THIRUVALLUVAR UNIVERSITY
MASTER OF SCIENCE

M.Sc. MATHEMATICS
DEGREE COURSE
UNDER CBCS
(With effect from 2020-2021)

The Course of Study and the Scheme of Examination

Sl. No.	*Study Components*		*ins. hrs / week*	*Credit*	*Title of the Paper*	*Maximum Marks*		
	Course Title					*CIA*	*Uni. Exam*	*Total*
SEMESTER I								
1.	Core	Paper -1	6	5	Algebra-I	25	75	100
2.		Paper -2	6	5	Real Analysis –I	25	75	100
3.		Paper -3	6	4	Ordinary Differential Equations	25	75	100
Internal Elective for same major students (Choose any one)								
4.	Core Elective	Paper-1	6	3	(to choose one out of 3) A. Probability Theory B. Mechanics C. Graph Theory	25	75	100
External Elective for other major students (Inter/multi disciplinary papers)								
5.	Open Elective	Paper-1	6	3	(to choose one out of 3) A. Basic Mathematics B. Mathematical Foundations C. Mathematical Modeling	25	75	100
			30	**20**		**125**	**375**	**500**
SEMESTER II						*CIA*	*Uni. Exam*	*Total*
6.	Core	Paper-4	6	5	Algebra-II	25	75	100
7.		Paper-5	6	5	Real Analysis –II	25	75	100
8.		Paper-6	6	4	Partial Differential Equations	25	75	100
Internal Elective for same major students (Choose any one)								
9.	Core Elective	Paper-2	5	3	(to choose one out of 3) A. Mathematical Statistics B. Fuzzy Set Theory C. Difference Equations	25	75	100
External Elective for other major students (Inter/multi disciplinary papers)								
10.	Open Elective	Paper-2	5	3	(to choose one out of 3) A. Fundamentals of Insurance B. Numerical Methods C. Fundamentals of Business Statistics	25	75	100
11.	*Field Study		-	2		100	-	100
12.	Compulsory Paper		2	2	Human Rights & Duties	25	75	100
			30	**24**		**250**	**450**	**700**

SEMESTER III						***CIA***	***Uni. Exam***	***Total***
13.	Core	Paper-7	6	6	Complex Analysis –I	25	75	100
14.		Paper-8	6	5	Topology	25	75	100
15.		Paper-9	6	5	Differential Geometry	25	75	100
Internal Elective for same major students								
16.	Core Elective	Paper-3	6	3	(to choose one out of 3) A. LaTeX B. Discrete Mathematics C. Operations Research	25	75	100
External Elective for other major students (Inter/multi disciplinary papers)								
17.	Open Elective	Paper-3	6	3	(to choose one out of 3) A. Mathematical Biology B. Quantitative Techniques C. SCILAB	25	75	100
18.	****MOOC Courses**		-	-				100
			30	**22**		**125**	**375**	**600**
SEMESTER IV						***CIA***	***Uni. Exam***	***Total***
19.	Core	Paper-10	5	4	Complex Analysis –II	25	75	100
20.		Paper-11	5	4	Fluid Dynamics	25	75	100
21.		Paper-12	5	5	Functional Analysis	25	75	100
22.	Core	Project	5	5	Project with *viva voce*	100 (75 Project +25 viva)		100
Internal Elective for same major students								
23.	Core Elective	Paper-4	5	3	**(to choose one out of 3)** A. Number Theory and Cryptography B. Advanced Numerical Analysis C. Calculus of Variations and Integral Equations	25	75	100
External Elective for other major students (Inter/multi disciplinary papers)								
24.	Open Elective (Non-Major)	Paper-4	5	3	**(to choose one out of 3)** A. Mathematical Economics B. Entrepreneurial Development C. Programming in C++	25	75	100
			30	**24**		**125**	**375**	**600**
			120	**90**				**2400**

*** Field Study**

There will be field study which is compulsory in the first semester of all PG courses with 2 credits. This field study should be related to the subject concerned with social impact. Field and Topic should be registred by the students in the first semester of their study along with the name of a mentor before the end of the month of August. The report with problem identification and proposed solution should be written in not less than 25 pages in a standard format and it should be submitted at the end of second semester. The period for undergoing the field study is 30 hours beyond the instructional hours of the respective programme. Students shall consult their mentors within campus and experts outside the campus for selecting the field and topic of the field study. The following members may be nominated for confirming the topic and evaluating the field study report.

(i). Head of the respective department

(ii). Mentor

(iii). One faculty from other department

****Mooc Courses**

Inclusion of the Massive Open Online Courses (MOOCs) with zero credits available on SWAYAM, NPTEL and other such portals approved by the University Authorities.

SEMESTER III
PAPER - 7

COMPLEX ANALYSIS - I

Course Objectives:

The objectives of the course is to

- introduce the notions of differentiability and analytic functions.
- discuss the elementary functions and complex integration.
- educate the conformal mappings and Mobius transformations.
- inculcate the concepts of Maximum Principle, Schwarz' Lemma And Liouville's Theorem.
- indoctrinate the applications of Classification of Singularities.

Unit – 1: Analytic Functions and Power Series **18 Hours**

Differentiability and Cauchy–Riemann Equations –Harmonic Functions –Power Series as an Analytic Function – Exponential and Trigonometric Functions – Logarithmic Functions – Inverse Functions. (Chapter 3, Sections: 3.1 to 3.6)

Unit – 2: Complex Integration **18 Hours**

Curves in the Complex Plane – Properties of Complex Line Integrals – Cauchy–Goursat Theorem – Consequence of Simply Connectivity – Winding Number or Index of a Curve – Cauchy Integral Formula – Taylor's Theorem – Zeros of Analytic Functions – Laurent Series. (Chapter 4, Sections: 4.1 to 4.5, 4.7, 4.10 to 4.12)

Unit – 3: Conformal Mappings and Mobius Transformations **18 Hours**

Principle of Conformal Mapping – Basic Properties of Mobius Maps – Fixed Points and Mobius Maps – Triples to Triples under Mobius Maps – The Cross-Ratio and its Invariance Property – Conformal Self-maps of Disks and Half-planes. (Chapter 5, Sections: 5.1 to 5.6)

Unit – 4: Maximum Principle, Schwarz' Lemma AndLiouville's Theorem **18 Hours**

Maximum Modulus Principle - Hadamard's Three Circles/Lines Theorems - Schwarz's Lemma and its Consequences - Liouville's Theorem - Doubly Periodic Entire Function - Fundamental Theorem of Algebra - Zeros of certain Polynomials (Chapter 6, Sections: 6.1 to 6.7)

Unit – V: Classification of Singularities

Isolated and Non-isolated Singularities – Removable Singularities – Poles – Further Illustrations through Laurent's Series – Isolated Singularities at Infinity – Meromorphic Functions – Essential Singularities and Picard's theorem. (Chapter 7, Sections: 7.1 to 7.7)

Prescribed Book

S. Ponnusamy, *Foundations of Complex Analysis*, Second Edition, Narosa Publishing House, New Delhi, 2012.

Reference Books:

1. Lars V. Ahlfors, *Complex Analysis*, 3rd Edition, McGraw-Hill Inc., New York, 1979.

2. J.W. Brown and R.V. Churchill, *Complex Variables and Applications*, 8th Edition, McGraw-Hill Higher Education, New York, 2009.
3. J.B. Conway, *Functions of One Complex Variable*, 2nd Edition, Narosa Publishing House, New Delhi, 1996.
4. V. Karunakaran, *Complex Analysis*, 2nd Edition, Narosa Publishing House, New Delhi, 2005.
5. H.A. Priestley, *Introduction to Complex Analysis*, 2nd Edition, Oxford University Press Inc., New York, 2005.

E-Materials:

1. https://ocw.mit.edu/courses/mathematics/18-112-functions-of-a-complex-variable-fall-2008/
2. https://ocw.mit.edu/courses/mathematics/18-04-complex-variables-with-applications-spring-2018/
3. https://www.coursera.org/learn/complex-analysis

Course Learning Outcomes

After the successful completion of this course, the students will be able to:

- Understand the differentiability and analytic functions.
- comprehend the elementary functions and complex integration.
- acquire the knowledge of conformal mappings and Mobius transformations
- discuss the Maximum Principle, Schwarz' Lemma And Liouville's Theorem.
- procure the applications of theClassification of Singularities.

PAPER - 8
TOPOLOGY

Course Objectives:

The objectives of the course is to

- introduce the mathematical analysis of open and closed sets and the significance of the topological spaces.
- give an insight about the continuous functions on topological spaces, product topology and topology induced by the metric.
- educate the connected spaces, connected subspaces, components and local connectedness.
- inculcate the notions of compactness, compact subspaces, limit point compactness and local compactness.
- indoctrinate the strong theoretical background about the countability axioms, the separation axioms and the consequences theorems.

Unit–1 :Topological Spaces **18 Hours**

Topological Spaces - Basis for a Topology - The Order Topology - The Product Topology on XxY - The Subspace Topology - Closed Sets and Limit Points.
(Chapter 2 - Sections: 12-17)

Unit–2 :Continuous Functions **18 Hours**

Continuous Functions - The Product Topology - The Metric Topology.
(Chapter 2 - Sections: 18-21)

Unit–3 :Connectedness **18 Hours**

Connected Spaces - Connected Subspaces of the Real Line - Components and Local Connectedness. (Chapter 3 - Sections: 23-25.)

Unit–4 :Compactness **18 Hours**

Compact Spaces - Compact Subspaces of the Real Line -Limit Point Compactness - Local Compactness. (Chapter 3 - Sections: 26-29.)

Unit–5 :Countability And Separation Axioms **18 Hours**

The Countability Axioms - The Separation Axioms - Normal Spaces - The Urysohn Lemma - The Urysohn Metrization Theorem - The Tietz Extension Theorem.
(Chapter 4 - Sections: 30-35)

Prescribed Book

James R. Munkres, *Topology*, 2nd Edition, Pearson Education Pvt. Ltd., Delhi, 2002.

Reference Books:

1. J. Dugundji, *Topology*, Prentice Hall of India Pvt. Ltd., New Delhi, 1975.
2. G.F. Simmons, *Introduction to Topology and Modern Analysis*, McGraw Hill Education, New York, 1963.

3. J.L. Kelley, *General Topology*, Van Nostrand Reinhold Company, New York, 1955.
4. L.A. Steen and J.A. Seebach, *Counterexamples in Topology*, Holt, Rinechart and Winston, New York, 1970.
5. S. Willard, *General Topology*, Addison–Wesley Publishing Company, USA, 1970.

E-Materials:

1. https://ocw.mit.edu/courses/mathematics/18-901-introduction-to-topology-fall-2004/index.htm
2. https://ocw.mit.edu/courses/mathematics/18-904-seminar-in-topology-spring-2011/index.htm
3. https://swayam.gov.in/nd2_cec20_ma12/preview

Course Learning Outcomes

After the successful completion of this course, the students will be able to:

- know the basics of open and closed sets and the significance of the topological spaces.
- comprehend the continuous functions on topological spaces, product topology and topology induced by the metric.
- understand the connected spaces, connected subspaces, components and local connectedness.
- acquire the notions of compactness, compact subspaces, limit point compactness and local compactness.
- understandthe various countability axioms and the separation axioms.

PAPER - 9

DIFFERENTIAL GEOMETRY

Course Objectives:

The objectives of the course is to

- introduces space curves and their intrinsic properties of a surface and geodesics.
- studythe non–intrinsic properties of a surface
- study the differential geometry of surfaces.

Unit-1: Space Curves **18 hours**

Definition of a space curve – Arc length – Tangent – Normal and binormal – Curvature and torsion – Contact between curves and surfaces – Tangent surface – Involutes and evolutes – intrinsic equations – Fundamental existence theorem for space curve – Helices.
(Chapter 1: Sections 1 to 9)

Unit-2:Intrinsic Properties of a Surface **18 hours**

Definition of a surface – Curves on a surface – Surface of revolution – Helicoids – Metric – Direction coefficients – Families of curves – Isometric correspondence – Intrinsic properties. (Chapter 2: Sections 1 to 9)

Unit-3: Geodesics **18 hours**Geodesics – Canonical geodesic equations – Normal properties of geodesics – Existence theorem – Geodesic parallels – Geodesic curvatures – Gauss Bonnet theorem – Gaussian curvature – Surface of constant curvature. (Chapter 2: Sections 10 to 18)

Unit-4: Non–Intrinsic Properties of a Surface **18 hours**
The second fundamental form – Principal curvature – Lines of curvature – Developable – Developable associated with space curves and with curves on surface – Minimal surfaces – Ruled surfaces. (Chapter 3: Sections 1 to 8)

Unit-5: Differential Geometry of Surfaces **18 hours**

Fundamental equations of surface theory – Fundamental existence theorem for surfaces – Compact surfaces whose points are umbilics– Hilbert's lemma – Compact surfaces of constant curvature – Complete surfaces.
(Chapter 3: Sections 9 to 11, Chapter 4: Sections 1 to 5)

Prescribed Book

T.J.Willmore, An Introduction to Differential Geometry, Oxford University Press,(17th Impression) New Delhi 2002. (Indian Print)

Reference Books:

1. Struik, D.T. Lectures on Classical Differential Geometry, Addison - Wesley, Mass. 1950.
2. Kobayashi. S. and Nomizu. K. Foundations of Differential Geometry, Interscience Publishers, 1963. 3. Wilhelm Klingenberg: A course in Differential Geometry, Graduate Texts in Mathematics, Springer-Verlag 1978.
3. J.A. Thorpe Elementary topics in Differential Geometry, Under - graduate Texts in Mathematics, Springer - Verlag 1979.

E-Materials:

http://www.math.ku.dk/noter/filer/geom1.pdf

Course Learning Outcomes

After the successful completion of this course, the students will be able to:

- understand the characteristics of curves and surfaces in space and also the fundamental existence theorem for space curves.
- discussthe intrinsic properties of surface.
- analysethe geodesics and its normal properties and familiar with GaussBonnet Theorem.
- discussthe developable.
- understand Hilbert's Lemma and the fundamental existence theorem for surface theory.

CORE ELECTIVE
PAPER - 3
(to choose one out of 3)
A. LaTeX

Course Objectives:

The objectives of the course is to

- inculcatethe computer knowledge.
- introduce the LaTeXsoftware
- train in the Preparation of Project and dissertations using LaTex.
- educate the Latex coding.

Unit – I: Basic Document and Bibliography 18 hours

Whats is LATEX – Simple typesetting – Fonts Type size – Document class – page style – page numbering – Formatting lengths – parts of a document – Dividing the document – what next? – Introduction – natbib – The BIBTEX program – BIBTEX Style files – Creating a bibliographic database. (Chapter 1 to 4)

Unit - II: Contents, Index, Glossary, Text, Row and Column 18 hours

Table of contents – Index – Glossary. Borrowed words – Poetry in typing – Making lists – When order matters – Description and definitions. (Chapter 5 to 6)

Unit – III: Typesetting Equations and Theorems 18 hours

Keeping tabs – Tables – The basics – Custom commands – More on mathematics – mathematics miscellany – New operations– The many fact of mathematics – Symbols – Theory in LATEX – Designer theorem-the amsthm package – Housekeeping.
(Chapter 7 to 9)

Unit - IV: Several Kinds of boxes and Floats, 18 hours

LR boxes – Paragraph boxes – Paragraph boxes with specific height – Nested boxes – Role boxes – The figure environment – The table environment. (Chapter 10 to 11)

Unit – V: Cross References in LATEX, Footnotes, Marginpars and Endnotes 18 hours

Why cross reference? – Let LATEX do it – Pointing to a page-the package varioref – Pointing outside-the package xr – Lost the keys? Use lables.tex – Footnotes – Marginal notes – Endnotes. (Chapter 12 to 13)

Prescribed Book

A Primer, Latex Tutorials, Indian TEX users group, Trivandrum, India.

www.tug.org.in

Reference Books:

1. Peter Flynn, A beginner's introduction to typesetting with LATEX,Silmaril Consultants, Textual Therapy Division, 2003.
2. George Gratzer,More Math Into LATEX, 4th Edition, Springer Science (2007).
3. Frank Mittelbach,Michel Goossens,TheLaTex Companion, Second Edition, Addison-Wesley, 2004.

E-Materials:

1. https://www.latex-tutorial.com/tutorials/
2. https://www.latex-tutorial.com/
3. http://www.tug.org.in/tutorials.html

Course Learning Outcomes

After the successful completion of this course, the students will be able to:

- prepare the LaTeX document and the e-contents.
- Able to construct structures, tables inclusions, header and footer, bibliography management, etc.
- Understand about the mathematics document preparation.

CORE ELECTIVE
PAPER - 3
B. DISCRETE MATHEMATICS

Course Objectives:

The objectives of the course is to

- explore the topics like lattices and its applications in switchingcircuits
- study the finite fields, polynomials and coding theory.

Unit-1: Lattices **18 hours**

Properties and examples of Lattices - Distributive lattices - Boolean algebras - Boolean polynomials - Minimal Forms of Boolean Polynomials. (Chapter 1: 1 – 6).

Unit-2: Applications of Lattices **18 hours**

Switching Circuits- Applications of Switching Circuits (Chapter 2: 7 – 8)

Unit -3: Finite Fields and Polynomials **18 hours**

Finite fields (Chapter 3: 13 only)

Unit -4: Finite Fields and Polynomials **18 hours**

Irreducible Polynomials over Finite fields - Factorization of Polynomials over Finite fields (Chapter 3: 14 – 15)

Unit -5: Coding Theory **18 hours**

Linear Codes - Cyclic Codes(Chapter 4: 17 – 18)

Prescribed Book

Rudolf Lidl& Gunter Pilz. Applied Abstract Algebra, Second Indian Reprint 2006, Springer Verlag, NewYork, (2006).

Reference Books

1. A.Gill, Applied Algebra for Computer Science , Prentice Hall Inc., New Jersey.
2. J.L.Gersting, Mathematical Structures for Computer Science (3 rdEdn.), ComputerScience Press, New York.
3. S.Wiitala, Discrete Mathematics- A Unified Approach, McGraw Hill Book Co.

E-Materials:

1. http://archives.math.utk.edu/topics/discreteMath.html
2. http://www.discrete-math-hub.com/resources-and-help.html

Course Learning Outcomes

After the successful completion of this course, the students will be able to:

- understand about Lattices, applications of Lattices
- discuss the Boolean algebras and polynomials
- procure strong theoretical background on Finite Fields and Polynomials.
- analsye the concept of coding theory and factorization of polynomials
- identify the various types of codes

CORE ELECTIVE
PAPER - 3
C. OPERATIONS RESEARCH

Course Objectives:

The objectives of the course is to

- introduce decision theory and tree analysis
- study the project management of PERT and CPM
- study the deterministic and probabilistic inventory systems, queues, replacement and maintenance problems.

Unit-1: Decision Theory **18 hours**

Steps in Decision theory Approach – Types of Decision Making Environments –Decision Making Under Uncertainty – Decision Making under Risk – Posterior Probabilities and Bayesian Analysis – Decision Tree Analysis– Decision Making with Utilities.
(**Chapter 11:** Sections 11.1 to 11.8)

Unit-2: Project Management: PERT And CPM **18 hours**

Basic Differences between PERT and CPM – Steps in PERT/ CPM Techniques – PERT / CPM Network Components and Precedence Relationships – Critical path Analysis – Probability in PERT Analysis – Project time –Cost Trade off – Updating the Project – Resource Allocation. (**Chapter 13:** Sections 13.1 to 13.7)

Unit-3: Deterministic Inventory Control Models **18 hours**

Meaning of Inventory control – Functional Classification – Advantage of Carrying Inventory – Features of Inventory System – Inventory Model building – Deterministic Inventory Models with no shortage – Deterministic Inventory with Shortages.
(**Chapter 14:** Sections 14.1 to 14.8)

Unit-4: Queueing Theory **18 hours**

Essential Features of Queuing System – Operating Characteristic of Queuing System – Probabilistic Distribution in Queuing Systems Classification of Queuing Models – Solution of Queuing Models – Probability Distribution of Arrivals and Departures –Erlangian Service time Distribution with k–phases.(**Chapter 16:** Sections 16.1 to 16.7,16.9.)

Unit-5: Replacement and Maintenance Models **18 hours**

Failure Mechanism of items– Replacement of Items Deteriorates with Time – Replacement of items that fail completely – other Replacement Problems
(**Chapter 17:** Sections 17.1 to 17.5)

Prescribed Book

J.K. Sharma, Operations Research (Second Edition), Macmillian (India), New Delhi, 2003.

Reference Books

1. F.S.Hillier and J.Lieberman, Introduction To Operations Research, (Eighth edition), Tata McGraw Hill Publishing Company, New Delhi, 2006.

2. C. Beightler, D.Phillips, and B. Wilde, Foundations of Optimization, (Second edition), Prentice Hall New York, 1979.
3. M.S. Bazaraa, J.J.Jarvis, and H.D.Sharall, John Wiley and sons, New York, 1990.
4. D. Gross and C.M. Harris, Fundamentals Of Queuing Theory [3rd Edition], Wiley and Sons, New York, 1998.
5. HamdyA.Taha, Operations Research, (Sixth edition), Prentice–Hall of India Private Limited, New Delhi.

E-Materials:

http://www2.math.umd.edu/~jmr/241/calc.htm

Course Learning Outcomes

After the successful completion of this course, the students will be able to:

- analyse various inventory control modules
- understand the concepts of network techniques
- discuss the maintenance models in replacements
- understand inventory control and functional role of inventory
- analyse various performance of queueing models

OPEN ELECTIVE
PAPER - 3
(to choose one out of 3)

1. MATHEMATICAL BIOLOGY

Course Objectives:

The objectives of the course is to

- understand and know the discrete population growth models.
- study the continuous growth models and qualitative behavior of populations
- know the mathematical models in epidemiology

Unit-1: Discrete Population Growth Models **18 hours**

Arithmetic Growth Model - Geometric Growth Model - Generalizations – AgeStructured Populations.(Chapter 2: 2.2 to 2.5)

Unit-2: Continuous Growth Models **18 hours**

The Linear Model - The Exponential Model - Model for the Distribution of drugs inthe body - Coalition Models.(Chapter 3: 3.2 to 3.5)

Unit-3: Continuous Growth Models (contd.) **18 hours**

Environmental Resistance - A Model for the Spread of Technological Innovations -The Gomertz Model - Bertalanffy Growth Model.(Chapter 3: 3.8 to 3.11)

Unit-4: Qualitative behavior of Populations **18 hours**

Autonomous Equations - Steady and Equilibrium State - Stability of Equilibrium State-Logistic Model with Harvesting - Fixed Points and their stability - The Logistic Map.(Chapter 5: 5.2 to 5.7)

Unit-5: Mathematical Models in Epidemiology **18 hours**

Plant Epidemics - Some features of Human Epidemics - A Simple Deterministic Epidemic Model - A more General Epidemic: SIR Disease.(Chapter 7: 7.2 to 7.5)

Prescribed Book

C. R. Ranganathan, A First Course in Mathematical Models of Population Growth (with MATLAB Program), Associated Publishing Company, New Delhi, 2006.

Reference Books:

1. Pundir, Bio Mathematics, APragati Edition, 2006.
2. J.N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East-West Press Pvt. Ltd., New Delhi, 1985.
3. Nicolas F. Britton, Essential Mathematical Biology, Springer International Edition, First Indian reprint, 2004.
4. Murray, Mathematical Biology, Springer International Edition, First Indian reprint, 2004.

E-Materials:

1. https://www.smb.org/
2. https://web.archive.org/web/20080827161431/http://www.biostatsresearch.com/repository/

Course Learning Outcomes

After the successful completion of this course, the students will be able to:

- Formulate the mathematical models for real world problems
- understand the concepts of Discrete Population Growth Models
- discuss the Continuous Growth Models
- analyse the Qualitative behavior of Populations and Mathematical Models in Epidemiology

OPEN ELECTIVE
PAPER - 3

B. QUANTITATIVE TECHNIQUES

Course Objectives:

The objectives of the course is to

- study the linear programming problem
- understand the transportation problem and assignment problem
- know the inventory control and PERT and CPM.

Unit – I: Linear Programming Problem **18 hours**

Introduction – Graphical Solution Method – Some Exceptional Cases – General Linear Programming Problem – Fundamental Properties of Solution – The Computational Procedure - Simplex Method. (Chapter 3: Sections: 3.1 to 3.4 and Chapter 4: Sections: 4.1 to 4.3)

Unit –II: Transportation Problem **18 hours**

Introduction - L.P Formulation of the Transportation Problem – Existence of Solution in T.P – Transportation Table – Solution of a Transportation Problem – Finding Initial Basic Feasible Solution - Test for optimality – Economic Interpretation of u_j's and v_j's – Degeneracy in Transportation Problem – Transportation Algorithm (Modi Method) . (Chapter 10: Sections: 10.1 to 10.3, 10.5, 10.8 to 10.13)

Unit – III: Assignment Problem **18 hours**

Introduction - Mathematical Formulation of the Problem - Solution Methods of Assignment Problem – Special Cases in Assignment Problems – Travelling Salesman Problem. (Chapter 11: Sections: 11.1 to 11.4, 11.7)

Unit – IV: Inventory Control **18 hours**

Introduction – Types of Inventories – Reasons for Carrying Inventories – The Inventory Decisions – Objective of Scientific Inventory Control – Costs Associated with Inventories – Factors Affecting with Inventory Control – An inventory Control Problem - Deterministic Inventory problem with No shortages. (Chapter 19: Sections: 19.1 to 19.10)

Unit – V: Network scheduling by PERT and CPM **18 hours**

Introduction – Network: Basic Components – Logical Sequencing - Rules of Network Construction – Concurrent Activities – Critical Path Analysis – Probability Considerations in PERT- Distinction between PERT and CPM. (Chapter 25 only)

Prescribed Book

KantiSwarup, P.K. Gupta, Man Mohan, Operations Research, Sultan Chand &Sons, New Delhi, 2008.

Reference Books

1. P.K. Gupta, Operations Research, 8-e, Krishna PrakasamMandir, Meerut, 1993.
2. P.K.Gupta and D.S. Hira, Operations Research, S. Chand & Company, New Delhi, 2000.
3. J.K.Sharma, Operations Research Theory and Applications, 2-e, Macmillian Business Books, 2003.
4. Hamdy A. Taha, Operations Research, Pearson Education, New Delhi, 2002.

E-Materials:

http://mathworld.wolfram.com

Course Learning Outcomes

After the successful completion of this course, the students will be able to:

- understand the linear programming problems(LPP)
- discuss the simplex method to solve LPP
- analyse the transportation and assignment problems
- acquire the knowledge of resource leveling
- study inventory control and functional role of inventory.
- learn PERT-CPM technique for project management

OPEN ELECTIVE
PAPER - 3

C. SCILAB

Course Objectives:

The objectives of the course is to

- acquire the practical knowledge of SCILAB
- solve the matrics, polynomials and differential equations.

Unit - I: **18 hours**

Login - Talking between Scilab and the Editor - Basic Commands - Linear Algebra - Loops and Conditionals - Help in Scilab. (Chapter 1: Sections 1.1 to 1.7).

Unit – II: **18 hours**

Matrices and Vectors - Solving Equations - Creating Matrices - Systems of Equations. (Chapter 2: Section 2.2).

Unit – III: **18 hours**

Plotting Lines and Data - Adding a Line - Hints for Good Graphs – Graphs - Function Plotting - Component Arithmetic - Printing Graphs - Saving Graphs. (Chapter 3: Sections 3.2, 3.3).

Unit – IV: **18 hours**

Evaluation of Polynomials – Polynomials - Linear Least Squares (Heath Computer Problem).(Chapter 6: Sections 6.2, 6.3, 6.4).

Unit – V: **18 hours**

Differential Equations - Scalar ODE's - Order 2 ODE's . (Chapter 8: Sections 8.2).

Prescribed Book

Graeme Chandler and Stephen Roberts, Scilab Tutorials for Computational Science, 2002.

Reference Books:

1. Scilab for very beginners, Scilab Enterprises, S.A.S, 143, bis rue Yves Le Coz – 78000 Versailles (France).
2. K. S. Surendran, SCILAB FOR DUMMIES, Version 2.6.
3. Some notes on SCILAB, Universit´e de Nice Sophia-Antipolis.

E-Materials:

https://www.scilab.org/

Course Learning Outcomes

After the successful completion of this course, the students will be able to

- acquire the practical knowledge of SCILAB
- analyse the matrices, polynomials in SCILAB
- solve the solutions of differential equations
- visualize the mathematical objects in 2D and 3D

SEMESTER IV

PAPER - 10

COMPLEX ANALYSIS - II

Course Objectives:

The objectives of the course is to

- introduce the concept of residues.
- evaluate contour integrals.
- educate the analytic continuation and poisson integral formula.
- inculcate the concepts of meromorphic and entire functions.
- indoctrinate the applications of open mapping, Hurwitz and Riemann mapping theorems.

Unit – 1: Calculus of Residues **15 hours**

Residue at a Finite Point – Residue at the Point at Infinity – Residue Theorem – Number of Zeros and Poles – Rouche's Theorem. (Chapter 7, Sections: 7.1 to 7.6 and Chapter 8, Sections: 8.1 to 8.5)

Unit – 2: Evaluation of Certain Integrals **15 hours**

Integrals of three types - Singularities on the Real Axis - Integrals Involving Branch Points - Estimation of Sums (Chapter 9, Sections: 9.1 to 9.6)

Unit – 3: Analytic Continuation **15 hours**

Direct Analytic Continuation - Monodromy Theorem - Poisson Integral Formula - Analytic Continuation via Reflection (Chapter 10, Sections: 10.1 to 10.4)

Unit – 4: Representation of Meromorphic and Entire Functions **15 hours**

Infinite Sums and Meromorphic Functions - Infinite Product of Complex Numbers - Infinite Products of Analytic Functions - Factorization of Entire Functions - The Gamma Function - The Zeta Function - Jensen's Formula - The Order and the Genus of Entire Functions (Chapter 11, Sections: 11.1 to 11.8)

Unit –5: Mapping Theorems **15 hours**

Open Mapping Theorem and Hurwitz' Theorem - Basic Results on Univalent Functions - Normal Families - The Riemann Mapping Theorem - Bieberbach Conjecture - The Bloch-Landau Theorems - Picard's Theorem (Chapter 12, Sections: 12.1 to 12.7)

Prescribed Book

S. Ponnusamy, *Foundations of Complex Analysis*, Second Edition, Narosa Publishing House, New Delhi, 2015.

Reference Books:

1. Lars V. Ahlfors, *Complex Analysis*, 3rd Edition, McGraw-Hill Inc., New York, 1979.
2. J.W. Brown and R.V. Churchill, *Complex Variables and Applications*, 8th Edition, McGraw-Hill Higher Education, New York, 2009.
3. J.B. Conway, *Functions of One Complex Variable*, 2nd Edition, Narosa Publishing House, New Delhi, 1996.
4. V. Karunakaran, *Complex Analysis*, 2nd Edition, Narosa Publishing House, New Delhi, 2005.

5. H.A. Priestley, *Introduction to Complex Analysis*, 2nd Edition, Oxford University Press Inc., New York, 2005.

E-Materials:

1. https://ocw.mit.edu/courses/mathematics/18-112-functions-of-a-complex-variable-fall-2008/
2. https://ocw.mit.edu/courses/mathematics/18-04-complex-variables-with-applications-spring-2018/
3. https://www.coursera.org/learn/complex-analysis

Course Learning Outcomes

After the successful completion of this course, the students will be able to

- Understand the concepts of residues
- Evaluate the integrals using Cauchy residue theorem.
- comprehend the harmonic functions and its consequences.
- understand the conformal mappings, normal families and Riemann mapping theorem.
- acquire the concepts of entire and meromorphic functions.
- procure the applications of analyticity and special functions.

PAPER - 11

FLUID DYNAMICS

Course Objectives:

The objectives of the course is to

- discuss kinematics of fluids in motion
- derive the equations of motion of a fluid
- study the three dimensional flows, two dimensional flows and viscous flows.

Unit-1: Kinematics of Fluids In Motion 15 hours

Real fluids and ideal fluids – Velocity of a fluid at a point, Stream lines, path lines, steady and unsteady flows – Velocity potential – The vorticity vector – Local and particle rates of changes – Equations of continuity – Worked examples – Acceleration of a fluid – Conditions at a rigid boundary. (Chapter 2: Sections 2.1 to 2.10)

Unit-2: Equations of Motion of Fluid 15 hours

Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary of two inviscid immiscible fluids – Euler's equation of motion – Discussion of the case of steady motion under conservative body forces. (Chapter 3: Sections 3.1 to 3.7)

Unit-3: Some Three Dimensional Flows 15 hours

Introduction – Sources, sinks and doublets – Images in a rigid infinite plane – Axis symmetric flows – Stokes stream function. (Chapter 4 : Sections 4.1, 4.2, 4.3, 4.5.)

Unit-4: Some Two Dimensional Flows 15 hours

Meaning of two dimensional flow – Use of Cylindrical polar coordinate – The stream function – The complex potential for two dimensional, irrational incompressible flow – Complex velocity potentials for standard two dimensional flows – Some worked examples – Two dimensional image systems – The Milne Thompson circle Theorem.

(Chapter 5 : Sections 5.1 to 5.8)

Unit-5: Viscous Flows 15 hours

Stress components in a real fluid – Relations between Cartesian components of stress – Translational motion of fluid elements – The rate of strain quadric and principal stresses – Some further properties of the rate of strain quadric – Stress analysis in fluid motion – Relation between stress and rate of strain – The co-efficient of viscosity and Laminar flow – The Navier – Stokes equations of motion of a Viscous fluid. (Chapter 8: Sections 8.1 to 8.9)

Prescribed Book

F. Chorlton, Text Book of Fluid Dynamics ,CBS Publications. Delhi ,1985.

Reference Books:

1. R.W.Fox and A.T.McDonald. Introduction to Fluid Mechanics, Wiley, 1985.
2. E.Krause, Fluid Mechanics with Problems and Solutions, Springer, 2005.
3. B.S.Massey, J.W.Smith and A.J.W.Smith, Mechanics of Fluids, Taylor and Francis, New York, 2005 4. P.Orlandi, Fluid Flow Phenomena, Kluwer, New Yor, 2002.
4. T.Petrila, Basics of Fluid Mechanics and Introduction to Computational Fluid Dynamics, Springer, berlin, 2004.

E-Materials:

http://web.mit.edu/1.63/www/lecnote.html

Course Learning Outcomes

After the successful completion of this course, the students will be able to

- understand the concepts of kinematics of fluids in motions.
- analyse the examples related to the equation of continuity and acceleration of a fluid
- discuss two-dimensional flows, the stream function and the Milne Thompson Circle theorem.
- acquire the concept of three-dimensional flows and derive Stoke's stream function
- discuss the viscous flows and Navier – Stokes equations of motion of a Viscous fluid.

PAPER - 12

FUNCTIONAL ANALYSIS

Course Objectives:

The objectives of the course is to

- study the details of Banach algebraand Hilbert Spaces
- providethe concept of conjugate space H*, adjoint, self-adjoint, normal and unitary operators.
- study the regular, singular elements, radical and semi-simplicity.
- study the details of structure of commutative Banach algebras
- know about the relationship between algebraic structure of linear space and distance structure of a metric space.

UNIT-I :Banach Spaces **15 hours**

Definition - Some examples - Continuous Linear Transformations - The Hahn -Banach Theorem (Chapter 9: Sections 46 to 48)

UNIT-II :Banach Spaces And Hilbert Spaces **15 hours**

Open mapping theorem - conjugate of an operator - Definition and some simple properties - Orthogonal complements - Orthonormal (Chapter 9: Sections 50 and 51 ; Chapter 10 : Sections 52, 53 and 54)

UNIT-III : Hilbert Space **15 hours**

Conjugate space H* - Adjoint of an operator - Self-adjoint operator - Normal and Unitary Operators – Projections (Chapter 10: Sections 55, 56,57,58 and 59)

UNIT-IV :Preliminaries nnBanach Algebras **15 hours**

Definition and some examples - Regular and single elements - Topological divisors of zero - spectrum - the formula for the spectral radius - the radical and semi-simplicity.
(Chapter 12 : Sections 64 to 69)

UNIT-V: Structure of Commutative Banach Algebras **15 hours**

Gelfand mapping –Applications of the formula $r(x) = \lim \left\| x^n \right\|^{1/n}$ - Involutions in Banach Algebras - Gelfand-Neumark Theorem.(*Chapter 13 : Sections 70 to 73)*

Prescribed Book

G.F.Simmons ,*Introduction to topology and Modern Analysis*, McGraw Hill International Book Company, New York, 1963.

Reference Books:

1. W. Rudin*Functional Analysis*, Tata McGraw-Hill Publishing Company, New Delhi, 1973
2. G. Bachman &L.Narici, *Functional Analysis* Academic Press, New York, 1966.
3. H.C. Goffman and G.Fedrick, *First course in Functional Analysis*, Prentice Hall of India, New Delhi, 1987
4. E. Kreyszig*Introductory Functional Analysis with Applications*, John wiley& Sons, New York.,1978.
5. Balmohan V. Limaye, Linear Functional Analysis for Scientists and Engineers, Springer.

E-Materials

http://www.math.ucdavis.edu/~hunter/book/ch5.pdf

Course Learning Outcomes

After the successful completion of this course, the students will be able to

- analyse the Banach space with examples
- understand the natural embedding N in N**
- discuss Banach spaces with the Hilbert spaces
- acquire the open mapping theorem, orthonormal complements and orthonormal sets
- derive Gelgand-Neumark theorem
- prove the structure theorems

CORE ELECTIVE

PAPER - 4

(to choose one out of 3)

A. NUMBER THEORY AND CRYPTOGRAPHY

Course Objectives:

The objectives of the course is to

- give elementary ideas from number theory which will have applications in cryptography.
- study the quadratic residues and reciprocity
- understand about public key and primality

UNIT–I Some Topics in Elementary Number Theory 15 hours

Time Estimates for doing arithmetic – Divisibility and Euclidean Algorithm – Congruence's – Some applications to Factoring. (Chapter I)

UNIT–II Cryptography 15 hours

Some simple cryptosystems – Enciphering matrices. (Chapter III)

UNIT–III Quadratic Residues 15 hours

Quadratics – Residues and reciprocity. (Chapter II)

UNIT–IV Public Key 15 hours

The idea of Public key Cryptography – RSA – Discrete Law – Knapsack – Zero–Knowledge.(Chapter IV : Sections 1 to 5)

UNIT–V Primalityand Factoring 15 hours

Pseudo–primes – The rho method – Fermat factorization and factor bases – The continued fraction method – The quadratic sieve method. (Chapter V: Sections 1 to 5)

Prescribed Book

Neal Koblitz, A Course in Number Theory And Cryptography, Springer–Verlag, New York,1987.

Reference Books:

1. Niven and Zuckerman, An Introduction to Theory of Numbers, Third Edition, Wiley Eastern Ltd, New Delhi,1976.
2. David M. Burton,Elementary Number Theory, Wm. C. Brown Publishers, Dubuque, Iowa, 1989.

3. K. Ireland and M. Rosen, A Classical Introduction to Modern Number Theory, Springer–Verlag,1972.

E-Materials

http://mathworld.wolfram.com

Course Learning Outcomes

After the successful completion of this course, the students will be able to

- discuss the elementary number theory
- understand the the quadratic, residues and reciprocity
- develop the idea of Public key cryptography, RSA and discrete law
- solve problems using the continued fraction method and the quadratic Sieve method
- analyseKnapsact, zero knowledge
- discuss Fermat factorization and factor bases.

CORE ELECTIVE

PAPER - 4

B. ADVANCED NUMERICAL ANALYSIS

Course Objectives:

The objectives of the course is to

- introduce the derivation of numerical methods with error analysis
- study the transcendental and polynomial equations
- study the system of linear algebraic equations
- understand the differentiation and integration
- solve problems on interpolation and ordinary differential equations

UNIT–I Transcendental and Polynomial Equations 15 hours

Iteration methods based on second degree equation –Rate of convergence – Iteration methods – Methods for complex roots – Polynomial equations.

(**Chapter 2:**Sections2.4 to 2.8)

UNIT–II System of Linear Algebraic Equations and Eigen Value Problems 15 hours

Direct methods –Triangularisation, Cholesky and Partition methods – Error analysis– Iteration methods – Eigen values and Eigenvectors – Jacobi's method, Given's method, Rutishaugher method and Power method. (**Chapter 3:** Sections 3.2 to 3.5)

UNIT–III Interpolation and Approximation 15 hours

Hermite Interpolations – Piecewise and Spline Interpolation – Bivariate interpolation – Approximation – Least Square approximation – Uniform approximation.

(**Chapter 4:**Sections4.5 to 4.10)

UNIT–IV Differentiation and Integration 15 hours

Numerical Differentiation – Partial Differentiation – Numerical Integration methods based on undetermined coefficients– Double integration.

(**Chapter 5:**Sections5.2, 5.5, 5.6, 5.8, 5.11)

UNIT–V ORDINARY DIFFERENTIAL EQUATIONS 15 hours

Numerical methods – Single step methods –Multistep methods –Predictor–Corrector methods.(**Chapter 6:**Sections6.2 to 6.5)

Prescribed Book

M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods For Scientific And Engineering Computation, 3rd Edition, New Age International, 1993.

Reference Books:

1. S. D. Corte and de Boor, Elementary Numerical Analysis – An Algorithmic approach, 3rd Edition, McGraw Hill International Book Company, 1980.
2. James B. Scarboraugh, Numerical Mathematical Analysis, Oxford& IBH Publishing Company, New Delhi.
3. F.B. Hildebrand, Introduction To Numerical Analysis, McGrawHill, New York, 1956.

E-Materials

1. https://www.math.upenn.edu/~wilf/DeturckWilf.pdf
2. https://web.archive.org/web/20120225082123/http://kr.cs.ait.ac.th/~radok/math/mat7/stepsa.htm
3. https://ocw.mit.edu/courses/mechanical-engineering/2-993j-introduction-to-numerical-analysis-for-engineering-13-002j-spring-2005/

Course Learning Outcomes

After the successful completion of this course, the students will be able to

- compute the solutions of transcendental and polynomial equations
- understand the system of linear algebraic equations
- analyse interpolation and extrapolation
- derive numerical differentiation and integrations
- evaluate double integrals
- solve differential equations by single and multi step methods

CORE ELECTIVE

PAPER - 4

C. CALCULUS OF VARIATION AND INTEGRAL EQUATIONS

Course Objectives:

The aim of the course is to introduce to

- the concept of calculus of variation and its applications and to introduce various types of integral equations
- study the methods of successive approximations and fredholm theory
- acquire knowledge on applications to Ordinary Differential Equations.

Unit– I: Variational Problems with Fixed Boundaries 15 hours

The concept of Variation and its properties – Euler's equation – Variational problems for functionals of the form –Functionals dependent on higher order derivatives – Functionals dependent on Functions of several independent variables– Variational problem in parametric form – Some applications to problems of mechanics.
(Book – 1, Chapter 1, Sections: 1.1 to 1.7)

Unit–II: VariationalProblems with Moving Boundaries 15 hours

Variational problem with a Movable boundary for a functional dependent on two functions – One sided variations – Reflection and Refraction of extremals – Diffraction of light rays. (Book–1, Chapter 2, Sections: 2.2 to 2.5)

Unit– III: Integral Equations 15 hours

Introduction– Definition– Regularity conditions– Special kinds of Kernels– Eigen values and Eigen functions – Convolution integral – Reduction to a system of algebraic equations – Examples –Fredholmalternative – Examples – An approximation method. (Book–2, Chapter 1, Sections: 1.1 to 1.5; Chapter 2,Sections: 2.1 to 2.5)

Unit–IV: Method of Successive Approximations and Fredholm Theory 15 hours

Method of successive approximations – Iterative scheme – Examples – Volterra integral equations –Examples – Some results about the resolvent kernel – The method of solution of Fredholmequation –Fredholm first theorem – Examples. (Book–2, Chapter 3, Sections:3.1to 3.5; Chapter 4,Sections: 4.1 to 4.3)

Unit–V: Applications to Ordinary Differential Equations 15 hours

Initial value problems – Boundary value problems – Examples – Singular integral equations – The Abel integral equations - Examples.
(Book–2, Chapter 5, Sections: 5.1 to 5.3; Chapter8, Sections: 8.1 to 8.2)

Prescribed Book

1. A. S. Gupta, *Calculus of Variations with Applications*, PHI, New Delhi, 2005.
2. Ram P.Kanwal, *Linear Integral Equations*, Theory and Techniques, Academic Press, NewYork, 1971.

Reference Books:

1. M. D. Raisinghania, *Integral Equations and Boundary Value Problems*, S. Chand & Co., New Delhi, 2007.
2. Sudir K. Pundir and RimplePundir, *Integral Equations and Boundary Value Problems*, PragatiPrakasam, Meerut. 2005.

E –Materials

http://www.maths.ed.ac.uk/~jmf/Teaching/Lectures/CoV.pdf

Course Learning Outcomes

After the successful completion of this course, the students will be able to

- understand theconcept of calculus of variation and its applications
- discuss the various types of integral equations
- analysethe methods of successive approximations and fredholm theory
- acquire knowledge on applications to Ordinary Differential Equations.

OPEN ELECTIVE

PAPER - 4

(to choose one out of 3)

A. MATHEMATICAL ECONOMICS

Course Objectives:
The aim of the course is to introduce to

- study the theory of FIRM and perfect competition
- understand about market equilibrium and welfare economics

Unit-1: The Theory of FIRM **15 hours**
Basic Concepts - Optimizing Behavior - Input Demands - Cost Functions – JointProducts - Generalization to m variables - (Chapter 4: Sections 4.1 to 4.6)

Unit-2: CES Production **15 hours**
Homogeneous Production functions – CESProduction Function.
(Chapter 5: Sections5.1 and 5.2)

Unit-3: Perfect Competition **15 hours**
Assumptions of Perfect Competition - Demand Functions - Supply Functions – Commodity - Market Equilibrium - An application to Taxation.
(Chapter 6: Sections 6.1 to 6.5)

Unit-4: Market Equilibrium **15 hours**
Factor-Market Equilibrium - Existence and Uniqueness of Equilibrium - Stability of Equilibrium - Dynamic Equilibrium with Lagged Adjustment.
(Chapter 6: Sections 6.6 to 6.9)

Unit-5:Welfare Economics **15 hours**
Pareto Optimality - the efficiency of Perfect competition - The efficiency of Imperfect competition - External Effects in consumption and Production - Taxes and Subsidies – Social Welfare functions - The theory of Second Best.
(Chapter 11 : Sections 11.1 to 11.7)

Prescribed Book

James M. Henderson and Richard E. Quandt, Micro Economic Theory
A Mathematical Approach, (3rd Edn.) Tata McGraw Hill, New Delhi, 2003.

Reference Books

1. William J. Baumol. Economic Theory and Operations Analysis, Prentice Hall ofIndia, New Delhi, 1978
2. A.C.Chiang, Fundamental Methods of Mathematical Economics, McGraw Hill, NewYork, 1984
3. Michael D. Intriligator, Mathematical Optimization and Economic Theory, PrenticeHall, New York, 1971.

4. A. Kautsoyiannis, Modern Microeconomics (2 ndedn) MacMillan, New York, 1979

E –Materials

1. https://curlie.org/Science/Math/Applications/Mathematical_Economics_and_Financial_Mathematics/
2. http://master-economics-qem.univ-paris1.fr/about/?no_cache=1

Course Learning Outcomes

After the successful completion of this course, the students will be able to

- understand the knowledge of FIRM theory and perfect competition
- analyse the CES production
- acquire the knowledge of market equilibrium
- control the stability of equilibrium
- discuss the welfare economics, taxes and subsidies

OPEN ELECTIVE

PAPER - 4

B. ENTREPRENEURIAL DEVELOPMENT

Course Objectives:

The aim of the course is to

- provide an understanding of basic concept in the area of entrepreneurship
- expose students to the idea generation, creating awareness of business opportunities, and familiarizing them with formal practices in effective project formation.
- provide insights to students on entrepreneurial finance and role of various government agencies in assisting entrepreneurship.

Unit-1: Introduction **15 hours**

Entrepreneur and Entrepreneurship – Concept – Definition - Classification of Entrepreneur – Women Entrepreneur - Functions of an Entrepreneur - Traits of successful Entrepreneur - Entrepreneurs Vs Professional Managers – Role of an Entrepreneur in Economic Development - Future challenges.

Unit-2: Entrepreneurial Development **15 hours**

Entrepreneurial Development Programmes – Meaning - Evolution and Objectives of EDP - Institutional efforts to develop Entrepreneurship - National Skill Development Corporation (NSDC) - Role of Government in Organising EDPs - Operational Problem of EDPs.

Unit-3: Project Management and Idea Generation **15 hours**

Project Management - Project Identification - Project Formulation - Project Design and Network Analysis – Overview of Project Appraisal - Project Report - Identification and Selection of Business Opportunity – Idea Generation – Overview of Techniques used for Idea Generation. - Individual creativity.

Unit-4: Entrepreneurial Finance and Development Agencies **15 hours**

Sources of Finance – Commercial Banks and Development Banks - Role of Agencies in assisting Entrepreneurship - District Industries Centers (DIC), Small Industries Service Institute (SISI), Entrepreneurship Development Institute of India (EDII), National Institute of Entrepreneurship & Small Business Development (NIESBUD), National Entrepreneurship Development Board (NEDB).

Unit-5: Government Policies and Benefits **15 hours**

Tax Benefits – Tax Holidays – Allowance for deducting Depreciation – Rehabilitation Allowance – Benefits available for MSMEs: PMEGP – NEEDS – UYEGP.

Prescribed Books

1. Dr. S.S. Khanka, Entrepreneurship Development - S. Chand & Co., New Delhi.
2. Jayashree Suresh, Entrepreneurial Development –Margham Publication, Chennai.
3. VasantDesa, Dynamics of Entrepreneurial Development –Himalaya Publication.
4. Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, Entrepreneurship - Tata McGraw Hill Publishing Company Limited, New Delhi.
5. Ravindranath V. Badi&Narayana, Entrepreneurship, Vrinda Publication (P) Ltd, New Delhi.

References Books:

1. Rabindra N. Kanungo, Entrepreneurship and Innovation, Sage Publications, New Delhi.
2. Holt D. H., Entrepreneurship New Venture Creation. New Delhi: Prentice Hall of India.
3. Hisrich R, and Peters, M., Entrepreneurship. New Delhi: Tata McGraw Hill.
4. Rajkonwar A.B., Entrepreneurship, Kalyani Publisher, Ludhiana.
5. Charantimath, Poornima, Entrepreneurship Development and Small Business Enterprises, Pearson Education, New Delhi.

E-Materials:

1. http://www.indcom.tn.gov.in/pmegp.html
2. http://www.indcom.tn.gov.in/needs.html
3. http://www.indcom.tn.gov.in/uyegp.html

Course Learning Outcomes

After the successful completion of this course, the students will be able to

- understand the knowledge of entrepreneurship
- analyse the entrepreneurial finance and role of various government agencies
- develop the idea generation, creating awareness of business opportunities, and familiarizing them with formal practices
- discuss the Government policies and benefits.

OPEN ELECTIVE

PAPER – 4

C. PROGRAMMING IN C++

Course Objectives:

- This course introduces a higher level language C++ for hands on experience on computers.

Unit –1: Tokens Expressions and control Structures **15 hours**

Tokens – Keywords – Identifiers and constants – Basic data types – Uses defined data types – Derived data types – Symbolic – Operators in C++ – Scope resolution operator – Manipolators – Operator overloading – Control structures. (Chapter 3: Sections: 3.1 to 3.24)

Unit –2: Functions **15 hours**

Characteristic of OOP – Function prototype – Default arguments – Inline functions – Function overloading – Template functions (Chapter 4: Sections: 4.2, 4.3, 4.6, 4.7, 4.9)

Unit-3: Classes in C++ **15 hours**

Classes –Constructors and destructors – Friend functions – Template classes – New and delete operators – Operator overloading. (Chapter 5: Sections: 5.1 to 5.15; Chapter 6: Sections: 6.1 to 6.9, Chapter 7: Sections: 7.1 to 7.5)

Unit –4: Inheritance **15 hours**

Single inheritance – Multiple inheritance – Hierarchical inheritance – Hybrid inheritance – Virtual functions (Chapter 8: Sections: 8.1 to 8.8)

Unit-5: **Polymorphism in C++** **15 hours**

Polymorphism. (Chapter 9: Sections: 9.6,9.7)

Prescribed Book

E.Balagurusamy, Object Oriented Programming with C++, 4-e, Tata McGraw Hill Pub.Co,New Delhi,2001

Reference Books

1. E.Balagurusamy, Numerical Methods, Tata McGraw Hill Publishing Company Ltd , New Delhi,1999.
2. John.H.Mathews, Numerical Methods for Mathematics, Science and Engineering, 2-e
   Prentice Hall India Pvt.,Ltd, 2003.
3. S.S.Sastry , Introductory to Numerical Methods , Prentice Hall India Pvt., Ltd, 2000
4. H.C.Saxena,Finite Differences and Numerical Analysis, S.Chand& Company Ltd, New Delhi, 2005.

E-Materials:

http:// en.wikipedia.org/wiki//c++/programme.

Course Learning Outcomes

After the successful completion of this course, the students will be able to

- understand the concept of Tokens Expressions and control Structures
- analyse the types of functions and classes used in C++
- discuss the inheritance and various types of inheritance
- acquire the knowledge of Polymorphism in C++

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