology - The order topology - The product topology on XxY - The subspace topology- Closed sets and limit points – Continuous functions. (Chapter II: Section 12 to 18)

Unit-II: Metric topology and Connectedness

The Product topology – The Metric Topology- Connected Spaces - Connected Subspaces of the Real line - Components and local connectedness. (Chapter II: Sections 19-21 Chapter III: Section 23-25)

Unit-III: Compactness

Compact spaces - Compact subspaces of the real line - Limit point compactness (Chapter III: Sections 26-28)

Unit-IV: Separation Axioms

The Countability axioms - The Separation axioms- Normal spaces. (Chapter IV: Sections 30-32)

Unit-V: Complete Metric Spaces

The Urysohn lemma - The Urysohn Metrization Theorem – Tietz Extension theorem. (Chapter IV, Sections 33 - 35)

Textbook

1. James R. Munkres, Topology, Second Edition, PHI Learning Pvt Ltd., New Delhi, 2009.

References

1. James Dugundji, Topology, Allyn& Bacon, 1966.
2. Sze-Tsen Hu, Elements of General Topology, Holden-Day Series in Mathematics, 1964.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PMA3111					Title of the Paper TOPOLOGY								Hours 7	Credits 6
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	3	2	3	4	4	3	4	3	4	3	3	3.23	
CO2	3	3	3	2	3	5	4	4	4	3	3	4	3	3.38	
CO3	3	3	3	3	3	4	4	4	3	4	3	3	4	3.38	
CO4	3	3	3	2	3	4	4	3	3	4	4	4	3	3.30	
CO5	3	3	3	3	3	4	3	4	4	3	4	3	4	3.38	
CO6	3	3	3	2	3	4	3	5	5	4	3	3	4	3.46	
CO7	3	3	3	3	3	4	4	3	5	3	4	3	4	3.46	
CO8	3	3	3	3	3	4	4	4	3	4	4	3	3	3.38	
													Overall Mean Score for COs		3.37

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 6**
18SCS3101A **Credits : 5**

Interdisciplinary Core:
DESIGN AND ANALYSIS OF ALGORITHMS

Course Outcomes:

1. To impart the students the knowledge of design and analysis of algorithms
2. To give tha basis for the core of computer science.
3. To give importance to finding the complexity (order) of algorithms.
4. To learn the linked lists and trees
5. To understand the searching and sorting methods.
6. Techniques in search and sort method

Unit-I: Algorithms

Introduction- Algorithm - Algorithm specification: Pseudocode Conventions, Recursive algorithms - Performance analysis: Space Complexity, Time Complexity, Asymptotic Notation, Practical Complexities. (Sections: 1.1, 1.2, 1.3.1 to 1.3.4)

Unit-II: Data structures and Queues

Arrays – ordered lists- Representation of Arrays-Stack and Queues – Fundamentals-Evaluation of Expressions. (Sections: 2.2,2.4,3.1,3.3)

Unit-III: Linked lists and trees

Linked Lists - Singly Linked Lists- Linked Stacks and Queues-More on Linked Lists-Simple algorithms of Doubly Linked Lists (insertion and deletion only).Trees- Binary Trees- Binary Tree Representations- Binary Tree Traversal. (Sections: 4.1,4.2,4.5,4.8,5.2,5.3,5.4).

Unit-IV: Search and Sort

Divide and conquer - General method - Binary search - Finding the maximum and minimum in a set of items - Merge sort - Quick sort - Selection sort. Basic Traversal and Search Techniques for graphs: Breadth First Search - Depth First Search. (Sections: 3.1 to 3.5,6.2)

Unit-V: Interpolations

Backtracking - The 8-Queens problem - Algebraic problems - The general method - Evaluation and interpolation - Horner's rule - Lagrange interpolation - Newtonian interpolation. (Sections: 7.1,7.2,9.1,9.2)

Textbooks:

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Fundamentals of Computer algorithms, Galgotia Publications Pvt. Ltd., 2004. Units: I, IV, V
2. Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures, Galgotia Book Source, 1981.Units: II, III

References

1. A.V. Aho, J.E.Hopcroft, J.D. Ullman, The Design and Analysis of Computer Algorithms, Addison-Wesley Publ. Comp., 1974.
2. Seymour E.Goodman and S.T. Hedetniemi, Introduction to the design and analysis of algorithms, McGraw Hill International Edition, 2002.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18SCS3101A					Title of the Paper Interdisciplinary Core: DESIGN AND ANALYSIS OF ALGORITHMS								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	4	3	3	4	3	2	4	4	2	3	3	3.15	
CO2	3	4	4	4	4	3	4	3	4	4	2	3	3	3.46	
CO3	4	3	4	3	3	3	4	2	3	4	3	2	2	3.07	
CO4	3	3	4	3	4	4	3	2	4	4	2	3	2	3.15	
CO5	4	3	4	3	4	4	3	4	3	3	3	2	3	3.30	
CO6	3	3	4	3	3	4	3	2	3	4	2	3	3	3.07	
									Overall Mean Score for COs					3.20	

Result: The Score for this Course is 3.2 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester III **Hours/Week: 4**
18PMA3202A **Credits : 4**

Core Elective:
ALGEBRAIC NUMBER THEORY

Course Outcomes:

1. To expose the students to the charm, niceties and nuances in the world of numbers.
2. To highlight some of the Applications of the Theory of Numbers.
3. Students can earn knowledge in primitive roots
4. To highlight the knowledge on Quadratic residues
5. To get the depth knowledge in Jacobi's symbols
6. Techniques in number theory

Unit-I: Congruences

Elementary Properties of Congruences - Complete Residue System - Reduced Residue System - Some Applications of Congruences. (Sec 2.1-2.3 pp.49-70)

Unit-II:Algebraic Congruences

Solutions of Congruences - Algebraic Congruences - Solutions of the Problems of the Type ax + by + c = 0 - Simultaneous Congruences. (Sec 2.4 - 2.7 pp.71-97)

Unit-III: Primitive Roots

Algebraic Congruence - Primitive Roots (Sec 3.1, 3.3, pp. 98-100, 108-122)

Unit-IV:Quadratic Residues

Theory of Indices , Quadratic Residues (Sec 3.4,6.1, pp.122-128, 218 - 225)

Unit-V: Jacobi's Symbol

Legendre's Symbol, Reciprocity Law - Quadratic Residue for Composite Modules - Jacobi's Symbol. (Sec 6.2-6.4, pp.225-246)

Textbook

1. K. C. Chowdhury, A First Course in Theory of Numbers, Asian Books Pvt. Ltd., New Delhi, 2004.

References

1. S.B.Malik, Basic Number Theory, Second Edition, Vikas Publishing House Pvt. Ltd., Noida, 2009.
2. George E. Andrews, Number Theory, Courier Dover Publications, 1994

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PMA3202A					Title of the Paper Core Elective: ALGEBRAIC NUMBER THEORY								Hours 4	Credits 4
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**								**Mean Score of COs**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**		
CO1	3	4	3	3	4	3	3	3	3	4	4	4	4	3.46	
CO2	3	3	3	2	3	4	3	4	4	3	3	4	4	3.30	
CO3	3	3	4	4	3	3	4	4	3	3	4	4	4	3.53	
CO4	3	4	3	3	4	3	4	3	4	4	4	4	4	3.61	
CO5	3	3	3	3	3	4	4	4	4	3	4	4	3	3.46	
CO6	3	3	3	3	4	3	4	3	4	4	3	4	4	3.46	
													Overall Mean Score for COs	**3.47**	

Result: The Score for this Course is 3.4 (High Relationship)

Note:

Mapping	**1-20%**	**21-40%**	**41-60%**	**61-80%**	**81-100%**
Scale	**1**	**2**	**3**	**4**	**5**
Relation	**0.0-1.0**	**1.1-2.0**	**2.1-3.0**	**3.1-4.0**	**4.1-5.0**
Quality	**Very poor**	**Poor**	**Moderate**	**High**	**Very High**

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester III **Hours/Week: 4**
18PMA3202B **Credits : 4**

Core Elective:
OPTIMIZATION TECHNIQUES

Course Outcomes:

1. To understand the theory behind optimization techniques.
2. To introduce the local theory of optimization.
3. To study the global theory of optimization.
4. To apply Kuhn-Tucker Theorem.
5. To highlight some of the applications of optimization techniques.
6. Applications into real life problems

Unit-I: Local theory

Optimisation of functional - Gateaux and Frechet Differentials - Frechet derivatives - Extrema - Euler-Lagrange Equations - Problems with variable end points. (Sec 7.1-7.6 Pages 169-184)

Unit-II: Global theory

Convex and concave functionals - Conjugate convex, concave functionals - Dual optimization problems - Min-Max theorem of game theory. (Sec 7.8, 7.10-7.13 Pages 190, 191, 195-208)

Unit-III:Local theory of constrained optimisation

Lagrange multiplier theorem - Inverse function theorem - Equality and Inequality constraints - Kuhn-Tucker theorem. (Sec 9.1-9.4 Pages 239-253)

Unit-IV:Iterative methods of optimization

Methods of solving equations - Successive approximation - Newton's method - Descent methods - Steepest descent. (Sec 10.1-10.5 Pages 271-289)

Unit-V:Conjugate direction methods

Conjugate gradient method - Methods for solving constrained problems - Projection method - The Primal-Dual method - Penalty Functions. (Sec 10.8-10.11 Pages 294-307)

Textbook

1. David G. Luenberger, Optimization by Vector Space Methods, Wiley Professional Paperback series, 1997.

References

1. C. Nelson Dorny, A Vector Space Approach to Models and Optimization, Robert Krieger Publishing Co., 1986.
2. Chander Mohan and Kusum Deep, Optimization Techniques, New Age International, 2010

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PMA3202B					Title of the Paper Core Elective: OPTIMIZATION TECHNIQUES								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	3	3	3	4	4	3	4	4	3	4	4	3.46	
CO2	3	3	4	3	3	3	4	4	3	4	3	4	3	3.38	
CO3	3	3	3	2	3	3	3	4	4	2	3	4	4	3.15	
CO4	3	3	2	2	3	4	4	3	3	4	4	3	2	3.07	
CO5	3	3	2	3	3	4	3	3	4	4	3	3	3	3.15	
CO6	3	4	3	4	3	4	4	3	4	3	4	4	4	3.61	
										Overall Mean Score for COs				**3.30**	

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester III **Hours/Week: 4**
18PMA3203A **Credits : 4**

Core Elective: AUTOMATA THEORY

Course Outcomes:

1. To make the students understand the nuances of Automata and Grammar.
2. To make them understand the applications of these techniques in computer.
3. To study context free grammar
4. To learn finite automata and lexical analysis
5. To understand basic parsing techniques.
6. Basic Knowledge of parsing Techniques

Unit-I: Finite Automata and Regular expressions

Definitions and examples - Deterministic and Nondeterministic finite Automata - Finite Automata with $\in -$ moves. (Book 1, Ch. 2: Sec. 2.1-2.4)

Unit-II: Context free grammar

Regular expressions and their relationship with automation - Grammar - Ambiguous and unambiguous grammars - Derivation trees - Chomsky Normal form. (Book 1, Ch. 2, Sec. 2.5, Ch.4, Sec.4.1-4.3, 4.5,)

Unit-III: Pushdown Automaton

Pushdown Automaton - Definition and examples - Relation with Context free languages. (Book 1, Ch.5: Sec.5.2, 5.3)

Unit-IV: Finite Automata and lexical analysis

Role of a lexical analyzer - Minimizing the number of states of a DFA - Implementation of a lexical analyzer. (Book 2, Ch.3: Sec.3.1-3.8)

Unit-V: Basic parsing techniques

Parsers - Bottom up Parsers - Shift reduce - operator precedence - Top down Parsers - Recursive descent - Predictive parsers. (Book 2, Ch.5: Sec. 5.1-5.5)

Textbooks

1. John E. Hopcroft and Jeffrey D. Ullman, Introduction to Automata theory, Languages and Computations, Narosa Publishing House, Chennai, 2000.
2. A.V. Aho and Jeffrey D. Ullman, Principles of Compiler Design, Narosa Publishing House, Chennai, 2002.

References

1. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Second Edition, Prentice Hall, 1997.
2. A.V. Aho, Monica S. Lam, R. Sethi, J.D. Ullman, Compilers: Principles, Techniques, and Tools, Second Edition, Addison-Wesley, 2007.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PMA3203A					Title of the Paper Core Elective: AUTOMATA THEORY								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	4	3	4	3	4	4	2	4	4	3	3	3	3.38	
CO2	3	3	3	4	3	4	4	3	3	4	2	3	3	3.23	
CO3	3	3	4	3	4	4	4	3	3	4	3	3	3	3.38	
CO4	4	3	3	4	4	3	4	2	3	4	3	2	3	3.23	
CO5	3	4	4	3	3	4	4	3	3	4	2	3	3	3.30	
CO6	3	4	4	3	3	4	4	2	4	3	2	2	3	3.15	
Overall Mean Score for COs															

Result: The Score for this Course is 3.1 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	**1**	**2**	**3**	**4**	**5**
Relation	**0.0-1.0**	**1.1-2.0**	**2.1-3.0**	**3.1-4.0**	**4.1-5.0**
Quality	**Very poor**	**Poor**	**Moderate**	**High**	**Very High**

***Values Scaling*:**

Mean Score of COs $= \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** $= \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester III **Hours/Week: 4**
18PMA3203B **Credits : 4**

Core Elective:
FUZZY ANALYSIS

Course Outcomes:

1. To make the students understand the nuances of Fuzzy Analysis.
2. To make them understand the applications of these techniques in real life problems
3. Knowledge of Fuzzy operations
4. Knowledge of fuzzy union and intersection
5. Fuzzy measures and probability measures
6. Fuzzy graphs and Fuzzy relations

Unit-I

Crisp sets and fuzzy sets - basic concept of fuzzy set - fuzzy logic - operations on fuzzy sets - general discussion fuzzy complements.

Book 1: chapter 1- 1.4, 1.6 & chapter 2-2.1 & 2.2.

Unit-II

Fuzzy union - fuzzy intersection - combinations operations.

Book 1: chapter 2 - 2.3, 2.4, 2.5.

Unit-III

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

Book 2: chapter 6 - 6.1, 6.1.1, 6.1.2, 6.2, 6.3.

Unit-IV

Fuzzy measures - general discussion - belief and plausibility measures - probability measures - possibility and necessity measures.

Book 1: chapter 4 - 4.1, 4.2, 4.3, 4.4.

Unit-V

Fuzzy decision making - individual decision making - fuzzy ranking methods - fuzzy linear programming.

Book 3: chapter 4 - 4.1, 4.2, 4.3, and 4.4.

Textbooks

1. George J.Klir, Tina.AFolger, Fuzzy sets, uncertainty and information, Prentice Hall of India Pvt Ltd, New Delhi, 2008.

2. H.J. Zimmermann, Fuzzy set theory and its applications, Second Edition, Springer New Delhi, 2006.
3. George J. Klir and Bo Yuan, Fuzzy sets and fuzzy logic theory and applications, Prentice-Hall of India private limited, New Delhi, 1995.

Reference

1. Timothy J. Ross, Fuzzy logic with Engineering Applications, McGraw-Hill, Inc. New Delhi, 2000.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PMA3203B					Title of the Paper Core Elective: FUZZY ANALYSIS								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	3	3	3	3	4	3	3	4	3	3	4		3.23
CO2	3	3	3	4	3	4	5	3	3	3	5	4	4		3.62
CO3	3	3	4	3	3	4	4	3	3	3	4	4	3		3.38
CO4	3	3	4	3	3	4	2	2	3	3	3	4	4		3.15
CO5	3	3	4	3	3	4	2	3	2	3	4	4	4		3.23
CO6	3	3	3	2	3	4	3	4	3	3	4	4	3		3.23
													Overall Mean Score for COs		3.31

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester III **Hours/Week: 4**
18PMA3303 **Credits : 4**

IDC-III (BS): OPERATIONS RESEARCH

Course Outcomes:

1. To introduce the notion by Transportation problem.
2. To study Assignment and LPP.
3. To introduce the concept of PERT/CPM.
4. To enlighten the students in the field of Operations Research which has many applications in management techniques.
5. To help the students to find optimum solution in business management problems.
6. Applications into real life problems

Unit-I: Transportation

Introduction - Finding initial basic feasible solution - North-west corner rule - least cost or matrix minima method - Vogel's approximation method - moving towards optimality - unbalanced transportation problems. (Sections 6.1, 6.5, 6.6, 6.9)

Unit-II: Assignment and LPP

Assignment algorithm, Linear programming formulation and graphical method. (Sections 7.3 full, Sections 2.1 to 2.3)

Unit-III: Decision analysis

Introduction - decision making environment - the maxmin or minmax criterion - the savage regret criterion - the Hurwitz criterion. (Sections 16.1 to 16.3)

Unit-IV: Replacement problem

Introduction - Replacement of equipment or asset deteriorating gradually - replacement of equipment that fails suddenly. (Sections 19.1 to 19.3, no proof of theorems, problems only)

Unit-V: Network Scheduling by PERT/CPM

Network and basic components - numbering the events - time calculations in networks - critical path method - PERT/CPM, PERT calculations. (Sections 21.2 to 21.7)

Textbook

1. KantiSwarup, P.K. Gupta and Man Mohan, Operations Research, Eighth Edition, Sulltan Chand & Sons, New Delhi, 1997.

References

1. Hamdy A. Taha, Operations Research: An Introduction, Ninth Edition, Prentice Hall, New Delhi, 2011.
2. V.Sundaresan, K.S. Subramanian, K. Ganesan, Resource Management Techniques, New Revised Edition, A.R.Publications, Sirkali, 2002

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester III	Code 18PMA3303					Title of the Paper IDC-III (BS): OPERATIONS RESEARCH								Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	4	3	3	4	4	4	3	4	3	3	4	4	4		3.62
CO2	3	3	3	4	4	4	4	3	4	3	4	4	4		3.85
CO3	3	3	3	5	4	4	4	4	3	4	3	4	2		3.54
CO4	3	4	3	4	4	3	4	4	3	3	4	3	3		3.46
CO5	3	3	3	4	4	4	4	3	4	3	3	4	3		3.46
CO6	3	3	3	4	4	3	3	4	3	4	4	3	4		3.46
													Overall Mean Score for COs		3.57

Result: The Score for this Course is 3.5 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester IV **Hours/Week: 6**
18PMA4112 **Credits : 5**

FUNCTIONAL ANALYSIS

Course Outcomes:

1. To introduce the concept of Functional Analysis
2. To study Hann Banach Theorem and its applications.
3. Knowledge of Banach spaces.
4. To introduce Inner Product Spaces.
5. To understand the operator theory in Hilbert Spaces.
6. Advance concepts in analysis
7. Infinite dimensional spaces
8. Knowledge of operators

Unit-I: Normed Linear Spaces

Normed linear spaces - Schauder Basis - Bounded Linear maps - Equivalent norms - Finite dimensional normed spaces - Dual spaces. (Ch. 3)

Unit-II: Hahn-Banach Theorem

General form - Continuous extension form- Second dual - Reflexive spaces - Dual of C [0,1] - Separation form of Hahn- Banach theorem. (Ch. 4: Sec 1-7)

Unit-III: Uniform Boundedness Principle and Open Mapping Theorem

Uniform boundedness principle - Weak Convergence - The Open Mapping Theorem - The Closed Graph Theorem. (Ch. 5: Sec. 1, 3 & Ch. 6: Sec.1, 3)

Unit-IV: Inner Product Spaces

Parallelogram law - Orothogonality - Orthonormal sets - Complete Orthonormal sets - Riesz Representation Theorem. (Ch. 7)

Unit-V: Hilbert Space Operators

Adjoint of an operator - Isometric operator - Unitary Operator - Self-Adjoint operator - Normal operator - Projection operator and its properties (Ch. 8)

Textbook

1. S.C. Bose, Introduction to Functional Analysis, MacMillan Publishers India, Delhi, 2000.

References

1. D. Somasundaram, A First Course in Functional Analysis, Narosa Book Distributors Private Ltd., 2008.
2. G.F. Simmons, Introduction to Topology and Modern Analysis, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2006.
3. Walter Rudin, Functional Analysis, Tata McGraw-Hill publishing Co. Ltd., New Delhi, 2006

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PMA4112					Title of the Paper FUNCTIONAL ANALYSIS								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	3	2	3	4	4	3	4	3	4	4	4	3.38	
CO2	3	3	3	3	3	3	4	4	3	4	4	3	4	3.38	
CO3	3	3	4	4	3	4	4	3	3	3	4	3	4	3.46	
CO4	3	3	3	3	3	4	4	3	4	3	4	4	4	3.46	
CO5	3	3	3	2	3	4	3	3	4	4	3	3	4	3.23	
CO6	3	3	4	3	3	3	4	3	3	4	3	3	4	3.31	
CO7	3	3	3	2	3	3	3	2	4	4	3	3	3	3.00	
CO8	3	3	3	3	2	4	3	4	3	3	4	4	3	3.23	
										Overall Mean Score for COs				3.31	

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester IV **Hours/Week: 6**
18PMA4113 **Credits : 5**

PARTIAL DIFFERENTIAL EQUATIONS

Course Outcomes:

1. Understanding the origin of partial differential equations
2. Understanding nonlinear partial differential equations
3. Integral surfaces passing through a given curve.
4. Understanding different methods of solving .
5. Applying higher order equations in physics
6. Analysing Linear Hyperbolic equations
7. The method of integral transforms
8. Understanding Laplace equations and its applications.

Unit-I

Partial differential equations origins of first order Partial differential equations Cauchy's problem for first order equations Linear equations of the first order Integral surfaces Passing through a Given curve surfaces Orthogonal to a given system of surfaces -Non linear Partial differential equations of the first order (Ch. II, Sec.1-7)

Unit II

Cauchy's method of characteristics -compatible systems of first order equations -Charpits method -Special types of first order equations -Solutions satisfying given condition- Jacobi's method. (Ch. II, Sec. 8-13)

Unit-III

Partial differential equations of the second order. The origin of second order equations second order equations in Physics -Higher order equations in Physics -Linear partial differential equations with constant co-efficient - Equations with variable co-efficients- Characteristic curves of second order equations (Ch. III, Sec. 1-6)

Unit-IV

Characteristics of equations in three variables-The solution of Linear Hyperbolic equations-Separation of variables. The method of Integral Transforms- Non Linear equations of the second order. (Ch. III, Sec.7-11)

Unit-V

Laplace equation : Elementary solutions of Laplace's equations- Families of equipotential Surfaces Boundary value problems-Separation of variables - Problems with Axial Symmetry (Ch. IV, Sec 2-6)

Textbook

1. Ian, N. Sneddon, Elements of Partial Differential Equations, Dover Publication INC, New York, 2006.

References

1. M. D. Raisinghania, Ordinary and Partial Differential Equations, S.Chand & Co. 2005.
2. E. T. Copson, Partial Differential Equations, Cambridge University Press, 1975.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PMA4113					Title of the Paper PARTIAL DIFFERENTIAL EQUATIONS								Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	3	3	2	3	4	4	4	4	4	3	4	3	3.38	
CO2	3	3	3	2	3	4	4	3	3	4	4	3	4	3.31	
CO3	3	3	3	2	3	4	4	3	4	4	3	4	2	3.23	
CO4	3	3	3	3	3	2	3	3	4	4	2	4	4	3.15	
CO5	3	3	3	3	3	4	3	4	3	4	3	4	3	3.31	
CO6	3	3	3	3	3	4	3	3	3	4	4	4	4	3.38	
CO7	3	3	3	2	3	3	3	4	3	4	3	4	3	3.15	
CO8	4	3	3	3	4	3	4	4	3	3	4	4	4	3.54	
										Overall Mean Score for COs				3.30	

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

Semester IV **Hours/Week: 6**
18PMA4114 **Credits : 5**

CALCULUS OF VARIATION, INTEGRAL EQUATION AND TRANSFORMS

Course Outcomes:

1. Know functionals and the construction of Euler's equation.
2. Be able to understand variational methods for solving differential equations.
3. Be able to analyse variational problems with moving boundaries.
4. Know different integrals equations and methods of solving them.
5. Be able to understand Green's function in reducing boundary value problems to integral equations.
6. Understanding Hilbert Schmidt theory
7. Know methods of finding infinite Fourier transforms and Fourier integrals
8. Applications of Fourier transforms

Unit-I

The calculus of Variations-Functionals-Euler's equations - Geodesics-variational problems involving several unknown functions.(Book 1: Chapter 9. Sec 1-11)

Unit-II

Functionals dependent on higher order derivatives-Variational problems involving several independent variables-Constrains and Lagrange multipliers.(Book 1:Chapter 9:Sec 12-14)

Unit-III

Isoperimetric problems- The general variation of a functional-Variational problems with moving boundaries-Hamilton's principle, Sturm – Liouville's problems and variational methods – Rayleigh's principle – Ritz method.(Book 1,Chapter 9, Sec 15-21)

Unit-IV

Integrals Equations - Introduction – Relation between differential and integral equations – Relationship between Linear differential equations and Volterra integral equations – The Green's function and its use in reducing boundary value problems to integral equations – Fredholm equations with separable kernels- Fredholm equations with symmetric kernals: Hilbert Schmidt theory – Iterative methods for the solution of integrals equations of the second

kind – The Neumann series –orthogonal kernels.(Book 1: Chapter 10 Sections 1-11)

Unit-V

Fourier transform – The infinite Fourier transform – The finite Fourier transform – Fourier integral theorem – Different forms of Fourier integrals formula – Problems related to Fourier integral and finite transform (Book 2: Chapter 2; Part 1 & Part 2)

Text Books

1. Dr. M.K. Venkatarman, Higher Mathematics for Engineering and Sciences, The National Publishing Company, 2001 (Units-I, II, III & IV).
2. J.K. Goyal and K.P. Gupta, Integral Transforms, K.K. Mittal for Pragati Prakashan, 7th Edition (1995-96), (Unit-V).

References

1. Krasnov, Kiselu and Marenko, Problems and Exercise in Integrals Equations, MIR Publishers 1971.
2. Francis. B. Hildebrand, Methods of Applied Mathematics, Prentice - Hall of India Pvt. Ltd., New Delhi, Second Edition 1968.
3. Ram. P. Kanwal, Linear Integral Equations – Theory and Techniques, Academic press, New York, 1971.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PMA4114	Title of the Paper CALCULUS OF VARIATION, INTEGRAL EQUATION & TRANSFORMS											Hours 6	Credits 5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)							Mean Score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	3	3	3	3	4	4	3	4	4	3	4	3	3.46
CO2	4	4	3	4	3	3	3	4	3	4	3	3	4	3.46
CO3	4	3	3	3	3	4	3	3	4	3	4	3	3	3.31
CO4	3	4	3	2	3	3	4	4	3	4	4	3	3	3.31
CO5	3	3	3	3	3	4	3	4	3	4	5	4	4	3.54
CO6	3	3	3	2	3	3	4	4	3	4	3	4	4	3.31
CO7	3	3	3	3	3	4	4	3	4	4	3	4	3	3.38
CO8	3	3	3	2	3	4	3	3	5	3	3	4	3	3.23
													Overall Mean Score for COs	3.38

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

Semester IV **Hours/Week: 4**
18PMA4115 **Credits : 4**

Skill Based:

PROBLEM SOLVING IN ADVANCED MATHEMATICS

Course Outcomes:

1. Problem Solving Techniques in Real Analysis
2. Problem Solving Techniques in Complex Analysis
3. Problem Solving Techniques in Algebra
4. Problem Solving Techniques in Linear Algebra
5. Problem Solving Techniques in Differential Equations
6. Skills required to clear NET/SET/GATE Examinations

Unit-I: Real Analysis

Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral.

Unit-II: Complex Analysis

Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues.

Unit-III: Algebra

Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Fields, Field extensions, Galois Theory.

Unit-IV: Linear Algebra

Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Inner Product spaces

Unit-V: Differential Equations

Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients

Text Books:

1. InfoStudy's Real Analysis by A.P.Singh Infostudy Publications
2. InfoStudy's Complex Analysis by A.P.Singh Infostudy Publications
3. InfoStudy's Modern Algebra by A.P.Singh Infostudy Publications
4. InfoStudy's Linear Algebra by A.P.Singh Infostudy Publications
5. InfoStudy's Differential Equation by A.P.Singh Infostudy Publications

Reference Books:

1. Walter Rudin, Principles of Mathematical Analysis, Third Edition, McGraw-Hill International Book Company, New York, 1976
2. John B. Conway, Functions of one Complex Variable, Second Edition, Springer Graduate Texts in Mathematics, New York, 1978
3. Joseph .A. Gallian , Contemporary Abstract Algebra , 7Th Edition Katherine Tegen Books
4. Seymour Lipschutz and Marc Lipson, Schaum's Outlines Linear Algebra Third Edition
5. Gilbert Strang , Introduction to Linear Algebra Fourth Edition, Wellesley Cambridge Press
6. Earl A. Coddington, An Introduction to Ordinary Differential Equations, Prentice-Hall of India, New Delhi, 1992
7. M.D. Raisinghania, Advanced Differential Equations, S. Chand and Company Ltd, New Delhi, 2001

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester IV	Code 18PMA4115			Title of the Paper Skill Based: PROBLEM SOLVING IN ADVANCED MATHEMATICS									Hours 4	Credits 4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)								Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	3	3	5	3	3	4	4	4	3	5	4	3	4	3.69
CO2	3	3	4	2	3	4	3	3	4	5	4	4	4	3.54
CO3	3	3	5	3	3	4	3	3	4	5	3	4	3	3.54
CO4	4	3	4	3	4	3	4	4	3	5	3	3	3	3.54
CO5	3	3	4	3	3	4	3	3	4	5	3	4	4	3.54
CO6	3	3	4	4	4	3	4	4	3	4	4	4	5	3.78
													Overall Mean Score for COs	3.61

Result: The Score for this Course is 3.6 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

***Values Scaling*:**

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$