Holy Cross College (Autonomous), Nagercoil-629004

Kanyakumari District, Tamil Nadu.

Nationally Re-Accredited with A$^+$ by NAAC IV cycle – CGPA 3.35

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

DEPARTMENT OF MATHEMATICS

SYLLABUS FOR UNDERGRADUATE PROGRAMME

Issued from the Deans Office

(With effect from the Academic year 2020– 2021)

DEPARTMENT OF MATHEMATICS

Vision

To empower women globally competent with human values and ethics acquiring academic and entrepreneurship skills through holistic education.

Mission

- To create opportunities which will ensure academic excellence in critical thinking, humanistic and scientific inquiry.
- To develop application oriented courses with the necessary input of values.
- To create a possible environment for innovation, team spirit and entrepreneurial leadership.
- To form young women of competence, commitment and compassion.

Programme Educational Objectives (PEO)

PEO 1	The graduates will apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.
PEO 2	The graduates pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.
PEO 3	The graduates will demonstrate the ability to utilize effectively the variety of teaching techniques and class room strategies and develop confidence to appear for competitive examinations and occupy higher levels of academic and administrative fields.

Programme Outcomes (PO)

PO	Upon completion of the B.Sc. Degree Programme, the graduates will be able to
PO - 1	equip students with hands on training through various courses to enhance entrepreneurship skills.
PO - 2	impart communicative skills and ethical values.
PO - 3	face challenging competitive examinations that offer rewarding careers in science and education.
PO - 4	apply the acquired scientific knowledge to face day to day needs and reflect upon green initiatives to build a sustainable environment.

Programme Specific Outcomes (PSO)

PSO	Upon completion of the B.Sc. Degree Programme, 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 4
PSO - 2	apply the mathematical knowledge and skills to develop problem solving skills cultivating logical thinking and face competitive examinations with confidence.	PO 3, 4
PSO - 3	develop entrepreneurial skills based on ethical values, become empowered and self-dependent in society.	PO 1,2
PSO - 4	enhance numerical ability and address problems in interdisciplinary areas which would help in project and field works.	PO 1
PSO - 5	pursue scientific research and develop new findings with global impact using latest technologies.	PO 4

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 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 (CIA).

Components of the B.Sc. Mathematics Programme

Part III - Major and Allied

Major	Core – Theory	(13 x 100)	1300
	Project	(1x100)	100
	Elective	(2x100)	200
Allied (I &II)	Theory	(4 x100)	400
	Practical	(1x 100)	100
	Total Courses		21
	Total Marks	(21x100)	2100

Course Structure

Distribution of Hours and Credits

Course	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem. VI	Total	
							Hours	Credits
Part I – Language	6 (4)	6 (4)	6 (4)	6 (4)	-	-	24	16
Part II - English	6 (4)	6 (4)	6 (4)	6 (4)	-	-	24	16
Part-III								
Major Core	6(4)	6(4)	6(4) + 5(4)	6(5) + 5(4)	6 (5) + 6 (5) + 6 (4)	6 (5) + 6 (5) + 5 (4) + 5 (4)	74	57
Major Elective	-	-	-	-	5 (4)	6 (4)	11	8
Major Project	-	-	-	-	5 (5)	-	5	5
Allied	6 (4)	6(4)	5(5)	5(5)	-	-	24	16
Part IV								
Add-on Course (Professional English)	2 (2)	2 (2)	2 (2)	2 (2)	-	-	8	8
NME (Non-Major Elective)	2 (2)	2 (2)	-	-	-	-	4	4
SEC (Skill Enhancement Course)	2 (2)	2 (2)	-	-	-	2 (2)	6	6
AEC (Ability Enhancement Course)	-	-	-	-	2 (2)	-	2	2
Total	**30 (22)**	**30 (22)**	**30 (23)**	**30 (24)**	**30 (25)**	**30 (24)**	**180**	**140**
Non-Academic Course								
Part V								
FC – I (Values for Life)	-	(1)	-	-	-	-	-	1
FC – II (Personality Development)	-	-	-	(1)	-	-	-	1
FC–III (Human Rights Education)	-	-	-	-	(1)	-	**-**	1

FC –IV (Gender Equity Studies)	-	-	-	-	-	(1)	-	1
SLP-Community Engagement Course	-	(1)	(1)	-	-	-	-	2
SLP-Extension activity (RUN)	-	-	(1)	(1)	-	-	-	2
STP - Clubs & Committees / NSS	-	(1)	-	(1)	-	-	-	2

Total number of Hours   = 180

Total number of Compulsory Credits   = 140+10

Non-Academic Courses are mandatory and conducted outside the regular working hours.

Skill Development Programme (Mandatory Certificate Course - 30 hours) is offered to all I year students.

Courses Offered

Semester	Course	Course Code	Title of the Course	Hours/ Week	Credits
I	**Part I**	TL2011 FL2011	Language:Tamil / French	6	4
	Part II	GE2012/ GE2111	General English	6	4
	Part III	MC2011	Major Core I: Differential Calculus and Trigonometry.	6	4
		MA2011	Allied I: Algebra and Calculus (for Physics and Chemistry)	6	4
	Part IV	APS201	Add-on Course : Professional English for Physical Sciences I	2	2
		MNM201	Non Major Elective Course (NME): Quantitative Aptitude - I	2	2
		SEC201/ SEC202	Skill Enhancement Course (SEC): Meditation and Exercise / Computer Literacy	2	2
	Part V	FCV201	Foundation Course I:Values for Life	-	-
		STP201	Student Training Programme (STP): Clubs & Committees / NSS	-	-
II	**Part I**	TL2021 FL2021	LanguageTamil French	6	4
	Part II	GE2022 / GE2121	General English	6	4
	Part III	MC2021	Major Core II: Classical Algebra and Integral Calculus	6	4
		MA2021	Allied II: Vector Calculus and Differential Equations (for Physics and Chemistry)	6	4
	Part IV	APS202	Add-on Course - Professional English for Physical Sciences II	2	2

		MNM202	Non Major Elective Course (NME): Quantitative Aptitude II	2	2
		SEC201/ SEC202	Skill Enhancement Course (SEC):Meditation and Exercise / Computer Literacy	2	2
	Part V	FCV201	Foundation Course I - Values for Life	-	1
		SLP201	Service Learning Programme(SLP): Community Engagement Course	-	-
		STP201	Student Training Programme (STP): Clubs & Committees / NSS	-	-
III	**Part I**	TL2031 FL2031	Language: Tamil French	6	4
	Part II	GE2031 / GE2131	General English	6	4
	Part III	MC2031	Major Core III: Differential Equations and Vector Calculus	6	4
		MC2032	Major Core IV: Real Analysis I	5	4
		MA2031	Allied III: Probability Theory and Distributions	5	5
	Part IV	APS203	Add-on Course - Professional English for Physical Sciences III	2	2
	Part V	FCV202	Foundation Course II: Personality Development	-	-
		SLP201	Service Learning Programme (SLP): Community Engagement Course	-	2
		SLP202	Service Learning Programme (SLP): Extension Activity (RUN)	-	-
		STP201	Student Training Programme (STP): Clubs & Committees / NSS	-	-
	Part I	TL2041/ FL2041	Language: Tamil French	6	4

IV	**Part II**	GE2041/ GE 2141	General English	6	4
	Part III	MC2041	Major Core V:Groups and Rings	6	5
		MC2042	Major Core VI: Analytical Geometry of 3 Dimensions	5	4
		MA2041	Allied IV: Applied Statistics	5	5
	Part IV	APS204	Add-on Course : Professional English for Physical Sciences IV	2	2
	Part V	FCV202	Foundation Course II: Personality Development	-	1
		SLP202	Service Learning Programme (SLP): Extension Activity (RUN)	-	2
		STP201	Student Training Programme (STP): Clubs & Committees / NSS	-	2
V	**Part III**	MC2051	Major Core VII: Linear Algebra	6	5
		MC2052	Major Core VIII: Real Analysis II	6	5
		MC2053	Major Core IX: Computer Oriented Numerical Methods	6	4
		MC20PR	Major - Project	5	5
		MC2055 MC2056 MC2057	Elective I (a) Graph Theory (b) Fuzzy Mathematics (c) Object Oriented Programming with C++	5	4
	Part IV	AEC201	AEC - Ability Enhancement Course: Environmental Studies	2	2
	Part V	FCV203	Foundation Course III: Human Rights Education (HRE)	-	1

		MC2061	Major Core X:Complex Analysis	6	5
		MC2062	Major Core XI: Mechanics	6	5
		MC2063	Major Core XII: Number Theory	5	4
	Part III	MC2064	Major Core XIII: Linear Programming	5	4
VI		MC2065 MC2066 MC2067	Elective II: (a) Astronomy (b) Boolean Algebra (c) Web Designing with HTML	6	4
	Part IV	SEM203	Skill Enhancement Course (*SEC) : Mathematics for Competitive Examination	2	2
	Part V	FCV204	Foundation Course IV: Gender Equity Studies	-	1
			TOTAL	**180**	**140+10**

*SEC (Mathematics for Competitive Examination) for the VI semester is offered for the students of the Department of Mathematics, to trigger their interest in quantitative aptitude and prepare them for Competitive Examinations.

NME (Quantitative Aptitude - I & II) for the I & II semesters is offered to the students of other departments to develop the quantitative aptitude needed for various Competitive Examinations. Students must have studied Mathematics as one subject in Higher Secondary to opt for this.

Project:
Project is introduced in the V Semester as one of the core subjects to make the students learn different mathematical concepts independently in teams and present the report with confidence.

Self-Learning - Extra Credit Courses

Semester	Course code	Title of the Course	Hours/week	Credit
III / V	MC20S1	Discrete Mathematics - I	-	2
IV/ VI	MC20S2	Discrete Mathematics - II	-	2
III -VI	-	Online Courses	-	1

Value Added Courses

Sl.No.	Course Code	Title of the Course	Total Hours
1	VAM201	Quick Arithmetic for Competitive Examinations	30
2	VAM202	Training for TNPSC and other Government Examinations	30

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
Continuous Internal Assessment (2)	5	5	5	5	5	5
Quiz (2)	1	1	1	1	1	1
Class Test (3)	3	3	3	3	3	3
Assignment / Group discussion / Problem Solving	6	6	6	6	6	6
Total Hours	**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
Continuous Internal Assessment (2)	5	5	5	5
Quiz	1	1	1	1
Class Test	3	3	3	3
Problem Solving / Assignment/ Group discussion	6	6	6	6
Total Hours	**75**	**90**	**90**	**75**

Examination Pattern

Part III (Major/ Elective/ Allied)

Ratio of Internal and External= 30:70

Internal Components and Distribution of Marks

Components	Marks
Continuous Internal Assessment (2)	15
Quiz (2 quizzes)	4
Class Test (3)	6
Class assignment/ Home assignment/ Field assignment/ Article review/ Group discussion/ Problem solving	5
Total	**30**

Question Pattern – External Examination

Internal Test	Marks	External Exam	Marks
Part A 4 x 1	4	Part A 10 x 1 (No choice)	10
Part B 3 x 4	12	Part B 5 x 4 (Internal choice)	20
Part C 3 x 8	24	Part C 5 x 8 (Internal choice)	40
Total	**40**	**Total**	**70**

Project

Distribution of marks for project

Internal : External = 40 : 60

Internal Components

Internal Viva = 20 marks

Regularity and Systematic work = 20 marks

External Components

Dissertation = 30 marks

Innovation = 10 marks

Presentation and Viva = 20 marks

Part IV (**Add-on Course/ Non Major Elective (NME)/ SEC/ AECC**)

Ratio of Internal and External – 50:50

a) **Add-on Course- Professional English**

Internal Components and Distribution of Marks

Internal Components	Marks
Listening	25
Speaking and Reading	25
Total	**50**

Question pattern for External Examination

External Exam	Marks
Part A 5 x 1 (No Choice)	5
Part B 5 x 3 (Internal Choice)	15
Part C 5 x 6 (Internal Choice)	30
Total	**50**

b) **Non – major Elective (NME)**

Internal Components and Distribution of Marks

Internal Components	Marks
Continuous Internal Assessment (2)	20
Quiz (2 quizzes)	15
Home assignment / Group discussion / Problem solving	15
Total	**50**

Question Pattern for Internal & External Examination

Internal Test	Marks	External Exam	Marks
Part A 4 x 1 (No Choice)	4	Part A 5 x 1 (No Choice)	5
Part B 3 x 4 (Internal Choice)	12	Part B 5 x 3 (Internal Choice)	15
Part C 3 x 8 (Internal Choice)	24	Part C 5 x 6 (Internal Choice)	30
Total	**40**	**Total**	**50**

c)   Skill Enhancement Course (SEC) - Computer Literacy

Internal Component

Component	Marks
Objective type questions (30x1)	30
Exercise (Book) compulsory (2x10)	20
Total	**50**

External Component

Component	Marks
Exercise 1	20
Exercise 2	10
Procedures for both Exercises	20
Total	**50**

Skill Enhancement Course (SEC) - Meditation and Exercise

Internal Component

Component	Marks
Objective type questions (20x1)	20
Exercise (2x10)	20
Assignment	10
Total	**50**

External Component

Component	Marks
Quiz	20
Written assessment (Questions are of open choice 15 questions 3 marks each – answer any 10 (10x3)	30
Total	**50**

d) Ability Enhancement Course (AEC) - Environmental Studies

Internal Component

Component	Marks
Project Report	30
Viva voce	20
Total	**50**

External Component

Component	Marks
Quiz	20
Written Test (Questions are of open choice 15 questions 3 marks each – answer any 10 (10x3)	30
Total	**50**

Part V

Foundation course

Ratio of Internal and External = 50: 50

a) Value Education I

Internal Component

Component	Marks
Song, Mime, Skit	20
Book Activities	20
A Kind Action	10
Total	**50**

External Component

Component	Marks
Quiz	20
Written Test Part A 5x2 = 10 Part B 5x4 = 20	30
Total	**50**

b) Value Education II

Internal Component

Component	Marks
Exercise from book	20
Skit	10
Group Album	20
Total	**50**

External Component

Component	Marks
Quiz	20
Written Test Part A 5x2 = 10 Part B 5x4 = 20	30
Total	**50**

c) **Human Rights Education / Gender Equity Studies**

Internal Component

Component	Marks
Album on current issues	20
Group Song, Mime, Skit	10
Open book test	20
Total	**50**

External Component

Component	Marks
Quiz	20
Written Test (Questions are of open choice 15 questions 3 marks each – answer any 10 (10x3)	30
Total	**50**

d) SLP -Community Engagement Course (CEC) /Unnath Bharath Abhiyan(UBA)

Field Work – 15 hrs; Class Hours – 15 hrs

Internal Component

Component	Marks
Assignment	10
Group Discussion	10
Attendance	30
Total	**50**

External Component

Component	Marks
Project Report / Case Study(10-15 pages in print)	50
Total	**50**

e) SLP – Service Learning Programme: Reaching the unreached Neighbourhood
- 60 Hours programme – Reaching the unreached Neighbourhood (RUN) Programme with one credit - included in the curriculum.
- If a student fails, she is not eligible to get the degree.

f) STP – Student's Training Programme
- Compulsory for all I & II year students.
- Clubs and Committees – Eco Club, YRC, Rotaract Club, NSS/ RRC, AICUF, Consumer Club, Legal Literacy and Women's Cell.
- Each student can opt for one of the clubs/ committees.

Semester I   **I**

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

Course Code   **: MC1711**

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

Objectives

1. To impart knowledge on applications of Differential Calculus and important conceptsof 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 - 5	U, E
CO – 5	categorize the methods of finding the sum of trigonometric series.	PSO - 4	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 asymptote - 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. & ThangaPandi Issac, A. (2014). Sequences and Series & Trigonometry.New Gamma Publishing House.

3. Rawat,K S. (2005). Trigonometry. Sarup & Sons.

4. Duraipandian, P. & KayalalPachaiappa. (2009). Trigonometry, Muhil Publishers.

5. Joseph A. Mangaladoss. (2005). Calculus. Presi - Persi Public

Allied I- Algebra and Calculus (Allied for Physics & Chemistry)

Course Code: MA2011

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4	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, 3	Ap
CO – 3	revise the properties of eigen values of the matrices.	PSO - 1	E
CO – 4	learn Beta, Gamma functions and evaluate integrals using them.	PSO - 4	E, U
CO – 5	practice the expansion of Fourier series and utilize the same for higher studies.	PSO - 4	Ap

Unit I

Theory of equations - Formation of equations - Polynomial equations with real coefficients - Rational roots - Irrational roots - Complex roots - Relation between roots andcoefficients - 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 method andHorner's method to find a root approximately.

Unit III

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

Unit IV

Beta and Gamma functions - Properties and results - 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. (Simple problems only)

Text Books:

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

   Part II: Chapters 4 and 5.

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 BookCompany.
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.

Add on Course- Professional English for Physical Sciences-I

Course Code: APS201

No. of Hours per Week	Credit	Total No. of Hours	Marks
2	2	30	100

Objectives

1. To develop the language skills of students by offering adequate practice in professional contexts
2. To develop strategic competence that will help in efficient communication

Course Outcome

CO	Upon completion of this course students will be able to	PSO Addressed	CL
CO - 1	recognise their own ability to improve their own competence in using the language	**PSO - 1**	U
CO - 2	use language for speaking with confidence in an intelligible and acceptable manner	**PSO - 6**	E
CO - 3	understand the importance of reading for life	**PSO - 1**	U
CO - 4	Understand the importance of writing in academic life	**PSO - 1**	U
CO - 5	Write simple sentences without committing error of spelling or grammar	**PSO - 7**	An

Unit I Communication:

1. Listening to Audio Text & answering Questions

2. Pair Walk

3. Comprehension passage

4. Developing a story with pictures

5. Vocabulary

Unit II Description:

1. Listening to Process Description – Online shopping

2. Speaking – Role play – sample 1

3. Reading Passages on Products

4. Process Description – Compare & Contrast

5. Vocabulary

Unit III Negotiation Strategies:

1. Listening to interviews of specialists

2. Brain Storming (Mind mapping)

3. Economic System (Longer Reading Text)

4. Why learn the skill of writing an essay

5. Vocabulary

Unit IV Presentation Skill:

1. Listening to Lecture – I

2. Short Talks – I

3. Reading comprehension – passage I

4. Writing Recommendations

5. Vocabulary

Unit V Critical Thinking Skills:

1. Listening Comprehension

2. Speaking – Making Presentation – Task 1 & 2

3. Reading – Comprehension Passages, Note making

4. Writing - Problem & Solution Essays, Creative writing

5. Vocabulary

Reference Book

1. TANSCHE (2020). Professional English for Physical Sciences, First edition

Quantitative Aptitude - I (NME)

Course Code: MNM201

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 students will be able to	PSO Addressed	CL
CO - 1	apply BODMAS rule for simplification and determine missing numbers in a sequence	PSO - 1	R
CO - 2	express numbers in the base of a fraction of 100.	PSO - 2	U
CO - 3	employ the problems related to the division of profit and loss of a business.	PSO - 4	Ap
CO - 4	measure the relative magnitude of two quantities in an effective way.	PSO - 2	C
CO - 5	construct and develop mathematical solutions to simple real life problems.	PSO - 1	Ap
CO - 6	learn ratio and proportion and practice duplication and triplication of ratios	PSO - 4	U, Ap

Unit I

Simplification - BODMAS rule - Modulus of a real number - Missing numbers in the expression.

Unit II

Percentage **-** Concepts of Percentage – Results on Population.

Unit III

Profit and Loss – Cost price – Selling Price – Profit or Gain – Loss – gain percentage - loss percentage.

Unit IV

Ratio and proportion – Fourth, third and mean proportional – comparison of ratios, compound ratio – duplicate and sub duplicate ratio- triplicate and sub triplicate ratio – variation.

Unit V

Partnership – Ratio of Division of Gains - Working and Sleeping partners – Chain Rule - Direct proportion – Indirect proportion.

Text Book:

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

Chapter: 4 (Examples 1- 20).
Chapter: 10 (Examples 1- 17).
Chapter: 11 (Examples 1- 15).
Chapters 12, and 13

Reference Books:

1. Abhijit Guha. (2006). Quantitative Aptitude for Competitive Examination. (4th Edition). Tata McGraw - Hill Education Private Limited.

2. Immaculate, M. (2009). Mathematics for Life. Nanjil offset Printers.

3. Arun Sharma. (2008). Objective Mathematics. (2#$ 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. (6th Revised Edition). Pragati Prakashan Educational Publishers.

Skill Enhancement Course (SEC): Computer Literacy
Course Code: SEC202

No. of Hours per Week	Credits	Total no. of hours	Total marks
2	2	30	100

Objective:

To enable students to understand the basic working of MS office which includes MS word, excel and power point

Unit I

Microsoft Word: Starting MS-Word – Introduction to word 2007 user interface – Understanding document views – Creating a new document – Saving a file – Printing a document – Opening an existing file – Microsoft word 2007 basic features.

Unit II

Formatting text – Formatting paragraphs – Graphics – Tables – Page Setup – Bullets and Numbering – Columns and Ordering – Text Boxes – Mail Merge.

Unit III

Microsoft Excel: Starting MS- Excel – Introduction to Excel 2007 user interface – Creating a New workbook – Saving a workbook – Opening an Existing workbook – Entering data into a cell – Selecting cells – Entering data using autofill – Using merge & center – Sorting data – Creating a table – Formatting a table.

Unit IV

Adjusting cell data alignment – Changing cell data orientation - Adding borders to cell – Basic operations on worksheet – Advanced operations on worksheets – Resizing columns and rows in a worksheet – Using formulas and functions – Charts.

Unit V

Microsoft PowerPoint: The PowerPoint window – PowerPoint views – Create a new presentation - Changing a slide layout – Inserting text on a new slide – Inserting a new slide – Rearrange the order of slides – Delete a slide – Save a presentation – Applying themes to a

presentation – Change background style – Creating a textbox – Format textboxes – Add an image – Format an image – WordArt – Slide transitions – Slide animation - Setup slide show.

Text Book

1. J. Anto Hepzie Bai & S. J. Jenepha Mary, ‒Step into Microsoft Office 2007‖.

LAB EXERCISES

MS WORD

1. Design an Invitation
2. Design a Book Cover
3. Prepare a Calendar
4. Mail Merge

MS EXCEL

1. Mark Sheet Preparation
2. Chart
3. Macro
4. Built-in Functions

MS POWERPOINT

1. Creating Resume
2. Birthday Greeting Card

Semester I & II

Foundation Course I - Values for Life

Course Code: FCV201

No. of hours per week	Credit	Total no. of hours	Marks
1	1	30	100

Objectives:

1. To inculcate the importance of values among the students
2. To instill personal, family, social and religious values among the learners
3. To equip them as responsible human beings

Course Outcome

CO	Upon completion of this course, the students will be able to	PSO Addressed	CL
CO-1	understand the human values, its importance and components	PSO-	U
CO-2	apply the values learnt in real life situation	PSO-	Ap
CO-3	comprehend the different personal values and its components	PSO-	U
CO-4	realize the personal values and to practice them	PSO -	Ap
CO - 5	understand the family values	PSO -	U

Unit I

Values – meaning- definition –value education - importance – objectives – essence – components- process - issues to be taught – benefits – significance of values in the present scenario - core value concerns – role of educators

Unit II

Personal Values – importance – purpose – factors that form personal values – components - assistance, truth, hard work, perseverance, respect for elders and teachers.

Unit III

Family Values - types – selfless love and service, sacrifice, Affection, gratitude, sharing humanity, kindness, peace, obedience - Infatuation – love – marriage – relationship Familial love – brotherly love – sisterly love – parental love – definition – quotes from title

Unit IV

Social values – function – benefits - Components – honesty, integrity, compassion, empathy, commitment, responsibility, discipline, punctuality, respect, courtesy, dedication, attitude.

Unit V

Religious values – faith, belief, forgiveness, surrender - Prayer – definition – components – types, benefits - God's love and protection – relevant quotes and reflections.

Text Book

Ed. Jansi, Mary, Jeyaseeli, Mary Helen Stella and Anitha Malby. Values for Life. Saras Publication, Nagercoil.

Major Core II- Classical Algebra and Integral Calculus

Course Code: MC2021

No. of Hours perWeek	Credits	Total No. of Hours	Marks
6	4	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 - 2	U
CO – 3	choose appropriate method for transformation of equations	PSO - 4	Ap
CO – 4	develop the skill of evaluation of double and triple integrals over different regions	PSO - 3	Ap
CO – 5	identify Beta, Gamma functions and utilize them for the evaluation of definite integrals	PSO - 5	Ap,E
CO – 6	develop the Fourier Series expansion in any interval and apply the same for solving technical and physical problems	PSO - 4	Ap, An

Unit I

Preliminaries - Fundamental theorem of Algebra - Relations between roots and coefficients - Symmetric functions of the roots - Sum of rth 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 - Horner's method.

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, 6.30.

2. Arumuga, 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 II

Allied II-Vector Calculus and Differential Equations (Allied for Physics & Chemistry)

Course Code: MA2021

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

Objectives:

1. To introduce the concept of vector operators
2. To impart the mathematical knowledge essential for solving problems inPhysical 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 - 4	Ap
CO - 3	find the complementary function and particular integral of a differential equation by using appropriate methods.	PSO - 2	Ap
CO - 4	use computational tools to solve problems and applications of partial differential equations of first order.	PSO - 5	E
CO - 5	use Laplace transform and their inverse to solve differential equations.	PSO - 4	Ap

Unit I

Vector differentiation - Gradient - Divergence and curl - Directional Derivative - Normal to a surface - Solenoidal, irrotational and harmonic vectors.

Unit II

Vector integration - Work done by a force - Evaluation of line integrals and surface integrals - Green's and Stokes theorems (Statement only) with problems

Unit III

Linear differential equation with constant coefficients - Particular integrals of the form e^{ax}, $\sin ax$, $\cos ax$, x^n, $e^{ax} f(x)$, $x^n f(x)$ - 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 Transform of standard functions and simple properties - Inverse Laplace transform of standard functions and simple properties - Solution of differential equation using Laplace Transform (excluding the solution of simultaneous differential equations).

Text Books:

1. Arumugam.S., &Thangapandi Issac, A. (2014). Analytical Geometry 3D and VectorCalculus. Palayamkottai, New Gamma Publishing House.

   Chapter 5: Chapter 7: Sections 7.1 and 7.3.

2. Arumugam. S., & Thangapandi Issac, A. (2011). Differential Equations and Applications. Palayamkottai, New Gamma Publishing House.

   Chapter 2: Sections 2.1 to 2.4; Chapter 3; Chapter 4: Sections 4.1 to 4.3.

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.

Add on Course- Professional English for Physical Sciences-II

Course Code: APS202

No. of Hours per Week	Credit	Total No. of Hours	Marks
2	2	30	100

Objectives:

1. To develop the language skills of students by offering adequate practice in professional contexts

2. To develop strategic competence that will help in efficient communication

Course Outcome

CO	Upon completion of this course, students will be able to	PSO Addressed	CL
CO - 1	recognise their own ability to improve their own competence in using the language	PSO - 1	U
CO - 2	use language for speaking with confidence in an intelligible and acceptable manner	PSO - 6	Ap
CO - 3	understand the importance of reading for life	PSO - 1	U
CO - 4	Understand the importance of writing in academic life	PSO - 1	U
CO - 5	write simple sentences without committing error of spelling or grammar	PSO - 7	An

Unit I Communication:

1. Listening to instruction
2. Small Group Work
3. Comprehension- Difference between facts & opinions
4. Developing a short poem with pictures
5. Vocabulary

Unit II Description:

1. Listening to Process Description - Cartographic Process
2. Speaking – Role play – sample 2
3. Reading Passages on Equipment's & gadgets
4. Paragraph: Sentence Definition & Extended Definition, Free writing
5. Vocabulary

Unit III Negotiation Strategies:

1. Listening to interviews of inventors in fields
2. Small Group Discussion – Specific
3. Longer reading text –The Art of Loving
4. Essay Writing – Solidarity
5. Vocabulary

Unit IV Presentation Skill:

1. Listening to Lecture – 2
2. Short Talks – Poverty and the need to alleviate it
3. Reading comprehension – passage 2
4. Interpreting Visual Inputs
5. Vocabulary

Unit V Critical Thinking Skills:

1. Listening for Information
2. Making Presentation task 3& 4
3. Motivational Articles on Professional Competence, Professional Ethics & Life Skill
4. Problem & Solution Essays, Summary Writing
5. Vocabulary

Reference Book

1. TANSCHE (2020). Professional English for Physical Sciences, First edition

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Semester II

Quantitative Aptitude - II (NME)

Course Code: MNM202

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No. of Hours per Week	Credit	Total No. of Hours	Marks
4	2	60	100

Objectives

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

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Course Outcome

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CO	Upon completion of this course the students will be able to	PSO addressed	CL
CO - 1	frame equations and solve problems involving ratios and fractions.	PSO - 2	Ap
CO - 2	calculate the area and compare the objects on the basis of their size and area.	PSO - 1	Ap
CO - 3	change the form of the number using logarithm and make tedious and confusing calculations simple.	PSO - 4	An
CO - 4	have sufficient knowledge about the basis of calculation.	PSO - 2	U, Ap
CO - 5	study the concept related to time, speed and distance.	PSO - 4	Ap

Unit I

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

Unit II

Problems on Trains - time taken by a train to cover l metres, $l + b$ metres – relation between a train and stationary/moving body.

Unit III

Compound Interest - interest compounded annually, half yearly and quarterly, different rates for different years.

Unit IV

Logarithms - properties of Logarithms - common Logarithms.

Unit V

Area - Results on Triangles- Pythagoras theorem, median, centroid, area of a triangle and rectangle.

Text Book:

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

Chapter 7: Examples 1-7 and 10; Chapter 18: Examples 1-5, 8 and 9

Chapter 22: Examples 1-10, except 22B; Chapter 23: (Examples 1-6)

Chapter 24: Examples 1 – 7 and 13-20

Reference Books:

1. Abhijit Guha. (2006). Quantitative Aptitude for Competitive Examination. (4th 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. (6th Revised Edition). Pragati Prakashan Educational Publishers

Skill Enhancement Course (SEC): Meditation and Exercise

Course Code: SEC 201

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

Objectives

1. To promote good - health and emotional stability among students
2. To increase relaxation of body and mind
3. To equip the students with traditional understanding of yogasanas and meditation
4. To prevent stress-related health problems

Unit I: Physical Health

Physical Structure of Human Body- Five Factors to Balance in Life- Nadisuthi-Neuro- Muscular Breathing Exercises - Eye exercises - Kapalabathi.

Unit II: Yogasanas

Surya Namaskar- Eka Pada Asana **(Viruchchasana) -** Chakrasana (sideways) - Uthkadasana - Padmasana- Vajrasana- Pachi Mothasana- Navasana- Pavana Mukthasana- Salabhasana- Dhanurasana- Makkarasana.

Unit III: Mind

Mind-Mental frequency- Meditation- Benefits of Meditation.

Unit IV: Personality Development

Analysis of Thought - Six roots for thought – Introspection for analysis of thought - Practical technique for analysis of thought - Moralization of desire - Analysis of desire - Practical technique for moralization of desire.

Unit V: Human Resources Development

Eradication of worries- Analyse your problems and eradicate worry - Practical exercise to eradicate worries- Benefits of Blessings - Effect of good vibrations - practicing blessing a daily habit.

Text Book:

Value Education - Vision for Wisdom World Community Service Centre, Aliyar.

Reference books:

1. Handbook on Yoga-N.C. Narayanan
2. Simplified Physical Exercises - ThathuvagnaniVethathiri Maharishi
3. Mind - ThathuvagnaniVethathiri Maharishi
4. Yoga for modern age - ThathuvagnaniVethathiri Maharishi.
5. Yogasanas-- Vision for Wisdom World Community Service centre, Aliyar.

Semester II & III

Service Learning Programme (SLP): Community Engagement Course

Course Code: SLP201

Credits	Total No. of Hours	Total Marks
2	**30 (15 classroom + 15 field)**	**100 (50 + 50)**

Objectives:

1. To develop an appreciation of rural culture, life-style and wisdom among students
2. To learn about the status of various agricultural and rural development programme
3. To understand causes for rural distress and poverty and explore solutions for the same
4. To apply classroom knowledge of courses to field realities and there by improve quality of learning

Learning Outcomes:

After completing this course, student will be able to

1. Gain an understanding of rural life, culture and social realities

2. Develop a sense of empathy and bond so mutuality with local community

3. Appreciate significant contributions of local communities to Indian society and economy

4. Learn to value the local knowledge and wisdom of the community

5. Identify opportunities for contributing to community's socio-economic improvements

Credit: 2credits, 30hours, at least 50% in field, compulsory for all students.

Contents:

Course Structure: 2 Credits Course (1Credit for Classroom and Tutorials and 1 Credit for Field Engagement)

S. No.	Module Title	Module Content	Assignment	Teaching/ Learning Methodology	No. of Classes
1	**Appreciation of Rural Society**	Rural lifestyle, rural society, caste and gender relations, rural values with respect to community, nature and resources, elaboration of ‒soul of India lies in villages'(Gandhi), rural infrastructure	Prepare a map (physical, visual or digital) of the village you visited and write an essay about inter-family relations in that village.	Class room discussions Field visit** Assignment Map	2 4 2
2	**Understanding rural economy & livelihood**	Agriculture, farming, land ownership, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural markets	Rural household economy, its challenges and possible pathways to address them	Field visit** Group discussions in class Assignment	3 4 1
3	**Rural Institutions**	Traditional rural organisations, Self-help Groups, Panchayat raj institutions (Gram Sabha, Gram Panchayat, Standing Committees), local civil society, local administration	How effectively are Panchayat raj institutions functioning in the village? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual)	Classroom Field visit** Group presentation of assignment	2 4 2
4	**Rural Development Programmes**	History of rural development in India, current national programmes: Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awaas Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA etc.	Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community; give suggestions about improving implementation of the programme for the rural poor.	Classroom Each student selects one program for field visit** Written assignment	2 4 2

**Recommended field-based practical activities:

- Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities
- Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the worksite
- Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures
- Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP)
- Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization
- Visit Rural Schools/ mid-day meal centres, study Academic and infrastructural resources and gaps
- Participate in Gram Sabha meetings, and study community participation
- Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries
- Attend Parent Teacher Association meetings and interview school dropouts
- Visit local Anganwadi Centre and observe the services being provided
- Visit local NGOs, civil society organisations and interact with their staff and beneficiaries,
- Organize awareness programmes, health camps, Disability camps and cleanliness camps
- Conducts oil health test, drinking water analysis, energy use and fuel efficiency surveys
- Raise understanding of people's impacts of climate change, building up community's disaster preparedness
- Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants
- Formation of committees for common property resource management, village pond maintenance and fishing

Teaching & Learning Methods

- A large variety of methods of teaching must be deployed:
- UGC will prepare an ICT based MOOC for self-paced learning by students for the1 credit to be conducted in the classroom.
- Reading & classroom discussions, Participatory Research Methods & Tools, Community dialogues, Oral history, social and institutional mapping, interactions with elected panchayat leaders and government functionaries, Observation of Gram Sabha, Field visits to various village institutions.

Recommended Readings Books:

1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, NewDelhi,2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs/
4. M.P. Boraian, Best Practices in Rural Development**,** Shanlax Publishers, 2016.

Journals:

1. Journals of Rural development, (published by NIRD & PR Hyderabad)
2. Indian Journal of Social Work, (by TISS, Bombay)
3. Indian Journal of Extension Education (by Indian Society of Extension Education)
4. Journal of Extension Education (by Extension Education Society)
5. Kurukshetra (Ministry of Rural Development, GoI)
6. Yojana (Ministry of Information and Broadcasting, GoI)

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VALUE ADDED COURSE

Quick Arithmetic for Competitive Examinations

Course Code: VAM201

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Unit-1

Simplification, Number system, surfs and indices, cube root, square root, HCF and LCM.

Unit-2

Average, ratio and proportion, percentage, problem on ages, partnership.

Unit-3

Men and work, time and work, time and distance.

Unit-4

Mensuration, area, surface area and volume.

Unit-5

Simple interest, compound interest, profit and loss, basic algebra.

Text Book: ‒Quantitative Aptitude‖ By Agarwal.

Major Core III - Differential Equations and Vector Calculus

Course Code: MC2031

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	4	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 - 2	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 - 2	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 $e^{!''}, \sin ax, \cos ax, x^{\#}, e^{!''}f(x), x^{\#}f(x)$, 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., & ThangapandiIssac. (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. PRESIPERSI 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. DuraiPandian, P., &LaxmiDuraiPandian. (1986). Vector Analysis. Emerald Publishers.

Semester III

Major Core IV - Real Analysis I

Course Code: MC2032

No. of Hours per Week	Credits	Total No. of Hours	Marks
5	4	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	understand the basic concepts of real numbers	PSO - 1	U
CO - 2	explain and analyse the primary concepts of sequences and series of real numbers.	PSO – 1,2	An
CO - 3	define convergence and divergence of sequences and series.	PSO – 1	R
CO - 4	calculate the limit points, upper and lower limits of the sequences.	PSO – 4	Ap
CO - 5	evaluate the convergence of series using different types of tests.	PSO – 4,5	E
CO - 6	develop the skill of analyzing various sequence and series.	PSO – 4,5	C

Unit I

Preliminaries – Mathematical Induction, Finite and Infinite Sets. The Real Numbers – The algebraic and order properties of R, Absolute value and the real line.

Unit II

The Real Numbers – The Completeness property of R, Applications of the supremum property, Intervals.

Unit III

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

Unit IV

Sequences – Some theorems on limits, Subsequences, Limit points, Cauchy sequences, The upper and lower limits of a sequence.

Unit V

Series of Positive Terms – Infinite series, Comparison test, Kummer's test, Root test and condensation test.

Text Books:

1. Robert G. Bartle, Donald R. Sherbert (Fourth Edition), Introduction to Real Analysis, John Wiley & Sons, Inc.
   Chapter 1: Sections 1.2, 1.3; Chapter 2: Sections 2.1 – 2.5
2. Arumugam, S., & Issac. (2010). Sequences and series, 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. Goldberg. R. - Methods of Real Analysis Oxford and IBH Publishing Co. New Delhi (2000).

2. Malik S.C and Savitha Arora (1991) - Mathematical Analysis, Wiley Eastern Limited New Delhi.

3. Bali, N. B. (2005). Real Analysis. Laxmi Publications.

4. Somasundaram, D., &Choudhary, B. (2010). A first course in Mathematical Analysis. Narosa Publishing House Pvt. Ltd.

5. Gupta, S. L., & Nisha Rani. (2008). Fundamental Real Analysis. Vikas Publishing House Pvt. Ltd.

Allied III - Probability Theory and Distributions

Course Code: MA2031

No. of Hours per Week	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 –2	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 –3	An
CO - 5	apply the techniques to prove the properties of probability and related distributions	PSO –4	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 - 5	E

Unit I

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

Unit II

Random Variables - Discrete and continuous random variables - Probability density function - Distribution function - Mathematical expectations - Mean and variance.

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. (42th Edition). Sultan Chand and Sons.

Part IV

Add on Course- Professional English for Physical Sciences-III

Course Code: APS203

No. of Hours per Week	Credit	Total No. of Hours	Marks
2	2	30	100

Objectives

1. To develop the language skills of students by offering adequate practice in professional contexts
2. To develop strategic competence that will help in efficient communication

Course Outcome

CO	Upon completion of this course, students will be able to	PSO Addressed	CL
CO - 1	recognise their own ability to improve their own competence in using the language	PSO - 1	U
CO - 2	use language for speaking with confidence in an intelligible and acceptable manner	PSO - 6	Ap
CO - 3	understand the importance of reading for life	PSO - 1	U
CO - 4	Understand the importance of writing in academic life	PSO - 1	U
CO - 5	Write simple sentences without committing error of spelling or grammar	PSO - 7	An

Unit I

- Listening – Answering comprehension exercises
- Speaking – Reading passages – open ended questions
- Reading – One subject based reading of text followed by comprehension activities / exercises
- Writing – Summary writing based on the reading passages (semi-guided)

Unit II

- Listening – Announcement
- Speaking – Just a minute activities
- Reading – Analyzing Ads
- Writing –Dialogue writing

Unit III

- Listening – Listening to interviews (subject based)
- Speaking – Interview with subject teachers / professionals (using video conferencing skills)
- Reading – Selected sample of web page
- Writing – Creating web pages
- Reading Comprehension – Essay on Digital competence for academic and professional life

Unit IV

- Listening – General videos (lifestyle and values)
- Speaking –Movie review, book review
- Writing – Poster making – writing slogans / captions (subject based) Reading –Essay on creativity and imagination

Unit V

- Speaking – Presentation using Power Point
- Reading / Writing – Circulars, minutes of meeting, paraphrasing

Reference Book:

1. TANSCHE (2020). Professional English for Physical Sciences, First edition.

Foundation Course II - Personality Development

Course Code: FCV202

No. of Hours per Week	Credit	Total No. of Hours	Marks
1	1	30	100

Objectives

1. To practice personal and professional responsibility
2. To develop and nurture a deep understanding of personal motivation

Course Outcome

CO	Upon completion of this course, the students will be able to	PSO Addressed	CL
CO-1	identify various dimensions and importance of effective personality	PSO-	A
CO-2	apply the models of positive thinking in real life situations	PSO-	A
CO-3	To overcome shyness and loneliness and cope up with the society.	PSO-	Y

Unit I

Personality – Factors influencing personality – Theories on personality – Types of personality. Self-acceptance – self-awareness–self-concept – elements - self-esteem – types of self-esteem – impact of self-esteem – importance – low self-esteem.

Unit II

Self-actualization– characteristics – Positive thinking – The profile of a positive thinker – Positive attitude – Models of positive thinking. Worry – Why to worry – ways to overcome – ways to turn negative thinking into positive.

Unit III

Motivation – Sources of motivation – Types of motivation – Factors determining motivation – characteristics of motivation. Goal setting – Types of goals – ways to achieve goals. Decision making – Steps for decision making.

Unit IV

Time Management – Definition – Controversies regarding time management – importance – Ways to manage time – controlling interruption – Leisure. Leadership and team building – types –qualities of a good leader – group formation – types- responsibilities of group members – instructions to form groups. Communication – classification – verbal and nonverbal – rules – hindrance to communication.

Unit V

Process of coping or adjustments – coping – mal adjustment – frustration – types – techniques to overcome frustration. Mental stress – types – mechanism of coping – positive and negative mechanism –steps for adjustment in life – coping with shyness – loneliness – techniques to overcome shyness and loneliness.

Textbook:

Aazhumai Vazhampera – Dr. Sr. Mary Jhonsy, Dr. M. Mary Helen Stella and Dr.Anitha Malbi

Reference books:

1. Personality Development (1999). Selvaraj, Palayamkottai Community College, V.M. Chattram, Tirunelveli.
2. Resource book for Value Education (2002). Mani Jacob, Institute of Value Education, New Delhi
3. You can win (1998). Shiv Kheera, published by Rajive Beri, Macmillan India Ltd, New Delhi.
4. The seven habits of highly effective people (1990). Covey Stephen, R. Simon and Schuster, New York.
5. Change or be changed (2008). Dr. Xavier Alphonse, S. published by ICRDCE, Chennai.

Self-Learning Course

Discrete Mathematics– I

Sub. Code: MS20S1

No. of Credits	Marks
2	100

Objective:

To develop the interest of self-learning in subject oriented courses

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	understand the basic principles of relations and its examples	PSO - 2	U
CO - 2	analyze various basic logical laws in Calculus and its properties	PSO – 3,4	An
CO - 3	develop the ability to solve problems in functions	PSO - 2	Ap
CO - 4	analyze real life problems using graph theory both quantitatively and qualitatively	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 – Subgraph – Walks – Closed walk – Open walk – Path – Length of a path - Circuit – Connected Graphs – Euler Graph – Hamiltonian Graph – Subgraph.

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

Reference Books:

1. Vatsa, B.S., &SuchiVatsa (2009). Discrete Mathematics. (IV 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. (VI Edition). Krishna Prakashan Media Pvt Ltd.
4. Bernard Kolman., RobertC.Busby.,&Sharon Cutler Ross.(2009). Discrete Mathematical Structures. (VI Edition). PHI Learning Pvt Ltd.
5. Lovasz, L., Pelikan, J., &Vesztergombi, K. (2008). Discrete Mathematics Elementary and Beyond. (V Edition) Springer International Edition.

Semester IV

Major Core V - Groups and Rings

Course Code: MC2041

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	5	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 - 2	C
CO - 4	Examine the properties of Ideals-Maximal and Prime ideals-Cosets-order of an element	PSO -5	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 - 2	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. (8th Edition). Vikas Publishing House.
2. Santiago, M.C. (2011). Modern Algebra. (1st Edition). Tata McGraw Publishing Company Limited.
3. Gopalakrishnan, N. S. (2015). University Algebra. (3rd Edition). New Age International Publishers.
4. Vatsa, B. S., & Suchi Vatsa. (2010). Modern Algebra. (2th Edition). New Age International Publishers.
5. Joseph A. Gallian. (1999). Contemporary Abstract Algebra. (4th Edition). Narosa Publishing House Pvt. Ltd.

Major Core VI - Analytical Geometry - **3 Dimensions**

Course Code: MC2042

No. of Hours per Week	Credit	Total No. of Hours	Marks
5	4	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	C
CO - 3	calculate the distance between points, 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, cone etc	PSO – 1	U
CO - 6	develop the skill in 3 - dimensional geometry to gain mastery in related courses	PSO – 5	Ap

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

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.

Unit V

The equation of a surface – Cone – Right circular cone – Intersection of a straight line and a quadric cone – Tangent plane and normal – Condition for a plane to touch the quadric cone – The angle between the lines in which a plane cuts the cone –Condition that the cone has three mutually perpendicular generators.

Text Book:

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

Chapters: 1 - 4 (Except sections 8, 9 in Chapter 3); Chapter: 5, Sections: 1-7

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#$ 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.
6. Kandasamy. P. and K. Thilagavathi – Mathematics for B.Sc., Vol IV – 2004, S.Chand and Co., New Delhi.
7. Thomas, G.B. and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
8. Bell, R.J.T. Elementary Treatise on Coordinate Geometry of Three Dimensions, McMillan India Ltd., 1994.

Semester IV

Allied IV - Applied Statistics

Course Code: MA2041

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 –2	Ap
CO - 2	recall the methods of classifying and analyzing data relative to single variable	PSO –4	R
CO - 3	describe the χ^2 distribution in statistics	PSO –3	U
CO - 4	distinguish between the practical purposes of a large and a small sample	PSO –1	An
CO - 5	understand that correlation coefficient is independent of the change of origin and scale	PSO –5	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 χ^2-distribution – χ^2 test 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. (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., & J. K.Goyal. (1987). Mathematical Statistics. (11th Edition). Krishna Bakashar Mandir.
5. Robert, V., Hogg., Joseph., Mckean, W., Allen., & Craig, T. (2013). Introduction to Mathematical Statistics. (6th Edition). Dorling Kindersley (India) Pvt. Ltd.

Part IV

Add on Course- Professional English for Physical Sciences-IV

Course Code: APS204

No. of Hours per Week	Credit	Total No. of Hours	Marks
2	2	30	100

Objectives:

1. To develop the language skills of students by offering adequate practice in professional contexts
2. To develop strategic competence that will help in efficient communication

Course Outcome

CO	Upon completion of this course, students will be able to	PSO Addressed	CL
CO - 1	recognise their own ability to improve their own competence in using the language	PSO - 1	U
CO - 2	use language for speaking with confidence in an intelligible and acceptable manner	PSO - 6	Ap
CO - 3	understand the importance of reading for life	PSO - 1	U
CO - 4	Understand the importance of writing in academic life	PSO - 1	U
CO - 5	Write simple sentences without committing error of spelling or grammar	PSO - 7	An

Unit I:

- Listening – Listening to two talks / Lectures by specialists on selected subjects
- Speaking – Small Group Discussions
- Reading – One Subject Based Reading text followed by comprehension activities / exercises
- Writing – Summary writing based on the reading passages (Free Writing)

Unit II:

- Listening – Product Launch
- Speaking – Debates
- Reading – Reading Texts on advertisements (On products relevant to the subject areas) and answering inferential questions
- Writing – Writing an argumentative / persuasive essay

Unit III:

- Listening – Interview by a famous celebrity
- Speaking –Interviewing any professional / Creating Vlogs (How to become vloger and use vloging to nurture interest – subject related)
- Reading – Blog
- Writing – Blog Creation

Unit IV:

- Listening – Listening academic videos (Prepared by EMRC Other MOOC videos on Indian academic sites)
- Speaking – Making oral presentations through short films – subject based
- Reading – How is creativity possible in Science (Continuation of essay in semester III)
- Writing – Creating flyers and Brochures (Subject Based)

Unit V:

- Speaking – Presentation (Without Aids)
- Reading & Writing – Product Profiles / Writing an Introduction.

Reference Book:

1. TANSCHE (2020). Professional English for Physical Sciences, First edition

Self-Learning Course

Discrete Mathematics – II

Sub. Code: MS20S2

No. of Credits	Marks
2	100

Objective:

To develop the interest of self-learning in subject oriented courses

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	Know various types of lattices and analyze its properties	PSO – 3,4	An
CO - 2	Understand the basic principles of Boolean Algebra	PSO - 2	U
CO - 3	Interpret matrices and apply these concepts to find solutions of a system of linear equations	PSO - 4	Ap
CO - 4	Use combinatorics for suitable applications	PSO - 3	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 equality 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, SCITECH Publications, Chennai.

Chapter 4: Sections 4.1 to 4.10; Chapter 7: 7.1 to 7.10

Chapter 10: Sections 10.1 to 10.11

Reference Books:

1. Vatsa, B. S., &SuchimVatsa. (2009). Discrete Mathematics. (IV 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. (VI Edition) Krishna Prakashan Media Pvt Ltd.

4. BernardKolman., RobertC. Busby., & Sharon Cutler Ross. (2009) Discrete Mathematical Structures. (VI Edition). PHI Learning Pvt Ltd.

5. Lovasz, L., Pelikan, J., & Vesztergombi, K. (2008). Discrete Mathematics Elementary and Beyond. (V Edition). Springer International Edition.

VALUE ADDED COURSE
Training for TNPSC and other Government Examinations
Course Code: VAM202

Objective:

To face TNPSC group exams, other competitive examinations like SSE etc.

Unit I: General Science

Physics: Universe- general scientific laws - scientific instruments – inventions and discoveries, national scientific laborations – science glossary - mechanics and properties of matter – physical quantities, standards and units – force, motion and energy – electricity and magnetism - heat, light and sound.

Basic Chemistry: Elements and compounds – bases & salts fertilizers – pestilisers – pesticides, insecticides

Botany: Main concept of life science.

Zoology: Blood & Blood circulation- human diseases preventions – communicable diseases

Unit II: Geography

Earth -universe – solar system – sivers in India- forest, wild life – minerals – population density.

Unit III: History & Culture of India

Indian history – culture & heritage of Tamil people – effect of British rule on socio economic factors – social reforms & religious moments – Indian national movement.

Unit IV: Indian Polity & Indian Exonomy

Constitution of India – preamble – salient features of constitutions- parts - Nature of Indian economy – t year plan models – land reform – agriculture – financecommission – planning commission.

Unit V: Mental Ability

Simplification – numbers – ratio and proportion – percentages – profit and loss – averages and mixtures – time and work – simple interest and compound interest- geometry and mensuration – statistics – data interpretation - alpha numeric reasoning – visual reasoning.

Text Books:

1. Manorama Year Book
2. Samacheer school books.

Semester V

Major Core VII- Linear Algebra

Course Code: MC2051

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- Rank and Nullity - Matrix of a Linear Transformation.

Unit III

Characteristic Equation and Cayley-Hamilton Theorem -Eigen values and Eigen vectors- Properties of Eigen values.

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- Partially ordered set-Lattices-Distributive Lattices-Modular Lattices-Boolean Algebra.

Text Book:

Arumugam, S., &ThangapandiIssac, 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; Chapter 9 : 9.1 to 9.5.

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.
3. New Delhi: Affiliated East West Press Pvt. Ltd.
4. Gopalakrishnan, N. S. (2015). University Algebra. (3^{rd}Edition). New Age International Publishers.
5. Vatsa, B. S., &SuchiVatsa. (2010).   Modern Algebra. (2nd Edition). New Age International Publishers.
6. Aloknath Chakrabarti. (2006). A First Course in Linear Algebra. Vijay Nicole Imprints Pvt.Ltd.

Major Core VIII-Real Analysis II

Course Code: MC2052

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

Objectives:

1. To introduce Metric Spaces and the concepts of completeness, continuity, connectedness and compactness

2. To use these 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 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 - 5	An
CO - 4	use basic concepts in the development of real analysis results	PSO - 1	C
CO - 5	Understand the concepts of metric space, connectedness and compactness of metric spaces	PSO - 3	U
CO- 6	Develop the ability to reflect on problems that are quite significant in the field of analysis	PSO -2	Ap

Unit I

Metric Space - definition and examples - Bounded sets - Open ball - Opens sets – Subspace- Interior of a set - Closed sets - Closure - Limit point - Dense sets.

Unit II

Complete metric space - Cantor's intersection theorem - Baire's Category theorem, Contraction mapping- Definition and examples - Contraction mapping 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.

Unit I - Chapter 2: Sections 2.0 to 2.10

Unit II - Chapter 3: Sections 3.0 to 3.2, Chapter 8: Section 8.1 (Upto theorem 8.2)

Unit III - Chapter: Sections 4.0 to 4.4

Unit IV - Chapter: Sections 5.0 to 5.3

Unit V - Chapter: Sections 6.0 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. (2nd Edition). Springer International Edition.
5. Norman., Haaser, B., & Joseph A. Sullivan. (1971). Real Analysis. Van Nostrand Reinhold Company.

Semester V

Major Core IX- Computer Oriented Numerical Methods

Course Code: MC2053

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

Objectives:

1. To provide suitable and effective numerical methods, for computing approximate numerical values of certain raw data
2. To lay foundation of programming techniques to solve mathematical problems

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	understand the elementary programming language and its structure	PSO - 4	U
CO - 2	develop computer programmes for the solution of various numerical problems	PSO - 5	C
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

Basis structure of C programs – C Tokens – Keywords and Identifiers - Constants – Variables – Data Types – Operations and Expressions – Arithmetic Operators – Relational Operators – Logical Operators – Assignment Operators – Increment and Decrement Operators – Conditional Operators - Bitwise Operators - Special Operators – Managing Input and Output Operations – Formatted Input [Excluding Inputting Integer Numbers] - Formatted Output [Excluding Output of Integer Numbers].

Unit II

Decision making and Branching – Decision making with IF statement – Simple IF statement – The IF…. Else statements – Nesting of IF... Else statements- The GOTO statement - Decision making and Looping – The WHILE Statement – The DO Statement – The FOR Statement.

Unit III

Solutions of algebraic and transcendental equations. Iteration method - Newton Raphson method – programs in C for Newton Raphson method - Interpolation - Newton's Interpolation formulae – programs in C for Newton's Forward Interpolation and Backward Interpolation - Lagrange's Interpolation formula.

Unit IV

Numerical differentiation - derivatives using Newton's forward difference formula - Newton's backward difference formula - Numerical integration - Newton cote's - quadrature formula - Trapezoidal rule - programs in C for Trapezoidal rule.

Unit V

Simpson's (1/3) rd rule - programs in C for Simpson's one - third rule- Simpson's (3/8)th rule - Numerical solution of differential equation - Taylor's series method - Picard's method.

Text Book:

1. Programming in ANSI C, E. Balagurusamy, McGraw Hill Education (India) private Limited. (Eighth Edition)

   Chapter: 2; page: 28; Chapter: 3; pages: 41-42, 45-47; Chapter: 4; pages: 68-77

   Chapter: 5; pages: 105, 113-114; Chapter: 6; pages: 131-133,135-140, 153-154,

   Chapter: 7; pages: 173-179

   In all the chapters worked –out problems are excluded.

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

   Chapter 3: Sections 3.0, 3.2 & 3.5; Chapter 7: Sections 7.1, 7.3;

   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.

   Chapter 12: Sections 12.6, 12.13, 12.14, 12.19, 12.20

   Practical: Topics in Italics from Unit III to Unit V.

Reference Books:

1. Sastry, S.S. (2003). Introduction methods of numerical analysis. (3rd Edition). Prentice Hall of India.

2. Scar Borough, J.N. (1966). Numerical mathematical analysis. (6th Edition). Oxford and IBH Publishing Co.

3. Gupta, P. P., G.S. Malik., & Sanjay Gupta. (1992). Calculus of finite differences and numerical analysis. (16th Edition). KRISHNA Prakashan Mandir.

4. Devi Prasad. (2010). An Introduction to Numerical Anaysis. Narosa Publishing House.

5. Bhupendra Singh. (2012). Numerical Analysis. (2nd Edition). Pragati Prakashan Educational Publishers.

Semester V
Project
Course Code: MC20PR

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

Project 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

Elective I: (a) Graph Theory

Course Code: MC2055

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

Objectives:

1. To introduce graphs and the concepts of connectedness, matchings, planarity and domination

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

Basics - Graphs - Pictorial representation - Subgraphs - Isomorphism and degrees - Walks and connected graphs - Cycles in graphs - Cut-vertices and cut-edges.

Unit II

Eulerian and Hamiltonian graphs - Eulerian graphs - Fleury's algorithm (omitting theorem 2.5) - Hamiltonian graphs - Weighted graphs - Chinese Post-Man Problem - Travelling Sales-man Problem - Bipartite graphs - Trees.

Unit III

Planar graphs - Euler formula - Platonic solids - Dual of a plane graph - Characterization of planar graphs - Colourings - Vertex colouring - Edge colouring - An algorithm for vertex colouring.

Unit IV

Directed Graphs - Connectivity in digraphs - Strong orientation of graphs - Eulerian digraphs - Tournament.

Unit V

Theory of Domination in Graphs - Dominating Sets, Relationship between independent sets and dominating sets, Irredundant sets, Upper Bounds and Lower Bounds for the Domination Number (G).

Text Books:

1. S. A. Choudum, A First Course in Graph Theory, Macmillan India Ltd., 2011.
   Chapter 1: Sections 1.1 – 1.7;
   Chapter 2: Sections 2.1, 2.2 (omitting theorem 2.5), 2.3 & 2.4;
   Chapter 3: Sections 3.1 & 3.3; Chapter 5: Sections 5.1 – 5.5;
   Chapter 6: Sections 6.1 – 6.3; Chapter 7: Sections 7.1 – 7.5.
2. V. R. Kulli, (2010). Theory of Domination in Graphs. Vishwa International Publications, Gulbarga.
   Chapter 2: 2.1 – 2.4.

Reference Books:

1. Arumugam, S., & Ramachandran, S. (2017). Invitation to Graph Theory. Scitech Publications Pvt. Ltd.
2. Kumaravelu, S., & Susheela Kumaravelu. (1999). Graph Theory. (1st Edition). Printers Janki calendar corporation, Sivakasi.
3. Harary F. (1988). Graph Theory. Narosa Publishing House.
4. Gary Chartrand., & Ping Zhang. (2006). Introduction to Graph Theory. McGraw-Hill Edition Pvt. Ltd.
5. Suresh Singh, G. (2010). Graph Theory. PHI Learning Private Limited, New Delhi.

Semester V
Elective I: (b) Fuzzy Mathematics
Course Code: MC2056

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:

Hooda Vivek Raich, 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. (4th 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.

Elective I: (c) Object Oriented Programming with C++

Course Code: MC2057

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 dimensional arrays - destructors. Defining operator overloading - overloading unary operators - manipulation of string using operators.

Unit V

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

Text Book:

Balagurusamy, E. (2011). Object oriented programming with C++. (5th Edition). (TMH). TataMaGraw 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] McGraw Hill Publication.
2. Paul Deitel., & Harvey Deitel. (2013). C++ How to program. (8th Edition). PHI Learning Private Limited Publication.
3. Stanley Hoffman. (2015). C++: For Beginners. Addison - Wesley professional.
4. Bjarne Stroustrup. (2014). Programming: Principles and practice using C++. (2nd Edition). Addison - Wesley professional.
5. Scott Meyers, (2014). Effective C++. (1st Edition). O _Reilly Media.

Semester V

Part IV

Ability Enhancement Course

Environmental Studies

Course Code: AEC201

Hours per Week	Credits	Total Hours	Marks
2	2	30	100

Objectives

1. To understand the ecosystem, biodiversity and their conservation
2. To make them identify the impact of pollution, disaster and population

Course outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	understand the multidisciplinary nature of environmental studies		U
CO - 2	recall the components of different ecosystems		R
CO - 3	interpret the levels of diversity and its conservation		A
CO - 4	analyze the impact of population, pollution and disasters		An

Unit I Multidisciplinary nature and Natural Resources

Multidisciplinary nature of environmental studies – scope of environmental studies- natural resources - renewable and non-renewable resources – land, water, forest and energy resources.

Unit II Eco system

Ecosystem – components –types – structure and function – food chain – food web – major ecosystems- forest, grass land, desert and aquatic - pond, marine and river ecosystems.

Unit III Biodiversity and conservation

Definition – magnitude of biodiversity - levels of diversity – biogeographical classification of India – Biodiversity hotspots in India – Himalayas, Indo Burma, Western Ghat and Sunderland, Endemic, Endangered Red Data Book - Insitu and Exsitu conservation.

Unit IV Environmental Pollution

Pollution – types, sources and effects of air, water, soil, noise, radioactive and plastic pollutions - Role of an individual in prevention of pollution.

Unit V Social Issues and Environment

Disaster - cyclone, flood, drought, earthquake and management - Population explosion – impact of population, growth on environment and social environment.

Reference books:

1. Sharma R.C, Gurbir sangha, (2018). Environmental Studies. New Delhi: Kalyani Publishers,
2. Murugeshan. R, (2014). Environmental studies, Madurai: Millennium publishers and distributors,
3. Arumugam.N, Kumaresan.V, (2012). Environmental Studies. Nagercoil: SARAS Publication.
4. Dr. Asthana.D.K., Dr. Meera Asthana, (2010). Environmental Studies. New Delhi: S.Chand & Company Ltd.,
5. Beny Joseph, (2018). Perspectives in Environmental Studies. New Age International Publishers.

Foundation Course Ill - Human Rights Education (HRE)

Course. Code: FCV203

Objectives

1. Make them to identify issues, problems and violation of human rights

2. Resolve the problems of human rights in their own life and society

Course outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO - 1	explains the historical growth of the idea of human rights.		U
CO - 2	interpret the problems of human rights and find solution.		A
CO - 3	analyze the importance of women and child rights		An
CO - 4	evaluate concepts and ideas of human rights		E

Unit I

Social Justice - Need for Social Justice, Parameters of Social justice. Untouchability - problems, causes, casteism. Social reformers - contributions of Dr. B.R. Ambedkar and E.V. Ramasamy. Role of Mandal commissions in Social justice - Social, educational, economic indicators and recommendations

Unit II

Human Rights - approaches and concept of human rights. United Nations - UN commission on Human rights, other UN bodieson Human rights. Fundamental rights of Indian Citizen. Fundamental duties of Indian Citizen. Political rights of Indian Citizen. Human rights concern in India.

Unit III

Women Rights - History and need of women rights. United Nation on women rights - issues by identified United Nation. Women and climate change. Women rights and problems. Problem faced by women during medieval and modern India.

Unit IV

Gender inequality - seven types of   inequality. Constitutional and legal provision for women in India. Special initiatives for women. Women struggle and reforms. Women today.

Unit V

Child Rights: History and declaration of rights of children. Convention on rights of child, Child rights in India. National commission on women rights. Issues faced by women. Constitutional and Legal provision in India. Child rights in Indian Constitution.

Reference Book:

Dr. Arymugam, N., Dr. Mohana., & Lr. Palkani. (2017). Value Based Education. (4th ed.). TamilNadu, Saras Publication

Major Core X- Complex Analysis

Course Code: MC2061

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 mappings	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 – 5	C

Unit I

Analytic functions - Differentiability, Cauchy Riemann equations, sufficient conditions, complex form of Cauchy Riemann equations, polar form of Cauchy Riemann equations analytic functions, harmonic function.

Unit II

Bilinear transformations - Elementary transformations (Definitions only), Bilinear transformations, Cross ratio, fixed points of Bilinear transformations, Mapping by elementary Functions- Mappings $w = z^2$, e^z, Sinz, Cosz, Coshz.

Unit III

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

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, Argument theorem, Rouche's theorem, Fundamental theorem of algebra, Evaluation of definite integrals (Type 1 only).

Text Book:

Arumugam, S., Thangapandi Issac, A., &Somasundaram, A. (2018). Complex Analysis. Scitech publications.

Chapter 2: Sections 2.5 - 2.8; Chapter 3: Sections 3.1 - 3.4;

Chapter 5: Sections 5.1 - 5.6; 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. (1st Edition). Pragati Prakashan Educational Publishers.
2. DuraiPandian, P., Laxmi Durai Pandian., &Muhilan, D. (2001). Complex Analysis. Emerald Publishers.
3. Duraipandian, P., &Kayalal Pachaiyappa. (2014). Complex Analysis. (1st 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.

Major Core XI- Mechanics

Course Code: MC2062

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

Objectives:

1. To visualize the application of Mathematics in Physical Sciences
2. To develop the capacity to predict the effects of force and motion

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 - 5	C
CO - 4	identify internal forces and moments of a rigid body	PSO - 3	Ap
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

Unit I

Forces Acting at a Point: Resultant and Components - Sample cases of finding the resultant – Analytical expression for the resultant of two forces acting at a point – Triangle forces – Perperndicular Triangular forces – Converse of the Trigangle of Forces- The Polygon of Forces -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

Couples – Equilibrium of two couples –Representation of a couple by a vector – Resultant of coplanar couples – Resultant of couple and a force - 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: Introduction – Experimental Results - Statical, Dynamical and Limiting friction - Laws of friction - Coefficient of friction - Angle of friction - Cone of friction – Numerical values - 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

Motion under the action of central forces – Velocity and Acceleration in Polar Coordinates – Equation of Motion in Polar Coordinates – Note on the equiangular spiral – Motion under a central force – Differential Equation of central orbits – Perpendicular from the pole on the tangent – Pedal equation of the central orbit – Pedal equation of some of the well-known curves – Velocities in a central orbit – Two – fold problems in central orbits

Text Books:

1. Venkataraman, M. K. (2012). Statics. (15th Edition). Agasthiar Publications.
   Chapter 2: Sections 2.1- 2.9; Chapter 3: Sections 3.1 to 3.13;
   Chapter 4: Sections: 4.1,4.2,4.5- 4.10; Chapter 6: Sections 6.1 to 6.3(Analytical proof only), 6.5, 6.7, 6.8 &
   Chapter 7: Sections 7.1 to 7.13 (up to example 15).
2. Venkataraman, M. K. (2012). Dynamics. (15th Edition). Agasthiar Publications.
   Chapter 6: Sections 6.1 to 6.10; Chapter 11: Sections 11.1 to 11.11

Reference Books:

1. Durai Pandian, P., Lexmi Durai Pandian., & Muthamizh Jayapragasam. (2011). Mechanics. Chand S. & Company Ltd.
2. Rajeshwari, I. (2016). Mechanics. (1st 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.

Major Core XII- Number Theory

Course Code: MC2063

No. of hours per week	Credits	Total No. of hours	Marks
5	4	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 - 2	Ap
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 - 4	An
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

Unit I

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

Unit II

The Diophantine Equation - 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. (7th 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. (4th 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.

Major Core XIII- Linear Programming

Course Code: MC2064

No. of hours per week	Credits	Total No. of hours	Marks
5	4	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 methods of optimization and to solve the problems	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

Formulation of L.P.P - Mathematical Formulation of L.P.P - Solution of L.P.P - Graphical method - Simplex method - Big-M Method - Algorithm for Big-M Method

Unit II

Two phase method - Phase I: Solving auxiliary LPP using Simplex method - Phase II: finding optimal basic feasible solution- 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 III

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 – Degeneracy in Transportation Problems

Unit IV

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

Unit V

Sequencing of Jobs- Introduction- Processing n jobs in two machines- Processing n jobs in m machines- Processing two jobs in m machines

Text book:

Arumugam, S., &Thangapandi Issac, A. (2015). Operations Research (Linear Programming). (1st Edition). New Gamma Publishing house.

Chapter 3: 3.1 - 3.7, 3.9, 3.10 & 3.11; Chapter 4: 4.1 & 4.2

Chapter 5: 5.1, 5.2; Chapter 8: 8.0 to 8.3

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. (5th 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. (5th Edition). Macmillan Publishers India Ltd.

Elective II: (a) Astronomy

Course Code: MC2065

No. of hours per week	Credits	Total No. of hours	Marks
6	4	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 motion of two particles relative to the common mass centre	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

Geocentric parallax - Parallax - Effects of Geocentric parallax – Changes in R.A and Declination of a body due to Geocentric Parallax - Angular diameter – Equatorial horizontal Parallax - Heliocentric Parallax – Effect of Heliocentric Parallax – To find the effect of Parallax on the Longitude and Latitude of a Star - Parsec

Unit IV

Kepler's laws - Eccentricity of Earth's orbit –Verification of Kepler's Laws (1) and (2) - Newton's deductions from Kepler's laws – To derive Kepler's Third Law from Newton's law of Gravitation –To find the mass of a planet – To fix the position of a planet in it's elliptic orbit – Geocentric and Heliocentric latitudes and longitudes – To prove that the Heliocentric longitude of the Earth and Geocentric longitude of the Sun differ by 180°

Unit V

Two Body Problem -Introduction – Newton's Fundamental equation of Motion – Motion of one particle relative to another- The motion of the common centre of mass- Motion of two particles relative to the common mass centre – Motion of a planet with respect to the Sun

Text Book:

Kumaravelu, S., & Susheela Kumaravelu. (2012). Astronomy. (10th Edition).
Chapter 2: art 39 to Art 83; Chapter 3: Art 93 & Art 106 to 116;
Chapter 5: Art 135 to143 & 145; Chapter 6: Art 146 to 156, 164 &165;
Chapter 8: Art 190 to 194; Chapter 16: Art 321 to 326

Reference Books:

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

Semester VI

Elective II: (b) Boolean Algebra

Course Code: MC2066

No. of hours per week	Credits	Total No. of hours	Marks
6	4	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. (1st Edition). New Delhi: Affiliated 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. (3rd 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.

Elective II: (c) Web Designing with HTML

Course Code: MC2067

No. of hours per week	Credits	Total No. of hours	Marks
6	4	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.
Chapters 4: 4.1 – 4.7; 5: 5.1 – 5.7; 6: 6.1 - 6.7; 7: 7.1 – 7.5; 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

Part IV

Skill Enhancement Course

Mathematics for Competitive Examinations

Course Code: SEM203

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 ages	PSO - 1	R
CO - 2	discuss the problems on profit and loss	PSO - 1	U
CO - 3	conversion of ratio into proportion and vice versa	PSO - 2	Ap
CO - 4	analyze the problems related to chain rule	PSO - 4	An
CO - 5	evaluate time and work related problems	PSO - 4	E

Unit I

Problems on Ages.

Unit II

Profit and Loss.

Unit III

Ratio and Proportion.

Unit IV

Chain Rule.

Unit V

Time and Work.

Text Book:

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

Chapters **:** 8, 11, 12, 14 and 15

Reference Books:

1. Guha, A. (2011). Quantitative Aptitude for Competitive Examinations. (4th Edition). McGraw Hill Education. (India) Pvt. Ltd.

2. Immaculate, M. (2009). Mathematics for Life. Nanjil offset Printers.

3. Arun Sharma. (2008). Objective Mathematics. (2nd 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. (6th Revised Edition). Pragati Prakashan Educational Publish

Semester VI

Part V

Foundation Course IV- Gender Equity Studies

Course Code: FCV204

No. of Hours per Week	Credits	Total No. of Hours	Marks
1	1	15	100

Objectives:

1. To understand the historical background and trace the position of women down the ages

2. To make the students aware of the legitimate rights and laws that aid women to march towards emancipation and empowerment

Course outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO-1	develop a critical judgment regarding the views of religions, epics and literary imagination about women	PSO-4	U
CO-2	analyze the socio-cultural and religious practices that subjugate women	PSO-4	An
CO-3	probe deep into the root cause of marginalization of women	PSO- 4	U
CO-4	understand the implementation of feministic concepts in practical life	PSO- 3	U
CO-5	examine how women are exploited as commercial commodities in advertisements and media	PSO-4	An

Unit I

Women in Historical Background

Women through the Ages

Unit II

Feminism – An Explanation

Feminist Thoughts in Practical Life

Unit III

As Religions see Women

Women in Christianity

Women in Islam

Unit IV

The Rights of Women

Women and the Constitution

Unit V

The Portrayal of Women in Advertisements

The End of Enslavement of Women

Empowerment of Women: Need of the Hour

Reference Book

Women in My Perspective. (2012). Nagercoil: HCC Women's Study Centre.

	Content addressed with Local needs
	Content addressed with National needs
	Content addressed with Regional needs
	Content addressed with Global needs

Holy Cross College (Autonomous), Nagercoil-629004

Kanyakumari District, Tamilnadu.

Nationally Re-Accredited with A+ by NAAC IV Cycle – (CGPA 3.35)

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

DEPARTMENT OF MATHEMATICS

SYLLABUS FOR POSTGRADUATE PROGRAMME

Issued from the Deans Office

(With effect from the Academic year 2020– 2021)

DEPARTMENT OF MATHEMATICS

Vision

To empower women globally competent with human values and ethics acquiring academic and entrepreneurship skills through holistic education.

Mission

- To create opportunities which will ensure academic excellence in critical thinking, humanistic and scientific inquiry.
- To develop application oriented courses with the necessary input of values.
- To create a possible environment for innovation, team spirit and entrepreneurial leadership.
- To form young women of competence, commitment and compassion.

Programme Educational Objectivities (PEOs)

PEO	Upon completion of M. Sc Degree Programme, the graduates will be able to
PEO – 1	The graduates use scientific and computational technology to solve socialissues and pursue research.
PEO– 2	The graduates will continue to learn and advance their careers in industry both in public and private sectors, government and academia.
PEO– 3	Our graduates will have the ability to apply analytical and theoretical skills to model and solve mathematical problems and work as efficient professionals.

Programme Outcomes (POs)

PO	Upon completion of M.Sc Degree Programme, the graduates will be able to
PO – 1	prepare successful professionals in industry, government, academia, research, entrepreneurial pursuits and consulting firms.
PO – 2	face and succeed in high level competitive examinations like NET, GATE and TOFEL
PO – 3	carry out internship programmes and research projects to develop scientific skills and innovative ideas.
PO – 4	utilize the obtained scientific knowledge to create eco-friendly environment.

Programme Specific Outcomes (PSOs)

PSO	Upon completion of M.Sc. Degree Programme, the graduates of Mathematics will be able to	PO Addressed
PSO – 1	utilize the knowledge gained for entrepreneurial pursuits.	PO – 1
PSO – 2	sharpen their analytical thinking, logical deductions and rigour in reasoning.	PO – 2
PSO – 3	use the techniques, skills and modern technology necessary to communicate effectively with professional and ethical responsibilities.	PO – 3
PSO - 4	Understand the applications of mathematics in a global economic environment and social context	PO – 4

Duration of Programme: 2Years

Medium of Instruction: English

Passing Minimum

A minimum of 50% in the external examination and an aggregate of minimum 50% is required. There is no minimum pass mark for the Continuous Internal Assessment.

Course Structure
Distribution of Hours and Credits

Course	Sem. I	Sem. II	Sem. III	Sem. IV	Total	
					Hours	**Credits**
Academic Courses						
Major Core – Theory	6 (5) + 6 (4) + 6 (4) + 6 (4) +	6 (5) + 6 (5) + 6 (4) + 6 (4) +	6 (5) + 6 (5) + 6 (5) +	6 (5) + 6 (5) + 6 (5) + 6 (4) +	114	95
Major Elective	6 (4)	6 (4)	6 (4)	6 (4)	24	20
Major Project	–	–	6 (5)		6	5
Total	**30(21)**	**30 (22)**	**30 (24)**	**30 (23)**	**120**	**90**
Non Academic Courses						
Life Skill Training – I	–	(1)	–	–	–	1
Life Skill Training – II	–	–	–	(1)	–	1
Service–Learning Programme (SLP) – Community Engagement Course		–	(2)	–	–	2
Summer Training Programme	–	–	–	(1)	–	1
TOTAL		**(1)**	**(2)**	**(2)**	–	**5**

Non-Academic Courses are mandatory and conducted outside the regular working hours

SLP (Service Learning Programme) – Community Engagement Course is conducted outside the regular working hours on Saturdays and holidays, during theII and III Semesters for all the PG students. No. of hours allotted for each of this programme is 30 and is supervised by the faculty in charge

STP (Summer Training Programme) (Mandatory Course – 30 hours) will beoffered in the second year for all the students.

Courses Offered

Semester	Course code	Title of the paper	Hours/week	Credits
I	PM2011	Core I - Algebra I	6	5
	PM2012	Core II - Analysis I	6	4
	PM2013	Core III - Probability and Statistics	6	4
	PM2014	Core IV - Ordinary Differential Equations	6	4
	PM2015 PM2016	Elective I - (a) **Numerical Analysis** (b) Fuzzy sets and Fuzzy logic	6	4
	LST201	Life Skill Training (LST) - I	-	-
II	PM2021	Core V- Modules and Vector Spaces	6	5
	PM2022	Core VI - Analysis II	6	5
	PM2023	Core VII - Partial Differential Equations	6	4
	PM2024	Core VIII - Graph Theory	6	4
	PM2025 PM2026	Elective II - (a) **Classical Dynamics** (b) Differential Geometry	6	4
	LST201	Life Skill Training (LST) - I	-	1
	SLP20P	Community Engagement Course	-	-
III	PM2031	–Field Theory and Lattices	6	5
	PM2032	Core X - Topology	6	5
	PM2033	Core XI - Measure Theory and Integration	6	5
	PM2034 PM2035	Elective III - (a) **Algebraic Number Theory and Cryptography** (b) Stochastic Processes	6	4
	PM20PR	Project	6	5
	LST202	Life Skill Training (LST) - II	-	-

	SLP20P	Community Engagement Course	-	2
IV	PM2041	Core XII - Complex Analysis	6	5
	PM2042	Core XIII - Functional Analysis	6	5
	PM2043	Core XIV - Operations Research	6	5
	PM2044	Core XV -Algorithmic Graph Theory	6	4
	PM2045 PM2046	Elective IV - (a) **Combinatorics** (b) Coding Theory	6	4
	LST202	Life Skill Training (LST) - II	-	1
	STP20P	Summer Training Programme	-	1
		TOTAL	**120**	**90+5**

Self– Learning Courses– Extra Credit Course

Semester	**Course Code**	**Title of the Course**	**Credits**
III	PM20S1	Algebra for SET/NET Examinations	2
IV	PM20S2	Analysis for SET/NET Examinations	2
II– IV	–	Online courses (Swayam/NPTL)	2

Question Pattern

Internal Test	**Marks**	**External Exam**	**Marks**
Part– A (10 x 1) (No Choice – simple objective type)	10	Part– A (20 x 1) (No Choice – simple objective type)	20
Part B (5 x 2) (No Choice objective type)	10	Part B (10 x 2) (No Choice objective type)	20
Part C (5 x 4) (No Choice objective type) Higher order thinking skills	20	Part C (5 x 4) (No Choice objective type) Higher order thinking skills	20
Total	**40**	**Total**	**60**

Summer Training Program

Semester	Name of the Course	Total hours	Credit
III/IV	–H20STP	30	1

Internal Component

Component	Marks
Assignment	20
Summer Training Program Attendance	30
Total	**50**

External Component

Course	Summative Examinations	Marks
Summer TrainingProgram	Project report (15– 20 pages print)	**50**
	Total	**50**

Instruction for Course Transaction Theory (Major Core / Elective)

Component	Sem. I	Sem. II	Sem. III	Sem. IV
Lecture hours	70/55	70/55	70/55	70/55
Continuous Internal Assessment (2)	5	5	5	5
Quiz (2)	1	1	1	1
Class Test (2)	2	2	2	2
Seminar	10	10	10	10
Problem Solving/ Openbook Test/ Group Discussion	2	2	2	2
Total hours / semester	**90/75**	**90/75**	**90/75**	**90/75**

Examination Pattern:

Allotment of Marks for PG Programme

Ratio ofInternal and External (Core/Elective): 40 : 60

(a). Major / Elective Internal: External – 40 : 60

Component	Marks	
	Internal	**External**
Core & Elective Courses Theory Papers	40	60
Practical's	40	60
Project	40	60
Life Skill Training (I & II)	50	50

Each paper carries an internal component.

There is a passing minimum for external component.

Continuous Internal Assessment

Component	Marks
Internal Test (2)	20
Quiz (2)	4
Class Test (2)	4
Seminar	4
GD/Open Book test/ Article Review/ Book Review	4
Online Home Assignment	4
Total	**40**

External Component

Internal Test	Marks	External Exam	Marks
Part A(4x1) (No Choice)	4	Part A(10x1) (No Choice)	10
Part B (5x3) (Internal Choice)	15	Part B (5x3) (Internal Choice)	15
Part C(3x7) (Internal Choice)	21	Part C (5x7) (Internal Choice)	35
Total	**40**	**Total**	**60**

Project

Distribution of marks for project

Internal : External = 40 : 60

Internal Components

Internal Viva = 20 marks

Regularity and Systematic work = 20 marks

External Components

Dissertation = 30 marks

Innovation = 10 marks

Presentation and Viva = 20 marks

Evaluation	Marks
Proposed title, review of literature and objectives.	-
I Review	10
II Review	10
Internal	20
Final External (Dissertation and Innovation)	40
* Final Project Viva (group & open)	20
Total marks	**100**

Life Skill Training– I (I Year)

Internal Component

Component	Marks
Album (20 pages)	40
Group Song, Mime, Skit (Group of 5 students)	20
Total	**60**

External Component

Course	Summative Examinations	Marks
Life Skill Training– I	Questions are of open choice. Students must answer 5 out of 7 questions. Each question carries 8 marks (5x8=40 marks)	**40**
	Total	**40**

Life Skill Training– II (II Year)

Internal Component

Component	Marks
Case Study (30 page)	60
Total	**60**

External Component

Course	Summative Examinations	Marks
Life Skill Training–II	Questions are of open choice. Students must answer out of 7 questions. Each question carries 8 marks (5x8=40 marks)	**40**
	Total	**40**

Community Engagement Programme– SLP Extension Activity (II & III sem)

Courses / Programmes conducted outside the regular working hours on Saturdays and holidays.

Number of hours allotted for each of these programmes is 30 and is supervised bythe faculty in charge.

Field work: 15 hours; Class hours: 15 hours

Internal Component

Component	Marks
Assignment	10
Group Discussion	10
Field work Attendance	30
Total	**50**

External Component

Course	Summative Examinations	Marks
Community Engagement Programme	Project report/ Case study (10– 15 pages print)	**50**
Total		**50**

Semester I
Major Core I - Algebra I
Course Code: PM2011

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, students will be able to	PSO Addressed	CL
CO -1	understand the fundamental concepts of abstract algebraand give illustrations.	PSO- 1	U
CO -2	analyze and demonstrate examples of various Sylow p-subgroups, automorphisms, conjugate classes, finite abelian groups, characteristic subgroups, rings, ideals, Euclidean domain, Factorization domain.	PSO- 2	An
CO -3	develop proofs for Sylow's theorems, finite abelian groups, direct products, Cauchy's theorem, Cayley's Theorem, automorphisms for groups.	PSO- 2	C
CO -4	develop the way of embedding of rings and design proofsfor theorems related to rings, polynomial rings, Division Algorithm, Gauss' lemma and Eisenstein Criterion	PSO- 2	C
CO -5	apply the concepts of Cayley's theorem, Counting principles, Sylow's theorems, Rings and Ideals in the structure of certain groups of small order.	PSO-4	Ap
CO -6	compare Euclidean domain and Unique factorizationdomain, Polynomial Rings, Polynomial Rings over Commutative Rings and various concepts in AbstractAlgebra	PSO- 3	E

Unit I

Automorphisms – Inner automorphisms – Cayley's Theorem – Applications – Another Counting principle – Conjucacy - Cauchy's theorem – Conjugate Classes.

Unit II

Sylow's first theorem (Second Proof) – p-Sylow subgroups - Second Part of Sylow's theorem - Third Part of Sylow's theorem - Direct products - Finite abelian groups.

Unit III

Rings: Some special classes of Rings - Characteristic of a Ring – Homomorphisms - Ideals and Quotient Rings - More Ideals and Quotient Rings.

Unit IV

The field of Quotients of an integral domain - Embedding of Rings - Euclidean Rings - Unique Factorization theorem – A particular Euclidean Ring – Fermat's Theorem.

Unit V

Polynomial Rings – The Division Algorithm – Polynomials over the Rational Field - Gauss' lemma – The Eisenstein Criterion - Polynomial Rings over Commutative Rings - Unique Factorization Domains.

Text Book:

Herstein, I. N. (1992). Topics in Algebra. (2nd Edition). New Delhi, Wiley Eastern Ltd.

Chapter 2: Sections 2.8, 2.9, 2.11 to 2.14; Chapter 3: Sections 3.2 to 3.11.

Reference Books:

1. Vijay K. Khanna., & Bhambri, S. K. (2013). A Course in Abstract Algebra. (Fiffth Edition). Vikas Publishing House Pvt. Ltd.
2. Joseph A.Gallian. (1999). Contemporary Abstract Algebra. (4th Edition). Narosa Publishing House.
3. John B. Fraligh. (1977). A first course in Abstract Algebra. (2nd Edition). Addition Wesley Publishing Company.
4. John R. Durbin. (2005). Modern Algebra. (5th Edition). John wiley & Sons.
5. Rudolf Lidl., & Gunter Pilz. (2009). Applied Abstract Algebra. (2nd Edition). Springer International Edition.

Semester I

Major Core II - Analysis I
Course Code: PM2012

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 - 3	U, Ap
CO - 2	deal with various examples of metric space, compact sets and completeness in Euclidean space.	PSO - 2	An
CO - 3	utilize the techniques for testing the convergence of sequence and series	PSO - 1	Ap
CO - 4	understand the important theorems such as Intermediate valued theorem, Mean value theorem, Roll's theorem, Taylor and L'Hospital theorem	PSO - 3	U
CO - 5	apply the concepts of differentiation in problems.	PSO - 4	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. (3rd Edition). McGraw Hill Education (India) Private Limited.

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

Reference Books:

1. Charles G. Denlinger. (2011). Elements of Real Analysis. (1st Edition). Jones & Burtlett Learning.
2. Tom M. Apostlal. (2002). Mathematical Analysis. (2nd Edition). New Delhi: Narosa Publishing House.
3. Somasundaram, D., & Choudhary, B.A. (2010). First Course in Mathematical Analysis. (5th Edition). Narosa Publishing House.
4. Gupta S. L., and Nisha Rani (1975). Fundamental Real Analysis. (2nd Edition). Vikas
5. Publishing house Pvt. Ltd.
6. Richard R. Goldberg. (1970). Methods of Real Analysis. (2nd Edition). Oxford & IBH Publishing Co. Pvt. Ltd.

Semester I

Major Core III- Probability and Statistics
Course code: PM2013

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 -2	R
CO - 2	compute marginal and conditional distributions and check the stochastic independence	PSO -2	U, Ap
CO - 3	recall Binomial, Poisson and Normal distributions and learn new distributions such as multinomial, Chi square andBivariate normal distributions.	PSO - 4	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 – 3,1	U, Ap
CO - 5	employ the relevant concepts of analysis to determine limiting distributions of random variables	PSO - 5	Ap
CO - 6	learn estimation, Point estimation and Confidence Intervals for Means, difference of means and variances.	PSO-2	U, Ap
CO - 7	design probability models to deal with real world problems and solve problems involving probabilistic situations.	PSO – 1,3	C, Ap

Unit I Conditional Probability and Stochastic Independence

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

Unit II Some Special Distributions

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

Unit III Distributions of Functions of Random Variables

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

Unit IV Limiting Distributions

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

Unit V Estimation

Estimation- Point Estimation- Measures of quality of Estimators- Confidence Intervals forMeans- Confidence intervals for difference of Means- Confidence intervals for Variances.

Text Book:

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

Chapter 2: 2.1 to 2.4; Chapter 3: 3.1 to 3.5; Chapter 4: 4.1 to 4.4

Chapter 5: 5.1 to 5.5; Chapter 6: 6.1 to 6.5

Reference Books:

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

<center>

Semester I

Major Core IV - Ordinary Differential Equations

Course code: PM2014

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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

<center>

Course Outcome

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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 – 2	R,U
CO - 2	solve linear ordinary differential equations with constant coefficients by using power series expansion.	PSO – 3	Ap
CO - 3	determine the solutions for a linear system of first order equations.	PSO – 2	U
CO - 4	learn properties of Legendre polynomials and Propertiesof Bessel Functions.	PSO – 4	U
CO - 5	analyze the concepts of existence and uniqueness ofsolutions of the ordinary differential equations.	PSO – 2	An
CO - 6	create differential equations for a large number of realworld problems.	PSO – 1	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

Legendre polynomials - properties of Legendre polynomials - Bessel's functions - TheGamma functions - Properties of Bessel Functions.

Unit V

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

Text Book:

George F. Simmons. (1991). Differential equations with Applications and Historical Notes. (Second edition). McGraw Hill International Editions.

Chapter 3: Sections - 14, 15, 16, 19; Chapter 5: Sections - 26 to 30.

Chapter 8: Sections - 44, 45, 46, 47; Chapter 10: Sections - 55, 56.

Reference Books:

1. Sharma, A.K. (2010). Advanced Differential Equations. Discovery publishing house.
2. Raisinghania, M. D. (2012). Ordinary and Partial Differential Equations. (Fourteenth 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. (Second Impression). Dorling Kindersley India Pvt. Ltd.
5. Doshi, J. B. (2009). Differential Equations for Scientists & Engineers. Narosa Publishing House.

Elective I (a) - Numerical Analysis

Course Code: PM2015

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

Objectives:

1. To study the various behaviour 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 - 2	R
CO - 2	understand the significance of the finite, forward, backward and central differences and their properties.	PSO - 3	U
CO - 3	learn the procedures of fitting straight lines and curves.	PSO - 2	U
CO - 4	compute the solutions of a system of equations by using appropriate numerical methods.	PSO - 1	Ap
CO - 5	solve the problems in ODE by using Taylor's series method, Euler's method etc.	PSO - 4	Ap

Unit I

Solution of Algebraic and Transcendental Equations - Introduction - Bisection Method - Method of False Position - Ramanujan's Method - Secant Method - Muller's Method.

Unit II

Differences of a polynomial - Newton's formulae for Interpolation - Central Difference Interpolation formulae - Gauss's central difference formulae - Stirling's formula - Bessel's formula - Everett's formula - Relation between Bessel's and Everett's formulae - Practical Interpolation.

Unit III

Least squares and Fourier Transforms - Introduction - Least squares Curve Fitting Procedure - Fitting a straight line - Multiple Linear Least squares - Linearization of Nonlinear laws - Curve fitting by Polynomials.

Unit IV

Numerical Linear Algebra - Introduction - Triangular Matrices - LU Decomposition of a matrix - 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.

Unit V

Numerical Solution of Ordinary Differential Equations - Solution by Taylor's series - Picard's method of successive approximations - Euler's method - Runge - Kutta methods - II order and IV order.

Text Book:

Sastry, S. S. (2000). Introductory Methods of Numerical analysis. (5th Edition). New Delhi, Prentice Hall of India PVT. Ltd.
Chapter 2: 2.1 to 2.3, 2.6 to 2.8; Chapter 3: 3.5 to 3.8; Chapter 4: 4.1, 4.2 (4.2.1 to 4.2.4)
Chapter 7: 7.1 to 7.3, 7.5 (7.5.1 to 7.5.4, 7.5.6), 7.6; Chapter 8: 8.1 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. (21st 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

Elective I (b) - Fuzzy Sets and Fuzzy Logic

Course Code: PM2016

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 studentswill be able to	PSO Addressed	CL
CO -1	define and explain the fundamental concepts of fuzzy set theory, including membership functions, fuzzy set operations (union, intersection, complement), and the extension principle.	PSO - 2	U
CO – 2	identify and analyze real-world problems where fuzzy logic can be applied effectively.	PSO - 4	An
CO – 3	design fuzzy logic systems for specific applications, such as fuzzy controllers for industrial processes or fuzzy decision-making systems.	PSO - 4	C
CO – 4	understand the components of a fuzzy inference system and implementing rule-based fuzzy systems for various applications.	PSO – 3	U
CO – 5	understand how to use fuzzy logic to control variables in dynamic systems, such as temperature control in HVAC systems or speed control in robotics.	PSO – 3	U
CO – 6	be familiar with software tools and programming languages commonly used for implementing fuzzy logic systems, such as MATLAB	PSO - 1	Ap
CO – 7	use these tools to simulate and solve fuzzy logic problems.	PSO - 2	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.

Life Skill Training - I

Course Code: LST201

No. of hours per week	Credit	Total no. of hours	Marks
1	1	30	100

Objectives:

1. To understand the fundamental rules of success
2. To practice integrity in day to day life

Course Outcome

CO	Upon completion of this course, the students will be able to	PSO Addressed	CL
CO-1	understand the human values to lead a successful life	PSO-	U
CO-2	apply the ethics in real life situation	PSO-	A
CO-3	analyze and improve one's attitude	PSO-	Y

Unit I

Success - Success formulae- Goals - The law of Karma, The law of clarity, and The law of flexibility - Positive Mental Attitude - The law of optimism and self-confidence.

Unit II

Purposeful-Burning desire - The law of desire and The law of energy - Planning and Preparation - The law of planning.

Unit III

Resources - The law of maximization - Time and its management: health, courage, strengths and weaknesses, attitude, will and skill, enthusiasm, initiative, creativity/resourcefulness/ingenuity, experience, appearance, orderliness and neatness, courtesy, politeness and manners, charisma, live life, have luck and skills.

Unit IV

Self-discipline -The law of time preference and The law of direction - Action - The law of applied effort and The law of compensation - Persistence.

Unit V

Prayers - The partnership with God - work with commitment towards the goal - work and prayer - Values - to attain stability in life -Benjamin Franklin's thirteen virtues.

Text Book

Rao, C.N. (2014). 10 Fundamental Rules of Success. India: V &S Publisher.

Reference Books:

1. Bellamy, D.R. (1999). 12 Secrets for Manifesting your Vision, Inspiration and Purpose. India: Master Mind Books.
2. Iyer, S.S. (2009). Managing for Value. New Delhi: New Age International Publishers.
3. Sharma, S.P. (1999). Success Through Positive Thinking. Delhi: Pustak Mahal
4. Raj, A.S. (2015). Personality Development. Delhi: Firewall Media.

Major Core V - Modules and Vector Spaces

Course Code : PM2021

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

Objective:

1. To understand the concept of Modules and the advanced forms of Matrices related to Linear Transformations

Course Outcome

CO	Upon completion of this course the studentswill be able to	PSO Addressed	CL
CO - 1	recall the definitions and properties of Vector Spaces and Subspaces	PSO - 2	R
CO - 2	analyze the concepts Linear Independence, Dependence and Basis	PSO - 2	An
CO - 3	apply the definition and properties of Linear transformation and Matrices of Linear transformation	PSO - 3	Ap
CO - 4	gain knowledge about characteristic polynomial, eigen vectors, eigen values and eigen spaces as well as the geometric and the algebraic multiplicities of an eigen value	PSO - 1	U
CO - 5	learn and apply Jordan form and triangular form for computations	PSO - 4	U

Unit I

Introduction to Module Theory: Basic definitions and examples, Quotient modules andmodule homomorphism's, Generation of Modules, Direct sums and Free Modules

Unit II

Vector Spaces: Elementary basic concepts, Linear Independence and Basis, Dual Spaces

Unit III

The Algebra of Linear Transformations, Characteristic Roots, Matrices, Canonical Forms:Triangular Form, Canonical Forms: Nilpotent Transformations

Unit IV

Canonical Forms: A Decomposition of V: Jordan Form, Canonical Forms: Rational Canonical Form, Trace and Transpose

Unit V

Determinants, Hermitian, Unitary and Normal Transformations, Real Quadratic forms

Text Books:

1. Herstein, I. N. (1992). Topics in Algebra. (Second Edition). New Delhi, Wiley Eastern Ltd.
   Chapter 4: 4.1, 4.2, 4.3; Chapter 6: 6.1 to 6.11
2. David S. Dummit, Richard M. Foote. (2004) Abstract Algebra. (Third Edition). John Wiley& Sons, Inc
   Chapter 10: 10.1,10.2, 10.3

Reference Books:

1. Kenneth Hoffman., & Ray Kunze. (2016). Linear Algebra. (Second Impression). Pearson India Education Services Pvt. Ltd.
2. Vijay K. Khanna., & Bhambri, S. K. A. (2013). Course in Abstract Algebra. (4th
3. Edition). Vikas Publishing House Pvt. Ltd.
4. Nathan Jacobson. (1984). Basic Algebra. Hindustan Publishing Corporation.
5. Joseph A. Gallian. (1999). Contemporary Abstract Algebra. (Fourth Edition). Narosa Publishing House. Reprint.
6. John B. Fraligh. (1977). A first course in Abstract Algebra. (Second Edition). Addition Wesley publishing company.

Semester II
Major Core VI - Analysis II
Course Code: PM2022

No. of hours per week	Credit	Total No. of hours	Marks
6	5	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 studentswill 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 difference 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 functionand rectifiable curves	PSO-3	U
CO -4	learn Parseval's theorem, Stone Weierstrass theorem and know about its physical significance in terms of the powerof the Fourier components.	PSO-4	U
CO -5	utilize the definition of differentiation and partial derivative of function of several variables to solve problems	PSO-3	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. (3rd Edition). McGraw Hill Education (India) Private Limited.

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. (1st Edition). New Delhi: Jones & Burtlett Learning.
2. Tom M. Apostlal. (2002). Mathematical Analysis. (2nd Edition). New Delhi: Narosa Publishing House.
3. Mittal. (2012). Real Analysis. (7th 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. (1st Edition). New Delhi: Firewall media.

Semester II

Major Core VII - Partial Differential Equations

Course Code: PM2023

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-2	R
CO-2	learn some methods to solve the problems of non- linear first order partial differential equations. homogeneous and non-homogeneous linear partial differential equations with constant coefficients and solve related problems.	PSO-1	U
CO-3	analyze the classification of partial differential equations in three independent variables – cauchy's problem for a secondorder partial differential equations.	PSO-3	An
CO-4	solve the boundary value problem for the heat equations and the wave equation.	PSO-4	Ap
CO-5	apply the concepts and methods in physical processes like heat transfer and electrostatics.	PSO-5	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

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 III

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 IV

Classification of Partial Differential equations of second order - Classification of P.D.E. in three independent variables – Cauchy's problem for a second order P.D.E. Characteristic equation and Characteristic curves of the second order P.D.E. – Laplace transformation. Reduction to Canonical (or normal) forms.

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. M.D. Raisinghania (1988) Advance Differential Equations. (16 th Revised and CorrectedEdition). New Delhi: S. Chand and company Ltd.
   Chapter 3: 3.1, 3.4 to 3.8B; 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; Chapter 8: 8.1 to 8.11

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. (2nd 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. (1st Indian Edition).Rhode Island, American Mathematical Society Providence.

Major Core VIII -Graph Theory

Course Code: PM2024

No. of hours per week	Credits	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	identify cut vertices and understand various versions of connectedness of a graph.	PSO-1	An
CO - 2	understand the concept of Digraphs and characterize Eulerian Digraphs.	PSO-4	U,C
CO - 3	recall the definitions of Matchings and design proof for characterization of graphs containing a 1-factor.	PSO-1	R
CO - 4	solve problems involving coloring and learn necessary conditions for planar graphs.	PSO-2,3	Ap
CO - 5	learn the basic definitions of domination and review the concept of distance in a graph.	PSO-4	U

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

Distance - The center of a graph - Distant Vertices – Domination - The Domination Number of a Graph – Exploration - Stratification.

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 12: 12.1and 12.2; Chapter 13: 13.1 and 13.2.

Reference Books:

1. Bondy, J. A., & Murty, U. S. R. (1976). Graph Theory with Applications. (1st Edition). Macmillan Press Ltd.
2. Douglas B.West. (2003). Introduction to Graph Theory. (2nd 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. Reinhard Diestel. (2006). Graph Theory. (2nd Edition). Springer InternationalEdition.

Elective II(a)-Classical Dynamics

Course Code: PM2025

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 - 4	R
CO – 2	understanding the generalized co-ordinates of the Mechanical system.	PSO - 1	U
CO – 3	apply D'Alembert's Principle to solve the problems involving system of particles.	PSO - 2	Ap
CO - 4	solve the Newton's equations for simple configuration using various methods.	PSO - 1	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 - 4	R
CO -7	evaluate the system of particles by deriving the Jacobi equation and Jacobi's theorem.	PSO - 1	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. (2nd 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.

Elective II(b)- Differential Geometry

Course Code: PM2026

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	to describe and analyze curves and surfaces in three-dimensional space, including their shapes, curvature, and parametric representations.	PSO – 2	U
CO – 2	to compute tangent vectors and normal curvature at any point on a curve or surface, enabling you to understand how objects bend and twist.	PSO – 2	U
CO – 3	to analyze and compute these important geometric concepts.	PSO – 3	An
CO - 4	gain proficiency in Riemannian metrics, which are used to measure distances and angles on curved surfaces.	PSO – 1	An
CO - 5	to apply the principles of differential geometry to solve practical problems in fields such as computer graphics, robotics, and general relativity, enhancing your problem-solving skills.	PSO – 3	Ap

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 centres 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

Major Core IX -Field Theory and Lattices

Course code : PM2031

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

Objectives:

1. To learn in depth, the concepts of Field Theory, Galois Theory 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 - 2	U
CO - 2	express the fundamental concepts of field theory, Galois theory	PSO - 2	U
CO - 3	demonstrate the use of Galois theory to construct Galois group over the rational	PSO - 3	E
CO - 4	distinguish between field theory and Galois theory	PSO - 3	Ap
CO - 5	interpret distributivity and modularity and apply these concepts in Boolean Algebra	PSO - 4	Ap
CO - 6	understand the theory of Frobenius Theorem	PSO -2	U
CO - 7	develop the knowledge of lattices and establish new relationships in Boolean Algebra	PSO - 1	C

Unit I

Extension fields – finite extension, algebraic extension.

Unit II

Roots of polynomials- More about roots.

Unit III

Elements of Galois theory- Galois group over the rationals.

Unit IV

Finite fields – Wedderburn's theorem (First proof only)- A Theorem of Frobenius.

Unit V

Partially ordered sets and lattices, Distributivity and modularity- Boolean algebra.

Text Books:

1. Topics in Algebra, I.N. Herstein, (2nd Edition, Wiley Eastern Ltd,Reprint 2011).

   Chapter 5: 5.1, 5.3, 5.5, 5.6, 5.8; Chapter 7: 7.1, 7.2 (Theorem 7.2.1 only), 7.3

2. Basic Algebra, Nathan Jacobson, Vol: I (Hindustan Publishing Corporation, Indian Edition,1984).

   Chapter 8: 8.1,8.2, 8.5.

Reference Books:

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

Major Core X - Topology

Course code : PM2032

No. of hours per week	Credit	Total No. of hours	Marks
6	4	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 - 4	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 - 4	C

Unit I

Topological spaces and Examples - Basis for a topology - The order topology - The product topology on $X \times Y$- The subspace topology - Closed sets and Limit points - Continuous function.

Unit II

The Product Topology – The metric topology – Sequence lemma – Uniform limit theorem - Connected spaces – Connected subspaces of the Real Line –Components and Local connectedness.

Unit III

Compact spaces - Compact subspaces of the Real Line – Uniform Continuity theorem – Limit point Compactness – Complete metric spaces – Compactness in metric spaces.

Unit IV

First and Second countable spaces –Lindeloff and Separable spaces - Countability axioms - The separation axioms - Normal spaces - The Urysohn's Lemma

Unit V

The Urysohn Metrization Theorem - Tietze Extension Theorem – The Tychonoff theorem – Stone Cech Compactifications

Text Book:

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

Sections: 12 - 21, 23- 28, 30 - 35, 37, 38, 43, 45

Reference Books:

1. Gupta, K. P. (2013). Topology. (21st Edition). Pragati Prakashan Publishers.
2. Kelley, J. L. (2009). General Topology. (3rd Indian reprint). Springer - Verlag.
3. George F. Simmons. (2004). Introduction to Topology and Modern Analysis. (2nd 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.

Major Core XI -Measure Theory and Integration

Course code : PM2033

No. of Hours per Week	Credit	Total No. of Hours	Marks
6	5	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 - 2	Ap
CO - 4	apply outer measure, differentiation and integration to intervals , functions and sets.	PSO - 2	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 - 4	C

Unit I

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. (3rd 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. (2nd Edition). New Age International Publishing.
3. Inder K. Rana. (2014). An Introduction to Measure and Integration. (2nd Edition). Narosa Publishing House.
4. Jain P. K., & Pankaj Jain. (2014). General Measure and Integration. (1st Edition). New Age International Publishers.
5. Chandrasekhar Rao, K. (2009). Topology. Narosa Publishing House.

Semester III

Elective III (a)-Algebraic Number Theory and Cryptography

Course code : PM2034

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

3. To know the concepts of Cryptography

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 - 2	U
CO - 3	apply binary quadratic forms for the decomposition of a number into sum of sequences	PSO - 3	Ap
CO - 4	determine solutions using Arithmetic Functions	PSO - 3	Ap
CO - 5	calculate the possible partitions of a given number and draw Ferrer's graph	PSO - 2	An
CO - 6	identify the public key using Cryptography	PSO - 4	An

Unit I

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 Functions of Number Thoery: Arithmetic functions- The Mobius Inversion Formula- Multiplicative functions. Some Diophantine Equations: Pythagorean Triangles.

Unit IV

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

Unit V

Public Key Cryptography – Concepts of public key Cryptography – RSA –Discrete logarithm - Basic facts - Elliptic curve cryptosystems.

Text Book:

1. Ivan Niven., Herbert S. Zuckerman., & Hugh L. Montgomery. (2006). An Introduction to the Theory of Numbers. (5th Edition). John - Wiley & Sons.
   Chapter 3: 3.1 - 3.6; Chapter 4: 4.2 and 4.3; Chapter 5: 5.3; Chapter 10: 10.1 - 10.4
2. Neal Koblitz, A Course in Number Theory and Cryptography Second Edition, Springer-Verlag, New York 1987.
   Chapter 4: 1-3; Chapter 6: 1 and 2

Reference Books:

1. Hardy, G. H., & Wright E. M. (1975). An Introduction to the Theory of Number. (4th Edition). Oxford at the Clarendon Press.
2. David M. Burton, Elementary Number Theory, Wm. C. Brown Publishers, Dubuque, lowa,1989.
3. Tom. M. Apostol. (1998). Introduction to Analytic Number Theory. Narosa Publishing House.
4. Kenneth Ireland., & Michael Rosen. (1990). A classical Introduction to Modern Number Theory. (2nd Edition). Springer International Edition.
5. Graham Everest., & Thomas Ward. (2008). An Introduction to Number Theory. Springer International Edition.
6. John Stillwell. (2008). Elements of Number Theory. Springer International Edition.
7. Cryptography and Network Security Principles and Practice by William Stallings, Prentice Hall, Fifth Edition, New Delhi, 2011.

Elective III (b)- Stochastic Processes

Sub. Code: PM2035

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	analyze and apply various probability models to describe random phenomena in real-world scenarios.	PSO – 1	An
CO – 2	develop proficiency in modeling and analyzing Markov chains, including their steady-state behavior and applications in decision-making processes.	PSO – 3	Ap
CO – 3	gain the skills to simulate and analyze stochastic processes using computational tools, enabling them to make probabilistic predictions.	PSO – 2	U
CO - 4	learn the fundamentals of stochastic calculus, enabling them to work with stochastic differential equations and their applications in finance and science.	PSO - 2	U
CO - 5	assess and manage risk in different contexts, such as finance and engineering, by applying stochastic modeling and decision-making techniques.	PSO - 4	An

Unit I

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/1 queuing 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
Project
Course Code: PM20PR

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

Course Outcomes

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

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
Life Skill Training - II
Course Code: LST202

No. of hours per week	Credit	Total no. of hours	Marks
1	1	30	100

Objectives:

1. To aid students in making right choices and decisions
2. To create awareness on practical methods that lead to personal and societal development

Course Outcome

CO	Upon completion of this course the students will be able to	PSO Addressed	CO
CO-1	identify the root cause of social evils and its consequences	PSO-	An
CO-2	understand the importance of personal and emotional well being	PSO-	Un
CO-3	empathies with the needy and disabled	PSO-	Ap

Unit I

Corruption - causes and types. Seeds and remedies of corruption - Casteism - causes and consequences - Communalism - characteristics - causes and remedial measures - Regionalism - characteristics - causes and remedial measures.

Unit II

Abortion - reason and methods. Birth control - Alcoholism - alcoholism and causes of drinking. Harmful effects of liquor - Drug addiction - causes - effects and control of drug addiction.

Unit III

Depression - signs - causes and treatments - Suicide - signs and treatments. Child labour.

Unit IV

Divorce - causes and effects. Steps to avoid divorce - Dowry system in India - Legislations to inhibit dowry system. Cases and problems.

Unit V

Care and concern for the aged and disabled - need to take care of elders. Caring of someone with physical disability - HIV and aids - basic facts - causes - prevention and treatment.

Text Book:

(Compilation will be provided to the students)

Reference Books:

1. CN. Shankar Rao, India Social Problems - A Sociological Perspective. S. Chand and Company Limited. New Delhi. 2015.
2. CN. Shankar Rao, Sociology of Indian Society. S. Chand and company limited. New Delhi. 2004
3. Gawain, Shakti and Laurel King. Living in the Light. - A Guide to Personal Transformation. Natraj Publishing. Canada. 1998.

Semester III

Self-Learning Course

Algebra for SET/CSIR-NET Exam

Course Code: PM20S1

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 – 2	U
CO – 3	recall matrix theory, linear equations and finding the rank and determine the determinant of matrices	PSO – 4	R
CO – 4	determine eigen values and eigen vectors and recall Cayley-Hamilton Theorem	PSO – 2	E
CO – 5	acquire knowledge in solving problems by using matrix representation of linear transformations and change of basis	PSO – 3	C
CO – 6	differentiate various forms in matrices	PSO – 2	An
CO – 7	solve problems in inner product spaces, orthonormal basis and quadratic forms	PSO - 2	Ap

Unit I

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. (Edition). Narosa Publishing House.
4. Kenneth Hoffman., & Ray Kunze. (2016). Linear Algebra. (Edition). Pearson India Education Services Pvt. Ltd.
5. John B. Fraleigh. (2003). A first course in Abstract Algebra. (Edition). Narosa Publishing House.

Complex Analysis (Major Core XII)

Course code : PM2041

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 - 3	R
CO - 3	demonstrate the ability to integrate knowledge and ideas of complex differentiation and complex integration	PSO - 4	U
CO - 4	use appropriate techniques for solving related problems and for establishing theoretical results	PSO - 3	Ap
CO - 5	evaluate complicated real integrals through residue theorem	PSO – 2, 4	E
CO - 6	know the theory of conformal mappings which has many physical applications and analyse its concepts	PSO – 3, 4	An

Unit I

Power series - Abel's theorem, Abel's limit theorem, The periodicity. Conformality - Arcs and closed curves, Analytic Functions in Regions, Conformal Mapping, Length and Area.

Unit II

Complex Integration - Fundamental theorems: 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 singularities, Taylor's theorem, Zeros and poles.

Unit III

Complex Integration: 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), Residue Theorem, The Argument Principle, Evaluation of Definite Integrals.

Unit IV

Series and Product developments: Partial Fractions and Entire Functions: Partial Fractions, Infinite products, Canonical products, Gamma functions, Jensen's formula, Hadamard's Theorem - Riemann Theta Function and Normal Families: Product development, Extension of $\zeta(s)$ to the whole plane, The zeros of zeta function, Equicontinuity, Normality and compactness, Arzela's theorem, Families of analytic functions, The classical Definition.

Unit V

Conformal Mappings: Riemann mapping theorem: Statement and proof, Boundary Behaviour, Use of the Reflection Principle - Conformal mappings of Polygons: Behaviour at an angle, Schwarz-Christoffel formula, Mapping on a rectangle - Harmonic Functions: Functions with mean value property, Harnack's Principle.

Text Book:

Ahlfors. (1979). Complex Analysis.(3rd Edition). Tata McGraw-Hill, New York.
Chapter 2: sections 2.4,2.5, 3.3; Chapter 3: sections 2.1 - 2.4
Chapter 4: sections 1.4, 1.5, 2.1 - 2.3, 3.1 - 3.4, 4.1 - 4.5, 5.1 - 5.3
Chapter 5: sections 2.1-2.4, 3.1, 3.2, 4.1, 4.2, 4.4, 5.1-5.5
Chapter 6: sections 1.1-1.3, 2.1-2.3, 3.1, 3.2

Reference Books:

1. H.A. Presfly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.
2. J.B. Corway, Functions of one Complex Variables, Springer-Verlag, International student Edition, Narosa Publishing Co.
3. E. Hille, Analytic function Theory (2 vols.), Gonm & Co, 1959.
4. M. Heins, Complex function Theory, Academic Press, New York,1968.
5. Karunakaran, V. (2002). Complex Analysis.Narosa Publishing House.
6. Shanthi Narayanan., & Mittal, P.K. (2011). Theory of Functions of a Complex Variable.S.Chand & Co Publication.
6. Ponnusamy, S. (2011). Foundations of Complex Analysis.(2nd Edition). Narosa Publishing House.

Major Core XIII -Functional Analysis

Course code : PM2042

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 -2	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 - 1	Ap
CO - 6	learn and understand the definition of Hilbert Spaces, Orthogonal Complements	PSO - 4	R
CO - 7	explain the concept of the adjoint of an operator, Normal and Unitary operators, Spectral Theory	PSO - 2	An

Unit I

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

Unit V

Banach Algebras: The definition and some examples – Regular and singular elements – The spectrum – The formula for the spectral radius.

Text Book:

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

Sections: 46 to 59,61,62, 64,65,67,68.

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.

Major Core XIV - Operations Research

Course code : PM2043

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	E
CO - 4	interpret Poisson and Exponential distributions and apply these concepts in Queuing models	PSO - 4	Ap
CO - 5	solve life oriented decision making problems by optimizing the objective function	PSO - 1	C

Unit I

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.

Major Core XV - Algorithmic Graph Theory

Course Code: PM2044

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

Objectives:

1. To instil knowledge about algorithms

2. To write innovative algorithms for graph theoretical problems.

Course Outcomes

CO	Upon completion of this course the students will be able to	PSO Addressed	CL
CO -1	understand basic algorithms and write algorithms for simple computing.	PSO - 1	U E
CO - 2	analyse the efficiency of the algorithm.	PSO - 2	An
CO - 3	understand and analyze algorithmic techniques to study basic parameters and properties of graphs	PSO - 2	R An
CO - 4	use effectively techniques from graph theory, to solve practical problems in networking and communication	PSO - 3	Ap

Unit I

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

Unit II

Elementary Graph Algorithms - Representation of Graphs, Breadth-first Search, Depth-first Search, Topological Sort, Strongly Connected Components.

Unit III

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, Difference Constraints and Shortest Paths.

Unit V

All-Pairs Shortest Paths - Shortest Paths and Matrix Multiplication, The Floyd-Warshall Algorithm, Johnson's Algorithm for Sparse Graphs.

Text Book:

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

Chapter I: 1.1 - 1.2 and 2.1 - 2.3

Chapter VI: 22.1 - 22.5, 23.1 - 23.2, 24.1 - 24.4 and 25.1 - 25.3.

Reference Books:

1. Kenneth H Rosen (2012). Discrete Mathematics and its Applications with Combinatorics and Graph Theory (Seventh Edition). Tata McGraw-Hill.
2. Gary Chartrand., &Ortrud R. Oellermann. (1993). Applied and Algorithmic Graph Theory. (International Editions). McGraw-Hill.
3. Bondy, J. A., &Murty, U. S. R. (1976). Graph Theory with Application. Macmillan.
4. Murugan, M. (2003). Graph Theory and Algorithms. Muthali Publishing House.
5. Hu, T. C. (1982). Combinatorial Algorithms. Addison-Wesley Publishing Company.
6. Alan Gibbons. (1985). Algorithmic Graph Theory. Cambridge University.

Elective IV (a) - Combinatorics

Course Code: PM2045

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, Generating functions, The Principle of Inclusion and Exclusion	PSO - 1	U
CO - 2	distinguish between permutation and combination, distribution of distinct and non-distinct objects	PSO - 2	An
CO - 3	correlate recurrence relation and generating function	PSO - 2	An
CO -4	solving problems by the technique of generating functions, combinations, recurrence relations, the principle of inclusion and exclusion	PSO - 3	Ap
CO - 5	interpret the principles of inclusion and exclusion, equivalence classes and functions	PSO - 4	An E
CO - 6	develop the concepts of Polya's fundamental theorem and apply in Polya's theory of counting	PSO - 4	C

Unit I

Permutations and combinations-The rules of sum and product- Permutations - Combinations - Distribution of distinct objects- Distribution of non-distinct objects.

Unit II

Generating functions - Generating functions for combinations - Enumerators for permutations- Distributions of distinct objects into non-distinct cells - Partitions of integers-The Ferrer's graph.

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: 1.1 to 1.6; Chapter 2: 2.1 to 2.6; 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. (3rd 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. (2nd Edition). John Wiley & sons.
6. Sey Mour Lipsc Hutz., & Marc Lars Lipson. (2010). Discrete Mathematics. (3rd Edition). Tata Mcgraw - Hill.

Semester IV

Elective IV (b) Coding Theory

Course Code: PM2046

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	learn how to create codes that can detect and correct errors in data transmission, ensuring reliable communication in digital systems.	PSO – 3	C
CO - 2	gain the ability to design codes that efficiently compress data, reducing storage requirements and improving transmission efficiency.	PSO – 1	An
CO - 3	learn techniques to create codes that enhance data security, making it difficult for unauthorized parties to intercept or decipher information.	PSO – 2	C
CO -4	apply coding theory principles to practical scenarios like data storage, network communication, and digital media to solve real-world problems.	PSO – 4	Ap
CO - 5	develop problem-solving skills by exploring the mathematical and algorithmic foundations of coding theory, preparing students for careers in computer science and information technology.	PSO - 2	E

Unit I

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. (3rd Edition).S pringer.

Chapters 1 (except 1.4), 2 (Sections 2.1 and 2.2 only), 3, 4, 5 (except 5.3);
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. (3rd 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
Self-Learning Course
Analysis for SET/ CSIR-NET Exam
Course Code: PM20S2

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, Archimedean property, convergence and limit points	PSO – 2	R
CO - 2	acquire knowledge to solve problems based on compactness and connectedness	PSO – 2	C
CO - 3	understand the definitions and theorems on normed linear space and metric space	PSO – 2	U
CO - 4	evaluate simple concepts and solve problems related to continuity, uniform continuity and monotonic functions	PSO – 4	Ap
CO - 5	analyze the methods for solving problems in Riemann-integrals and improper integrals	PSO – 2	An
CO - 6	expand the sequences and series for the given problems	PSO – 3	Ap
CO - 7	compare convergence and uniform convergence and apply them in solving related problems	PSO – 2	An, Ap

Unit I

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. (2nd 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. (1st corrected Edition). Narosa Publishing house.

5. Richard R. Goldberg. (1970). Methods of Real Analysis. Oxford & IBH Publishing Co. Pvt. Ltd.

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	Content addressed with National needs
	Content addressed with Regional needs
	Content addressed with Global needs