DEPARTMENT OF MATHEMATICS

With effect from the academic year 2017 - 18

Aim

The programme lays a strong foundation in various branches of Mathematics. It aims at imparting knowledge, developing problem solving skills, cultivating logical thinking and creating interest for further studies. It also envisages in acquiring problem solving skills for competitive examinations, numerical ability in core and interdisciplinary areas which would widen the scope of career prospects.

Objectives

1. To enable the students to have keen exposure to the different branches of Mathematics so as to grasp a comprehensive knowledge of Mathematics.
2. To facilitate the students of B.Sc. Mathematics to join post graduate studies which in turn will offer them job opportunities and research pursuits.
3. To cultivate logical thinking and analytical skills which will sharpen their concentration and critical analysis.
4. To help the students of Mathematics to apply the skills and knowledge gained through the study of Mathematics to real life situations and face competitive examinations with confidence.

Eligibility Norms for Admission

Those who seek admission to B.Sc. Mathematics must have passed the Higher Secondary Examinations conducted by the Board of Higher Secondary Examination, Tamil Nadu with Mathematics as one of the subjects or any other examination recognized and approved by the Syndicate of the Manonmaniam Sundaranar University, Tirunelveli.

Duration of the Programme: 3 Years

Medium of Instruction: English

Passing Minimum

A minimum of 40% in the external examination and an aggregate of minimum 40% is required. There is no minimum pass mark for Continuous Internal Assessment.

Components of the B.Sc. Mathematics Programme

Part III - Major and Allied

Major		
	Core – Theory (13 x 100)	1300
	Major Project (1 x 100)	100
	Major Elective (2 x 100)	200
Allied (I & II)		
	Theory (4 x 100)	400
	Practical (1 x 100)	100
Total Courses	21	
Total Marks	(21 x 100)	2100

Course Structure

Distribution of Hours and Credits

Course	**Sem. I**	**Sem. II**	**Sem. III**	**Sem. IV**	**Sem. V**	**Sem. VI**	**Total**	
							Hours	**Credits**
Language	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
English	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
Major Core	6 (5)	6 (5)	6(4) + 5(4)	6(5) + 5(4)	6(5) + 6(5) + 6(5)	6(5) + 6(5) + 5(5) + 5 (5)	74	62

Elective	-	-	-	-	5 (4)	6 (5)	11	9
Project	-	-	-	-	5 (5)	-	5	5
Allied –Theory	4 (4)	4 (4)	5 (5)	5 (5)	-	-	18	18
Allied – Practical	2	2 (2)					4	2
AECC	2 (2)	2 (2)	-	-	-	-	4	4
SBC	-	-	2 (2)	2 (2)	2 (2)	2 (2)	8	8
NMEC	4 (2)	4 (2)	-	-	-	-	8	4
* FC - I (Values for Life)	-	(1)	-	-	-	-	-	1
* FC - II (Personality Development)				(1)				1
* FC - III (HRE)	-	-	-	-	(1)	-	-	1
* FC - IV (WS)	-	-	-	-	-	(1)	-	1

*** SDP - Certificate Course**	**-**	**(1)**	**-**	**-**	**-**	**-**	**-**	**1**
*** SLP - Extension Activity (RUN)**	**-**	**-**	**(1)**	**-**	**-**	**-**	**-**	**1**
*** STP - Clubs & Committees / NSS**	**-**	**-**	**-**	**(1)**	**-**	**-**	**-**	**1**
Total	**30 (19)**	**30 (23)**	**30 (22)**	**30 (24)**	**30 (27)**	**30 (28)**	**180**	**140 + 3**

Total Number of Hours = 180

Total Number of Credits = 140 + 3

***Courses / Programmes conducted outside the regular working hour**

Courses Offered

Semester	Course	Subject code	Paper	Hours/ week	Credit
I	**Part I**	TL1711 FL1711	Language: Tamil French	6	3
	Part II	GE1711 GE1712	General English: A Stream B Stream	6	3
	Part III	MC1711	Major Core I: Differential Calculus and Trigonometry	6	5
		MA1711	Allied I: Algebra and Calculus (for Physics and Chemistry)	6	5
	Part IV	AEC171	Ability Enhancement Compulsory Course (AECC): English Communication	2	2
		MNM171	Non Major Elective Course (NMEC): Mathematics for life - I	4	2
		VEC172	Foundation Course I : Values for Life	-	-
	Part V	SDP172	Skill Development Programme (SDP) - Certificate Course	-	-
		STP174	Student Training Programme (STP) - Clubs & Committees / NSS	-	-
	Part I	TL1721 FL1721	Language Tamil French	6	3
	Part II	GE1721	General English A Stream	6	3

II		GE1722	B Stream		
	Part III	MC1721	Major Core II: Classical Algebra and Integral Calculus	6	5
		MA1721	Allied II: Vector Calculus and Differential Equations (for Physics and Chemistry)	6	5
	Part IV	AEC172	Ability Enhancement Compulsory Course (AECC): Environmental Studies	2	2
		MNM172	Non Major Elective Course (NMEC): Mathematics for life – II	4	2
		VEC172	Foundation Course I: Values for Life	-	1
	Part V	SDP172	Skill Development Programme (SDP): Certificate Course	-	1
		STP174	Student Training Programme (STP): Clubs & Committees / NSS	-	-
III	**Part I**	TL1721 FL1721	Language: Tamil French	6	3
	Part II	GE1721 GE1722	General English: A Stream B Stream	6	3
	Part III	MC1731	Major Core III: Differential Equations and Vector Calculus	6	4
		MC1732	Major Core IV: Sequences and series	5	4
		MA1731	Allied III: Probability Theory and		

			Distributions	5	5
	Part IV	SBC173/ SBC174	Skill Based Course (SBC): Meditation and Exercise / Computer Literacy	2	2
		VEC174	Foundation Course II: Personality Development	-	-
	Part V	STP174	Student Training Programme (STP): Clubs & Committees / NSS	-	-
		SLP173	Service Learning Programme (SLP): Extension Activity (RUN)	-	1
IV	**Part I**	TL1741/ FL1741	Language Tamil French	6	3
	Part II	GE1741 GE1742	General English A Stream B Stream	6	3
	Part III	MC1741	Major Core V: Groups and Rings	6	5
		MC1742	Major Core VI: Analytical Geometry - 3 Dimensions	5	4
		MA1741	Allied IV: Applied Statistics	5	5
	Part IV	SBC173/ SBC174	Skill Based Course (SBC): Meditation and Exercise / Computer Literacy	2	2
		VEC174	Foundation Course II - Personality Development	-	1
	Part V	STP174	Student Training Programme (STP): Clubs & Committees / NSS	-	1

V	**Part III**	MC1751	Major Core VII: Linear Algebra	6	5
		MC1752	Major Core VIII: Real Analysis	6	5
		MC1753	Major Core IX: Graph Theory	6	5
		MC1754	Major – Project	5	5
		MC1755 MC1756 MC1757	Elective I: (a) Numerical Methods (b) Fuzzy Mathematics (c) Object Oriented Programming with C++	5	4
	Part IV	MSK175	Skill Based Course (*SBC): Mathematics for Competitive Examination – I	2	2
		HRE175	Foundation Course III: Human Rights Education (HRE)	-	1
	Part III	MC1761	Major Core X: Complex Analysis	6	5
		MC1762	Major Core XI: Mechanics	6	5
		MC1763	Major Core XII: Number Theory	5	5
		MC1764	Major Core XIII: Operations Research	5	5
		MC1765 MC1766 MC1767	Elective II: **(a) Astronomy** (b) Boolean Algebra (c) Web Designing with HTML	6	5
	Part IV	MSK176	Skill Based Course(*SBC): Mathematics for Competitive Examination-II	2	2

VI		WSC176	Foundation Course IV : Women's Studies (WS)	-	1
			TOTAL	**180**	**140+3**

***SBC (Mathematics for Competitive Examination - I & II)** for the V & VI semesters is offered for the students of our department, to trigger their interest in quantitative aptitude and prepare them for Competitive Examinations.

NMEC (Mathematics for life - I & II) is offered to the students of other departments for the I & II semesters to develop the quantitative aptitude needed for various Competitive Examinations. Students must have studied Mathematics in Higher Secondary to opt for these courses.

Project is introduced in the V Semester to make the students learn different mathematical concepts independently and present the report with confidence.

Self-Learning - Extra Credit Course

Semester	Subject code	Title of the paper	Hours/week	Credit
III / V	MC17S1	Discrete Mathematics - I	-	2
IV/ VI	MC17S2	Discrete Mathematics - II	-	2

Instruction for Course Transaction

Distribution of Total Hours - Major Core

Components	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem. VI
Lecture hours	75	75	75/60	75/60	75/60	75/60
Assignment / Group discussion / Problem Solving	10	10	10	10	5	5
CIA (Test, Quiz)	5	5	5	5	5	5
Seminar	-	-	-	-	5	5
Total Hours / semester	**90**	**90**	**90/75**	**90/75**	**90/75**	**90/75**

Distribution of Total Hours - Elective/ Allied

Components	Elective		Allied	
	Sem. V	Sem. VI	Sem. I/II	Sem. III /IV
Lecture hours	60	75	75	60
Problem Solving / Assignment/ Group discussion	10	10	10	10
CIA (Test, Quiz)	5	5	5	5
Total Hours	**75**	**90**	**90**	**75**

Value Added Courses

S. No.	Name of the course	Total hours	Credit
I	Training for TNPSC group examinations	30	1
II	Quick Arithmetic for Competitive examinations	30	1

1. Value added course 1: To motivate the students to take up government examinations.

2. Value added course 1: To enhance the quantitative aptitude needed for Competitive examinations.

Examination Pattern

Ratio of Internal and External:

(Major / Elective / Allied)	**25 : 75**			**NMEC**	**40 : 60**	
Components of Internal:	Test	:	15	Test	:	20
	Quiz	:	5	Quiz	:	10
	Assignment	:	5	Assignment	:	10
	Total	**:**	**25**	**Total**	**:**	**40**

Question Pattern (Major / Allied/ Elective)

Internal Test	**Marks**	**External Exam**	**Marks**
Part A 4 × 1 (No Choice)	4	Part A 10 × 1 (No Choice)	10
Part B 2 × 5 (Internal Choice)	10	Part B 5 × 5 (Internal Choice)	25
Part C 2 × 8 (Internal Choice)	16	Part C 5 × 8 (Internal Choice)	40
Total	**30**	**Total**	**75**

Question Pattern (NMEC)

Internal Test	**Marks**	**External Exam**	**Marks**
Part A 4 × 1 (No Choice)	4	Part A 10 × 1 (No Choice)	10
Part B 3 × 3 (Internal Choice)	9	Part B 5 × 3 (Internal Choice)	15

Part C 1 × 7 (Internal Choice)	7	Part C 5 × 7 (Internal Choice)	35
Total	**20**	**Total**	**60**

B.Sc. Programme Outcomes (PO)

PO	Upon completion of the B.Sc. Degree Programme , the graduates will be able to
PO - 1	apply the acquired scientific knowledge to face day to day needs.
PO - 2	create innovative ideas through laboratory experiments.
PO - 3	carry out field works and projects independently and in collaboration with other institutions and industries.
PO - 4	reflect upon green initiatives and take responsible steps to build a sustainable environment.
PO - 5	face challenging competitive examinations that offer rewarding careers in science and education.
PO - 6	impart communicative skills and ethical values.
PO - 7	equip students with hands on training through various courses to enhance entrepreneurship skills.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO	Upon completion of B.Sc. Mathematics, the graduates will be able to	PO Addressed
PSO - 1	acquire a strong foundation in various branches of mathematics to formulate real life problems into mathematical models.	PO - 1
PSO - 2	develop problem solving skills, cultivating logical thinking, and face competitive examinations with confidence	PO - 5
PSO - 3	enhance numerical ability and address problems in interdisciplinary areas which would help in project and field works.	PO - 3
PSO - 4	apply the mathematical knowledge and skills to face competitive examination with confidence.	PO - 5
PSO - 5	pursue higher studies which in turn will offer them job opportunities in government and public sector undertakings, banks, central government institutes etc.	PO - 5
PSO - 6	develop entrepreneurial skills, become empowered and self-dependent in society.	PO - 7
PSO - 7	understand the professional, ethical, legal, security, social issues and responsibilities.	PO - 4
PSO - 8	apply knowledge of principles, concepts and results in specific subject area to analyse their local and global impact.	PO - 3
PSO - 9	communicate appropriately and effectively, in a scientific context using present technology and new findings.	PO - 6

Semester I **: I**

Name of the Course **: Differential Calculus and Trigonometry**

Course Code **: MC1711**

No. of hours per week	Credit	Total No. of hours	Marks
6	5	90	100

Objectives:

1. To impart knowledge on applications of Differential Calculus and important concepts of Trigonometry
2. To enhance problem solving skills

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the idea of derivative, rules of differentiation and understand the concept of p-r equation	PSO - 1	R
CO - 2	learn the concepts of curvature, circle of curvature, evolute and apply the concepts to solve problems.	PSO - 2	U, Ap
CO - 3	recognize the rules of identifying asymptotes and employ the same to different curves	PSO - 3	Ap, U
CO - 4	acquire the knowledge about hyperbolic functions and compare it with circular functions, trigonometric functions , inverse trigonometric functions and their properties.	PSO - 1	U, E
CO - 5	categorize the methods of finding the sum of trigonometric series	PSO - 8	An

Unit I

Curvature - Radius of curvature in Cartesian, parametric and polar co-ordinates - $p - r$ equation of a curve - Formula for radius of curvature in $p - r$ co-ordinates.

Unit II

Co-ordinates of the centre of curvature - Circle of curvature - Evolute.

Unit III

Linear asymptotes - Asymptotes parallel to co-ordinate axes and inclined asymptotes - Intersection of a curve with its asymptotes - Asymptotes of polar curves.

Unit IV

Hyperbolic functions - Relations between hyperbolic functions - Inverse hyperbolic functions, Logarithm of complex quantities.

Unit V

Summation of trigonometric series - Method of differences - Sum of sines of n angles in A.P - Sum of cosines of n angles in A.P - Summation of series by using complex quantities.

Text Books:

1. Arumugam, S., & Issac, A. (2014). Calculus. Palayamkottai: New Gamma Publishing House.
   Chapter 3: Sections 3.3 - 3.5, 3.11 of Part - I
2. Narayanan, S., & Manicavachagom Pillay, T. K. (2012). Trigonometry.
   S. V. Publications.
   Chapters: 4; Chapter 5: Section 5; Chapter 6 (except sections 3.1, 3.2 and related Problems).

Reference Books:

1. Narayanan, S. & Manicavachagom Pillay, T. K. (2007). Calculus. (Volume I). Viswanathan Printers & Publishers.
2. Arumugam, S. & Thanga Pandi Issac, A. (2014). Sequences and Series & Trigonometry. New Gamma Publishing House.
3. Rawat, K. S. (2005). Trigonometry. Sarup & Sons.
4. Duraipandian, P. & Kayalal Pachaiappa. (2009). Trigonometry, Muhil Publishers.
5. Joseph A. Mangaladoss. (2005). Calculus. Presi - Persi Publications.

Semester I : **I**

Name of the Course : **Algebra and Calculus (Allied for Physics & Chemistry)**

Course Code : **MA1711**

No. of hours per week	Credit	Total No. of hours	Marks
6	5	90	100

Objectives:

1. To impart knowledge in concepts related to Algebra
2. To solve problems in Physical Science

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the fundamentals of algebraic equations, matrices and rules of integration	PSO - 1	R
CO - 2	practice the formation of equations and compute symmetric functions of roots in terms of coefficients	PSO - 2	U, Ap
CO - 3	revise the properties of Eigen values of the matrices	PSO - 3	Ap, U
CO - 4	learn Beta, Gamma functions and evaluate integrals using them	PSO - 4	U, E
CO - 5	practice the expansion of Fourier series and utilize the same for higher studies	PSO - 5	An

Unit I

Theory of equations - Formation of equations - Relation between roots and coefficients - Symmetric functions of the roots in terms of coefficients.

Unit II

Transformation of equations - Formation of equation whose roots are multiplied by k and diminished by h - Approximate solutions of Numerical Equations - Newton's and Horner's method.

Unit III

Matrices - Characteristic matrix - Characteristic equation of a matrix - Cayley Hamilton theorem (Statement only) - Eigen values and Eigen vectors - Properties of Eigen values.

Unit IV

Beta and Gamma functions - Properties - Evaluation of integrals using Beta and Gamma Functions - Relation between Beta and Gamma functions.

Unit V

Fourier Series Expansion - Fourier coefficients - Half Range Expansion - Sine Series, Cosine Series.

Text Books:

1. Arumugam, S., & Issac, A. (2012). Allied Mathematics (Paper - I). Palayamkottai, New Gamma Publishing House.
   Chapter 1: Sections 1.1, 1.2, 1.4 and 1.5; Chapter 2: Sections 2.3 and 2.4.
2. Arumugam, S., & Issac, A. (2007). Allied Mathematics (Paper - III). Palayamkottai, New Gamma Publishing House.
   Chapters 2 and 3.

Reference Books:

1. Manicavachagom Pillay, T. K. & Natarajan, T., & Ganapathy, K. S. (2007). Algebra. (Volume I). Viswanathan Printers & Publishers.
2. Paul. K. Rees., & Fred W. Sparks. (1967). College Algebra. McGraw - Hill Book Company.
3. Narayanan, S., & Manicavachagom Pillay, T. K. (2007). Calculus. (Volume I). Viswanathan Printers & Publishers.
4. Joseph A. Mangaladoss. (2005). Calculus. Presi - Persi Publications.
5. Narayanan, S., & Manicavachagom Pillay, T. K. (2007). Calculus. (Volume II). S.Viswanathan Printers & Publishers PVT. Ltd.

Semester I **I**

Name of the Course **: Mathematics for life I (NMEC)**

Course Code **: MNM171**

No. of hours per week	Credit	Total No. of hours	Marks
4	3	60	100

Objectives:

1. To develop the quantitative aptitude of the students
2. To solve problems required for various competitive examinations

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the formation of number system	PSO – 1	R
CO - 2	review the rules of operations on numbers	PSO – 2	U
CO - 3	differentiate and compare different types of fractions	PSO – 3	An
CO - 4	apply BODMAS rule for simplification and determine missing numbers in a sequence	PSO – 5	Ap
CO - 5	construct the mathematical simple real life problems and develop solutions	PSO – 9	C

Unit I

Numbers - Face value and Place value of a Digit in a Number - Test of divisibility, Applications of Algebraic Formulae, Unit digit - Series

Unit II

H. C. F and L. C. M of numbers - Factorization method - Common division method, H.C.F and L.C.M of decimal fraction - Comparison of fractions.

Unit III

Decimal fraction - Conversion of decimal into vulgar fraction - Operations on decimal fractions - Comparison of fractions - Recurring decimal - Mixed recurring decimal.

Unit IV

Simplification - BODMAS rule - Modulus of a real number - Virnaculum - Some real life problems, Missing numbers in the expression.

Unit V

Square root and cube root - Finding square root by factorization method - Perfect square and perfect cube.

Text Book:

Aggarwal, R.S. (2014). Quantitative Aptitude. S. Chand and Company LTD.

Chapters: 1 to 5

Reference Books:

1. Abhijit Guha. (2006). Quantitative Aptitude for Competitive Examination. (4^{th} Edition). Tata McGraw - Hill Education Private Limited.
2. Immaculate, M. (2009). Mathematics for Life. Nanjil offset Printers.
3. Arun Sharma. (2008). Objective Mathematics. (2^{nd} Edition). Tata McGraw - Hill Publishing Company Limited.
4. Chauhan, R.S. Objective Mathematics. (2011). Unique Publishers.
5. Goyal, J. K., & Gupta K. P. (2011). Objective Mathematics. (6^{th} Revised Edition). Pragati Prakashan Educational Publishers.

Semester I : **II**

Name of the Course : **Classical Algebra and Integral Calculus**

Course Code : **MC1721**

No. of hours per week	Credit	Total No. of hours	Marks
6	5	90	100

Objectives:

1. To give a sound knowledge in Classical Algebra
2. To solve problems in applications of Integral Calculus

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	recall the fundamentals of algebraic equations and rules of integration	PSO – 1	R
CO – 2	apply fundamental theorem of algebra in framing and solving equations	PSO – 1	U
CO – 3	choose appropriate method for transformation of equations	PSO – 1	Ap
CO – 4	develop the skill of evaluation of double and triple integrals over different regions	PSO – 1	Ap
CO – 5	identify Beta, Gamma functions and utilize them for the evaluation of definite integrals	PSO – 1	Ap, E
CO – 6	develop the Fourier series expansion in any interval and apply the same for solving technical and physical problems	PSO – 1	Ap, An

Unit I

Preliminaries - Fundamental theorem of Algebra - Relations between roots and coefficients - Symmetric functions of the roots - Sum of r^{th} powers of the roots - Newton's theorem on the sum of the powers of the roots.

Unit II

Transformation of Equations - Roots with sign changed - Roots multiplied by a given number - Reciprocal equations - Increasing or decreasing the roots of a given equation by a given quantity - Removal of terms - Descarte's rule of signs – Rolle's theorem.

Unit III

Double integrals - Evaluation of double integrals - Changing the order of integration - Triple integrals.

Unit IV

Beta and Gamma functions - Definition and properties - Relation between Beta and Gamma functions - Evaluation of integrals using Beta and Gamma functions.

Unit V

Fourier series expansion - Fourier coefficients, Half range series expansion - Sine and cosine series - Fourier series and half range series expansion in an arbitrary interval.

Text Books:

1. Manicavachagom Pillay, T. K., & Natarajan, T., & Ganapathy, K. S. (2007). Algebra. (Volume I). S. Viswanathan Printers & Publishers.

   Chapter 6: Sections 6.1 to 6. 17, 6.19, 6.20, 6.24, 6.25.

2. Arumugam, S., & Issac, A. (2014). Calculus. Palayamkottai, New Gamma Publishing House.

   Chapter 3: Sections 3.1 to 3.3; Chapters 4 & 5 of Part - II

Reference Books:

1. Arumugam, S., & Issac, A. (2003). Classical Algebra. Palayamkottai, New Gamma Publishing House,
2. Narayanan, S., & Manicavachagom Pillay, T. K. (2007). Calculus. (Volume II). S.Viswanathan Printers & Publishers PVT. Ltd.
3. Paul. K. Rees., & Fred W. Sparks. (1967). College Algebra. McGraw - Hill Book Company.
4. Sharma, A. K. (2005). Text Bok of Multiple Integrals. Discovery Publishing House.
5. Dhami, H. S. (2009). Integral Calculus. New Age International Publishers.

Semester I : **II**

Name of the Course : **Vector Calculus and Differential Equations (Allied)**

Course Code : **MA1721**

No. of hours per week	Credit	Total No. of hours	Marks
6	5	90	100

Objectives:

1. To introduce the concept of vector operators
2. To impart the mathematical knowledge essential for solving problems in Physical Science

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	explain the physical meaning and properties of curl and divergence	PSO – 1	U
CO - 2	practice the computation of line integrals, surface integrals	PSO – 2	Ap
CO - 3	use computational tools to solve problems and applications of partial differential equations of first order	PSO – 2	Ap
CO - 4	find the complementary function and particular integral of a differential equation by using appropriate methods	PSO – 8	U
CO - 5	use Laplace transform and their inverse to solve differential equations	PSO – 3	Ap

Unit I

Vector differentiation - Gradient - Divergence and curl - Solenoidal, irrotational and harmonic vectors.

Unit II

Vector integration - Work done by a force - Evaluation of line integrals and surface integrals.

Unit III

Linear differential equation with constant coefficients - Particular integrals of the form e^{ax},$sin\ sin\ ax$,$cos\ cos\ ax$, x^n, $e^{ax}f(x)$, $x^nf(x)$, Homogeneous linear equations.

Unit IV

Partial differential equations of first order - Formation - Methods of solving the first order differential equation - Lagrange's Equation.

Unit V

Laplace Transformation - Properties, Inverse Laplace transform - Properties.

Text Books:

1. Arumugam, S., & Thangapandi Issac, A. (2011). Analytical Geometry 3D and Vector calculus. Palayamkottai, New Gamma Publishing House.
   Chapter 5; Chapter 7: Sections 7.1 and 7.2.
2. Arumugam, S., & Issac, A. (2007). Allied Mathematics (Paper - II). Palayamkottai, New Gamma Publishing House.
   Chapter 5; Chapter 6: Sections 6.1 to 6.4; Chapter 7: Sections 7.1 to 7.3.

Reference Books:

1. Narayanan., & Manicavachagam Pillai, K. (1980). Vector Algebra & Analysis. S.Viswanathan Printers & Publishers PVT. Ltd.
2. Gupta, P. P., Malik, G. S, Gupta, R. K. (1985). Vector Analysis. Rastogi Publications.
3. Durai Pandian, P., & Laxmi Durai Pandian. (1986). Vector Analysis. Emerald Publishers.
4. Sankaranarayanan and others. (2006). Differential Equations and Applications. PRESI - PERSI Publishers.
5. Venkatachalapathy, S. G. (2012). Ordinary Differential Equations. Margham Publications.

Semester I : **II**

Name of the Course : **Mathematics for life – II (NMEC)**

Course Code : **MA1721**

No. of hours per week	Credit	Total No. of hours	Marks
4	3	60	100

Objectives:

1. To develop the quantitative aptitude of the students
2. To solve problems needed for various competitive examinations

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	find the average of numbers and solve some real life problems	PSO – 4	U, Ap
CO - 2	frame equations and solve problems involving ratios and fractions	PSO – 3	Ap
CO - 3	apply law of indices sand surds to find missing numbers in an expression	PSO – 4	Ap
CO - 4	compare surds and ratio	PSO – 8	An
CO - 5	learn ratio and proportion and practice duplication and triplication of rations	PSO – 6	U, Ap
CO – 6	employ the problems related to ages and apply the same to real life situations	PSO – 4	Ap

Unit I

Average - Average of numbers, Average Speed, Some real life problems.

Unit II

Problems on Numbers - Framing and solving equations involving unknown numbers - Problems involving ratios and fractions.

Unit III

Problems on ages - Comparison on ages of two persons - Ratio of ages.

Unit IV

Surds and Indices - Application of laws of indices and surds - Missing numbers in the expression - Comparison of surds.

Unit V

Ratio and Proportion - Fourth, third and mean proportional - Comparison of ratios, Compound ratio - Duplicate and sub-duplicate Ratio - Triplicate and sub-triplicate ratio - Variation.

Text Book:

Aggarwal, R.S. (2014). Quantitative Aptitude. (Revised Edition). S. Chand and Company LTD.

Chapters: 6 to 9 and 12.

Reference Books:

1. Abhijit Guha. (2006). Quantitative Aptitude for Competitive Examination. (4^{th} Edition). Tata McGraw - Hill Education Private Limited.
2. Immaculate, M. (2009). Mathematics for Life. Nanjil offset Printers.
3. Arun Sharma. (2008). Objective Mathematics. (Second Edition). Tata McGraw - Hill Publishing Company Limited.
4. Chauhan, R.S. (2011). Objective Mathematics. Unique Publishers.
5. Goyal, J. K., & Gupta, K. P. (2011). Objective Mathematics. (6^{th} Revised Edition). Pragati Prakashan Educational Publishers.

Semester : **III**

Name of the course : **Differential Equations and Vector Calculus**

Course Code : **MC1731**

No. of hours per week	Credit	Total No. of hours	Marks
6	6	90	100

Objectives:

1. To gain deeper knowledge in differential equations, differentiation and integration of vector functions
2. To apply the concepts in higher mathematics and physical sciences

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	distinguish linear, nonlinear, ordinary and partial differential equations	PSO – 4	An
CO - 2	solve linear differential equations with constant and variable coefficients	PSO – 8	U
CO - 3	explain the basic properties of Laplace Transforms and Inverse Laplace Transforms.	PSO – 1	U
CO - 4	use the Laplace transform to find the solution of linear differential equations	PSO – 2	Ap
CO - 5	learn methods of forming and solving partial differential equations	PSO – 3	U
CO - 6	learn differentiation and integration of vector valued functions	PSO – 4	U
CO - 7	evaluate line and surface integrals using Green's theorem, Stoke's theorem and Gauss divergence theorem	PSO – 8	Ap, E
CO - 8	apply the concepts to solve problems in physical sciences and engineering	PSO – 3	Ap

Unit I

Linear differential equation with constant coefficients - Particular integrals of functions of the form e^{ax}, $sin\ sin\ ax$, $cos\ cos\ ax$, x^n, $e^{ax}f(x)$, $x^nf(x)$, Homogeneous Linear equations.

Unit II

Laplace Transformation - Properties, Inverse Laplace transform - Properties - Solving linear differential equations and simultaneous equations of first order using Laplace transform.

Unit III

Formation of partial differential equations - First order partial differential equation - Methods of solving the first order partial differential equations - Lagrange's Equation. Charpit's method.

Unit IV

Vector differentiation - Gradient - Equation of tangent plane and normal line - Unit normal - divergence and curl - Solenoidal, irrotational and harmonic vectors.

Unit V

Vector integration - Line integrals & Surface integrals, Green's, Stoke's and Gauss divergence theorems (statement only). Verification of Green's, Stoke's and Gauss divergence theorems.

Text Books:

1. Arumugam, S., & Issac. (2011). Differential equations and applications. New Gamma Publishing House.
   Chapter 2: Sections 2.1 to 2.4, Chapter 3, Chapter 4: Sections 4.1 to 4.3 & 4.5.
2. Arumugam, S., & Thangapandi Issac. (2014). Analytical Geometry 3D and Vector calculus. Palayamkottai: New Gamma Publishing House.
   Chapters 5 and 7.

Reference Books:

1. Sankaranarayanan., & others. (2006). Differential equations and applications. PRESI-PERSI Publishers.
2. Narayanan., & Manicavachagampillai. (2009). Differential Equations. Vishwanathan S. Printers & Publishers Pvt. Ltd.
3. Venkatachalapathy, S. G. (2012). Ordinary Differential Equations. Margham Publications.
4. Narayanan., & Manicavachagampillai, K. (1980). Vector Algebra & Analysis. Viswanathan, S. Printers & Publishers Pvt. Ltd.
5. Durai Pandian, P., & Laxmi Durai Pandian. (1986). Vector Analysis. Emerald Publishers.

Semester : **III**

Name of the course : **Sequences and Series**

Course Code : **MC1732**

No. of hours per week	Credit	Total No. of hours	Marks
5	5	75	100

Objectives:

1. To introduce the primary concepts of sequences and series of real numbers
2. To develop problem solving skills

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	explain the primary concepts of sequences and series of real numbers	PSO – 1	U
CO - 2	define convergence and divergence of sequences and series	PSO – 1	R
CO - 3	distinguish between convergence and divergence of sequences and series	PSO – 2	U
CO - 4	relate the behaviour of monotonic and geometric sequences and series	PSO – 8	Ap
CO - 5	calculate the limit and peak point of sequences	PSO – 3	An
CO - 6	analyze the importance of Cauchy's general principle of convergence of sequences and series	PSO – 7	An
CO - 7	evaluate the convergence of series using different types of tests.	PSO – 4	E
CO - 8	develop the skill of analyzing in sequence and series.	PSO – 4	An

Unit I

Sequences - Range of a sequence - Limits - Bounded, monotonic, convergent, oscillating and divergent sequences.

Unit II

Algebra of limits - Null Sequence - Behavior of monotonic sequences - Behavior of Geometric Sequence.

Unit III

Subsequences - Limit Points - Cauchy sequences in R and Cauchy's general principle of convergence.

Unit IV

Series - Convergence and divergence - Cauchy's general principle of convergence - Comparison test - Alternative forms of the Comparison test - Behaviour of harmonic series.

Unit V

Test of convergence of series with Kummer's test, D' Alembert's Ratio test, Raabe's test, Root test, Cauchy's condensation test (proof using comparison test).

Text Book:

Arumugam, S., & Issac. (2006). Sequences and series. Palayamkottai: New Gamma Publishing House.

Chapter 3: Sections 3.1 to 3.7, 3.9 - 3.11.

Chapter 4: Sections 4.1, 4.2 (problems related to ratio and root tests from sections 4.3 and 4.4).

Reference Books:

1. Bali, N. B. (2005). Real Analysis. Laxmi Publications.
2. Somasundaram, D., & Choudhary, B. (2010). A first course in Mathematical Analysis. Narosa Publishing House Pvt. Ltd.
3. Singh, J. P. (2010). Real analysis. Ane Books Pvt. Ltd.
4. Gupta, S. L., & Nisha Rani. (2008). Fundamental Real Analysis. Vikas Publishing House Pvt. Ltd.
5. Balaji, G. (2014). Engineering Mathematics. I. Balaji Publishers.

Semester : **III**

Name of the course : **Probability Theory and Distributions (Allied)**

Course Code : **MA1731**

No. of hours	Credit	Total No. of hours	Marks
5	5	75	100

Objectives:

1. To impart knowledge on the basic concepts of Probability theory and Probability distributions
2. To apply the theory in real life situations

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the definition of probability and set functions	PSO – 1	R
CO - 2	differentiate between probability and conditional probability and compute according to the requirement	PSO – 4	An
CO - 3	understand the definition of random variables, their types and related concepts	PSO – 1	U
CO - 4	detect the different probability distributions which are widely used	PSO – 4	An
CO - 5	apply the techniques to prove the properties of probability and related distributions	PSO – 8	Ap
CO - 6	choose the suitable probability distribution corresponding to a given data	PSO – 5	E
CO - 7	test the validity of a given data	PSO - 9	E

Unit I

Probability - Experiment - Sample space - Events - Conditional probability - Properties - independent events - Multiplication rule of probability - Baye's Theorem.

Unit II

Probability - Experiment - Sample space - Events - Conditional probability - Properties - independent events - Multiplication rule of probability - Baye's Theorem.

Unit III

Moment generating function - Properties - Cumulant generating function - Characteristic function - Poisson distribution - Recurrence formula for moments - Fitting of Poisson distribution.

Unit IV

Binomial distribution - Moment generating function about origin and mean Recurrence formula for moments - Mode of Binomial distribution - Fitting of Binomial distribution.

Unit V

Normal Distribution - Properties of Normal curve - Moment generating function about origin and mean - Moments - Standard Normal distribution - Fitting of Normal distribution by area method and ordinate method.

Text Book:

Arumugam, S., & others. (2006). Statistics. New Gamma Publishing House.

Chapter 11: 11.1 - 11.2; Chapter 12: 12.1 - 12.6; Chapter 13: 13.1 - 13.3.

Reference Books:

1. Kapur, J.N., & Saxena. (1986). Mathematical Statistics. (12th Edition). Chand & Company.
2. Pillai, R.S.N., & Bagavathi, V. (1989). Statistics. (12th Edition). Chand & Company.
3. Mangaladoss., & others. (1994). Statistics and its application. Suja Publishing House.
4. Sharma, J.N., & Goyal, J. K. (1987). Mathematical Statistics. (11th Edition). Krishna Bakashar Mandir.
5. Gupta, S.P. (2012). Statistical Methods. (42nd Edition). Sultan Chand and Sons.

Semester : **III/ V**

Name of the course : **Self-Learning Course – Discrete Mathematics - I**

Course Code : **MC17S1**

Objectives:

1. To develop the interest of self-learning in diverse subjects related to mathematics
2. To convert real life problems into mathematical problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	learn some important notions of graph theory	PSO – 1	U
CO - 2	be familiar with the definitions of basic graph theory	PSO – 1	U
CO - 3	give matrix representation of various graphs	PSO - 5	C
CO - 4	prove simple results in graph theory	PSO - 1	U
CO - 5	write algorithms for proven results	PSO - 5	C
CO - 6	understand the basics of relations and functions	PSO - 1	U
CO - 7	classify the types of functions and relations	PSO - 4	An
CO - 8	draw the graphs of given functions	PSO - 5	C
CO - 9	cite examples of different types of functions	PSO - 1	U
CO - 10	analyze the difference between a relation and a function	PSO - 4	An

Unit I

Graph - Undirected Graph - Directed Graph - Multi Graph - Pseudo Graph - Simple Graph - General Graph - Degree of a vertex - Theorems - Finite Graph - Order of a Graph - Size of a Graph - Null Graph - Isolated Graph - Regular Graph - Isomorphic Graphs.

Unit II

Matrix Representation of a Graph - Adjacency matrices - Incidence Matrix - Examples - Sub graph - Walks - Closed walk - Open walk - Path - Length of a path - Circuit - Connected Graphs - Euler Graph - Hamiltonian Graph - Sub graph.

Unit III

Propositional Calculus - Connectives - Tautology and contradiction - Examples - Equivalence Formulae - Implication - Laws of Implication and Equivalence - Basic Logical Laws - Procedure for proving Tautological Implications - Duality Law.

Unit IV

Relations - Complementary Relation - Inverse Relation - Union and intersection of two Relations - Symmetric Relation - Anti Symmetric Relation - Reflexive Relation - Transitive Relation - Equivalence Relation - Partially ordering Relation - Domain and Range of a Relation - Composition of Relations - Examples.

Unit V

Functions - Definition and Examples of Functions - Types of Functions - Classification of Functions - Algebraic Functions - Transcendental Functions - Composition of functions - Identity - Function - Inverse of a Function - Problems.

Text Book:

Geetha, P. (2011). Discrete Mathematics. Chennai: SCITECH Publications.
Chapter 11: Sections 11.1 ,11.2 & 11.3 (11.3.1 to 11.3.6 only)
Chapter 1: Sections 1.1 to 1.9; Chapter 3: Sections 3.23 to 3.33;
Chapter 5: Sections 5.1 to 5.8.

Reference Books:

1. Vatsa, B. S., & Suchi Vatsa. (2009). Discrete Mathematics. (4^{th} Edition). New Age International Publications.
2. Mallik, D.S., & Sen, M. K. (2010). Discrete Mathematics Theory and Applications. (Revised Edition). Cengage Learning India Pvt. Ltd.
3. Chauhan, J.P. (2015). Discrete Structures and Graph Theory. (6^{th} Edition). Krishna Prakashan Media Pvt. Ltd.
4. Bernard Kolman., Robert C. Busby., & Sharon Cutler Ross. (2009). Discrete Mathematical Structures. (6^{th} Edition). PHI Learning Pvt. Ltd.
5. Lovasz, L., Pelikan, J., & Vesztergombi, K. (2008). Discrete Mathematics Elementary and Beyond. (5^{th} Edition). Springer International Edition.

Semester : **IV**

Name of the course : **Groups and Rings**

Course Code : **MC1741**

No. of hours per week	Credit	Total No. of hours	Marks
6	6	90	100

Objectives:

1. To introduce the concepts of Group theory and Ring theory
2. To gain more knowledge essential for higher studies in Abstract Algebra

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	recall the definitions of groups ,rings, functions and also examples of groups and rings	PSO - 1	R
CO – 2	explain the properties of groups, rings and different types of groups and rings	PSO - 1	U
CO – 3	develop proofs of results on Permutation groups ,Cyclic groups, Quotient group, Subgroups, sub rings , quotient rings	PSO - 5	C
CO – 4	examine the properties of Ideals, Maximal and Prime ideals, Cosets, order of an element	PSO - 8	E
CO – 5	test the homomorphic and isomorphic properties of groups and rings	PSO - 4	An
CO - 6	develop the concepts of ordered integral domains and Unique Factorization Domains	PSO - 5	E
CO - 7	apply the theory of Groups and Rings and solve problems	PSO - 8	Ap

Unit I

Groups - Definition and examples - Permutations - subgroups - cyclic groups.

Unit II

Order of an element - Normal subgroups - Cosets and Lagrange's theorem.

Unit III

Quotient groups - Isomorphism - Fundamental theorem of homomorphism.

Unit IV

Rings - Definition and examples - Elementary properties of rings - Isomorphism of rings - Types of rings - Characteristic of a ring.

Unit V

Subrings - Ideals - Ordered integral domain - Unique factorization domain.

Text Book:

Arumugam, S., & Thangapandi Issac, A. (2011). Modern Algebra. Scitech Publications.

Chapter 3: Sections 3.1, 3.4 - 3.11; Chapter 4: Sections 4.1 to 4.10, 4.12, 4.13

Reference Books:

1. Surjeet Singh., & Qazi Zameeruddeen. (2006). Modern Algebra. (8^{th} Edition). Vikas Publishing House.
2. Santiago, M.C. (2011). Modern Algebra. (1^{st} Edition). Tata McGraw Publishing Company Limited.
3. Gopalakrishnan, N. S. (2015). University Algebra. (3^{rd} Edition). New Age International Publishers.
4. Vatsa, B. S., & Suchi Vatsa. (2010). Modern Algebra. (2^{nd} Edition). New Age International Publishers.
5. Joseph A. Gallian. (1999). Contemporary Abstract Algebra. (4^{th} Edition). Narosa Publishing House Pvt. Ltd.

Semester : **IV**

Name of the course : **Analytical Geometry – 3 Dimensions**

Course Code : **MC1742**

No. of hours per week	Credit	Total No. of hours	Marks
5	5	75	100

Objectives:

1. To gain deeper knowledge in three dimensional Analytical Geometry
2. To develop creative thinking, innovation and synthesis of information

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the basic definitions and concepts of planes and lines	PSO – 1	R
CO - 2	demonstrate the Projection of the line joining two points, Cosines of the line joining two points and will be able to solve problems	PSO – 3	Ap
CO - 3	calculate the distance between points, lines and planes and the angles between lines and planes	PSO – 2	An
CO - 4	draw three dimensional surfaces from the given information	PSO – 4	An
CO - 5	discuss the characteristics and properties of 3 - dimensional objects like sphere, cube etc.,	PSO – 1	U
CO - 6	develop the skill in 3 - dimensional geometry to gain mastery in related courses	PSO – 6	C

Unit I

Distance between points - Angle between two lines - Projection on a line - Direction cosines - Direction ratios of the join of two points - Projection of the line joining two points - Cosines of the line joining the points - Conditions for perpendicularity and parallelism.

Unit II

Equation of a plane in different forms - Intercept form - normal form - Angle between the planes -The ratio in which the plane divides the line joining the points - A plane through the line of intersection of two given planes - length of perpendicular - Planes bisecting the angle between two planes.

Unit III

Equation of a line in different forms - The plane and the straight line - Angle between the lines-image of a line - plane and a line - Line of intersection of two planes - Angle between a line and a plane - Co-planarity of two lines.

Unit IV

Shortest distance between two lines - The equations of two skew lines in a simplified form - The Intersection of three planes - Volume of a tetrahedron.

Unit V

Equation of the sphere in its general form - Determination of the centre and radius of a sphere - The length of the tangent from the point to the sphere - Section of sphere by a plane - Intersection of two spheres - Tangent plane.

Text Book:

Manicavachagom Pillay, T. K., & Natarajan. (2007). Analytical Geometry (Part II-Three dimensions). Viswanathan S. Printers & Publishers Pvt. Ltd.

Chapters: 1 - 4 (Except section 9 in chapter 3).

Reference Books:

1. Arumugam, S., & Thangapandi Issac, A. (2014). Analytical Geometry 3D and Vector Calculus. New Gamma Publishing House.
2. Kar, B.K. (2012). Advanced Analytical Geometry and Vector Calculus. (Revised Edition). Books and Allied (p) Ltd.
3. Chatterjee, D. (2009). Analytical Geometry Two and Three Dimensions. New Delhi: Narosa Publishing House Pvt.Ltd.
4. Jain, P. K., Khalil Ahmad. (1999). Textbook of Analytical Geometry of Three Dimensions. (2^{nd} Edition). New Age International (p) Limited Publishers.
5. Arup Mukherjee., & Naba Kumar Bej. (2015). Analytical Geometry of Two and Three Dimensions. (Advanced Level). Books and Allied (p) Ltd.

Semester : **IV**

Name of the course : **Applied Statistics (Allied)**

Course Code : **MA1741**

No. of hours per week	Credit	Total No. of hours	Marks
5	5	75	100

Objectives:

1. To acquire the knowledge of correlation theory and testing hypothesis
2. To solve research and application oriented problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	identify and demonstrate appropriate sampling processes	PSO – 8	An
CO – 2	recall the methods of classifying and analyzing data relative to single variable	PSO – 1	R
CO - 3	describe the 3^2 distribution in statistics	PSO – 7	U
CO - 4	distinguish between the practical purposes of a large and a small sample	PSO – 8	An
CO - 5	understand that correlation coefficient is independent of the change of origin and scale	PSO – 4	U

Unit I

Correlation - Properties of correlation coefficient - Rank correlation - Regression - Equation of regression lines - Angle between regression lines.

Unit II

Test of significance - Sampling - Sampling distribution - Testing of hypothesis - Procedure for testing of hypothesis for large samples - Test of significance for proportions and percentages.

Unit III

Test of significance for means, difference of sample means, standard deviation and correlation coefficient.

Unit IV

Test of significance for small samples - Test of significance based on t-distribution - Test of significance based on F-test - Test of significance of an observed sample correlation.

Unit V

Test based on 3^2-distribution - 3^2test for population variance, goodness of fit and independence of attributes - Yate's Correction.

Text Book:

Arumugam, S., & Thangapandi Isaac, A. (2006). Statistics. New Gamma Publishing House. Palayamkotai.

Chapters: 6, 14, 15, 16.

Reference Books:

1. Kapur, J. N., & Saxena. (1986). Mathematical Statistics. (12^{th} Edition). Chand & Company.
2. Pillai, R. S. N., & Bagavathi, V. (1989). Statistics. (12^{th} Edition). Chand & Company.
3. Mangaladoss., & Others. (1994). Statistics and its Application. Suja Publishing House.
4. Sharma, J. N., & J. K. Goyal. (1987). Mathematical Statistics. (11^{th} Edition). Krishna Bakashar Mandir.
5. Robert,V., Hogg., Joseph., Mckean, W., Allen., & Craig, T. (2013). Introduction to Mathematical Statistics. (6^{th} Edition). Dorling Kindersley (India) Pvt. Ltd.

Semester : **IV/ VI**

Name of the course : **Self-Learning Course – Discrete Mathematics - II**

Course Code : **MC17S2**

Objectives:

1. To develop the interest of self-learning in diverse subjects related to Mathematics
2. To convert real life problems into mathematical problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	interpret mathematical notation and mathematical definitions	PSO - 1	U
CO - 2	define eigen values and eigen vectors	PSO - 1	R
CO - 3	develop a historical perspective of modern discrete mathematics	PSO - 5	C
CO - 4	explain the Basic Boolean Algebra laws	PSO - 1	U
CO - 5	evaluate discrete mathematics problems that involve computing permutations and combinations of a set	PSO - 4	An
CO - 6	relate distributive lattice and complimented lattice	PSO - 2	Ap

Unit I

Lattices - Introduction - Hasse Diagram - Examples and Problems - Properties of a Lattice with proof - Distributive Lattice - Complimented Lattice - Sublattice - Definition - Isotonicity property - Modular inequality in a Lattice.

Unit II

Boolean Algebra - Definition - Basic Boolean Algebra laws - Principle of Duality - Chain - Properties - Direct product of lattices - Problems.

Unit III

Matrices - Definition - Rank of a matrix - Elementary transformations - Solutions of a system of linear equations.

Unit IV

Eigen values and Eigen vectors - Singular and Non-singular matrices - Inverse of a square matrix - Adjoint of a square matrix - Cayley Hamilton Theorem.

Unit V

Combinatorics - The basics of counting - Product Rule - The Sum Rule - Pigeonhole Principle - Permutation - combination - Circular Permutation - Problems.

Text Book:

P. Geetha. (2011). Discrete Mathematics. Chennai: SCITECH Publications.

Chapter 4: Sections 4.1 to 4.10; Chapter 10: Sections 10.1 to 10.11;

Chapter 7: 7.1 to 7.10

Reference Books:

1. Vatsa, B. S., & SuchimVatsa. (2009). Discrete Mathematics. (4^{th} Edition). New Age International Publications.
2. Mallik, D. S., & Sen, M. K. (2010). Discrete Mathematics Theory and Applications. (Revised Edition). Cengage Learning India Pvt. Ltd.
3. Chauhan, P. (2015). Discrete Structures and Graph Theory. (6^{th} Edition). Krishna Prakashan Media Pvt. Ltd.
4. Bernard Kolman., Robert C. Busby., & Sharon Cutler Ross. (2009). Discrete Mathematical Structures. (6^{th} Edition). PHI Learning Pvt. Ltd.
5. Lovasz, L., Pelikan, J., & Vesztergombi, K. (2008). Discrete Mathematics Elementary and Beyond. (5^{th} Edition). Springer International Edition.

Semester : **V**

Name of the course : **Linear Algebra**

Course Code : **MC1751**

No. of hours per week	Credits	Total No. of hours	Marks
6	5	90	100

Objectives:

1. To introduce the algebraic system of Vector Spaces, inner product spaces
2. To use the related study in various physical applications

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall and define Groups ,Fields and their properties	PSO - 1	R
CO - 2	cite examples of vector spaces ,subspaces and linear transformations	PSO - 1	U
CO - 3	determine the concepts of linear independence, linear dependence , basis and dimension of vector spaces	PSO - 1	U
CO - 4	correlate rank and nullity ,Linear transformation and matrix of a Linear transformation	PSO - 2	Ap
CO - 5	examine whether a given space is an inner product space and the orthonormality of sets	PSO - 3	Ap

Unit I

Vector spaces - Definition and Examples - Subspaces - Linear transformation.

Unit II

Span of a Set - Linear Independence - Basis and Dimension.

Unit III

Rank and Nullity - Matrix of a Linear Transformation - Characteristic Equation and Cayley-Hamilton Theorem - Eigen values and Eigen vectors.

Unit IV

Inner Product Spaces - Definition and examples - Orthogonality - Orthogonal complement.

Unit V

Bilinear forms - Quadratic forms - Reduction of a quadratic form to the diagonal form.

Text Book:

Arumugam, S., & Thangapandi Issac, A. (2011). Modern Algebra. Scitech Publications (India) Pvt. Ltd.

Chapter 5: 5.1 to 5.8 Chapter 6: 6.1 to 6.3

Chapter 7: 7.7 & 7.8 Chapter 8: 8.1 & 8.2.

Reference Books:

1. Santiago, M. L. (2001). Modern Algebra. New Delhi: Tata McGraw Hill Publishing Company Ltd.
2. Krishnamoorthy, V., & Mainra, V. P. (1976). An Introduction to Linear Algebra. New Delhi: Affiliated East West Press Pvt. Ltd.
3. Gopalakrishnan, N. S. (2015). University Algebra. (3^{rd} Edition). New Age International Publishers.
4. Vatsa, B. S., & Suchi Vatsa. (2010). Modern Algebra. (2^{nd} Edition). New Age International Publishers.
5. Aloknath Chakrabarti. (2006). A First Course in Linear Algebra. Vijay Nicole Imprints Pvt. Ltd.

Semester : **V**

Name of the course : **Real Analysis II**

Course Code : **MC1752**

No. of hours per week	Credits	Total No. of hours	Marks
6	5	90	100

Objectives:

1. To introduce Metric Spaces and the concepts of completeness, continuity, connectedness, compactness and uniform convergence
2. To use these concepts in higher studies

Course Outcome

CO	Upon completion of this course the students will be able to	PSOs Addressed	CL
CO - 1	understand the concepts of completeness, continuity and discontinuity of metric spaces	PSO - 1	U
CO - 2	apply the metric space theorems to real life situations	PSO - 4	Ap
CO - 3	distinguish between continuous functions and uniform continuous functions	PSO - 9	An
CO - 4	use basic concepts in the development of real analysis results	PSO - 1	C
CO - 5	understand the concepts of countable sets, metric space, connectedness, compactness of metric spaces	PSO - 7	U
CO - 6	develop the ability to reflect on problems that are quite significant in the field of real analysis	PSO - 8	Ap

Unit I

Countable and Uncountable sets - Metric Space - definition and examples - Bounded sets - Open ball - Opens sets - Subspace.

Unit II

Interior of a set - Closed sets - Closure - Limit point - Dense sets - Complete metric space - Cantor's intersection theorem - Baire's Category theorem.

Unit III

Continuity of functions - Composition of continuous functions - Equivalent conditions for continuity - Homeomorphism - Uniform continuity - Discontinuous functions on R.

Unit IV

Connectedness - Definition and examples - Connected subsets of R - Connectedness and continuity - Intermediate value theorem.

Unit V

Compactness - Compact space - Compact subsets of R - Equivalent Characterisations for Compactness - Compactness and continuity.

Text Book:

S. Arumugam., & Issac. (2013). Modern Analysis. New Gamma Publishing House.

Chapter 1: Sections 1.2 and 1.3; Chapters 2 to 6.

Reference Books:

1. Bali, N. P. (2005). Real Analysis. Lakshmi Publications.
2. Richard., R. & Goldberg. (1973). Methods of Real Analysis. Oxford & IBH Publishing Co.
3. Sudhir., Ghorpade, R., Balmohan., & Limaye, V. (2006). A Course in Calculus and Real Analysis. Springer International Edition.
4. Protter, M. H., & Morrey, C. B. (1991). A First Course in Real Analysis. (2^{nd} Edition). Springer International Edition.
5. Norman., Haaser, B., & Joseph A. Sullivan. (1971). Real Analysis. Van Nostrand Reinhold Company.

Semester : **V**

Name of the course : **Graph Theory**

Course Code : **MC1753**

No. of hours per week	Credits	Total No. of hours	Marks
6	5	90	100

Objectives:

1. To introduce graphs, directed graphs and the concepts of connectedness and labelings
2. To apply these concepts in research

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	understand the basic definitions to write the proofs of simple theorems	PSO - 1	U
CO – 2	employ the definitions to write the proofs of simple theorems	PSO - 2	Ap
CO – 3	relate real life situations with mathematical graphs	PSO - 3	Ap
CO – 4	develop the ability to solve problems in graph theory	PSO - 4	An
CO – 5	analyze real life problems using graph theory both quantitatively and qualitatively	PSO - 4	An

Unit I

Graphs and Sub graphs - Definition and Examples - Degrees, Sub graphs, Isomorphism - Ramsey Numbers - Independent sets and coverings - Intersection graphs and line graphs - Matrices - Operations on graphs. Degree Sequences - Graphic Sequences.

Unit II

Connectedness - Walks, Trails and Paths - Connectedness and Components - Blocks - Connectivity. Eulerian Graphs - Hamiltonian Graphs (excluding theorem 5.10).

Unit III

Trees - Characterisation of trees - Centre of a tree - Matchings - Matchings in bipartite graphs.

Unit IV

Planarity - Definition and properties - Colourability - Chromatic number and chromatic index - The Five Colour Theorem - Chromatic polynomials.

Unit V

Directed Graphs - Definition and Basic Properties, Paths and Connections –Eulerian Trail - Digraphs and Matrices - Tournaments.

Text Book:

Arumugam, S., & Ramachandran, S. (2017). Invitation to Graph Theory. Scitech Publications Pvt. Ltd.

Chapters 2 to 5 (excluding theorem 5.10); Chapters 6 & 7; Chapter 8: 8.1; Chapter 9 (excluding section 9.3); Chapter 10.

Reference Books:

1. Kumaravelu, S., & Susheela Kumaravelu. (1999). Graph Theory. (1^{st} Edition). Printers Janki calendar corporation, Sivakasi.
2. Harary F. (1988). Graph Theory. Narosa Publishing House.
3. Balakrishnan, R., & Ranganathan, K. (2013). A Text book of Graph Theory. Springer International Edition.
4. Gary Chartrand., & Ping Zhang. (2006). Introduction to Graph Theory. McGraw-Hill Edition Pvt. Ltd.
5. Douglas B. West. (2003). Introduction to Graph Theory. (2^{nd} Edtion). Prentice - Hall of India private limited.

Semester : **V**

Name of the course : **Project**

Course Code : **MC17534**

No. of hours per week	Credits	Total No. of hours	Marks
6	**5**	90	100

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	choose a new topic of their interest	PSO - 1	U
CO – 2	develop the attitude of studying a topic in depth independently	PSO - 4	An
CO – 3	express their views with confidence in a group	PSO - 1	U
CO - 4	relate with the group members and reap the best harvest	PSO - 3	Ap
CO - 5	develop communication skills through oral presentation	PSO - 4	An
CO - 6	create a taste for research in mathematics	PSO - 5	C
CO - 7	develop confidence to face interviews	PSO - 5	C
CO - 8	Interpret and analyze data mathematically	PSO - 4	An

Dissertation framework

1. The Project format should be in:

- Font - Times New Roman
- Heading - Font size 14 (Bold) - Uppercase
- Sub headings - Font size 12 (Bold) — Lowercase; should be numbered.
- (Eg: Introduction 1; Subheading 1.1; 1.2)
- Text, the content of the dissertation — Font size -12 (Normal).
- Citation - Any works of other researchers, if used either directly or indirectly should be indicated at appropriate places in the text.

The citation may assume any one of the following forms:

i) A paper, a monograph or a book with single author may be designated by the name of the first author followed by the year of publication, placed inside brackets at the appropriate places in the text.

ii) A paper, a monograph, or a book with two authors may be designated by the name of the first and second author followed by the year of publication, placed inside brackets at the appropriate places in the text.

iii) A paper, a monograph, or a book with more than two authors may be designated by the name of the first author followed by et al, and the year of publication, placed inside brackets at the appropriate places in the text.

- Line space - 1.5
- Margin - 2" on the left and 1" on the right, Gutter -0.5.
- Page Numbering — Bottom middle alignment; excluding initial pages and
- reference
- Total number of pages - Minimum 30 - Maximum 50 (excluding initial pages and
- reference).
- The Tables and Figures should be included subsequently after referring them in
- the text of the Thesis.
- The thesis from Chapters should be printed on both sides.

II. Project Report must be completed within the stipulated time.

III. Submission of Project Report:

- One soft copy (PDF format in CD)
- Three hard copies (soft binding) duly signed and endorsed by the Supervisor and the Head.

The Project Report **will have three main parts:**

I. Initial Pages - in the following sequence

(a) Title Page
(b) Certificate from the Supervisor
(c) Declaration by the candidate endorsed by the Supervisor and HOD.
(d) Acknowledgement (within one page - signed by the candidate).
(e) Table of Contents
(f) List of abbreviations
(g) Abstract

II. Main body of the dissertation

(a) Introduction with Literature review and Objectives
(b) Methodology
(c) Results
(d) Discussion
(e) Summary
(f) References

III Reference

The guidelines for reference

Journal Article: with Single Author

Waldron, S 2008, ‒Generalized Welch bound equality sequences are tight frames‟, IEEE Transactions on Information Theory, vol. 49, no. 9, pp. 2307-2309.

Journal Article: with Two Authors

Conley, TG & Galeson, DW 1998, ‒Nativity and wealth in mid-nineteenth century cities‟, Journal of Economic History, vol. 58, no. 2, pp. 468-493.

Journal Article: with more than two Authors

Alishahi, K, Marvasti, F, Aref, VA & Pad, P 2009, „Bounds on the sum capacity of synchronous binary CDMA channels“, Journal of Chemical Education, vol. 55, no. 8, pp. 3577-3593.

Books

Holt, DH 1997, Management Principles and Practices, Prentice-Hall, Sydney. Centre for Research, M S University - Ph.D. Revised Guidelines Page | 39 / 41

E-book

Aghion, P & Durlauf, S (eds.) 2005, Handbook of Economic Growth, Elsevier, Amsterdam. Available from: Elsevier books. [4 November 2004].

Conference Proceeding Paper with Editors

Riley, D 1992, „Industrial relations in Australian education“, in Contemporary Australasian industrial relations: proceedings of the sixth AIRAANZ conference, ed. D. Blackmur, AIRAANZ, Sydney, pp. 124-140.

Conference Proceeding Paper without Editors

Fan, W, Gordon, MD & Pathak, R 2000, ―Personalization of search engine services for effective retrieval and knowledge management“, Proceedings of the twenty-first international conference on information systems, pp. 20-34.

Website

Australian Securities Exchange 2009, Market Information. Available from: [5 July 2009].

Thesis

Unpublished Hos, JP 2005, Mechano chemically synthesized nano materials for intermediate temperature solid oxide fuel cell membranes. Ph.D. thesis, University of Western Australia. Newspaper Print Ionesco, J 2001, 'Federal election: new Chip in politics', The Advertiser 23 October, p. 10.

Semester : **V**

Name of the course : **Numerical Methods – Elective I (a)**

Course Code : **MC1755**

No. of hours per week	Credits	Total No. of hours	Marks
5	4	75	100

Objectives:

1. To study Numerical differentiation and Numerical integration using different formulae
2. To develop various methods for solving applied scientific problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	understand the basic definitions and meaning of interpolation	PSO - 1	U
CO - 2	select appropriate numerical methods and apply the same to various types of problems	PSO - 1	U
CO - 3	apply numerical methods to obtain approximate solutions to mathematical problems	PSO - 3	Ap
CO - 4	employ different methods of constructing a polynomial using various methods	PSO - 2	A
CO - 5	compare the rate of convergence of different numerical formula	PSO - 4	An
CO - 6	distinguish the advantages and disadvantages of various numerical methods	PSO - 4	An

Unit I

Solutions of algebraic and transcendental equations. Iteration method - Newton Raphson method - Finite difference - Difference operators.

Unit II

Newton's Interpolation formulae - Lagrange's Interpolation formula - divided difference - Newton's divided difference formula.

Unit III

Numerical differentiation - derivatives using Newton's forward difference formula - backward difference formula.

Unit IV

Numerical integration - Newton cote's - quadrature formula - Trapezoidal rule- Simpson's (1/3) rd rule - Simpson's (3/8) th rule**.**

Unit V

Numerical solution of differential equation - Taylor's series method - Picard's method.

Text Book:

Arumugam, S.,Thangapandi Issac, A., & Somasundaram, A. (2002). Numerical Methods. Scitech Publications Pvt. Ltd.

Chapter 3: Sections 3.0, 3.2 & 3.5 Chapter 6: Sections 6.1;

Chapter 7: Sections 7.1, 7.3 - 7.5;

Chapter 8: Sections 8.1, 8.2 & 8.5 (except Weddle's rule, Boole's rule & Romberg's method) & Chapter 10: Sections 10.1 &10.2.

Reference Books:

1. Sastry, S.S. (2003). Introduction methods of numerical analysis. (3^{rd} Edition). Prentice Hall of India.
2. Scar Borough, J.N. (1966). Numerical mathematical analysis. (6^{th} Edition). Oxford and IBH Publishing Co.
3. Gupta, P. P., G.S.Malik., & Sanjay Gupta. (1992). Calculus of finite differences and numerical analysis. (16^{th} Edition). KRISHNA Prakashan Mandir.
4. Devi Prasad. (2010). An Introduction to Numerical Anaysis. Narosa Publishing House.
5. Bhupendra Singh. (2012). Numerical Analysis. (2^{nd} Edition). Pragati Prakashan Educational Publishers.

Semester : **V**

Name of the course : **Fuzzy Mathematics – Elective I (b)**

Course Code : **MC1756**

No. of hours per week	Credits	Total No. of hours	Marks
5	4	75	100

Objectives:

1. To understand Fuzzy concepts of sets and operations
2. To apply the Fuzzy concepts in image processing, machine learning and artificial intelligence

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	understand the basic mathematical operations carried out on fuzzy sets	PSO - 1	U
CO - 2	compare fuzzy sets with crisp sets	PSO - 4	An
CO - 3	explain classical logic and fuzzy logic	PSO - 1	U
CO - 4	describe the significance of fuzzy systems and genetic algorithms	PSO - 1	U
CO - 5	solve problems that are appropriately solved by neural networks , fuzzy logic and genetic algorithms	PSO - 3	Ap
CO - 6	apply the concepts fuzzy systems and neural networks in various fields like machine intelligence and robotics	PSO - 2	Ap
CO - 7	differentiate between Possibility theory and Probability theory	PSO - 4	An

Unit I

Crisp set - Operations on Crisp Set - Fuzzy Set -Types of Fuzzy set - Operations on Fuzzy Sets - Properties of operation on Fuzzy Sets - Product on Fuzzy Sets. Fuzzy Numbers Linguistic Variables - Fuzzy Arithmetic.

Unit II

Operation On Fuzzy Numbers, Fuzzy Equations - Lattice of Fuzzy Numbers - Classical Logic - Logical Connectives - Truth Values and Truth Tables - Algebra of Statements - Logical Identies and implications - Fuzzy Logic - Fuzzy Logic Truth Tables - Fuzzy Connectives. Fuzzy Grammar - Properties of Modifier - Inference Rules.

Unit III

Relations on Fuzzy set - Composition of Fuzzy Relation - Fuzzy Equivalence Relation - Fuzzy ordering relation - operations on fuzzy Relation - Role of Fuzzy Relation Equation.

Unit IV

Fuzzy Data Mining - Fuzzy Systems Neural Network - Fuzzy Automata - Fuzzy Systems and Genetic Algorithm.

Unit V

Fuzzy Measure, Evidence Theory - Dempster Rule of Combination - Marginal Basic Assignment - Possibility Theory - Possibility Theory versus Probability Theory.

Text Book:

HoodaVivekRaich, D.S. (2015). Fuzzy Set Theory and Fuzzy Controller, Narosa Publishing House.

Chapter 1: 1.2 - 1.6; Chapter 2: 2.2 - 2.7; Chapter 3: 3.2 - 3.12;
Chapter 4: 4.2 - 4.7; Chapter 5: 5.2- 5.6; Chapter 6: 6.2 - 6.7

Reference Books:

1. Zimmermann, H. J. (2001). Fuzzy Set Theory and Its Applications. (4^{th} Edition). Springer International Edition.
2. Bhargava, A. (2013). Fuzzy Set Theory Fuzzy logic and their Application. S.Chand Publishing.
3. Ganesh, M. (2006). Fuzzy sets and Fuzzy logic. Prentice Hall India learning private limited.
4. Shinghal. (2012). Introduction to Fuzzy logic. Prentice Hall India learning private Limited.
5. Nanda, S. & Das, N. R. (2015). Fuzzy Mathematical Concepts. Narosa Publishing House Pvt. Ltd.

Semester : **V**

Name of the course : **Computer Oriented Programming with C++– Elective I(c)**

Course Code : **MC1757**

No. of hours per week	Credits	Total No. of hours	Marks
5	4	75	100

Objectives:

1. To learn and write programmes in C++ Language
2. To enhance job opportunities

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	apply C++ features to program design and implementation	PSO - 3	Ap
CO - 2	explain object oriented concepts and describe how they are supported by C++	PSO - 1	U
CO - 3	use C++ to demonstrate practical experience in developing object oriented solutions	PSO - 2	Ap
CO - 4	design and implement programs using C++	PSO - 3	Ap
CO - 5	analyze a problem description and design object oriented software using good coding practices and techniques	PSO - 4	An
CO - 6	implement an achievable practical applications and analyze issues related to object oriented techniques in the C++ programming language	PSO - 5	C
CO – 7	use common software patterns in object oriented design and recognize their applicability to other software development contexts	PSO – 1	U
CO - 8	create application using C++ programming language	PSO - 5	C
CO - 9	write algorithm for programs	PSO - 1	U

Unit I

Basic concepts of object - oriented programming - benefits of OOP - applications of C++ - simple program - more statements - structure of C++ program - creating the source file - compiling and linking.

Unit II

Tokens - keywords - identifiers and constants - basic data types - user defined data types - derived data types - symbolic constants - variables - operators - manipulators - expressions and their types - operator overloading - operator precedence - control structures. Functions in C++ - main function - function prototyping - call by reference - return by reference - in line functions - default argument - function overloading - math library functions.

Unit III

Classes and objects - defining member functions - C++ program with class - member functions - arrays within a class - arrays of objects - objects as function arguments - returning objects - constant member functions - pointer to members.

Unit IV

Constructors - parametrized constructors - multiple constructors - constructors with default arguments - dynamic initialization - copy constructor - dynamic constructor - constructing two dimensionl arrays - destructors. Defining operator overloading - overloading unary operators - manipulation of string using operators.

Unit V

Defining derived class - single inheritance - multilevel inheritance - hierarchial inheritance - hybrid inheritance - virtual base classes - abstract classes - nesting classes - basic concepts in pointers.

Text Book:

Balagurusamy, E. (2011). Object oriented programming with C++. (5^{th} Edition).(TMH).Tata MaGraw Hill Publication.

Chapter 1: Sections 1.5 - 1.8; Chapters 2 to 8 and Chapter 9: Sections 9.1, 9.2.

Reference Books:

1. Ravichandran, D. (2002). Programming with C^{++} Tata MaGraw Hill Publication.
2. Paul Deitel., & Harvey Deitel. (2013). C++ How to program. (8^{th} Edition). PHI Learning Private Limited Publication.
3. Stanley Hoffman. (2015). C++: For Beginners. Addison - Wesley professional.
4. BjarneStroustrup. (2014). Programming: Principles and practice using C++. (2^{nd} Edition). Addison - Wesley professional.
5. Scott Meyers, (2014). Effective C++. (1^{st} Edition). O 'Reilly Media.

Semester : **V**

Name of the course : **Mathematics for Competitive Examinations - I**

Course Code : **MSK175**

No. of hours per week	Credits	Total No. of hours	Marks
2	2	30	100

Objectives:

1. To develop the quantitative aptitude of the students
2. To solve problems needed for various competitive examinations

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the problems on percentage	PSO - 1	R
CO - 2	discuss the problems on population and depreciation	PSO - 1	U
CO - 3	conversion of decimal into percentage and vice versa	PSO - 2	Ap
CO - 4	use percentage concept to solve applied technical problems	PSO - 3	Ap
CO - 5	analyze the problems related to inlet and outlet of the tank	PSO - 4	An
CO - 6	evaluate time and distance related problems	PSO - 4	E
CO - 7	create the ability to make an appropriate mixture	PSO - 5	C

Unit I

Percentage - Conversion of decimal into percentage and vice versa, Problems on Population and Depreciation.

Unit II

Partnership - Problems on ratio of division of gains, working partners and sleeping partners.

Unit III

Pipes and Cistern - Problems related to inlet and outlet of the tank.

Unit IV

Time and Distance - Average speed, ratio of speeds.

Unit V

Boats and Streams - Speed of downstream, Speed of upstream, Speed of still water, Rate of stream - Alligation or Mixture.

Text Book:

Agarwal, R.S. (2014). Quantitative Aptitude. (Revised Edition). S. Chand & Company Pvt. Ltd.

Chapters**:** 10,13, 16, 17, 19 and 20.

Reference Books:

1. Guha, A. (2011). Quantitative Aptitude for Competitive Examinations. (4^{th} Edition). McGraw Hill Education. (India) Pvt. Ltd.
2. Immaculate, M. (2009). Mathematics for Life. Nanjil offset Printers.
3. Arun Sharma. (2008). Objective Mathematics. (2^{nd} Edition). Tata McGraw-Hill Publishing Company Limited.
4. Chauhan, R.S. (2011). Objective Mathematics. Unique Publisher.
5. Goyal, J. K., & Gupta, K. P. (2011). Objective Mathematics. (6^{th} Revised Edition). Pragati Prakashan Educational Publishers.

Semester : **VI**

Name of the course : **Complex Analysis**

Course Code : **MC1761**

No. of hours per week	Credits	Total No. of hours	Marks
6	5	90	100

Objectives:

1. To introduce the basic concepts of differentiation and integration of Complex functions
2. To apply the related concepts in higher studies

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	understand the geometric representation of complex numbers	PSO - 1	U
CO - 2	use differentiation rules to compute derivatives and express complex- differentiable functions as power series	PSO - 4	E
CO - 3	compute line integrals by using Cauchy's integral theorem and formula	PSO - 3	E
CO - 4	identify the isolated singularities of a function and determine whether they are removable, poles or essential	PSO - 1	U
CO - 5	evaluate definite integrals by using residues theorem	PSO - 8	E

Unit I

Complex numbers - conjugation and modulus, inequalities, square root, geometrical representation, n^{th} roots of complex numbers, circles, straight lines, regions of the complex plane, the extended complex plane.

Unit II

Analytic functions - Differentiability, Cauchy Riemann equations, Analytic functions, Harmonic function. Bilinear transformations - Elementary transformations (Definitions only), Bilinear Transformations, Cross ratio.

Unit III

Complex integration - Definite Integral, Cauchy's theorem, Cauchy's integral formula.

Unit IV

Series Expansions - Taylor Series, Laurent's Series, Zeros of Analytic Functions, Singularities. (Definitions & examples only).

Unit V

Calculus of Residues - Residues, Cauchy's Residue Theorem, Evaluation of Definite Integrals (Type 1only).

Text Book:

Arumugam, S., Thangapandi Issac, A., & Somasundaram, A. (2018). Complex Analysis. Scitech publications.
Chapter 1: Sections 1.1 - 1.9; Chapter 2: Sections 2.5 - 2.8;
Chapter 3: Sections 3.1 - 3.3; Chapter 6: Sections 6.1 - 6.3;
Chapter 7: Sections 7.1- 7.4 & Chapter 8: Sections 8.1 - 8.3 (Type 1 only)

Reference Books:

1. Goyal., Gupta., & Pundir. (2012). Complex Analysis. (1^{st} Edition). Pragati Prakashan Educational Publishers.
2. Durai Pandian, P., Laxmi Durai Pandian., & Muhilan, D. (2001). Complex Analysis. Emerald Publishers.
3. Duraipandian , P., & Kayalal Pachaiyappa. (2014). Complex Analysis. (1^{st} Edition). S. Chand and Company Pvt. Ltd.
4. Ruel V. Churchill., & James Ward Brown. (1990). Complex Variables and Applications. McGraw-Hill International Edition.
5. Anuradha Gupta. (2011). Complex Analysis. Ane Books Pvt. Ltd.

Semester **VI**

Name of the course **: Mechanics**

Course Code **: MC1762**

No. of hours per week	Credits	Total No. of hours	Marks
6	5	90	100

Objectives:

1. To study the application of Mathematics in Physical Sciences
2. To solve related problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	calculate the reactions necessary to ensure static equilibrium	PSO - 2	U
CO - 2	apply the principles of static equilibrium to particles and rigid bodies	PSO - 4	Ap
CO - 3	understand the ways of distributing loads	PSO - 7	U
CO - 4	identify internal forces and moments of a rigid body	PSO - 6	U
CO - 5	apply the basic principles of projectiles into real world problems	PSO - 2	Ap
CO - 6	classify the laws of friction	PSO - 4	An
CO - 7	describe energy methods for particles and systems of particles	PSO - 1	U
CO - 8	understand the general principles of dynamics	PSO - 7	U

CO - 9	differentiate the various frictional forces	PSO - 2	An

Unit I

Lami's Theorem - Parallel Forces, like and unlike parallel forces - Equilibrium of three coplanar forces - Centre of two parallel forces - Moments - Varignon's theorem of moments - Generalised theorem of moments.

Unit II

Coplanar Forces - Reduction of any number of coplanar forces - Conditions for a system of forces to reduce to a single force or a couple - Change of the base point - Equation to the line of action of the resultant - Solution of problems.

Unit III

Friction - Statical, Dynamical and Limiting friction - Laws of friction - Coefficient of friction - Angle of friction - Cone of friction - Equilibrium of a body on a rough inclined plane - Problems on friction.

Unit IV

Projectiles - Equation of path - Characteristics of the motion of the projectile - Maximum horizontal range - Two directions of projection for a given velocity - Velocity of the projectile.

Unit V

Simple Harmonic Motion in a straight line - General solution of the SHM - Geometrical representation - Change of origin - Simple harmonic motion on a curve - Simple pendulum - Period of oscillation of a simple pendulum - Equivalent simple pendulum - Seconds pendulum.

Text Books:

1. Venkataraman, M. K. (2012). Statics. (15^{th} Edition). Agasthiar Publications. Chapter 2: Section 2.9; Chapter 3: Sections 3.1 to 3.13; Chapter 6: Sections 6.1 to 6.3(Analytical proof only), 6.5, 6.7, 6.8, 6.13; Chapter 7: Sections 7.1 to 7.13 (up to example 15).
2. Venkataraman, M. K. (2012). Dynamics. (15^{th} Edition). Agasthiar Publications. Chapter 6: Sections 6.1 to 6.10; Chapter 10: Sections 10.1 to 10.5, 10.11 to 10.15.

Reference Books:

1. Durai Pandian, P., Lexmi Durai Pandian., & Muthamizh Jayapragasam. (2011). Mechanics. Chand S. & Company Ltd.
2. Rajeshwari, I. (2016). Mechanics. (1^{st} Edition). Saras Publication.
3. Chaudhry, K. R., & Aggarwal, A. C. (1983). Elements of Mechanics. Chand, S.& Company Ltd.
4. Mathur, D. S. (1985). Mechanics. S.Chand & Company Ltd.
5. John., Synge, L., Byron., & Griffith, A. (1970). Principles of Mechanics. (International Student Edition). McGraw - Hill Kogakusha Ltd.

Semester : **VI**

Name of the course : **Number Theory**

Course Code : **MC1763**

No. of hours per week	Credits	Total No. of hours	Marks
5	5	75	100

Objectives:

1. To introduce the fundamental principles and concepts in Number Theory
2. To apply these principles in other branches of Mathematics.

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	express the concepts and results of divisibility of integers effectively	PSO - 1	U
CO - 2	construct mathematical proofs of theorems and find counter examples for false statements	PSO - 6	C
CO - 3	collect and use numerical data to form conjectures about the integers	PSO - 5	Ap
CO - 4	understand the logic and methods behind the major proofs in Number Theory	PSO - 7	U
CO - 5	solve challenging problems related to Chinese remainder theorem effectively	PSO - 3	E
CO - 6	build up the basic theory of the integers from a list of axioms	PSO - 1	U
CO - 7	explore some current research problems in number theory	PSO - 2	C
CO - 8	apply Fermat's theorem and Wilsons theorem effectively	PSO - 8	Ap
CO - 9	use mathematical induction and other types of proof writing techniques	PSO - 1	Ap
CO - 10	understand and utilize mathematical functions and empirical principles and processes	PSO - 7	U

Unit I

Divisibility Theory in the Integers - The Division Algorithm -The greatest common divisor - The Euclidean Algorithm.

Unit II

The Diophantine Equation $ax + by = c$ - Primes and Their Distribution -The fundamental theorem of arithmetic - The Sieve of Eratosthenes.

Unit III

The Theory of Congruences - Basic properties of congruence - Linear congruences and the Chinese remainder theorem.

Unit IV

Fermat's Little theorem and Pseudo primes - Absolute pseudo primes - Wilsons theorem - Quadratic Congruence.

Unit V

Number Theoretic Functions - The sum and number of divisors -The Mobius Inversion formula - The greatest integer function.

Text Book:

David M. Burton. (2017). Elementary Number Theory. (7^{th} Edition). McGraw Hill Education (India) Private Limited.

Chapter 2: Sections 2.2 - 2.5; Chapter 3: Section 3.1 & 3.2

Chapter 4: Sections 4.2, 4.4; Chapter 5: Sections 5.2, 5.3

Chapter 6: Sections 6.1- 6.3

Reference Books:

1. Ivan Niven., & Herbert S. Zucker man. (1976). An Introduction to the Theory of Numbers. Wiley Eastern limited.
2. Kumaravelu., & Sucheela Kumaravelu. (2002). Elements of Number Theory. Raja Sankar Offset Printers.
3. Hardy, G.H., & Wright, E.M. (1975). An introduction to the theory of Numbers. (4^{th} Edition). Oxford at the Clarendon Press.
4. Tom M. Apostel. (1998). Introduction to Analytic Number Theory. Narosa Publishing House.
5. John Sitillwell. (2009). Elements of Number Theory. Springer International Student Edition.

Semester : **VI**

Name of the course : **Operations Research**

Course Code : **MC1764**

No. of hours per week	Credits	Total No. of hours	Marks
5	5	75	100

Objectives:

1. To formulate real life problems into mathematical problems
2. To solve life oriented and decision making problems by optimizing the objective function

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	understand the origin and development of Operations Research	PSO - 1	U
CO - 2	explain what is an LPP	PSO - 1	U
CO - 3	define how to formulate an LPP with linear constraints	PSO - 1	R
CO - 4	maximize the profit, minimize the cost, minimize the time in transportation problem , Travelling salesman problem, Assignment problem	PSO - 3	Ap
CO - 5	identify a problem in your locality, formulate it as an LPP and solve	PSO - 4	C

Unit I

Introduction - Origin and Development of Operations Research - Nature and features of Operations Research - Applications of Operations Research - Formulation of L.P.P - Mathematical Formulation of L.P.P - Solution of L.P.P - Graphical method.

Unit II

Simplex method - Big-M Method - Algorithm for Big-M Method - Two phase method - Phase I: Solving auxiliary LPP using Simplex method - Phase II: finding optimal basic feasible solution.

Unit III

Duality in L.P.P - Primal - Formation of dual L.P.P - Matrix form of primal and its dual - Fundamental theorem of duality - Dual simplex method - Dual Simplex Algorithm - Degeneracy and cycling in L.P.P.

Unit IV

Transportation problems - Mathematical formulation of Transportation Problems - Dual of a Transportation Problem - solution of a Transportation Problem - North-West corner rule - Row minima method - Column minima method - Least cost method - Vogel approximation method.

Unit V

Assignment Problems - Mathematical formulation - Solution to assignment problems - Hungarian Algorithm for solving Assignment Problem - Travelling Salesman Problem.

Text book:

1. Kanti Swarup., Gupta, P. K., & Man Mohan. (2009). Operations Research. Sultan Chand & Sons.
2. Arumugam, S., & Thangapandi Issac, A. (2015). Operations Research (Linear Programming). (1^{st} Edition). New Gamma Publishing house.

   Chapter 3: 3.1 - 3.7, 3.9, 3.10; Chapter 4: 4.1; Chapter 5: 5.1, 5.2

Reference Books:

1. Gupta, P.K., & Hira, D.S. (1997). Operations Research. S.Chand and Co. Ltd.
2. Sankara Narayanan, T., & Joseph A. Mangaladoss. (2004). Operations Research. (5^{th} Edition). Persi - Persi Publications.
3. Handy, A. Taha. (1989). Operations Research - An Introduction. (3^{rd} Edition). Mac Millan Publishing Co. Inc.
4. Vittal, P. R., & Malini, V. (2013). Operations Research. Margham Publications.
5. Sharma, J. K. (2013). Operations Research – Theory and Applications. (5^{th} Edition). Macmillan Publishers India Ltd.

Semester : **VI**

Name of the course : **Astronomy – Elective II (a)**

Course Code : **MC1765**

No. of hours per week	Credits	Total No. of hours	Marks
6	5	90	100

Objectives:

1. To introduce space science and to familiarize the important features of the planets, sun, moon and stellar universe
2. To predict lunar and solar eclipses and study the seasonal changes.

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	define the spherical trigonometry of the celestial sphere	PSO - 1	U
CO - 2	discuss the Kepler's laws	PSO - 1	U
CO - 3	calculate the maximum and minimum number of eclipses near a node in a year	PSO - 2	Ap
CO - 4	interpret latitude and longitude and apply this to find the latitude and longitude of a particular place	PSO - 4	E
CO - 5	distinguish between geometric parallax and horizontal parallax	PSO - 4	An

Unit I

Spherical trigonometry (only the four formulae) Celestial sphere - Four systems of coordinates - Diurnal motion - Sidereal Time - Hour angle and Azimuth at rising - Morning and Evening stars - Circumpolar stars.

Unit II

The Earth - Zones of the earth - Perpetual Day and Perpetual night - Terrestrial latitude and longitude - Dip of Horizon - Twilight, Duration of Twilight, Twilight throughout night, Shortest Twilight.

Unit III

Refraction - Tangent formula, Constant of Refraction, Refraction on Horizontal and Vertical arcs, Refraction of any arc, Cassini's Formula, Horizontal Refraction. Geocentric parallax - Horizontal parallax - Effect of Geocentric parallax on Right Ascension and Declination - Angular diameter - Geocentric parallax and Refraction.

Unit IV

Kepler's laws - Eccentricity of Earth's orbit - Newton's Law of Gravitation - Newton's deductions from Kepler's laws.

Unit V

Eclipses - Lunar Eclipse - Solar Eclipse - Condition for a Lunar Eclipse - Synodic period of nodes Ecliptic limits - Maximum and minimum number of eclipses near a node in a year - Saros of Chaldeans - Duration of lunar and solar Eclipses.

Text Book:

Kumaravelu, S., & Susheela Kumaravelu. (2012). Astronomy. (10^{th} Edition).

Chapter 2 up to article 83; Chapter 3: Art 93 & Art 106 to 116;

Chapters 4, 5, 6 up to Art 154; Chapter 13

Reference Books:

1. Subramanian, K., Subramanian, L. V. Venkataraman., & Brothers. (1965). A textbook of Astronomy. (1^{st} Edition). Educational Publishers.
2. Ramachandran, G. V. (1970). A text book of Astronomy. (7^{th} Edition). Theni Printers.
3. Daniel Fleish., Julia Kregenow. (2013). Mathematics of Astronomy. (1^{st} Edition). Cambridge University Press. New York.
4. Smart, W. M. (1949). Spherical Astronomy. (4^{th} Edition). Cambridge university press.
5. Jean Meeus. (2002). More Mathematical Astronomy morsels. (1^{st} Edition). Willmann Bell Publishing.

Semester : **VI**

Name of the course : **Boolean Algebra – Elective II (b)**

Course Code : **MC1766**

No. of hours per week	Credits	Total No. of hours	Marks
6	5	90	100

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Objectives:

1. To introduce the algebraic structures like lattices and Boolean algebra
2. To apply these concepts in various branches of Mathematics

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	discuss the primary concepts of Lattices and Boolean algebra	PSO - 1	U
CO - 2	recognize upper bound, lower bound, greatest lower bound	PSO - 1	R
CO - 3	differentiate between lattices and complete lattices	PSO - 1	U
CO - 4	relate the concepts of lattice homomorphism and isomorphism	PSO - 2	Ap
CO - 5	formulate problems in Lattices and Boolean Algebra	PSO - 5	C

Unit I

Partially ordered sets - Chain - Upper and lower bounds - Least upper bound and greatest lower bound - Problems.

Unit II

Lattices - Complete lattice - Principle of duality - Sub lattices - Problems.

Unit III

Lattice homomorphism - Isomorphism theorem - Modular lattice - The chain conditions - Schreier's theorem - Problems.

Unit IV

Decomposition theory for lattices with Ascending chain conditions - Independence - Complemented modular lattice - Problems.

Unit V

Boolean Algebras - elementary properties of complements in Boolean Algebras - Stone's theorem - problems.

Text Books:

1. Jacobson, N. (1965). Lectures in Abstract Algebra. (1^{st} Edition). New Delhi: Affliated East- West Press Private Ltd.
   Chapter 7.
2. Arumugam, S. (2008). Modern Algebra. Scitech publications.
   Problems only.

Reference Books:

1. Vijay Khanna, K., Bhambri, S. K. (1994). Lattices and Boolean Algebra. Vikas Publishing House.
2. Sharma, J. K. (2011). Discrete Mathematics. (3^{rd} Edition). Macmillan Publishers India Ltd.
3. Goodstein, R.L. (2007). Boolean Algebra. Dover Publications Inc.
4. Bradford Henry Arnold. (2011). Logic and Boolean Algebra. Dover Publications Inc.
5. Steven Givant., & Paul halmos. (2009). Introduction to Boolean Algebras. Springer.

Semester : **VI**

Name of the course : **Web Designing with HTML – Elective II (c)**

Course Code : **MC1767**

No. of hours per week	Credits	Total No. of hours	Marks
6	5	90	100

Objectives:

1. To understand the importance of the web as a medium of communication
2. To create an effective web page with graphic design principles

Course Outcome

CO	Upon completion of this course the students will be able to:	PSO Addressed	CL
CO - 1	define modern protocols and systems used on the web(such as HTML,HTTP)	PSO - 1	U
CO - 2	employ fundamental knowledge on web designing with makeup language	PSO - 2	Ap
CO - 3	gain strong knowledge in HTML	PSO - 1	U
CO - 4	use critical thinking skills to design and implement an interactive websites with regard to issues of usability, accessibility and internationalism	PSO - 4	An
CO - 5	to pursue future courses in website development and design	PSO - 2	Ap

Unit I

Introduction to HTML - Designing a Home Page - History of HTML - HTML Generations - HTML Documents - Anchor Tag - Hyper Links - Sample HTML Documents.

Unit II

Head and Body Sections - Header Sections - Title - Prologue - Links - Colorful Web Page - Comment Lines - Some Sample HTML Documents.

Unit III

Designing the Body Section - Heading Printing - Aligning the Headings - Horizontal Rule - Paragraph - Tab Setting - Images and Pictures - Embedding PNG Format Images.

Unit IV

Ordered and Unordered Lists - Lists - Unordered Lists - Headings in a List - Ordered Lists - Nested Lists.

Unit V

Table Handling - Tables -Table Creation in HTML - Width of the Table and Cells - Cells Spanning Multiple Row/Columns Coloring Cells - Column Specification - Some Sample Tables.

Text Book:

Xavier, C. World Wide Web Design with HTML. Tata Mcgram Hill Publishing Company Limited.

Chapter 4: Sections 4.1 – 4.7; Chapter 5: 5.1 – 5.7;

Chapter 6: 6.1 - 6.7; Chapter 7: 7.1 – 7.5; Chapter 8: 8.1 – 8.7

Reference Books:

1. Castro., Elizabeth., & Hyslop. (2013). HTML5, And CSS: Visual Quickstart Guide. (Eight Edition). Peachpit Press.
2. Devlin., & Ian. (2011). HTML5 Multimedia: Develop and Design. Peachpit Press.
3. Felke., & Morris. (2013). Basics of Web Design: HTML5 & CSS3. (2nd Edition). Addition -Wesley.
4. Felke & Morris. (2014). -Web Development & Design Foundations with HTML5. (7th Edition). Addition - Wesley.
5. John Duckett. (2011). HTML and CSS: Design and Build Website. (1st Edition). John wiley and sons.

Semester : **VI**

Name of the course : **Mathematics for Competitive Examinations - II**

Course Code : **MSK176**

No. of hours per week	Credits	Total No. of hours	Marks
2	2	30	100

Objectives:

1. To develop the quantitative aptitude of the students
2. To solve problems needed for various competitive examinations

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recognize the difference between volume and surface areas	PSO - 1	R
CO - 2	demonstrate the basic concepts of Compound interest	PSO - 1	U
CO - 3	apply analytical techniques to solve stocks and shares problems	PSO - 2	Ap
CO - 4	calculate time taken by the train to pass a pole and similar problems.	PSO - 4	An
CO - 5	compare the surface areas of cuboid and cube	PSO - 4	An
CO - 6	evaluate the volume of cylinder	PSO - 5	E
CO - 7	measure the surface area of the sphere	PSO - 4	E
CO - 8	examine the face value and market value	PSO - 4	An

Unit I

Problems on Trains - Finding the time taken by the train to pass a pole or an object of length - Relative Speed - Crossing time of two trains.

Unit II

Compound Interest - Annual, Half-yearly and Quarterly Compound Interest - Present Worth.

Unit III

Volume and Surface Areas - Cuboid, Cube, Cylinder, Cone, Sphere, Hemisphere.

Unit IV

Calendar - Counting Odd Days - Day of the Week related to Odd Days. Clocks.

Unit V

Stocks and Shares - Face Value - Market Value - Brokerage. Banker's Discount - Banker's Discount - Banker's Gain.

Text Book:

Agarwal, R.S. (2014). Quantitative Aptitude. S. Chand & Company Pvt. Ltd.

Chapters: 18, 22, 25, 27, 28, 29 and 33.

Reference Books:

1. Guha, A. (2011). Quantitative Aptitude for Competitive Examinations. (4^{th} Edition). McGraw Hill Education (India) Pvt. Ltd.
2. Immaculate, M. (2009). Mathematics for Life. Nanjil offset Printers.
3. Arun Sharma. (2008). Objective Mathematics. (2^{nd} Edition). Tata McGraw-Hill Publishing Company Limited.
4. Chauhan, R.S. (2011). Objective Mathematics. Unique Publishers.
5. Goyal, J. K., & Gupta, K. P. (2011). Objective Mathematics. (6^{th} Edition). Pragati Prakashan Educational Publishers.

	Content addressed with Employability
	Content addressed with Entrepreneurship

M.Sc. Programme Outcomes (PO)

PO	Upon completion of M.Sc. Degree Programme, the graduates will be able to
PO - 1	recognize the scientific facts behind natural phenomena.
PO - 2	relate the theory and practical knowledge to solve the problems of the society.
PO - 3	prepare successful professionals in industry, government, academia, research, entrepreneurial pursuits and consulting firms
PO - 4	face and succeed in high level competitive examinations like NET, GATE and TOFEL.
PO - 5	carry out internship programmes and research projects to develop scientific skills and innovative ideas.
PO - 6	utilize the obtained scientific knowledge to create eco-friendly environment.
PO - 7	prepare expressive, ethical and responsible citizens with proven expertise

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO	Upon completion of M.Sc. Mathematics, the graduates will be able to	PO Addressed
PSO - 1	have a strong base in theoretical and applied mathematics.	PO – 2
PSO - 2	sharpen their analytical thinking, logical deductions and rigor in reasoning.	PO – 4
PSO - 3	understand the tools required to quantitatively analyze data and have the ability to access and communicate mathematical information.	PO – 7
PSO - 4	write proofs for simple mathematical results.	PO – 5
PSO - 5	acquire knowledge in recent developments in various branches of mathematics and participate in conferences / seminars / workshops and thus pursue research.	PO – 3
PSO - 6	utilize the knowledge gained for entrepreneurial pursuits	PO – 3
PSO - 7	understand the applications of mathematics in a global, economic, environmental, and societal context.	PO - 6
PSO - 8	use the techniques, skills and modern technology necessary to communicate effectively with professional and ethical responsibility.	PO - 7
PSO - 9	develop proficiency in analyzing, applying and solving scientific problems.	PO - 5

DEPARTMENT OF MATHEMATICS

M.Sc Programme

With effect from the academic year 2017 – 18

Course Structure

Distribution of Hours and Credit

Course	Sem. I	Sem. II	Summer vacation	Sem. III	Sem. IV	Total	
						Hours	Credit
Core - Theory	6 (5) + 6 (4) + 6 (4) + 6 (4)	6 (5) + 6 (4) + 6 (4) + 6 (4)	-	6 (5) + 6 (5) + 6 (4)	6 (5) + 6 (5) + 6 (5) + 6 (4)	90	67
Elective	6 (4)	6 (4)	-	6 (4)	6 (4)	24	16
Project	-	-	-	6 (4)	-	6	4
*Life Skill Training - I	-	(1)	-	-	-	-	1
*Life Skill Training - II	-	-	-	-	(1)	-	1
*Summer Training Programme	-	-	(1)		-	-	1
TOTAL	**30 (21)**	**30 (22)**	**(1)**	**30 (22)**	**30 (24)**	**120**	**90**

*** Courses / Programmes conducted outside the regular working hours**

Courses offered

Semester	Course code	Title of the paper	Hours/week	Credit
I	PM1711	Core I - Algebra I	6	5
	PM1712	Core II - Analysis I	6	4
	PM1713	Core III - Probability and Statistics	6	4
	PM1714	Core IV - Ordinary Differential Equations	6	4
	PM1715 PM1716	Elective I - (a) **Numerical Analysis** (b) Fuzzy sets and Fuzzy logic	6	4
II	PM1721	Core V- Algebra II	6	5
	PM1722	Core VI - Analysis II	6	4
	PM1723	Core VII - Partial Differential Equations	6	4
	PM1724	Core VIII - Graph Theory	6	4
	PM1725 PM1726	Elective II - (a) **Classical Dynamics** (b) Differential Geometry	6	4
	LST172	Life Skill Training (LST) - I	-	1
III	PM1731	Core IX - Algebra III	6	5
	PM1732	Core X - Topology	6	5
	PM1733	Core XI - Measure Theory and Integration	6	4
	PM1734 PM1735	Elective III - (a) **Algebraic Number Theory** (b) Stochastic Processes	6	4

	PM17PR	Project	6	4
IV	PM1741	Core XII - Complex Analysis	6	5
	PM1742	Core XIII - Functional Analysis	6	5
	PM1743	Core XIV - Operations Research	6	5
	PM1744	Core XV -Algorithmic Graph Theory	6	4
	PM1745 PM1746	Elective IV - (a) **Combinatorics** (b) Coding Theory	6	4
	LST174	Life Skill Training (LST) - II	-	1
	STP171	Summer Training Programme	-	1
		TOTAL	**120**	**90**

Self-Learning - Extra Credit Course

Semester	Course code	Title of the paper	Hours/week	Credit
III	PM17S1	Algebra for SET/CSIR-NET Exam	-	2
IV	PM17S2	Analysis for SET/ CSIR-NET Exam	-	2

Semester : I **Major Core I**

Name of the Course : Algebra I

Course code : PM1711

No. of hours per week	Credit	Total No. of hours	Marks
6	5	90	100

Objectives:

1. To study abstract Algebraic systems
2. To know the richness of higher Mathematics in advanced application systems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	understand the concepts of automorphism, inner automorphism, Sylow P- subgroups, finite abelian groups, characteristic, subgroups of groups	PSO - 7	U
CO - 2	analyze and demonstrate examples of various Sylow P-subgroups, automophisms	PSO - 9	An
CO - 3	develop proofs for Sylow's theorems , Fundamental theorem of finite abelian groups, direct products, Cauchy's theorem, automorphisms of groups.	PSO - 4	C
CO - 4	understand various definitions related to rings and ideals and illustrate	PSO - 4	U, Ap
CO - 5	develop the way of embedding of rings and design proofs for theorems related to rings	PSO - 3	C
CO - 6	understand the concepts of Euclidean domain and factorization domain and give illustrations.	PSO - 3	U, Ap
CO - 7	compare Euclidean and Unique factorization domains and develop the capacity for proving the concepts	PSO - 2	E, An

Unit I

Automorphisms and conjugate elements: Inner automorphism - Characteristic subgroups - Conjugate elements - Cauchy's theorem - Similar permutations (Excluding partition of an integer).

Unit II

Sylow's theorems and Direct products: Sylow p-subgroups - Sylow's first theorem - Sylow's second theorem - Sylow's third theorem - Sylow Groups in S_{p^k} - Direct products - Finite abelian groups - Fundamental theorem of finite abelian groups.

Unit III

Rings: Examples - Sub Rings - Sum of two Sub Rings - Characteristic of a Ring -Product of Rings - Ideals - Sum of two Ideals - Product of two Ideals.

Unit IV

Homomorphisms and embedding of Rings: Quotient Rings - Homomorphisms - First theorem of isomorphism - Second theorem of isomorphism - Embedding of Rings - More on Ideals - Maximal Ideals - Prime Ideal.

Unit V

Euclidean and factorization domains: Euclidean Domains - Prime and irreducible elements - Polynomial Rings - Greatest common divisor - Unique Factorization Domains.

Text Book:

. Vijay K. Khanna., & Bhambri, S. K. (2013). A Course in Abstract Algebra. (Fourth Edition). Vikas Publishing House Pvt. Ltd.

Chapter 4: pages 167 - 197 (Theorems & only the problems 1 - 7, 21, 23, 30);

Chapter 5: Theorems & only the problems 1 - 4, 7 - 10, 15 - 17;

Chapter 7: Theorems & only the problems 1 - 6, 9, 10, 25, 26, 33 - 43;

Chapter 8: Theorems & only the problems 1 - 10, 26 - 33;

Chapter 9: Pages 396 - 465 (only Theorems).

Reference Books:

1. Herstein, I. N. (1992). Topics in Algebra. (2^{nd} Edition). New Delhi, Wiley Eastern Ltd.
2. Joseph A.Gallian. (1999). Contemporary Abstract Algebra. (4^{th} Edition). Narosa Publishing House.
3. John B. Fraligh. (1977). A first course in Abstract Algebra. (2^{nd}Edition). Addition Wesley Publishing Company.
4. John R. Durbin. (2005). Modern Algebra. (5^{th} Edition). John wiley & Sons.
5. Rudolf Lidl., & Gunter Pilz. (2009). Applied Abstract Algebra. (2^{nd} Edition). Springer International Edition.

Semester : I **Major Core II**

Name of the Course : Analysis I

Course code : PM1712

No. of hours per week	Credit	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To understand the basic concepts of analysis
2. To formulate a strong foundation for future studies

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO -1	explain the fundamental concepts of analysis and their role in modern mathematics.	PSO - 9	U
CO -2	deal with various examples of metric space, compact sets and completeness in Euclidean space.	PSO - 3	An
CO -3	learn techniques for testing the convergence of sequences and series .	PSO - 8	U
CO -4	understand the Cauchy's criterion for convergence of real and complex sequence and series	PSO - 1	U
CO -5	apply the techniques for testing the convergence of sequence and series	PSO - 3	An
CO -6	understand the important theorems such as Intermediate valued theorem, Mean value theorem, Roll's theorem, Taylor and L' Hospital theorem	PSO - 1	U
CO -7	apply the concepts of differentiation in problems.	PSO - 9	Ap

Unit I

Basic topology - Metric spaces - Open and closed sets - Dense sets - Compact sets - Weierstrass theorem - Perfect sets - Cantor set - Connected sets.

Unit II

Convergent sequences - Subsequences - Cauchy sequences - Complete metric space - Upper and lower limits - Some special sequences.

Unit III

Series - Cauchy criterion for convergence of series - series of nonnegative terms - The root and ratio tests - Power series - Summation by parts - Absolute convergence - Addition and multiplication of series - Rearrangements of series.

Unit IV

Continuity - Limits of functions - Continuity and compactness - Continuity and connectedness, discontinuities - Monotonic functions - Infinite limits and limits at infinity.

Unit V

Differentiation - Mean value theorems - The continuity of derivatives - L' Hospital's rule - Taylor's theorem - Differentiation of vector valued functions.

Text Book:

Walter Rudin. (1976). Principles of Mathematical Analysis. (3^{rd} Edition). Singapore:Mc GRAW Hill Book Company.

Chapter 2: 2.15 - 2.47; Chapters 3, 4, 5.

Reference Books:

1. Charles G. Denlinger. (2011). Elements of Real Analysis. (1^{st} Edition). Jones & Burtlett Learning.
2. Tom M. Apostlal. (2002). Mathematical Analysis. (2^{nd} Edition). New Delhi: Narosa Publishing House.
3. Somasundaram, D., & Choudhary, B.A. (2010). First Course in Mathematical Analysis. (5^{th} Edition). Narosa Publishing House.
4. Mainak Mukherjee. (2011). A Course in Real Analysis. New Delhi: Narosa Publishing house.
5. Richard R. Goldberg. (1970). Methods of Real Analysis. (2^{nd} Edition). Oxford & IBH Publishing Co. Pvt. Ltd.

Semester : I **Major Core III**

Name of the Course : Probability and Statistics

Course code : PM1713

No. of hours per week	Credit	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To upgrade the knowledge in Probability theory
2. To solve NET / SET related Statistical problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the basic probability axioms, conditional probability, random variables and related concepts	PSO -1	R
CO - 2	compute marginal and conditional distributions and check the stochastic independence	PSO - 3	U, Ap
CO - 3	recall Binomial, Poisson and Normal distributions and learn new distributions such as multinomial, Chi square and Bivariate normal distributions.	PSO - 2	R,U
CO - 4	learn the transformation technique for finding the p.d.f of functions of random variables and use these techniques to solve related problems	PSO - 8	U, Ap
CO - 5	employ the relevant concepts of analysis to determine limiting distributions of random variables	PSO - 5	Ap
CO - 6	design probability models to deal with real world problems and solve problems involving probabilistic situations.	PSO - 7	C,Ap

Unit I

Conditional probability - Marginal and conditional distributions, Correlation coefficient - Stochastic independence - Necessary and sufficient conditions for stochastic independence.

Unit II

The Binomial, Trinomial and Multinomial distributions - Poisson distribution - Gamma, Chi-square, Normal and Bivariate Normal distributions.

Unit III

Sampling theory - Transformations of variables of discrete and continuous type - Beta distribution, the t and F distributions.

Unit IV

Extension of change of variable technique - Distributions of order statistics – Moment generating function technique - Distributions of $\bar{x}$ and nS^2 $/\sigma^2$- Expectations of functions of random variables.

Unit V

Limiting distributions - Stochastic convergence - Limiting moment generating functions - Central limit theorem - Some theorems on limiting distributions.

Text Book:

Robert V. Hogg., & Allen T. Craig. (2004). Introduction to Mathematical Statistics. (4^{th} edition). New Delhi, Pearson Education.

Chapters 2 to 5.

Reference Books:

1. Kapur, J.N., & Saxena, H.C. (2010). Mathematical Statistics. (12^{th} Edition). S. Chand & Co.
2. Kadarkarai Thangam, K., & Subas Chandra Bose, A. (1995). Probability and Statistics. (1^{st} Edition). Jeyalakshmi Publishers.
3. Morris H. DeGroot. (1975). Probability and Statistics. Addison Wesley Publishing Company.
4. Suddhendu Biswass., & Sriwastav, G.L. (2011). Mathematical Statistics. Narosa Publishing House.
5. Murthy, T.S.R. (1995). Probability and Statistics.(1^{st} Edition). I.K. International Publishing House.

Semester : I **Major Core IV**

Name of the Course : **Ordinary differential equations**

Course code : **PM1714**

No. of hours per week	Credit	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To study mathematical methods for solving differential equations
2. Solve dynamical problems of practical interest

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the definitions of degree and order of differential equations and determine whether a system of functions is linearly independent using the Wronskian definition.	PSO - 1	R,U
CO - 2	solve linear ordinary differential equations with constant coefficients by using power series expansion	PSO - 9	Ap
CO - 3	determine the solutions for a linear system of first order equations	PSO - 3	U
CO - 4	learn Boundary Value Problems and find the Eigen values and Eigen functions for a given Sturm Liouville Problem	PSO - 3	U
CO - 5	analyze the concepts of existence and uniqueness of solutions of the ordinary differential equations	PSO - 9	An
CO - 6	create differential equations for a large number of real world problems	PSO - 7	C

Unit I

Second order Linear Equations: The general solution of a homogeneous equation - The use of a known solution to find another - The method of variation of parameters.

Unit II

Power series solutions and special functions: A review of power series - Series solutions of first order equations - Second order linear equations - Ordinary points - Regular singular points.

Unit III

Systems of first order equations: Linear systems - Homogeneous Linear systems with constant coefficients.

Unit IV

The Existence and Uniqueness of solutions: The method of Successive approximations - Picard's theorem - Systems. The second order linear equations.

Unit V

Boundary value problems: Introduction - Sturm Liuville problem - Green's functions - Nonexistence of solutions.

Text Books:

1. George F. Simmons. (1991). Differential equations with Applications and Historical Notes. (2^{nd} Edition). McGraw Hill International Editions.
   Chapter 3: 14, 15, 16, 19; Chapter 5: 26 to 30
   Chapter 10: 55, 56; Chapter 13: 68 to 70
2. Deo S.G., & Raghavendra V. (1991). Ordinary Differential Equations and stability theory. (4^{th} reprint). Tata McGraw - Hill Publishing Company Limited.
   Chapter 7: 7.1, 7.2, 7.3.

Reference Books:

1. Sharma, A.K. (2010). Advanced Differential Equations. Discovery publishing house.
2. Raisinghania, M. D. (2012). Ordinary and Partial Differential Equations. (14^{th} Revised Edition). Ramnagar, New Delhi: S. Chand and company Ltd.
3. Arnold, V. I. (2009). Ordinary Differential Equations. New Delhi: PHI Learning Private limited.
4. John C. Polking., & David Arnold. (2011). Ordinary Differential Equations. (2^{nd} Impression). Dorling Kindersley India Pvt. Ltd.
5. Doshi, J. B. (2009). Differential Equations for Scientists & Engineers. Narosa Publishing House.

Semester : I **Elective I(a)**

Name of the Course : Numerical Analysis

Course code : PM1715

No. of hours per week	Credit	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To study the various behavior pattern of numbers
2. To study the various techniques of solving applied scientific problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the methods of finding the roots of the algebraic and transcendental equations.	PSO - 1	R
CO - 2	derive appropriate numerical methods to solve algebraic and transcendental equations.	PSO - 5	Ap
CO - 3	understand the significance of the finite, forward, backward and central differences and their properties.	PSO - 3	U
CO - 4	draw the graphical representation of each numerical method.	PSO - 5	Ap
CO - 5	solve the differential and integral problems by using numerical methods. (Eg. Trapezoidal rule, Simpson's rule etc.)	PSO - 5	Ap
CO - 6	solve the problems in ODE by using Taylor's series method, Euler's method etc.	PSO - 5	Ap
CO - 7	differentiate the solutions obtained by Numerical methods and exact solutions.	PSO - 3	C
CO - 8	compute the solutions of a system of equations by using appropriate numerical methods.	PSO - 9	Ap

Unit I

Solution of Algebraic and Transcendental Equations - Bisection Method - Method of False Position - Iteration Method - Newton-Raphson Method - Secant Method - Muller's Method.

Unit II

Finite Differences - Forward Differences - Backward Differences - Central Differences - Detection of Errors by use of difference tables - Differences of a polynomial - Newton's formulae for Interpolation - Central Difference Interpolation formulae - Gauss's central difference formulae - Stirling's formulae - Bessel's formulae - Everett's formulae.

Unit III

Numerical Differentiation - Errors in Numerical Differentiation - Numerical Integration - Trapezoidal rule - Simpson's 1/3 rule - Simpson's 3/8 rule - Boole's and Weddle's rule.

Unit IV

Solution of Linear systems - Direct Methods - Gauss elimination - Necessity for Pivoting - Gauss-Jordan method - Modification of the Gauss method to compute the inverse - LU Decomposition method - Solution of Linear systems - Iterative methods.

U**nit V**

Solution by Taylor's series - Picard's method of successive approximations - Euler's method - Runge - Kutta methods - II order and III order.

Text Book:

Sastry, S. S. (2000). Introductory Methods of Numerical analysis. (5^{th} Edition). New Delhi, Prentice Hall of India Pvt Ltd.

Chapter 2: 2.1 to 2.5, 2.7, 2.8; Chapter 3: 3.3 (3.3.1 to 3.3.3), 3.4 to 3.6, 3.7 (3.7.1 to 3.7.4)

Chapter 6: 6.2 (6.2.1), 6.4 (6.4.1 to 6.4.4); Chapter 7: 7.5 (7.5.1 to 7.5.4, 7.5.6, 7.6).

Chapter 8: 8.2 to 8.5.

Reference Books:

1. Balagurusamy, E. (2002). Numerical Methods. New Delhi: Tata McGraw Hill Publishing Company Ltd.
2. Rao, H. S. G. (2011). Numerical Methods. New Delhi: IK International publishing House PVT Ltd.
3. Goel Mittal. (2011). Numerical Anaysis. (21^{st} Edition). Pragati Prakashan Educational Publishers.
4. Vedamurthy, V. N., & N. ch. S. N. Iyengar. (2009). Numerical Methods. New Delhi,Vikas Publising House PVT. LTD.
5. Devi Prasad. (2010). An Introduction to Numerical Anaysis. Narosa Publishing House.

Semester : I **Elective I(b)**

Name of the Course : **Fuzzy Sets and Fuzzy Logic**

Course code : **PM1716**

No. of hours per week	Credit	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To understand Fuzzy logic
2. To apply Fuzzy concepts in other branches of Mathematics

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the definition of fuzzy subsets and operations on fuzzy subsets	PSO - 2	U
CO - 2	understand fuzzy arithmetic and operations on fuzzy numbers	PSO - 1	R
CO - 3	distinguish between crisp sets and fuzzy subsets at the conceptual level.	PSO - 3	U
CO - 4	become familiar with fuzzy relations and the properties of these relations.	PSO - 9	An
CO - 5	apply fuzzy relations and binary fuzzy relations in solving problems	PSO - 5	Ap

Unit I

Crisp set - Operations on crisp set - Fuzzy sets - Basic types - Basic concepts -Additional properties of α-Cuts - representation of Fuzzy sets - Extension principle for Fuzzy sets.

Unit II

Operations on Fuzzy sets - Types of operations - Fuzzy complements - Fuzzy intersections: t-Norms - Fuzzy unions: t-Conorms - Combinations of operations - Aggregation operations.

Unit III

Fuzzy arithmetic - Fuzzy numbers - Operations on Fuzzy number - Linguistic variables - Arithmetic operations on intervals - Arithmetic operations on Fuzzy numbers.

Unit IV

Fuzzy relations - Relations on Fuzzy set - Composition of Fuzzy relation - Lattice of Fuzzy numbers - Fuzzy equations - Crisp versus Fuzzy relations - Projections.

Unit V

Binary Fuzzy relations - Binary relations on a single set - Fuzzy equivalence relations - Fuzzy compatibility relations - Fuzzy ordering relations.

Text Book:

George J. KlirBo Yuan. (2012). Fuzzy Sets and Fuzzy Logic Theory and Applications. New Delhi: PHI Learning Private Limited.

Chapter 1 : Sections 1.3, 1.4 ; Chapter 2: Sections 2.1 - 2.3;
Chapter 3 : Sections 3.1 - 3.6; Chapter 4: Sections 4.1 - 4.6;
Chapter 5 : Sections 5.1 - 5.7.

Reference Books:

1. Hooda, D. S. (2015). Fuzzy Set Theory and Fuzzy Controller. Vivek Raich Narosa Publishing House.
2. Bhargava, A. K. (2013). Fuzzy Set Theory Fuzzy logic and their Application. S. Chand Publishing.
3. Ganesh, M. (2006). Fuzzy sets and Fuzzy logic. Prentice Hall India learning private limited.
4. Shinghal. (2012). Introduction to Fuzzy logic. Prentice Hall India learning private limited.
5. Nanda, S., & Das, N. R. (2015). Fuzzy Mathematical Concepts. Narosa Publishing House Pvt. Ltd.

Semester : **II** **Major Core V**

Name of the Course : **Algebra –II**

Course code : **PM1721**

No. of hours per week	Credit	Total No. of hours	Marks
6	5	90	100

Objectives:

1. To understand the concept of Extension field
2. To apply the idea of advanced forms of matrices related to linear transformations in real life situations

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall finite and infinite dimensional vector spaces and subspaces and their properties	PSO - 1	R
CO - 2	compute inner products and determine orthogonality on vector spaces, including Gram-Schmidt Orthogonalization.	PSO - 5	U
CO - 3	use the definition and properties of Linear transformation and matrices of Linear transformation and change of basis including kernel and range.	PSO - 5	Ap
CO - 4	compute the characteristic polynomial, Eigen vectors, Eigen values and Eigen spaces as well as the geometric and the algebraic multiplicities of an Eigen value	PSO - 6	Ap
CO - 5	analyze invariant subspaces, cyclic subspaces and T-annihilator.	PSO - 3	An
CO - 6	cite examples of roots of polynomials and splitting fields	PSO - 9	C

Unit I

Vector spaces: Subspaces - Sum of Subspaces - Quotient Spaces - Homomorphisms of Linear Transformations - Linear Span - Linear Dependence and Independence.

Unit II

Linear Transformations: Algebra of linear transformations - Invertible linear transformations - Matrix of a linear transformation - Dual spaces.

Unit III

Eigen values and Eigen vectors: Characteristic polynomials - Characteristic polynomial of a linear operator - Minimal polynomials - Diagonolizable operators - Primary decomposition theorem.

Unit IV

Invariant subspaces - Triangulable linear operator - Cyclic subspaces - T-annihilator - Projection.

Unit V

Fields: Algebraic extensions - Roots of polynomials - Splitting fields.

Text Book:

Vijay K. Khanna., & Bhambri, S. K. A. (2013). Course in Abstract Algebra. (4^{th} Edition). Vikas Publishing House Pvt. Ltd.

Chapter 10: Theorems & only the problems 1 - 5, 7 - 9, 11 - 14, 18 - 22

Chapter 11: Theorems & only the problems 1 - 7, 16 - 19, 23 - 26

Chapter 12: Theorems & only the problems 1 - 10, 15 - 17, 22 - 25, 37 - 39, 47 - 54, 67-71

Chapter 13: Theorems & only the problems 1 - 7 & 11 - 17.

Reference Books:

1. Herstein, I. N. (1992). Topics in Algebra. (2^{nd} Edition). New Delhi: Wiley Eastern Ltd.
2. Nathan Jacobson. (1984). Basic Algebra. Hindustan Publishing Corporation.
3. Joseph A. Gallian. (1999). Contemporary Abstract Algebra. (4^{th} Edition). Narosa Publishing House. Reprint.
4. Kenneth Hoffman., & Ray Kunze. (2016). Linear Algebra. (2^{nd} Impression). Pearson India Education Services Pvt. Ltd.
5. John B. Fraligh. (1977). A first course in Abstract Algebra. (2^{nd} Edition). Addition Wesley publishing company

Semester : II **Major Core VI**

Name of the Course : Analysis-II

Course code : PM1722

No. of hours per week	Credit	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To make the students understand the advanced concepts of Analysis
2. To pursue research in Analysis related subjects

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO -1	recall the definition of continuity, boundedness and some results on uniform convergence	PSO - 1	R
CO -2	recognise the differences between pointwise and uniform convergence of a sequence of functions and Riemann Stieltjes integrals.	PSO – 2	An
CO -3	understand the close relation between equicontinuity and uniform convergence of sequence of continuous function and rectifiable curves	PSO - 3	U
CO -4	learn Parseval's theorem, Stone Weierstrass theorem and know about its physical significance in terms of the power of the Fourier components.	PSO - 7	U
CO -5	utilize the definition of differentiation and partial derivative of function of several variables to solve problems	PSO - 9	Ap

CO -6	interpret the concept of the contraction principle and the inverse function theorem	PSO - 2	U

Unit I

The Riemann Stieltjes integrals - Definition and Existence of the Integral - Properties of the integral - Integration of vector-valued function - Rectifiable curves.

Unit II

Sequences and series of functions - Uniform convergence - Continuity - Integration - Differentiation.

Unit III

Equicontinuous families of functions - Wierstrass theorem - Stone Wierstrass theorem.

Unit IV

Some special functions - Power series - The algebraic completeness of the Complex field - Fourier series - Parseval's theorem.

Unit V

Differentiation - Partial derivatives - The contraction principle - The inverse function theorem.

Text Book:

Walter Rudin. (1976). Principles of Mathematical Analysis. (3^{rd} Edition). McGraw Hill International.

Chapters 6, 7; Chapter 8: 8.1 to 8.5 & 8.8 to 8.16; Chapter 9: 9.10 to 9.25.

Reference Books:

1. Charles G. Denlinger. (2011). Elements of Real Analysis. (1^{st} Edition). New Delhi: Jones & Burtlett Learning.
2. Tom M. Apostlal. (2002). Mathematical Analysis. (2^{nd} Edition). New Delhi: Narosa Publishing House.
3. Mittal. (2012). Real Analysis. (7^{th} Edition). Pundir Pragati Prakashan Educational Publishers.
4. Mainak Mukherjee. (2011). A Course in Real Analysis. New Delhi: Narosa Publishing house.
5. Bali, N.P. (2016). Real Analysis. (1^{st} Edition). New Delhi: Firewall media.

Semester : II **Major Core VII**

Name of the Course : **Partial Differential Equations**

Course code : **PM1723**

No. of hours per week	Credit	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To formulate and solve different forms of partial differential equations
2. Solve the related application oriented problems

Course Outcome

CO	Upon completion of this course the student will be able to	PSO Addressed	CL
CO - 1	recall the definitions of complete integral, particular integral and singular integrals.	PSO - 1	R
CO - 2	learn some methods to solve the problems of non-linear first Order Partial Differential Equations	PSO - 3	U
CO - 3	analyze homogeneous and non-homogeneous linear partial differential equations with constant coefficients and solve related problems	PSO - 9	An
CO - 4	solve the boundary value problems for the heat equations and the wave equations	PSO - 7	Ap
CO - 5	apply the concepts and methods in physical processes like heat transfer and electrostatics	PSO - 8	Ap

Unit I

Nonlinear Partial Differential Equations of order one - complete integral, particular integral, singular integral - Compatible system of First Order Equations - Charpit's Method.

Unit II

Special methods of solutions applicable to certain standard forms - Standard form I, II, IIII, IV - Jacobi's method for solving nonlinear first Order Partial Differential Equations in Two independent variables - Cauchy's method of Characteristics for solving nonlinear first Order Partial Differential Equations.

Unit III

Homogeneous and Non Homogeneous Linear Partial Differential Equations with constant coefficients - Solution of Homogeneous and Non Homogeneous Linear Partial Differential Equations with constant coefficients - Method of finding Complementary Function of Linear Homogeneous Partial Differential Equations with constant coefficients - Particular Integral of Homogeneous Partial Differential Equations - General method of finding Particular Integral of Linear Homogeneous Partial Differential Equations.

Unit IV

Non Homogeneous Linear Partial Differential Equations with constant coefficients - Reducible and Irreducible Linear Differential operators - Reducible and Irreducible Linear Differential Equations with constant coefficients - Determination of Complementary Function of Reducible Non Homogeneous Linear Partial Differential Equations with constant coefficients - General Solution of Non Homogeneous Linear Partial Differential Equations with constant coefficients - Determination of Particular Integral of Non Homogeneous Linear Partial Differential Equations with constant coefficients.

Unit V

Boundary Value Problem - Solution by Separation of variables - Solution of One Dimensional Wave Equation - Solution of Two Dimensional Wave Equation - Vibration of Circular Membrane - Solution of One Dimensional Heat Equation - Solution of Two Dimensional Laplace's Equation - Solution of two dimensional heat equation.

Text Books:

1. Raisinghania, M. D. (2012). Ordinary and Partial Differential Equations. (14^{th} Revised Edition). New Delhi: S. Chand and company Ltd.
   Chapter 3: 3.1, 3.4 to 3.8B; Chapter 3: 3.9, 3.10 to 3.18, 3.22, 3.23.
   Chapter 4: 4.1 to 4.6, 4.12, 4.13; Chapter 5: 5.1 to 5.3, 5.5, 5.10 to 5.13.
2. Sharma, A. K. (2010). Advanced Differential Equations. Dicovery Publishing House.
   Chapter 12: 12.1 to 12.8.

Reference Books:

1. Amaranath, T. An Elementary Course in Partial Differential Equations. (2^{nd} Edition). New Delhi: Narosa Publishing House.
2. Ian Sneddon. (1957). Elements of Partial Differential Equations. International Edition.
3. Kevorkian, J. (2006). Partial Differential Equations. Springer International Edition.
4. Sharma, I. N., & Kehar Singh. (2009). Partial Differential Equations for Engineers and Scientists. (Second Edition). Narosa Publishing House PVT. LTD.
5. Lawrence C. Evans. (2009). Partial Differential Equations. (1^{st} Indian Edition). Rhode Island, American Mathematical Society Providence.

Semester : **II** **Major Core VIII**

Name of the Course : **Graph Theory**

Course code : **PM1724**

No. of hours per week	Credit	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To introduce the important notions of graph theory
2. Develop the skill of solving application oriented problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the basic definitions and fundamental concepts of graph theory	PSO - 1	R
CO - 2	identify cut vertices and understand various versions of connectedness of a graph	PSO - 2	U
CO - 3	solve problems involving connectivity and colorings of vertices and edges	PSO - 5	Ap
CO - 4	understand the concepts of Digraphs, Geodetic Sets, Matchings, Factorization, Hamiltonian, decompositions and Graceful labelling of a graph	PSO - 4	U
CO - 5	cite examples of planar and nonplanar graphs, learn necessary conditions for planar graphs	PSO - 8	Ap
CO - 6	determine the Ramsey number of certain graphs and identify the center of a graph	PSO - 3	U, Ap

CO - 7	modify the methods involved in the proof of certain theorems	PSO - 4	C

Unit I

Connectivity: Cut vertices - Blocks - Connectivity - edge connectivity - Geodetic Sets.

Unit II

Digraphs: Strong Digraphs - The First Theorem of Digraph Theory - Eulerian digraph - Tournaments.

Unit III

Matchings and Factorization: Matchings - Gallai Identities - Factorization - Petersen's Theorem - Hamiltonian Factorization - Decompositions and Graceful Labelings -Steiner triple system.

Unit IV

Planarity: Planar Graphs - The Euler Identity - Kuratowski's Theorem, Coloring: Vertex Coloring - Brook's Theorem - Edge Coloring - The Heawood Map Coloring Theorem - The Five Color Theorem.

Unit V

Ramsey Numbers: The Ramsey Number of Graphs - Turan's Theorem, Distance: The center of a graph - Distant Vertices.

Text Book:

Gary Chartrand., & Ping Zhang. (2006). Introduction to Graph Theory. McGraw Hill Education (India).

Chapter 5: 5.1 - 5.3 and 5.5; Chapter 7: 7.1and 7.2; Chapter 8: 8.1 - 8.3

Chapter 9: 9.1; Chapter 10: 10.2 - 10.4; Chapter 11: 11.1and 11.2; Chapter 12: 12.1and 12.2

Reference Books:

1. Bondy, J. A., & Murty, U. S. R. (1976). Graph Theory with Applications. (1^{st} Edition). Macmillan Press Ltd.
2. Douglas B.West. (2003). Introduction to Graph Theory. (2^{nd} Edition). Pearson Education services.
3. Frank Harary. (2001). Graph Theory. Narosa Publishing House.
4. Balakrishnan, R., & Ranganathan, K. (2013). A Text Book of Graph Theory. Springer International Edition.
5. Rei+nhard Diestel. (2006). Graph Theory. (2^{nd} Edition). Springer International Edition.

Semester : II **Elective II (a)**

Name of the Course : Classical Dynamics

Course code : PM1725

No. of hours per week	Credit	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To gain deep insight into concepts of Dynamics
2. To do significant contemporary research

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the concepts of Newton's laws of motion, momentum, acceleration, motion of a particle.	PSO - 1	R
CO - 2	understanding the generalized co-ordinates of the Mechanical system.	PSO - 3	U
CO - 3	apply D'Alembert's Principle to solve the problems involving system of particles.	PSO - 5	Ap
CO - 4	solve the Newton's equations for simple configuration using various methods.	PSO - 4	C
CO - 5	transforming the Lagrangian equations to Hamiltonian equations.	PSO - 2	U
CO - 6	define the canonical transformations and Lagrange and Poisson brackets.	PSO - 1	R
CO -7	evaluate the system of particles by deriving the Jacobi equation and Jacobi's theorem.	PSO - 7	E
CO - 8	understand the foundation of Hamilton's Principle and differential forms.	PSO - 2	U

Unit I

The Mechanical System - Generalized coordinates - Constraints - Virtual work and D' Alembert's Principle - Energy and Momentum.

Unit II

Derivation of Lagrange's equations - Problems using Lagrange's equation - Integrals of the motion.

Unit III

Hamilton's Principle - Hamilton's Equations - Legendre transformation - Other Variational Principles - Modified Hamilton's Principle - Principle of least action - Examples.

Unit IV

Hamilton's Principal function - The canonical integral - Pfaffian differential forms - The Hamilton - Jacobi equation - Jacobi's theorem - Conservative systems and ignorable coordinates - Examples.

Unit V

Canonical Transformations - Differential forms and generating functions - Special transformations - Lagrange and Poisson brackets.

Text Book:

Greenwood G. T. (1979). Classical Dynamics. Prentice Hall.

Chapter 1: 1.1 - 1.5; Chapter 2: 2.1 - 2.3; Chapter 4:4.1 - 4.3

Chapter 5: 5.1, 5.2; Chapter 6: 6.1 - 6.3

Reference Books:

1. Goldstein, H. (1994). Classical Mechanics. (2^{nd} Edition). Narosa Publishing.
2. Synge, J. L., & Griffith, B. A. (1959). Principle of Mechanics. McGraw Hill.
3. Rutherford, D. E. (2000). Classical Mechanics. New York: Oliver Boyd.
4. Chorlton, F. (1969). Text book of Dynamics. Van Nostrand.
5. Javier E. Hasbun. (2009). Classical Mechanics. Jones and Bartlett Publishers.

Semester : II **Elective II(b)**

Name of the Course : Differential Geometry

Course code : PM1726

No. of hours per week	Credit	Total No. of hours	Marks
6	4	90	100

Objectives:

1. To study coordinate free geometry
2. Apply the theory in Tensors and theory of relativity

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the concepts of curvature, normal, tangent, binomial and the relevant formulae	PSO - 1	R
CO - 2	analyze differential equations using Families of curves, Geodesics on a surface and orthogonal trajectories.	PSO - 9	An
CO - 3	calculate the curvature , torsion of curves and surfaces and also calculate involutes, evolutes of osculating circle, osculating sphere etc.	PSO - 5	Ap
CO - 4	explain the concepts of curves and surfaces in first and second fundamental form and Developable surfaces at high level.	PSO - 7	U
CO - 5	obtain the family of curves such as parabola general equation, circles general equation etc	PSO - 5	Ap
CO - 6	articulate the connections between geometry and other disciplines, possibly including topology, algebra, analytical geometry and applied mathematics.	PSO - 9	U

Unit I

Theory of space curves - Arc length - Tangent, normal, principal normal, Curvature, torsion.

Unit II

Contact between curves and surfaces - Osculating circle and osculating sphere - Locus of centers of spherical curvature - tangent surfaces, involutes, evolutes - intrinsic equation of space curves - fundamental theorem for space curves - helices.

Unit III

The first fundamental form and local intrinsic properties of a surface - introduction - Definition of a surface - Curves on surfaces - General surfaces of revolution - Helicoids - Metric on a surface - Direction coefficients on a surface.

Unit IV

Families of curves - Orthogonal trajectories - Double family of curves - Isometric correspondence - Intrinsic properties - Geodesics on a surface - Introduction and its differential equations - Canonical geodesic equations.

Unit V

The second fundamental forms - Principal and lines of curvature - The Dupin 'sindicatrix - Developable surfaces - Developable associated with space curves and curves on surfaces.

Text Book:

Willmore, T. J. (1959). An introduction to Differential Geometry. (1st Edition). Oxford Press.

Chapter 1 (except section 5); Chapter 2: Sections 1 to 11; Chapter 3: Sections 1 to 5

Reference Books:

1. Somasundaram, D. (2010). Differential geometry - A First Course. Narosa Publishing House.
2. Auslander, L., Harper., & Row. (1965). Differential Geometry. J London Mathematical Society
3. Khanna, M. L. (1975 - 76). Differential geometry. Jai prakash Nath & Co.
4. Gupta., & Malik Pundir. (2012). Differential Geometry. Pragathi Prakashan.
5. Martin M. Lipschutz. (1969). Differential geometry - Theory and Problems. McGraw - Hill Book Company.

	Content addressed with Employability
	Content addressed with Entrepreneurship

DEPARTMENT OF MATHEMATICS

M.Sc Programme

With effect from the academic year 2017 – 18

Course Structure

Distribution of Hours and Credit

Course	Sem. I	Sem. II	Summer vacation	Sem. III	Sem. IV	Total	
						Hours	Credit
Core - Theory	6 (5) + 6 (4) + 6 (4) + 6 (4)	6 (5) + 6 (4) + 6 (4) + 6 (4)	-	6 (5) + 6 (5) + 6 (4)	6 (5) + 6 (5) + 6 (5) + 6 (4)	90	67
Elective	6 (4)	6 (4)	-	6 (4)	6 (4)	24	16
Project	-	-	-	6 (4)	-	6	4
*Life Skill Training - I	-	(1)	-	-	-	-	1
*Life Skill Training - II	-	-	-	-	(1)	-	1
*Summer Training Programme	-	-	(1)		-	-	1
TOTAL	**30 (21)**	**30 (22)**	**(1)**	**30 (22)**	**30 (24)**	**120**	**90**

*** Courses / Programmes conducted outside the regular working hours**

Courses offered

Semester	Course code	Title of the paper	Hours/week	Credit
I	PM1711	Core I - Algebra I	6	5
	PM1712	Core II - Analysis I	6	4
	PM1713	Core III - Probability and Statistics	6	4
	PM1714	Core IV - Ordinary Differential Equations	6	4
	PM1715 PM1716	Elective I - (a) **Numerical Analysis** (b) Fuzzy sets and Fuzzy logic	6	4
II	PM1721	Core V- Algebra II	6	5
	PM1722	Core VI - Analysis II	6	4
	PM1723	Core VII - Partial Differential Equations	6	4
	PM1724	Core VIII - Graph Theory	6	4
	PM1725 PM1726	Elective II - (a) **Classical Dynamics** (b) Differential Geometry	6	4
	LST172	Life Skill Training (LST) - I	-	1
III	PM1731	Core IX - Algebra III	6	5
	PM1732	Core X - Topology	6	5
	PM1733	Core XI - Measure Theory and Integration	6	4
	PM1734 PM1735	Elective III - (a) **Algebraic Number Theory** (b) Stochastic Processes	6	4

	PM17PR	Project	6	4
IV	PM1741	Core XII - Complex Analysis	6	5
	PM1742	Core XIII - Functional Analysis	6	5
	PM1743	Core XIV - Operations Research	6	5
	PM1744	Core XV - Algorithmic Graph Theory	6	4
	PM1745 PM1746	Elective IV - (a) **Combinatorics** (b) Coding Theory	6	4
	LST174	Life Skill Training (LST) - II	-	1
	STP171	Summer Training Programme	-	1
		TOTAL	**120**	**90**

Self Learning - Extra Credit Course

Semester	**Course code**	**Title of the paper**	**Hours/week**	**Credit**
III	PM17S1	Algebra for SET/CSIR-NET Exam	-	2
IV	PM17S2	Analysis for SET/ CSIR-NET Exam	-	2

M.Sc. Programme Outcomes (PO)

PO	Upon completion of M.Sc. Degree Programme, the graduates will be able to
PO - 1	recognize the scientific facts behind natural phenomena.
PO - 2	relate the theory and practical knowledge to solve the problems of the society.
PO - 3	prepare successful professionals in industry, government, academia, research, entrepreneurial pursuits and consulting firms
PO - 4	face and succeed in high level competitive examinations like NET, GATE and TOFEL.
PO - 5	carry out internship programmes and research projects to develop scientific skills and innovative ideas.
PO - 6	utilize the obtained scientific knowledge to create eco-friendly environment.
PO - 7	prepare expressive, ethical and responsible citizens with proven expertise

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO	Upon completion of M.Sc. Mathematics, the graduates will be able to :	PO Addressed
PSO - 1	Have a strong base in theoretical and applied mathematics.	PO - 2
PSO - 2	Sharpen their analytical thinking, logical deductions and rigor in reasoning.	PO - 4
PSO - 3	Understand the tools required to quantitatively analyze data and have the ability to access and communicate mathematical information.	PO - 7
PSO - 4	Write proofs for simple mathematical results.	PO - 5
PSO - 5	Acquire knowledge in recent developments in various branches of mathematics and participate in conferences / seminars / workshops and thus pursue research.	PO - 3
PSO - 6	Utilise the knowledge gained for entrepreneurial pursuits	PO - 3
PSO - 7	Understand the applications of mathematics in a global, economic, environmental, and societal context.	PO - 6
PSO - 8	Use the techniques, skills and modern technology necessary to communicate effectively with professional and ethical responsibility.	PO - 7
PSO - 9	Develop proficiency in analyzing, applying and solving scientific problems.	PO - 5

Semester : **III** **Major Core IX**

Name of the Course : **Algebra-III**

Course code : **PM1731**

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	5	90	100

Objectives:

1. To learn in depth the concepts of Galois Theory, theory of modules and lattices
2. To pursue research in pure Mathematics

Course Outcome

CO	Upon completion of this course the students will be able to	PSO addressed	CL
CO - 1	recall the definitions and basic concepts of field theory and lattice theory	PSO - 1	U
CO - 2	express the fundamental concepts of field theory, Galois theory and theory of modules	PSO - 1	U
CO - 3	demonstrate the use of Galois theory to construct Galois group over the rationals and modules	PSO - 9	U
CO - 4	distinguish between free modules , quotient modules and simple modules .	PSO - 2	Ap
CO - 5	interpret distributivity and modularity and apply these concepts in Boolean Algebra	PSO - 3	E
CO - 6	understand the theory of Frobenius Theorem ,four square theorem and Integral Quaternions	PSO - 7	U
CO - 7	develop the knowledge of lattices and establish new relationships in Boolean Algebra	PSO - 8	C

Semester : III Major Core X

The Elements of Galois Theory - Galois Groups over the Rationals.

Unit II

Finite fields - Wedderburn's theorem. (First proof only).

Unit III

A Theorem of Frobenius - Integral Quaternions and the four square Theorem.

Unit IV

Modules-Definitions - Direct Sums - Free Modules - Vector Spaces - Quotient Modules - Homomorphisms - Simple Modules -Modules over PID's.

Unit V

Partially ordered set and Lattices - Distributivity and Modularity, Boolean Algebra.

Text books:

1. Herstein, I.N. (2007). Topics in Algebra. (2nd Edition). New Delhi: Wiley Eastern Ltd.
   Chapter 5 : 5.6, 5.7; Chapter 7: 7.1, 7.2,7.3,7.4
2. Musili, C. (2006). Rings and Modules. (2nd Revised Edition). Narosa Publishing House.
   Chapters 5.
3. Nathan Jacobson. (1984). Basic Algebra - I. (Indian Edition). Hindustan Publishing Corporation.
   Chapter 8: 8.1,8.2,8.5.

Reference Books:

1. Joseph A. Gallian. (1999). Contemporary Abstract Algebra. (4^{th} Edition). Narosa Publishing House.
2. Nathan Jacobson. (1984). Basic Algebra. (Indian Edition). Hindustan Publishing Corporation.
3. Joseph Rotsman. (2010). Galois Theory. (2^{nd} Edition). Springer International Edition.
4. John R. Durbin. (2005). Modern Algebra. (5^{th} Edition). John wiley & Sons.
5. Rudolf Lidl and Gunter Pilz. (2009). Applied Abstract Algebra. (2^{nd} Edition). SpringerInternational edition.

Unit I

Name of the Course : Topology

Course code : PM1732

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	5	90	100

Objectives:

1. To distinguish spaces by means of simple topological invariants
2. To lay the foundation for higher studies in Geometry and Algebraic Topology

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	understand the definitions of topological space, closed sets, limit points, continuity, connectedness, compactness, separation axioms and countability axioms.	PSO - 3	U
CO – 2	construct a topology on a set so as to make it into a topological space	PSO - 5	C
CO – 3	distinguish the various topologies such as product and box topologies and topological spaces such as normal and regular spaces.	PSO - 3	U, An
CO – 4	compare the concepts of components and path components, connectedness and local connectedness and countability axioms.	PSO - 2	E, An
CO – 5	apply the various theorems related to regular space, normal space, Hausdorff space, compact space to other branches of mathematics.	PSO - 1	Ap
CO – 6	construct continuous functions, homeomorphisms and projection mappings.	PSO - 5	C

Semester : III Major Core X

Topological spaces - basis for a topology - The order topology - The product topology on $X \times Y$- The subspace topology - Closed sets and Limit points - Hausdorff spaces.

Unit II

Continuous function - Homeomorphism - Constructing Continuous functions - The product topology - Comparison of the box and product topologies.

Unit III

Connected spaces - Product of connected spaces - Components and local connectedness - Compact spaces.

Unit IV

Local compactness – One-point compactification - The countability axioms - First countable - Second countable - Lindelof space - Separable - The separation axioms.

Unit V

Normal spaces - The Urysohn Lemma - Completely Regular Space - The Tietze Extension Theorem.

Text Book:

James R. Munkres. (2002). Topology. (2^{nd} Edition). Pearson Education Inc.

Sections: 12 - 19, 23, 25, 26, 29 - 33, 35.

Reference Books:

1. Gupta, K. P. (2013). Topology. (21^{st} Edition). Pragati Prakashan Publishers.
2. Kelley, J. L. (2009). General Topology. (3^{rd} Indian reprint). Springer - Verlag.
3. George F. Simmons. (2004). Introduction to Topology and Modern Analysis. (2^{nd} Indian reprint). McGraw Hill.
4. Willard, S. (1970). General Topology. Addison - Wesley Publishing Co Inc.
5. Joshi, K. D. (1983). Introduction to General Topology. Wiley Eastern Ltd.

Unit I

Name of the Course : Measure theory and Integration

Course code : PM1733

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	4	90	100

Objectives:

1. To generalize the concept of integration using measures
2. To develop the concept of analysis in abstract situations

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	define the concept of measures and Vitali covering and recall some properties of convergence of functions,	PSO - 1	R
CO – 2	cite examples of measurable sets , measurable functions, Riemann integrals, Lebesgue integrals.	PSO - 3	U
CO – 3	apply measures and Lebesgue integrals to various measurable sets and measurable functions	PSO - 9	Ap
CO – 4	apply outer measure, differentiation and integration to intervals , functions and sets.	PSO - 8	Ap
CO – 5	compare the different types of measures and Signed measures	PSO - 3	An
CO – 6	construct L^p spaces and outer measurable sets	PSO - 5	C

Semester : III Major Core XI

Lebesgue Measure - Introduction, outer measure - Measurable sets and Lebesgue measure - Measurable functions - Littlewood's three principles (no proof for first two).

Unit II

The Lebesgue integral - The Riemann Integral - The Lebesgue integral of a bounded function over a set of finite measure - The integral of a non-negative function - The general Lebesgue integral.

Unit III

Differentiation and integration - Differentiation of monotone functions - Functions of bounded variation - Differentiation of an integral - Absolute continuity.

Unit IV

Measure and integration - Measure spaces - Measurable functions - Integration - general convergence theorems - Signed measures.

Unit V

The L^P spaces - Measure and outer measure - Outer measure and measurability - The extension theorem.

Text Book:

Royden, H. L. (2004). Real Analysis. (3^{rd} Edition). Prentice Hall of India.

Chapters: 3, 4, 5, 11 (except 3.4, 4.5, 5.5, 11.6)

Chapter: 12 (sections 1 and 2)

Reference Books:

1. De Barra, G. (2009). Measure Theory and Integration. New Age International (P) Limited Publishers.
2. Jain, P. K., Gupta, V. P., & Pankaj Jain. (2015). Lebesgue Measure and Integration. (2^{nd} Edition). New Age International Publishing.
3. Inder K. Rana. (2014). An Introduction to Measure and Integration. (2^{nd} Edition). Narosa Publishing House.
4. Jain P. K., & Pankaj Jain. (2014). General Measure and Integration. (1^{st} Edition). New Age International Publishers.
5. Chandrasekhar Rao, K. (2009). Topology. Narosa Publishing House.

Semester : III **Elective III (a)**

Name of the Course : Algebraic Number Theory

Course code : PM1734

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	4	90	100

Objectives:

1. To gain deep knowledge about Number theory
2. To study the relation between Number theory and Abstract Algebra

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	recall the basic results of field theory	PSO - 1	R
CO – 2	understand quadratic and power series forms and Jacobi symbol	PSO - 7	U
CO – 3	apply binary quadratic forms for the decomposition of a number into sum of sequences	PSO - 6	Ap
CO – 4	determine solutions of Diophantine equations	PSO - 2	An
CO – 5	detect units and primes in quadratic fields	PSO - 3	An
CO – 6	calculate the possible partitions of a given number and draw Ferrer's graph	PSO - 8	An
CO – 7	identify formal power series and compare Euler's identity and Euler's formula	PSO - 3	U

Quadratic Reciprocity and Quadratic Forms: Quadratic Residues - Quadratic Reciprocity - The Jacobi Symbol.

Unit II

Binary Quadratic Forms - Equivalence and Reduction of Binary Quadratic Forms - Sum of Two Squares.

Unit III

Some Diophantine Equations - Pythagorean Triangles - Algebraic Numbers: Polynomials - Algebraic Numbers.

Unit IV

Algebraic Number Fields - Algebraic Integers - Quadratic Fields - Units in Quadratic Fields - Primes in Quadratic Fields.

Unit V

Partition Function - Ferrers Graphs - Formal Power Series - Eulers Identity - Eulers Formula.

Text Book:

Ivan Niven., Herbert S. Zuckerman., & Hugh L. Montgomery. (2006). An Introduction to the Theory of Numbers. (5^{th} Edition). John - Wiley & Sons.

Chapter 3 : 3.1 - 3.6; Chapter 5 : 5.3;
Chapter 9 : 9.1 - 9.7; Chapter 10 : 10.1 - 10.4

Reference Books:

1. Hardy, G. H., & Wright E. M. (1975). An Introduction to the Theory of Number. (4^{th} Edition). Oxford at the Clarendon Press.
2. Kenneth Ireland., & Michael Rosen. (1990). A classical Introduction to Modern Number Theory. (2^{nd} Edition). Springer International Edition.
3. Graham Everest., & Thomas Ward. (2008). An Introduction to Number Theory. Springer International Edition.
4. John Stillwell. (2008). Elements of Number Theory. Springer International Edition.
5. Tom. M. Apostol. (1998). Introduction to Analytic Number Theory. Narosa Publishing House.

Semester : III **Elective III (b)**

Name of the Course : **Stochastic Processes**

Course code : **PM1735**

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	4	90	100

Objectives:

1. To understand the stochastic models
2. To relate the models studied to real life probabilistic situations

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	recall the concept of the theory of probability	PSO - 1	R
CO – 2	understand the definitions and specification of stochastic processes	PSO - 2	U
CO – 3	differentiate between different states of Markov system	PSO - 3	U
CO - 4	categorize different stochastic processes such as Poisson processes, Yule- Fury processes, birth and death processes	PSO - 3	An
CO – 5	calculate residual and current life times using renewal processes	PSO - 2	An
CO – 6	select the suitable queuing model in real life situations	PSO - 7	E
CO – 7	apply the theory to create the correct stochastic model for a given problem	PSO - 8	Ap

Stochastic processes - Specification of Stochastic processes - Stationary processes - Markov chain - Transition probabilities - Random walk - Higher transition probabilities.

Unit II

Classification of states and chains - Transient and recurrent states - Stability of a Markov system.

Unit III

Markov process with discrete state space - Poisson process-Generalizations of Poisson process - Poisson Cluster process - Pure birth process - Yule-Furry process - Birth Immigration Process - Birth and death process.

Unit IV

Renewal processes - Renewal process in Discrete time - Renewal process in continuous time - Renewal Equation-Renewal theorems - Residual and current life times.

Unit V

Stochastic processes in queuing - Queuing processes - Steady state behaviour of M/M/1queuing Model-Non-Markovian Queuing Models-Queues with Poisson input- M/G/1 and GI/M/1 queuing models.

Text Book:

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

Chapter 2: Sections 2.1,2.2,2.3; Chapter 3: Sections 3.1,3.2,3.4,3.6.

Chapter 4: Sections 4.1, 4.3 (except 4.3.5 - 4.3.7), 4.4.

Chapter 6: Sections 6.1.1- 6.1.3, 6.2 (except example 2(b)), 6.3, 6.5 (except 6.5.2), 6.7.

Chapter 10: Sections 10.1(except 10.1.4), 10.2 (except 10.2.3.1),10.7 (except examples 7(a),7(b) & sections 10.7.3,10.7.4), 10.8 (except example 8(a)).

Reference Books:

1. Narayan Bhat, U. (1972). Elements of Applied Stochastic Processes. (Second Edition). John Wiley & Sons. New York.
2. Prabhu, N.V. (1970). Stochastic Processes. Mac Millon. New York.
3. Bhat, B.R. (2010). Stochastic Models Analysis and Applications. New Age International (P) Limited Publishers.
4. Veerarajan, T. (2006). Probability, Statistics and Random Processes. Tata McGraw - Hill Publishing Company Limited.
5. Salil Kumar Chaudhri., & Ashis K. Chakraborthy. (2009). Statistical Methods. Asian Books Private Ltd.

Semester **III**

Name of the Course **: Project**

Course code **: PM17PR**

No. of hours per week	Credits	Total No. of hours	Marks
6	**5**	90	100

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	become aware of current research topics in mathematics and choose a new Research topic.	PSO - 1	R
CO – 2	create the habit of studying Research articles in depth	PSO - 6	C, An
CO – 3	submit a formal report to document the outcome of the project and get practice in writing projects.	PSO - 9	U, C
CO – 4	understand and develop mathematical concepts effectively and correlate the same to other disciplines	PSO - 6	U,C
CO – 5	present papers in Conferences/Workshops/Seminars.	PSO - 5	U, Ap
CO – 6	apply mathematics creatively and think critically	PSO - 8	U, Ap

Guidelines

- All the students must undertake dissertation work at the final year (III semester).
- The students, with the consent of the Supervisor, HoD and the Principal can pursue their project in another institution, especially with MoU/ Collaboration for the successful completion of the project work.

Evaluation

Evaluation	Marks	Month/ Date	Evaluator
Proposed title, review of literature and objectives.	-	3rd Week of III Semester	-
I Review	10	July	Supervisor
II Review	10	August	Supervisor
Final- Internal	20	September/ October	Supervisor
External - Dissertation *Viva-voce (individual & open)	40 20	October /November	Ext. examiner
Total marks	100		

* Mode of presentation by Power Point

Dissertation framework

1. The Project format should be in:

- Font - Times New Roman
- Heading - Font size 14 (Bold) - Uppercase
- Sub headings - Font size 12 (Bold) — Lowercase; should be numbered.
- (Eg: Introduction 1; Subheading 1.1; 1.2)
- Text, the content of the dissertation — Font size -12 (Normal).
- Citation - Any works of other researchers, if used either directly or indirectly should be indicated at appropriate places in the text.

The citation may assume any one of the following forms:

i) A paper, a monograph or a book with single author may be designated by the name of the first author followed by the year of publication, placed inside brackets at the appropriate places in the text.

ii) A paper, a monograph, or a book with two authors may be designated by the name of the first and second author followed by the year of publication, placed inside brackets at the appropriate places in the text.

iii) A paper, a monograph, or a book with more than two authors may be designated by the name of the first author followed by et al, and the year of publication, placed inside brackets at the appropriate places in the text.

- Line space - 1.5
- Margin - 2" on the left and 1" on the right, Gutter -0.5.
- Page Numbering — Bottom middle alignment; excluding initial pages and
- reference
- Total number of pages - Minimum 30 - Maximum 50 (excluding initial pages and
- reference).
- The Tables and Figures should be included subsequently after referring them in
- the text of the Thesis.
- The thesis from Chapters should be printed on both sides.

II. Project Report must be completed within the stipulated time.

III. Submission of Project Report:

- One soft copy (PDF format in CD)
- Three hard copies (soft binding) duly signed and endorsed by the Supervisor and the Head.

The Project Report **will have three main parts:**

I. Initial Pages - in the following sequence

- **(a)** Title Page
- **(b)** Certificate from the Supervisor
- **(c)** Declaration by the candidate endorsed by the Supervisor and HOD.
- **(d)** Acknowledgement (within one page - signed by the candidate).
- **(e)** Table of Contents
- **(f)** List of abbreviations
- **(g)** Abstract

II. Main body of the dissertation

- **(a)** Introduction with Literature review and Objectives
- **(b)** Methodology
- **(c)** Results
- **(d)** Discussion
- **(e)** Summary
- **(f)** References

III. Reference

The guidelines for reference

Journal Article: with Single Author

Waldron, S 2008, ‒Generalized Welch bound equality sequences are tight frames‟, IEEE Transactions on Information Theory, vol. 49, no. 9, pp. 2307-2309.

Journal Article: with Two Authors

Conley, TG & Galeson, DW 1998, ‒Nativity and wealth in mid-nineteenth century cities‟, Journal of Economic History, vol. 58, no. 2, pp. 468-493.

Journal Article: with more than two Authors

Alishahi, K, Marvasti, F, Aref, VA & Pad, P 2009, „Bounds on the sum capacity of synchronous binary CDMA channels‟, Journal of Chemical Education, vol. 55, no. 8, pp. 3577-3593.

Books

Holt, DH 1997, Management Principles and Practices, Prentice-Hall, Sydney. Centre for Research, M S University - Ph.D. Revised Guidelines Page | 39 / 41

E-book

Aghion, P & Durlauf, S (eds.) 2005, Handbook of Economic Growth, Elsevier, Amsterdam. Available from: Elsevier books. [4 November 2004].

Conference Proceeding Paper with Editors

Riley, D 1992, „Industrial relations in Australian education‟, in Contemporary Australasian industrial relations: proceedings of the sixth AIRAANZ conference, ed. D. Blackmur, AIRAANZ, Sydney, pp. 124-140.

Conference Proceeding Paper without Editors

Fan, W, Gordon, MD & Pathak, R 2000, ―Personalization of search engine services for effective retrieval and knowledge management‟, Proceedings of the twenty-first international conference on information systems, pp. 20-34.

Website

Australian Securities Exchange 2009, Market Information. Available from: [5 July 2009].

Thesis

Unpublished Hos, JP 2005, Mechano chemically synthesized nano materials for intermediate temperature solid oxide fuel cell membranes. Ph.D. thesis, University of Western Australia. Newspaper Print Ionesco, J 2001, 'Federal election: new Chip in politics', The Advertiser 23 October, p. 10.

Semester : **III** **SLC**

Name of the Course : **Algebra for SET/CSIR-NET Exam**

Course code : **PM17S1**

Objectives:

1. To enhance problem solving skills
2. To enable the students to clear the CSIR - NET/SET Exams

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	solve the problems based on vector spaces, sub spaces and linear transformations	PSO - 2	Ap
CO – 2	understand the significant of linear independence, basis and dimensions	PSO - 1	U
CO – 3	recall matrix theory, linear equations and finding the rank and determine the determinant of matrices	PSO - 1	R
CO – 4	determine eigen values and eigen vectors and recall Cayley-Hamilton Theorem	PSO - 7	E
CO – 5	acquire knowledge in solving problems by using matrix representation of linear transformations and change of basis	PSO - 5	C
CO – 6	differentiate various forms in matrices	PSO - 3	An
CO – 7	solve problems in inner product spaces, orthonormal basis and quadratic forms	PSO - 2	Ap

Semester : IV Major Core XII

To solve NET/SET based problems in Vector spaces - Subspaces - linear dependence - Basis and dimension - Algebra of linear transformations.

Unit II

To solve NET/SET based problems in Algebra of matrices - Rank and determinant of matrices - linear equations.

Unit III

To solve NET/SET based problems in Eigen values and Eigen vectors - Cayley-Hamilton theorem.

Unit IV

To solve NET/SET based problems in Matrix representation of linear transformations - Change of basis - Canonical forms-Diagonal forms - Triangular forms - Jordan forms.

Unit V

To solve NET/SET based problems in Inner product spaces - Orthonormal basis Quadratic forms - Reduction and classification of quadratic forms.

Reference Books:

1. Vijay K. Khanna., & Bhambri, S.K. (2017). A Course in Abstract Algebra. Vikas Publishing House Pvt. Ltd.
2. Dr. Alok Kumar. Mathematical Sciences for CSIR-UGC NET/JRF/SET. Upkar Prakashan. Code No - 1587.
3. Joseph A. Gallian. (1999). Contemporary Abstract Algebra. (4^{th} Edition). Narosa Publishing House.
4. Kenneth Hoffman., & Ray Kunze. (2016). Linear Algebra. (2^{nd} Edition). Pearson India Education Services Pvt. Ltd.
5. John B. Fraleigh. (2003). A first course in Abstract Algebra. (3^{rd} Edition). Narosa Publishing House.

Unit I

Name of the Course : Complex Analysis

Course code : PM1741

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	5	90	100

Objectives:

1. To impart knowledge on complex functions
2. To facilitate the study of advanced mathematics

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	understand the fundamental concepts of complex variable theory	PSO - 1	U
CO – 2	effectively locate and use the information needed to prove theorems and establish mathematical results	PSO - 6	R
CO – 3	demonstrate the ability to integrate knowledge and ideas of complex differentiation and complex integration	PSO - 9	U
CO – 4	use appropriate techniques for solving related problems and for establishing theoretical results	PSO - 8	Ap
CO – 5	evaluate complicated real integrals through residue theorem	PSO - 9	E

Unit I

Complex Functions - Introduction to the Concept of Analytic Function - Analytic functions, Polynomials, Rational functions, Elementary Theory of Power Series - Sequences, Series, Uniform Convergence.

Semester : IV Major Core XIII

Power series - Abel's theorem, Abel's limit theorem, The Exponential and Trigonometric functions - The periodicity.

Unit III

Analytic functions as mappings - conformality - Arcs and closed curves, Analytic Functions in Regions, Conformal Mapping, Length and Area, Linear transformations - The linear group, The Cross Ratio, Symmetry.

Unit IV

Complex Integration - Fundamental theorems - Line Integrals, Rectifiable Arcs, Line Integrals as Functions of Arcs, Cauchy's Theorem for a Rectangle, Cauchy's Theorem in a Disk, Cauchy's integral formula - The Index of a Point with Respect to a Closed Curve, The Integral Formula, Higher Derivatives, Local Properties of Analytic Functions - Removable singularties and Taylor's theorem, Zeros and poles.

Unit V

The local mapping, The maximum principle, The General Form of Cauchy's Theorem - Chains and Cycles, Simple Connectivity, Homology, The General Statement of Cauchy's Theorem (statement only), The Calculus of Residues - The Residue Theorem, The Argument Principle, Evaluation of Definite Integrals.

Text Book:

Ahlfors. (1979). Complex Analysis. (3^{rd} Edition). Tata McGraw Hill. New York.

Chapter 2: sections 1.2 - 1.4, 2.1 - 2.5, 3.1 - 3.3; Chapter 3: sections 2.1 - 2.4, 3.1- 3.3

Chapter 4: sections 1.1 - 1.5, 2.1 - 2.3, 3.1 - 3.4, 4.1 - 4.4, 5.1 - 5.3

Reference Books:

1. Karunakaran, V. (2002). Complex Analysis. Narosa Publishing House.
2. Shanthi Narayanan., & Mittal, P.K. (2011). Theory of Functions of a Complex Variable. S. Chand & Co Publication.
3. Ponnusamy, S. (2011). Foundations of Complex Analysis. (2^{nd} Edition). Narosa Publishing House.
4. Theodore W. Gamelin. (2008). Complex Analysis. Springer International Edition.
5. Kapoor, A. K. (2011). Complex Variables. (Reprint Edition). World Scientific Publishing Co. Pvt. Ltd.

Unit II

Name of the Course : Functional Analysis

Course code : PM1742

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	5	90	100

Objectives:

1. To study the three structure theorems of Functional Analysis and to introduce Hilbert Spaces and Operator theory
2. To enable the students to pursue research

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	learn and understand the definition of linear space , normed linear space, Banach Space and their examples	PSO - 1	R
CO – 2	explain the concept of different properties of Banach Spaces, Hahn Banach theorem	PSO - 7	U
CO – 3	compare different types of operators and their properties, Natural imbedding	PSO - 2	Ap
CO – 4	explain the ideas needed for open mapping theorem , Open Mapping theorem	PSO - 1	C
CO – 5	construct the idea of projections , the spectrum of an operator and develop problem solving skills , Matrices, Determinants	PSO - 5	Ap
CO - 6	learn and understand the definition of Hilbert Spaces, Orthogonal Complements	PSO - 1	R
CO – 7	explain the concept of the adjoint of an operator, Normal and Unitary operators, Spectral Theory	PSO - 2	An

Semester : IV Major Core XIV

Banach spaces - Definition and examples - Continuous linear transformations - The Hahn Banach theorem.

Unit II

The natural imbedding of N into N** - The open mapping theorem - The conjugate of an operator.

Unit III

Hilbert spaces - Definition and properties - Orthogonal complements - Orthonormal sets - The conjugate space.

Unit IV

Adjoint of an operator, self adjoint operators - Normal and unitary operators - Projections.

Unit V

Matrices - Determinants - Spectral theory - Spectrum of an operator - The spectral theorem.

Text Book:

Simmons, G. F. (1963). Introduction to Topology and Modern Analysis. Tata McGraw Hill.

Sections: 46 to 62

Reference Books:

1. Soma Sundaram, D. (2014). A first course in Functional Analysis. Narosa Publishing House Pvt. Ltd.
2. Chandra Sekhara Rao, K. (2002). Functional Analysis. Narosa Publishing House.
3. Thamban Nair, M. (2002). Functional Analysis. A First Course. Prentice Hall of India.
4. Erwin Kreyzig. (2006). Introductory Functional Analysis with Applications. John Wiley and Sons Publication.
5. Casper Goffman., & George Pedrick. (1974). First course in Functional Analysis. Prentice/ Hall of India Private Limited.

Unit I

Name of the Course : Operations Research

Course code : PM1743

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	5	90	100

Objectives:

1. To learn optimizing objective functions
2. To solve life oriented decision making problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	explain the fundamental concept of DP model , Inventory model and Queuing model	PSO - 2	U
CO – 2	relate the concepts of Arrow (Network)diagram representations, in critical path calculations and construction of the Time chart	PSO - 3	U
CO – 3	distinguish deterministic model and single item	PSO - 3	U
CO – 4	interpret Poisson and Exponential distributions and apply these concepts in Queuing models	PSO - 6	R
CO – 5	solve life oriented decision making problems by optimizing the objective function	PSO - 7	C

Semester : IV Major Core XIV

Elements of the DP Model - The Capital Budgeting Example - More on the definition of the state - Examples of DP Models and computations - Solution of Linear Programming by Dynamic programming - Game theory.

Unit II

Arrow (Network) Diagram Representations - Critical Path Calculations - Construction of the Time Chart and Resource Leveling - Probability and Cost Considerations in Project Scheduling.

Unit III

A Generalised Inventory model - Types of Inventory Models - Deterministic Models - Single Item Static Model - Single Item Static - Model with Price Breaks - Multiple - Item static Model with Storage Limitations - Single - Item.

Unit IV

Basic Elements of the Queueing Model - Roles of Poisson and Exponential Distributions - Queue with Combined Arrivals and Departure - Queueing Models of Type : (M/M/1): (GD/∞/∞) , (M/M/1): (GD/N/∞).

Unit V

Queueing Models of Types : (M/G/1): (GD/∞/∞) - The Pollaczek - Khintchine Formula, (M/M/C) : (GD/∞/∞) - (M/M/∞) : (GD/∞/∞) Self service Model, (M/M/R) : (GD/K/K) R < K - Machine Service -Tandem or series queues.

Text Book:

Handy.A. Taha. (1989). Operations Research - An Introduction. (3rd Edition). MacMillan Publishing Co. Inc.

Chapter 9: Section 9.1 - 9.3, 9.5; Chapter 11: Section 11.4;
Chapter 12: Section 12.1 - 12.4; Chapter 13: Section 13.1 - 13.3 (except 13.3.5);
Chapter 15: Section 15.1, 15.2 (only 15.2.1, 15.2.2), 15.3 (15.3.1, 15.3.2, 15.3.3, 15.3.4, 15. 3.6, 15.3.7), 15.5 - (only15.5.1).

Reference Books:

1. Er. Prem Kumar Gupta., & Dr. Hira, D.S. (2014). Operations Research. (7th Edition). S. Chand and company private ltd.
2. Sharma, J.K. (2009). Operations Research: Theory and Applications. (4th Edition). Macmillian Publishers India ltd.
3. Panneerselvam, R. (2009). Operations Research. (2nd Edition). PHI Learning private ltd.
4. Prem Kumar Gupta., Dr. Hira, D. S., & AartiKamboj. (2012). Introduction to Operations Research. S. Chand and Company ltd.
5. Naidu, N. V. R., Rajendra, G., & Krishna Rao, T. (2011). Operations Research. (Kindle Edition). IK. International Publishing house private ltd.

Unit III

Name of the Course : Algorithmic Graph Theory

Course code : PM1744

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	4	90	100

Objectives:

1. To instill knowledge about algorithms
2. To write innovative algorithms for graph theoretical problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	write algorithms for basic computing and analyse the efficiency of the algorithm	PSO - 1	R E
CO – 2	use effectively algorithmic techniques to study basic parameters and properties of graphs	PSO - 4	U
CO – 3	use effectively techniques from graph theory, to solve practical problems in networking and communication	PSO - 6	Ap
CO – 4	apply the Algorithms in computer science , biology, chemistry, physics, sociology and engineering	PSO - 9	Ap

Unit I

The Role of Algorithms in Computing - Algorithms, Algorithm as a Technology. Getting Started - Insertion Sort, Analyzing Algorithms.

Unit II

Elementary Graph Algorithms - Representation of Graphs, Breadth-first Search, Depth-first Search.

Semester : IV Major Core XV

Minimum Spanning Trees - Growing a Minimum Spanning Tree, The algorithms of Kruskal and Prim.

Unit IV

Single Source Shortest Paths - The Bellman-Ford Algorithm, Single-source Shortest Paths in Directed Acyclic Graphs, Dijkstra's Algorithm.

Unit V

All-Pairs Shortest Paths - Shortest Paths and Matrix Multiplication, The Floyd-Warshall Algorithm.

Text Book:

Thomas H. Cormen., Charles E. Leiserson., Ronald L. Rivest., & Clifford Stein. (2010). Introduction to Algorithms. (3^{rd} Edition). PHI Learning Pvt. Limited.

Chapter I: 1.1 - 1.2 and 2.1 - 2.2

Chapter VI: 22.1 - 22.3, 23.1 - 23.2, 24.1 - 24.3 and 25.1 - 25.2.

Reference Books:

1. Gary Chartrand., & Ortrud R. Oellermann. (1993). Applied and Algorithmic Graph Theory. (International Editions). McGraw-Hill.
2. Bondy, J. A., & Murty, U. S. R. (1976). Graph Theory with Application. Macmillan.
3. Murugan, M. (2003). Graph Theory and Algorithms. Muthali Publishing House.
4. Hu, T. C. (1982). Combinatorial Algorithms. Addison-Wesley Publishing Company.
5. Alan Gibbons. (1985). Algorithmic Graph Theory. Cambridge University.

Semester : IV **Elective IV (a)**

Name of the Course : Combinatorics

Course code : PM1745

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	4	90	100

Objectives:

1. To do an advanced study of permutations and combinations
2. Solve related real life problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	discuss the basic concepts in permutation and combination, Recurrence Relations	PSO - 3	U
CO – 2	distinguish between permutation and combination	PSO - 9	An
CO – 3	correlate recurrence relation and generating function	PSO - 2	U
CO -4	solving problems by the technique of generating functions	PSO - 7	Ap
CO – 5	interpret the principles of inclusion and exclusion	PSO - 2	U
CO – 6	develop the concepts of Polya's fundamental theorem and apply in Polya's theory of counting	PSO - 6	C

Permutations and combinations - The Rules of sum and product - Permutations - Combinations - Distribution of Distinct Objects.

Unit II

Generating Functions - Generating Functions for Combinations - Enumerators for Permutations.

Unit III

Recurrence Relations - Linear Recurrence Relations with Constant Coefficients - Solution by the Technique of Generating Functions.

Unit IV

The Principle of Inclusion and Exclusion - The General Formula - Derangements - Permutations with Restrictions on Relative Positions - The Rook Polynomials.

Unit V

Polya's Theory of Counting - Equivalence Classes under a Permutation Group - Equivalence classes of Function - Weights and Inventories of Functions - Polya's Fundamental Theorem.

Text Book:

Liu, C.L. (1988). Combinatorial Mathematics. McGraw Hill.

Chapters 1: 1.1to 1.5; Chapter 2: 2.1 to 2.3; Chapter 3: 3.1 to 3.3

Chapter 4: 4.1 to 4.6; Chapter 5: 5.3 to 5.6

Reference Books:

1. Anderson. (1974). Combinatorial Mathematics. Elarendon Press.
2. Balaji, G. (2010). Discrete Mathematics. (3^{rd} Edition).G. Balaji Publishers.
3. Robert J. Mceliece., Robert B. Ash., & Carol Ash. (1989). Introduction to Discrete Mathematics. Mcgraw-Hill International Editions.
4. Laszlo Lovasz. (1979). Combinatorial problems and Exercises. North - Holland publishing company.
5. Alan Tucker. (1984). Applied Combinatorics. (2^{nd} Edition). John Wiley & sons.

Semester : IV **Elective IV (b)**

Name of the Course : Coding Theory

Course code : PM1746

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	4	90	100

Objectives:

1. To learn the different procedures of coding and decoding
2. To avail job opportunities in a number of detective agencies

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO – 1	explain the fundamental concepts of coding theory	PSO - 1	U
CO – 2	analyze the fundamental problems of coding theory and the properties of specific codes	PSO - 3	An
CO – 3	translate the fundamental problems to mathematical problems	PSO - 4	C
CO – 4	construct codes by various methods for the chosen problem	PSO - 4	C
CO – 5	solve the problems by recalling the concepts of finite field, polynomial rings and finite groups	PSO - 8	R
CO – 6	apply coding theory in transmission of information in telecommunication (cell phones, data modems etc,.)	PSO - 8	Ap
CO – 7	design simple cyclic codes with given properties	PSO - 4	C

Mathematical Background: Algebra - Krawtchouk Polynomials - Combinatorial theory - Shannon's Theorem: Introduction - Shannon's Theorem.

Unit II

Linear codes: Block codes - Linear codes - Hamming codes - Majority logic decoding - Weight Enumerators - The Lee metric.

Unit III

Some good codes: Hadamard codes and generalizations - The binary Golay code - The ternary Golay code - Constructing codes from other codes - Reed-Muller code - Kerdock codes.

Unit IV

Bound on codes: The Gilbert bound - Upper bounds - Cyclic codes: Definitions - Generator matrix and check polynomial - Zeros of a cyclic code.

Unit V

The idempotent of a cyclic code - Other Representations of cyclic codes - BCH codes - Decoding BCH codes - Binary cyclic codes of length 2n (n odd).

Text Book:

Van Lint, J. H. (2000). Introduction to Coding Theory. (3^{rd} Edition).S pringer.

Chapters 1 (except 1.4), 2 (Sections 2.1 and 2.2 only), 3, 4, 5 (except 5.3), and Chapter 6 (except 6.8, 6.9 and 6.11).

Reference Books:

1. Borda, M. (2011). Fundamentals in information theory and coding. Springer.
2. Raymond Hill. (1986). A First Course in Coding Theory. Clarendon Press. Oxford.
3. Vera Pless. (1998). Introduction to the Theory of Error - Correcting Codes. (3^{rd} Edition). John Wiley and Sons Inc.
4. Cary Huffman, W., & Vera Pless. (2003). Fundamentals of Error - Correcting codes. Cambridge University Press.
5. Stefan M. Moser., & Po-Ning Chen. (2012). A Student's Guide to Coding and Information Theory. Cambridge University press.

Semester **: IV** **SLC**

Name of the Course **: Analysis for SET/CSIR-NET Exam**

Course code **: PM17S2**

Objectives:

1. To enhance problem solving skills
2. To enable the students to clear the CSIR-NET/SET Exams

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	recall the basic concepts of real number system, archimedian property, convergence and limit points	PSO - 1	R
CO - 2	acquire knowledge to solve problems based on compactness and connectedness	PSO - 5	C
CO - 3	understand the definitions and theorems on normed linear space and metric space	PSO - 1	U
CO - 4	evaluate simple concepts and solve problems related to continuity, uniform continuity and monotonic functions	PSO - 2	Ap
CO - 5	analyze the methods for solving problems in Riemann-integrals and improper integrals	PSO - 9	An
CO - 6	expand the sequences and series for the given problems	PSO - 8	Ap
CO - 7	compare convergence and uniform convergence and apply them in solving related problems	PSO - 7	An, Ap

To solve NET/SET based problems in Real number system as a complete ordered field - Archimedean property - Sequences and series - Convergence - Lim sup, Lim inf.

Unit II

To solve NET/SET based problems in Metric spaces - Compactness and Connectedness - Normed linear spaces.

Unit III

To solve NET/SET based problems in Continuity - Uniform continuity - Discontinuity - Monotonic functions.

Unit IV

To solve NET/SET based problems in Riemann sum - Riemann integrals - Improper integrals.

Unit V

To solve NET/SET based problems in Sequences and series of functions - Uniform convergence.

Reference Books:

1. Tom M. Apostol. (2002). Mathematical Analysis. (2^{nd} Edition). Narosa Publishing House.
2. Dr. Alok Kumar. Mathematical Sciences for CSIR-UGC NET/JRF/SET. Upkar Prakashan. Code No - 1587.
3. Charles G. Denlinger. (2011). Elements of Real Analysis. Jones and Bartlett Learning.
4. Somasundaram, D., & Choudhary, B. (2010). A First Course in Mathematical Analysis. (1^{st} corrected Edition). Narosa Publishing house.
5. Richard R. Goldberg. (1970). Methods of Real Analysis. Oxford & IBH Publishing Co. Pvt. Ltd.

	Content addressed with Employability
	Content addressed with Entrepreneurship