பகுதி – I, **தமிழ்** **பருவம்** I

16LSU101 : **தமிழ் முதல் தாள்** 4-H,4-C

(இளநிலை அறிவியல் பட்ட வகுப்புகளுக்குரியது)

பாடத்திட்டப் *பொதுநோக்கம்*

- *கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், மேம்படுத்துதல்.*
- *ஆய்வுநோக்கை மேம்படுத்துதல்.*
- *இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.*
- *மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.*
- *வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.*
- *அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.*

பாடத்திட்டப் பயன் விளைவு

1. *இந்திய குடியுரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இந்திய குடியுரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இடம்பெறுகின்ற, 'தமிழ் இலக்கிய வரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.*
2. *கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத் தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.*
3. *தமிழின் வளர்ச்சித் துறையாகிய, 'அறிவியல் தமிழ்' ; 'இணைய தமிழ்' குறித்த பன்நோக்கு அணுகுமுறையிலான ஆய்வுச் சிந்தனை மேம்பாடு.*
4. *வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .*
5. *சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப் பேணுவதற்குக் கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மை வளர்ச்சி.*
6. *மொழிபெயப்புத் துறைசார்ந்த வேலைவாய்புத் திறன் பெற்றிருத்தல்*

அலகு – I : இக்கால இலக்கியம்: **(10 மணிநேரம்)**

கல்வி : மகாகவி பாரதியார் – சுயசரிதை - ஆங்கிலக் கல்வி.

இன்றைய நிலை : கவிமணி தேசிக விநாயகம் பிள்ளை – ஒற்றுமையே உயிர்நிலை.

மனிதநேயம் : கவிஞர் சிற்பி பாலசுப்பிரமணியன் –மலையாளக் காற்று.

சூழலியல் : கவிஞர் வைதீஸ்வரன் - விரல் மீட்டிய மழை.

பெண்ணியம் : கவிஞர் சுகந்தி சுப்பிரமணியம் – புதையுண்ட வாழ்க்கை.

அலகு – II : அற இலக்கியம்: **(10 மணிநேரம்)**

கொன்றை வேந்தன்: 1-50 பாடல்கள்

திருக்குறள்: பண்புடைமை, வினைத்திட்பம் – 20 குறள்கள்

பழமொழி நானூறு: 5 பாடல்கள்

அலகு - III : சிற்றிலக்கியம்: **(10 மணிநேரம்)**

மூவருலா: 1-26 கண்ணிகள்

திருச்செந்தூர் முருகன் பிள்ளைத்தமிழ்: 2 பாடல்கள்

கலிங்கத்துப் பரணி: போர்பாடியது - 9 பாடல்கள்

அலகு – IV : கட்டுரை: **(10 மணிநேரம்)**

1. உயர்தனிச் செம்மொழி - பரிதிமாற்கலைஞர்
2. கட்டிடக்கலை - அ. இராசமாணிக்கனார்
3. வாழ்க்கை - இளவழகனார்
4. ஆளுமைத்திறன் அறிவோம் - ஸ்ரீகண்ணன்
5. மணற்கேணி - நெ.து.சுந்தரவடிவேலு

அலகு- V : மொழிப்பயிற்சி: **(8 மணிநேரம்)**

1. படைப்பிலக்கியப் பயிற்சிகள் (கதை, கவிதை, கட்டுரை, உரைநடை)
2. மொழிபெயர்ப்பு
3. இலக்கணப் பயிற்சிகள்.

பாட நூல்: கற்பகச்சோலை – தமிழ் ஏடு. *கற்பகம் பல்கலைக்கழகத் தமிழ்த் துறை வெளியீடு.*

Semester – I

		L	T	P	C
16ENU101	**ENGLISH- I**	**4**	**0**	**0**	**4**

Course Objectives:

- To help students enhance their Language skills
- To introduce different kinds of literary works
- To familiarize different genres of Literature
- To instruct moral values through literature.
- To improvise their productive and receptive skills
- To strengthen the basic knowledge about grammar

Course Outcome:

1. Develop the four types of skills
2. Reading and comprehending literary works
3. Genres of literature to provide moral education
4. Develop communication skills in business environment
5. Interpersonal skills will be developed.
6. Betterment of language competence.

UNIT I

Prose: Google Guys (Extract) – Richard L Brandt
Poetry: The Blind Pedlar – Osbert Sitwell
Short Story: A Garden So Rich – Christie Craig
Vocabulary: Prefix, Antonyms, Sentence Completion
Grammar: Article, Adverb, Pronoun

UNIT II

Prose: Happiness 101 – Geeta Padmanabhan
Poetry: An Old Woman **–** Arun Kolatkar
Vocabulary: Suffix, Analogies
Grammar: Noun, Adjective

UNIT III

Prose: Structured Procrastination – John Perry
Short Story: The Umbrella Man – Roald Dahl
One-Act Play: The Boy Who Stopped Smiling – Ramu Ramanathan
Vocabulary: Synonyms, Euphemisms, Word Definitions
Grammar: Verb, Conjunction and Interjection, Indirect/Reported Speech

UNIT IV

Poetry: No Sentence – Anjum Hassan
One-Act Play: While the Auto Waits- O' Henry
Vocabulary: Words Often Confused, Anagrams
Grammar: Preposition, Voice- Active and Passive

UNIT V

Short Story: The Bird **–** Amar Jalil
One-Act Play: The Cellphone Epidemic – Claudia I. Haas
Vocabulary: Portmanteau Words, One Word Substitution
Grammar: Question, Pronunciation

Prescribed Text:

Rao, G. Chandralekha et al. Spring 2013**.** Emerald Publishers: Chennai.

Suggested Reading:

Shyamala, V. English for Communication. 2006. Emerald Publishers: Chennai

Semester – I

		L	T	P	C
16MMU101	**CALCULUS**	**4**	**0**	**0**	**4**

Course Objectives

This course enables the students to learn

- The concepts of essentials of concavity, inflection points and its geometrical applications.
- The Higher order derivatives and its applications in business, economics and life sciences.
- The Leibniz rule and its applications in exponential and trigonometric.
- The concepts of volumes by slicing, disks and washers' methods, volumes by cylindrical shells, parametric equations and parameterizing a curve.
- The concepts of vector functions, operations with vector-valued functions, limits and continuity of vector functions.
- Recognize the appropriate tools of calculus to solve applied problems.

Course Outcomes (COs)

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

1. Understand the concepts of hyperbolic functions.
2. Explore the concept of reduction formula and calculate limits in indeterminate forms by a repeated use of L'Hospital rule.
3. Use single and multiple integration to calculate the arc length, area and volume.
4. Understand the techniques of sketching conics and properties of conics.
5. Know about the knowledge on application of vector functions.
6. Acquire the knowledge on application of Kepler's second law.

UNIT I

Hyperbolic functions, higher order derivatives, Leibniz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$,

UNIT II

Curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences. Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin nx\, dx$, $\int \cos nx\, dx$, $\int \tan nx\, dx$, $\int \sec nx\, dx$, $\int \log x^n\, dx$, $\int \sin^n x \sin^m x\, dx$.

UNIT III

Volumes by slicing, disks and washers methods, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution.

UNIT IV

Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification into conics using the discriminant, polar equations of conics.

UNIT V

Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration, modeling ballistics and planetary motion, Kepler's second law.

SUGGESTED READINGS

TEXT BOOK

1. Strauss M.J., Bradley G.L.,and Smith K. J., (2007). Calculus, Third Edition ,Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

REFERENCES

1. Thomas G.B., and Finney R.L., (2005). Calculus, Ninth Edition, Pearson Education, Delhi.
2. Anton H., Bivens I., and Davis S.,(2002). Calculus, Seventh Edition, John Wiley and Sons (Asia) P. Ltd., Singapore.
3. Courant R., and John F., (2000). Introduction to Calculus and Analysis (Volumes I & II), Springer-Verlag, New York.

		Semester – I			
		L	T	P	C
16MMU102	ALGEBRA	6	1	0	6

Course Objectives

This course enables the students to learn

- The functions, relations, systems of linear equations and linear transformations.
- How to identify, evaluate and simplify algebraic expressions using the correct operations.
- The basic concepts of linear algebra.
- The concepts of principles of mathematical induction.
- The solution and application of linear systems.
- The application of matrix, inverse of matrix and system of linear equations.

Course Outcomes (COs)

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

1. Know about the basic concepts of set theory.
2. Describe the categories of functions.
3. Understand the algorithms on operation.
4. Use matrix operations to solve system of linear equations.
5. Learn how to find characteristic equation, eigen value and eigen vector for matrix.
6. Know about the applications of linear systems and linear independence.

UNIT I

Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational Indices and its applications.

UNIT II

Equivalence relations, Functions, Composition of functions, Invertible functions, One to one Correspondence and cardinality of a set, Well-ordering property of positive integers.

UNIT III

Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, Statement of Fundamental Theorem of Arithmetic.

UNIT IV

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation Ax=b, solution sets of linear systems, applications of linear systems, linear independence.

UNIT V

Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of Rn, dimension of subspaces of Rn and rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix.

SUGGESTED READINGS

TEXT BOOKS

1. Titu Andreescu., and Dorin Andrica,(2006). Complex Numbers from A to Z, Birkhauser. Library of Congress Cataloging-in-Publication Data Andreescu, Titu, (**For Unit –I**).

2. Edgar G. Goodaire and Michael M. Parmenter, ,(2005)**.** Discrete Mathematics with Graph Theory, 3rd Edition, Pearson Education (Singapore) P. Ltd., Indian Reprint.(**For Unit –II)**

3.David C. Lay., (2007). Linear Algebra and its Applications, Third Edition, Pearson Education Asia, Indian Reprint. **(For Unit III, IV and V)**

REFERENCE

1. Kenneth Hoffman., Ray Kunze., (2003).Linear Algebra, Second edition, Prentice Hall of India Pvt Ltd, New Delhi.

Semester – I

		L	T	P	C
16MMU103	**REAL ANALYSIS**	**6**	**2**	**0**	**6**

Course Objectives

This course enables the students to learn

- The fundamental properties of the real numbers that underpin the formal development of real analysis
- About the extreme points, Root test, Ratio test.
- The alternating series, and series of functions.
- The concepts of real Sequence, Bounded sequence, Cauchy convergence criterion for sequences.
- The basic theorems on monotone sequences and their convergence.
- About the Power series and radius of convergence.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Understand about the categories of sets.
2. Acquire the knowledge on limits and convergence of sequences.
3. Know the types of test of convergence for series.
4. Familiarize about the basic theorems on monotone sequences.
5. Know about the integrability and differentiability of functions.
6. Understand the Power series and radius of convergence.

UNIT I

Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano -Weierstrass theorem.

UNIT II

Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).

UNIT III

Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test(Tests of Convergence without proof). Definition and examples of absolute and conditional convergence.

UNIT IV

Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.

UNIT V

Series of functions, Pointwise and uniform convergence. Mn-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence.

SUGGESTED READINGS

TEXT BOOK

1. Apostol T. M., (2002). Calculus (Vol. I), John Wiley and Sons (Asia) P. Ltd.

REFERENCE

1. Fischer E., (2012). Intermediate Real Analysis, Springer Verlag.
2. Ross K.A., (2003).Elementary Analysis- The Theory of Calculus Series - Undergraduate Texts in Mathematics, Springer Verlag.
3. Bartle R.G., and Sherbert D. R., 2000. Introduction to Real Analysis, John Wiley and Sons (Asia) Pvt. Ltd.

		Semester – I
		L T P C
16MMU111	**CALCULUS (PRACTICAL)**	**0 0 3 2**

Course Objectives

This course enables the students to learn

- To demonstrate comprehension in relevant area of calculus
- Problem solving through (computer language) programming.
- The basic structure of the programme, declaration and usage of variables.
- The basic MATLAB (matrix laboratory) programme.
- The usage of MATLAB in order to facilitate understanding and visualization of mathematical problems
- The practical preparation knowledge to apply the acquired knowledge and skills.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Familiarize with the programming environment.
2. Acquire the problem solving skills through computer programming.
3. Understand to write diversified solutions using programming language.
4. Plot of graphs of functions (exponential, logarithmic, trigonometric).
5. Sketching parametric curves (Eg. Trochoid, cycloid, epicycloids, hypocycloid).
6. Deal with different input/output methods.

List of Practical (using MATLAB/Mathematica)

(Any 8 programs)

1. Plotting of graphs of function $e^{ax + b}$, log(ax + b), 1/(ax + b), sin(ax + b), cos(ax + b), |ax + b| and to illustrate the effect of a and b on the graph.

2. Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.

3. Sketching parametric curves (Eg. Trochoid, cycloid, epicycloids, hypocycloid).

4. Obtaining surface of revolution of curves.

5. Tracing of conics in cartesian coordinates/ polar coordinates.

6. Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, hyperbolic paraboloid using cartesian coordinates.

7. Matrix addition.

8. Matrix multiplication.

9. Inverse of a matrix.

10. Transpose of a matrix.

பகுதி – I, தமிழ்

பருவம் II

16LSU201 : **தமிழ் இரண்டாம் தாள்** 4-H,4-C

(இளநிலை அறிவியல் பட்ட வகுப்புகளுக்குரியது)

பாடத்திட்டப் *பொதுநோக்கம்*

- *கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், மேம்படுத்துதல்.*
- *ஆய்வுநோக்கை மேம்படுத்துதல்.*
- *இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.*
- *மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.*
- *வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.*
- *அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.*

பாடத்திட்டப் பயன் விளைவு

1. *இந்திய குடியுரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இந்திய குடியுரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இடம்பெறுகின்ற, 'தமிழ் இலக்கிய வரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.*
2. *கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத் தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.*
3. *தமிழின் வளர்ச்சித் துறையாகிய, 'அறிவியல் தமிழ்' ; 'இணைய தமிழ்' குறித்த பன்நோக்கு அணுகுமுறையிலான ஆய்வுச் சிந்தனை மேம்பாடு.*
4. *வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .*
5. *சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப் பேணுவதற்குக் கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மை வளர்ச்சி.*
6. *மொழிபெயப்புத் துறைசார்ந்த வேலைவாய்புத் திறன் பெற்றிருத்தல்*

அலகு – I : பக்தி இலக்கியம் (10 மணிநேரம்)

சைவ, வைணவ இலக்கியங்கள் - தோற்றம் ,வளர்ச்சி, வரலாறு.

1. *சைவம்* - *பெரியபுராணம் - திருமூலநாயனார் புராணம்.*

2. *வைணவம்* - *பெரியாழ்வார் திருமொழி: 10 பாடல்கள்.*

அலகு – II : சங்க இலக்கியம் (15 மணிநேரம்)

சங்க இலக்கியங்கள் அறிமுகம்

அ). எட்டுத்தொகை

நற்றிணை : *பிரசம் கலந்த – பாலை -110*

குறுந்தொகை : *கருங்கட்டாக் கலை – குறிஞ்சி- 69*

ஐங்குறுநூறு : *நெய்தல்-தொண்டிப்பத்து:*

திரைஇமிழ் இன்னிசை-171

பதிற்றுப்பத்து : *சிதைந்தது மன்ற - 27*

பரிபாடல்: *பரிபாடல் திரட்டு-மதுரை நகர்ச்சிறப்பு –*

உலகம் ஒரு நிறையாத்தான்-6, மாயோன் கொப்பூழ்-7, செய்யாட்கு இழைத்த-9, கார்த்திகை காதில்-10, ஈவாரைக் கொண்டாடி-11.

கலித்தொகை : *சுடர்தொடீ கேளாய்: குறிஞ்சிக்கலி- 36*

அகநானூறு : *அன்னாய் வாழி வேண்டன்னை - குறிஞ்சி - 48*

புறநானூறு : *யாதும் ஊரே யாவருங் கேளிர் –பொதுவியல்- 192*

ஆ). பத்துப்பாட்டு

திருமுருகாற்றுப்படை - பழமுதிர்ச்சோலையின் சிறப்பு

முருகன் இருப்பிடங்கள் *– 'சிறுதினை மலரொடு' என்பதிலிருந்துதொடங்கி, 'அறிந்தவாறே' என்பது வரையிலான தொடர்கள்: 218-249.*

முருகன் அருள்புரிதல் – 'தெய்வம் சான்ற' என்பதிலிருந்து தொடங்கி, 'நல்குமதி' என்பது வரையிலான தொடர்கள்: 286-295.

அலகு - III : காப்பியம் **(6 மணிநேரம்)**

சிலப்பதிகாரம்:

மங்கல வாழ்த்துப் பாடல்: (21-29) – கண்ணகியின் சிறப்பு:

'நாகநீள் நகரொடு' என்பதிலிருந்து தொடங்கி,

'கண்ணகி என்பாண் மன்னோ' என்பது வரையிலான தொடர்கள்.

நடுகற்காதை: (207-234) - சேரன் செங்குட்டுவன் கண்ணகிக்குக் கோயில் எடுத்தல்:

'அருந்திறலரசர்' என்பதிலிருந்து தொடங்கி, 'மன்னவரேறென்' என்பது வரையிலான தொடர்கள்.

வாழ்த்துக்காதை: (482-485) - செங்குட்டுவனுக்குக் கண்ணகி காட்சியளித்தல்:

'என்னே' என்பதிலிருந்து தொடங்கி, 'விசும்பில் தோன்றுமால்' என்பது வரையிலான தொடர்கள்.

வழக்குரை காதை: பத்தினிப் பெண்டிர் எழுவர் கதை: 'நீர்வார் கண்ணை' என்பதிலிருந்து தொடங்கி, 'புகாரென் பதியே' என்பது வரையிலான தொடர்கள்.

வஞ்சினமாலை: 'வன்னி மரமும்' என்பதிலிருந்து தொடங்கி, 'பதிப்பிறந்தேன்' என்பது வரையிலான தொடர்கள்.

அலகு – IV : சிறுகதை **(10 மணிநேரம்)**

1. **குளத்தங்கரை அரசமரம் – வ.வே.சுஐயர்**
2. **காட்டில் ஒரு மான் - அம்பை**
3. **நாற்காலி – கி.ராஜநாராயணன்**
4. **நகரம் – சுஜாதா**

அலகு- V : மொழிப்பயிற்சி **(7 மணிநேரம்)**

படைப்பிலக்கியப் பயிற்சிகள் (கதை, கவிதை, கட்டுரை, உரைநடை)
மொழிபெயர்ப்பு

பாட நூல்: கற்பகச்சோலை – தமிழ் ஏடு. கற்பகம் பல்கலைக்கழகத் தமிழ்த் துறை வெளியீடு.

Semester II

		L	T	P	C
16MMU201	**DIFFERENTIAL EQUATIONS**	**4**	**0**	**0**	**4**

Course Objectives

This course enables the students to learn

- First order exact differential equations, linear homogeneous and non homogeneous equations of higher order with constant coefficients.
- The complete solution of a non-homogeneous differential equation with constant coefficients by the method of undetermined coefficients.
- The transform of a periodic function.
- The applications of the inverse Laplace transform.
- The Euler's equations, method of variation of parameters.
- The predatory-prey model and its analysis, epidemic model of influenza and its analysis.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Understand the concepts of explicit, implicit and singular solutions of a differential equation.
2. Acquire knowledge on linear and bernoulli's equaitons.
3. Know the concepts of population model.
4. Understand the method of solving differential equation using variation of parameters. Identify the applications of differential equations.
5. Know about the concepts of Euler's equation, method of undetermined coefficients and method of variation of parameters.
6. Understand the predatory-prey model and its analysis, epidemic model of influenza and its analysis.

UNIT I

Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation.

UNIT II

Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.

UNIT III

Introduction to compartmental model, exponential decay model, lake pollution model (case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), exponential growth of population, limited growth of population, limited growth with harvesting.

UNIT IV

General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.

UNIT V

Equilibrium points, Interpretation of the phase plane, predatory-prey model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.

SUGGESTED READINGS

TEXT BOOK

1. Ross S.L., (2004). Differential Equations, Third Edition, John Wiley and Sons, India.

REFERENCES

1. Martha L Abell., and James P Braselton., (2004). Differential Equations with MATHEMATICA, Third Edition, Elsevier Academic Press.

2. Sneddon I.,(2006). Elements of Partial Differential Equations, McGraw-Hill, International Edition, New Delhi.

Semester – II

		L	T	P	C
16MMU202	**THEORY OF REAL FUNCTIONS**	**6**	**1**	**0**	**6**

Course Objectives

This course enables the students to learn

- The solution of Reciprocal and Binomial Equations and properties of the derived functions.
- About the relations between the roots and coefficients**.**
- The concept of continuous functions and limits of functions.
- The Applications of mean value theorem to inequalities and approximation of polynomials.
- Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions.
- The transformations of equations

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Learn about the Limits of functions and continuous functions.
2. Understand uniform continuity, non-uniform continuity criteria, uniform continuity theorem.
3. Know about the, algebra of differentiable functions.
4. Familiarize about the Mean value theorem and its applications.
5. Know about the Cauchy's mean value theorem.
6. Understand the Taylor's theorem with Cauchy's form of remainder.

UNIT I

Limits of functions, sequential criterion for limits, divergence criteria. Limit theorems, one sided limit. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity.

UNIT II

Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.

UNIT III

Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem. Rolle's theorem.

UNIT IV

Mean value theorem, intermediate value property of derivatives, Darboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Taylor's theorem to inequalities.

UNIT V

Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, application of Taylor's theorem to convex functions, relative extrema. Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions, $\ln(1 + x)$, $1/ax+b$ and $(1 +x)n$.

SUGGESTED READINGS

TEXT BOOK

1. Bartle R., and Sherbert D.R.,(2003). Introduction to Real Analysis, John Wiley and Sons.

REFERENCES

1. Mattuck A., (2013). Introduction to Analysis, Prentice Hall.

2. Ghorpade S. R. and Limaye B.V., (2006). A Course in Calculus and Real Analysis, Springer. New York.
3. Ross K.A., (2004). Elementary Analysis: The Theory of Calculus, Springer. New York.

		Semester - II			
		L	T	P	C
16MMU203	**GROUP THEORY I**	**6**	**2**	**0**	**6**

Course Objectives

This course enables the students to learn

- Group homomorphism, isomorphism, automorphism and its related properties.
- The concept of internal and external direct product.
- The properties of cyclic groups, permutations and cosets.
- The concepts Abelian groups, divisible and reduced groups and Torsion group.
- The extension of group structure to finite permutation groups.
- The basic concepts of group actions and their applications.

Course Outcomes (COs)

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

1. Expertise on fundamental of groups.
2. Know about Subgroups and its properties.
3. Understand the concept of cyclic groups and its properties.
4. Acquire the knowledge on basic concepts of external direct product of a finite number of groups.
5. Apply Cauchy's theorem for finite abelian groups.
6. Understand the concepts of Abelian groups, Torsion group, divisible and reduced groups.

UNIT I

Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups.

UNIT II

Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups.

UNIT III

Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.

UNIT IV

External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.

UNIT V

Abelian groups, finitely generated abelian group, divisible and reduced groups, Torsion group,

SUGGESTED READINGS

TEXT BOOK

1. Fraleigh.J.B., (2004). A First Course in Abstract Algebra , Seventh edition , Pearson Education Ltd, Singapore.

REFERENCES

1. Artin.M., (2008). Algebra, Prentice-Hall of India, New Delhi.

2. Joseph A. Gallian., (2006). Contemporary Abstract Algebra, Fourth Edition, Narosa Publishing House, New Delhi.

3. Herstein.I.N., (2010). Topics in Algebra, Second Edition, Wiley and sons Pvt Ltd, Singapore.

4. Joseph J. Rotman, (2001). An Introduction to the Theory of Groups, Fourth Edition, Springer Verlag.

Semester II

		L	T	P	C
16MMU211	**DIFFERENTIAL EQUATIONS(PRACTICAL)**	**0**	**0**	**3**	**2**

Course Objectives

This course enables the students to learn

- Problem-solving through programming.
- Hands-on training using lab components.
- Plotting of second order solution of differential equations and recursive sequences.
- Cauchy's root test and Ratio test by plotting the ratio.
- The exponential growth and decay, the population growth of species or the change in investment return over time.
- The usage of program to solve the differential equations.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Demonstrate comprehension in fundamental topics of computing, algorithms, computer organization and software systems.
2. Have applied knowledge of areas of computing to create solutions to challenging problems, including specify, design, implement and validate solutions for new problems.
3. Be aware of current research activity in computing through activities including reading papers, hearing research presentations.
4. Know about successfully planning and completing an individual research project in computing or its application.
5. Understand Cauchy's root test and Ratio test by plotting the ratio.
6. Acquire the knowledge on Growth model and Decay model.

List of Practical (using any software)

(Any 8 programs)

1. Plotting of second order solution family of differential equation.
2. Growth model (exponential case only).
3. Decay model (exponential case only).
4. Lake pollution model (with constant/seasonal flow and pollution concentration).
5. Case of single cold pill and a course of cold pills.
6. Limited growth of population (with and without harvesting).
7. Predatory-prey model (basic volterra model, with density dependence, effect of DDT, two prey one predator).
8. Plotting of recursive sequences.
9. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.
10. Study the convergence/divergence of infinite series by plotting their sequences of partial sum.
11. Cauchy's root test by plotting nth roots.
12. Ratio test by plotting the ratio of nth and (n+1)th term.

Semester – II

		L	T	P	C
16AEC201	**ENVIRONMENTAL STUDIES**	**4**	**0**	**0**	**4**

Course Objectives

This course enables the students to learn

- The awareness about environmental problems among people.
- About various renewable and nonrenewable resources of the region.
- The appropriate judgments and decisions for the protection and improvement of the earth.
- The concept of Environmental Pollution, effects and control measures of urban and industrial wastes.
- About the concepts of Social Issues and the Environment.
- The causes and effects of Environmental pollution.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Create the awareness about environmental problems among people.
2. Motivate the public to participate in environment protection and improvement.
3. Know about the Role of Information Technology in environment and human health.
4. Develop an attitude of concern for the environment and biodiversity at global.
5. Investigate the Environmental Pollution, effects and control measures of urban and industrial wastes.
6. Solve Environment Protection Act, Wildlife Protection Act. Forest Conservation Act.

UNIT I

Environment Definition, scope and importance, components, Ecosystem Definition, Concept, Scope, importance, Structure and functions of ecosystem. Energy flow, Ecological succession Food chains and food webs. Classification of ecosystem.

UNIT II

Natural Resources - Renewable and Non-renewable Resources: Natural resources and associated problems. Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources: Use and over-utilization, exploitation. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles. Ill-effects of fireworks.

UNIT III

Biodiversity and Its Conservation: Introduction, definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT IV

Environmental Pollution - Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste management: Causes, effects and control measures of urban and industrial wastes. Role of an

individual in prevention of pollution. Pollution case studies. Disaster management: Foods, earthquake, cyclone and landslides.

UNIT V

Social Issues and the Environment: From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness. Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health.

SUGGESTED READINGS

TEXT BOOKS

1. Tripathy.S.N., and Sunakar Panda., (2004). Fundamentals of Environmental Studies, Second Edition, Vrianda Publications Private Ltd, New Delhi.

2. Arvind Kumar., (2004). A Textbook of Environmental Science, APH Publishing Corporation, New Delhi.

3. Verma P.S., and Agarwal V.K., (2001). Environmental Biology (Principles of Ecology); S.Chand and Company Ltd., New Delhi.

4. Anubha Kaushik, C.P.Kaushik, (2004). Perspectives in Environmental Studies, New Age International Pvt. Ltd. Publications, New Delhi.

REFERENCES

1. Singh, M.P., B.S. Singh and Soma S. Dey, (2004). Conservation of Biodiversity and Natural Resources. Daya Publishing House, Delhi.

2. Daniel B.Botkin and Edward A. Keller., (2014). Environmental Science, John Wiley and Sons, Inc., New York.

3. Uberoi, N.K., (2005). Environmental Studies, Excel Books Publications, New Delhi, India.

Semester - III

		L	T	P	C
16MMU301	**NUMERICAL METHODS**	**4**	**0**	**0**	**4**

Course Objectives

This course enables the students to learn

- The basic concepts of numerical methods.
- The Numerical integration and differentiation, numerical solution of ordinary differential equations.
- The Engineering problems which are impossible to solve by analytical means.
- Numerical methods to solve linear system of equations**.**
- The numerical solution of initial value problems and boundary value problems**.**
- The appropriate numerical methods to solve algebraic and transcendental equations.

Course Outcomes (COs)

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

1. Study the concept of Newton's Method.
2. Realize the system of linear algebraic eqution along with specified methods.
3. Know about the basic concepts of Interpolation.
4. Understand the Gregory forward and backward difference interpolation.
5. Familiar with numerical integration and differentiation, numerical solution of ordinary differential equations.
6. Use the solutions of differential equations by Runge-Kutta methods.

UNIT I

High speed computation: Algorithms, Convergence, Errors: Relative, Absolute, Round off, Truncation. Transcendental and Polynomial equations: Bisection method - Newton's method - False Position method - Secant method - Rate of convergence of these methods.

UNIT II

System of linear algebraic equations: Gaussian Elimination - Gauss Jordan methods - Gauss Jacobi method - Gauss Seidel method and their convergence analysis – LU decomposition - Power method.

UNIT III

Interpolation: Lagrange and Newton's methods. Error bounds - Finite difference operators. Gregory forward and backward difference interpolation – Newton's divided difference – Central difference – Lagrange and inverse Lagrange interpolation formula.

UNIT IV

Numerical Differentiation and Integration: Gregory's Newton's forward and backward differentiation-Trapezoidal rule, Simpson's rule, Simpsons 3/8th rule, Boole's Rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpson's rule.

UNIT V

Ordinary Differential Equations: Taylor's series - Euler's method – modified Euler's method - Runge-Kutta methods of orders two and four.

SUGGESTED READINGS

TEXT BOOK

1. Jain. M.K., Iyengar. S.R.K.,and Jain R.K., (2012). Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, New Delhi .

REFERNCES

1. Bradie B., (2007).A Friendly Introduction to Numerical Analysis, Pearson Education, India,

2. Gerald C.F., and Wheatley P.O., (2006). Applied Numerical Analysis, Sixth Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi.

3. Uri M. Ascher and Chen Greif., (2013). A First Course in Numerical Methods, Seventh Edition., PHI Learning Private Limited.

4. John H., Mathews and Kurtis D. Fink., (2012). Numerical Methods using Matlab, Fourth Edition., PHI Learning Private Limited.

5. Sastry S.S., (2008). Introductory methods of Numerical Analysis, Fourth edition, Prentice Hall of India, New Delhi.

Semester – III

		L	T	P	C
16MMU302	**RING THEORY AND LINEAR ALGEBRA I**	**6**	**2**	**0**	**6**

Course Objectives

This course enables the students to learn

- Linear transformations, homomorphism, isomorphism and its properties.
- The basic definitions of Rings, subrings, vector spaces, subspaces, algebra of subspaces, isomorphism and its properties.
- The concept of ideals and maximal ideals
- Fundamental characteristics of vector spaces.
- Concepts of linear transformations and their role in modern mathematics.
- The concept of ring homomorphisms, properties of ring homomorphisms.

Course Outcomes (COs)

On successful completion of this course, the student will be able to:

1. Understand the concept of rings, subrings, vector spaces, subspaces, algebra of subspaces, isomorphism and its properties.
2. Understand the concept of ring homomorphisms, properties of ring homomorphisms.
3. Know about the Vector spaces and dimension.
4. Analyze Linear transformations and matrix representation of a linear transformation.
5. Study change of coordinate matrix and its properties.
6. Understand Isomorphism theorems I, II and III, field of quotients.

UNIT I

Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

UNIT II

Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients.

UNIT III

Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

UNIT IV

Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations.

UNIT V

Isomorphism: Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

SUGGESTED READINGS

TEXT BOOK

1. Fraleigh.J.B., (2004). A First Course in Abstract Algebra , Seventh Edition , Pearson Education Ltd, Singapore.

REFERENCES

1.Joseph A. Gallian., (2013). Contemporary Abstract Algebra, Fourth Edition, Narosa Publishing House, New Delhi.

2. Kumaresan S., (2000). Linear Algebra- A Geometric Approach, Prentice Hall of India, New Delhi.

Semester – III

		L	T	P	C
16MMU303	**MULTIVARIATE CALCULUS**	**6**	**2**	**0**	**6**

Course Objectives

This course enables the students to learn

- The basics concept of functions of several variables.
- Mastery in the skills of limit and continuity functions of two variables.
- Definition and compute partial derivatives, directional derivatives and differentials.
- Find local extreme values of functions of several variables, test for saddle points, examine the conditions for the existence of absolute extreme values.
- Differential, integral and double integral calculus for functions of more than one variable.
- The mathematical tools and methods are used extensively in the physical sciences, engineering and economics.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Understand the functions of several variables.
2. Know about the Extrema of functions of two variables.
3. Use double, triple and its applications.
4. Know about the change of variables in double integrals and triple integrals
5. Synthesize the key concepts of line integrals and its applications.
6. Ability to apply the knowledge of Green's theorem and Stoke's theorem.

UNIT I

Functions of several variables: Limit and continuity of functions of two variables, partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes.

UNIT II

Extrema of functions of two variables: Method of Lagrange multipliers, constrained optimization problems, Definition of vector field, divergence and curl.

UNIT III

Double integration over rectangular region: Double integration over non-rectangular region, double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates. Change of variables in double integrals and triple integrals

UNIT IV

Line integrals: Applications of line integrals, Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path.

UNITV

Green's theorem: Surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.

SUGGESTED READINGS

TEXT BOOK

1. Strauss M.J., Bradley G.L. and Smith K. J., (2007). Calculus, Third Edition, Dorling Kindersley (India) Pvt.Ltd. (Pearson Education), Delhi.

REFERENCES

1. Thomas G.B., and Finney R.L., (2005). Calculus, Ninth Edition, Pearson Education, Delhi.

2. Marsden E., Tromba A.J. and Weinstein A., (2005). Basic Multivariable Calculus, Springer (SIE), Indian reprint, New Delhi.
3. James Stewart., (2001). Multivariable Calculus, Concepts and Contexts, Second Edition, Brooks Cole, Thomson Learning, USA.

Semester – III

		L	T	P	C
16MMU304A	**LOGIC AND SETS**	**4**	**2**	**0**	**4**

Course Objectives

This course enables the students to learn

- First-order formula of predicate logic is a tautology using a natural-deduction style formal system.
- The formal definitions of predicates, operations on sets and pertaining to relations.
- The concepts of Set operations and the laws of set theory and Venn diagrams.
- Composition of relations, Types of relations, Partitions, Partial ordering relations and n-ary relations.
- The enhancement of logical thinking and its application to computer science.
- The methods of mathematical logic.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Acquire the knowledge about propositions, conjunction, disjunction, logical equivalences and counting principle.
2. Identify between binding variables and negations.
3. Use the language of set theory, interpreting issues in different areas of mathematics.
4. Know the concepts Difference and Symmetric difference of two sets.
5. Mastery in the concepts of relations.
6. Study Composition of relations, Types of relations, Partitions, Partial ordering relations and n-ary relations.

UNIT I

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators.

UNIT II

Propositional equivalence: Logical equivalences.
Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

UNIT III

Sets: Subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets.

UNIT IV

Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections.

UNIT V

Relation: Product set, Composition of relations, Types of relations, Partitions. Equivalence Relations with example of congruence modulo relation, Partial ordering relations, n-ary relations.

SUGGESTED READINGS

TEXT BOOK

1. Grimaldi R.P.,(2004). Discrete Mathematics and Combinatorial Mathematics, Pearson Education, Pvt.Ltd, Singapore.

REFERENCES

1. Halmos P.R.,(2011). Naive Set Theory, Springer Pvt Ltd, New Delhi.
2. Kamke E., (2010).Theory of Sets, Dover Publishers, New York.

Semester – III

		L	T	P	C
16MMU304B	**PROGRAMMING WITH C AND C++**	**4**	**2**	**0**	**4**

Course Objectives

This course enables the students to learn

- The fundamentals of C and C++ programming language.
- The strength of C which provide programmers with the means of writing efficient, maintainable and portable code.
- Know the concept of a large problem into smaller parts, writing each part as a module or function
- Acquire the knowledge about a program in a high-level language being translated by a compiler into machine language program and then executed.
- The Memory Allocation and Using Classes in C++.
- Translate the computer algorithms to computer programs.

Course Outcomes (COs)

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

1. Know the basic concept of C and C++.
2. Understand the concept of functions and arrays.
3. Understand the concept structures and unions.
4. Understand pointers and references in C++.
5. Understand the concept of Differentiating between static and dynamic memory allocation.
6. Acquire the knowledge of translate the computer algorithms to computer programs.

UNIT I

Introduction to C and C++:

History of C and C++, Overview of Procedural Programming and Object-Orientation Programming, Using main () function, Compiling and Executing Simple Programs in C++. **Data Types, Variables, Constants, Operators and Basic I/O:** Declaring, Defining and Initializing Variables, Scope of Variables, Using Named Constants, Keywords, Data Types, Casting of Data Types, Operators (Arithmetic, Logical and Bitwise), Using Comments in programs, Character I/O (getc, getchar, putc, putcharetc), Formatted and Console I/O (printf(), scanf(), cin, cout), Using Basic Header Files (stdio.h, iostream.h, conio.hetc).**Expressions, Conditional Statements and Iterative Statements:**Simple Expressions in C++ (including Unary Operator Expressions, Binary Operator Expressions), Understanding Operators Precedence in Expressions, Conditional Statements (if construct, switch-case construct), Understanding syntax and utility of Iterative Statements (while, do-while, and for loops), Use of break and continue in Loops, Using Nested Statements (Conditional as well as Iterative)

UNIT II

Functions and Arrays: Utility of functions, Call by Value, Call by Reference, Functions returning value, Void functions, Inline Functions, Return data type of functions, Functions parameters, Differentiating between Declaration and Definition of Functions, Command Line Arguments/Parameters in Functions, Functions with variable number of Arguments.

Creating and Using One Dimensional Arrays (Declaring and Defining an Array, Initializing an Array, ACSUessing individual elements in an Array, Manipulating array elements using loops), Use Various types of arrays (integer, float and character arrays / Strings) Two-dimensional Arrays (Declaring, Defining and Initializing Two Dimensional Array, Working with Rows and Columns), Introduction to Multi-dimensional arrays.

UNIT III

Derived Data Types (Structures and Unions): Understanding utility of structures and unions, Declaring, initializing and using simple structures and unions, Manipulating individual members of structures and unions, Array of Structures, Individual data members as structures, Passing and returning structures from functions, Structure with union as members, Union with structures as members. **Pointers and References in C++:** Understanding a Pointer Variable, Simple use of Pointers (Declaring and Dereferencing Pointers to simple variables), Pointers to Pointers, Pointers to structures, Problems with Pointers, Passing pointers as function arguments, Returning a pointer from a function, using arrays as pointers, Passing arrays to functions. Pointers vs. References, Declaring and initializing references, using references as function arguments and function return values

UNIT IV

Memory Allocation in C++: Differentiating between static and dynamic memory allocation, use of malloc, calloc and free functions, use of new and delete operators, storage of variables in static and dynamic memory allocation.**File I/O, Preprocessor Directives:** Opening and closing a file (use of fstream header file, ifstream, ofstream and fstream classes), Reading and writing Text Files, Using put(), get(), read() and write() functions, Random aCSUess in files, Understanding the Preprocessor Directives (#include, #define, #error, #if, #else, #elif, #endif, #ifdef, #ifndef and #undef), Macros.

UNIT V

Using Classes in C++: Principles of Object-Oriented Programming, Defining & Using Classes, Class Constructors, Constructor Overloading, Function overloading in classes, Class Variables &Functions, Objects as parameters, Specifying the Protected and Private ACS Uess, Copy Constructors, Overview of Template classes and their use. **Overview of Function Overloading and Operator Overloading:** Need of Overloading functions and operators, Overloading functions by number and type

of arguments, Looking at an operator as a function call, Overloading Operators (including assignment operators, unary operators) **Inheritance, Polymorphism and Exception Handling:** Introduction to Inheritance (Multi-Level Inheritance, Multiple Inheritance), Polymorphism (Virtual Functions, Pure Virtual Functions), Basics Exceptional Handling (using catch and throw, multiple catch statements), Catching all exceptions, Restricting exceptions, Rethrowing exceptions.

SUGGESTED READINGS

1. Herbtz Schildt, (2003). C++: The Complete Reference, Fourth Edition, McGraw Hill.
2. Bjarne Stroustrup, (2013). The C++ Programming Language, Fourth Edition, Addison-Wesley.
3. Bjarne Stroustroup, (2014). Programming Principles and Practice using C++, Second Edition, Addison- Wesley.
4. E Balaguruswamy,(2008). Object Oriented Programming with C++, Tata McGraw-Hill Education.New Delhi.
5. Paul Deitel, Harvey Deitel, (2011) . C++ How to Program, Eighth Edition, Prentice Hall.
6. John R. Hubbard, (2000).Programming with C++, Schaum's Series, Second Edition. McGraw Hill Professional.
7. Andrew Koeni, Barbara, E. Moo,(2000). ACSUelerated C++, Published by Addison-Wesley .
8. Scott Meyers, (2005). Effective C++, Third Edition, Published by Addison-Wesley.
9. Harry, H. Chaudhary, (2014) . Head First C++ Programming: The Definitive Beginner's Guide, First Create space Inc, O-D Publishing, LLC USA.
10. Walter Savitch, (2007). Problem Solving with C++, Pearson Education.
11. Stanley B. Lippman, JoseeLajoie., Barbara E. Moo.,(2012). C++ Primer, Published by Addison-Wesley, 5th Edition.

WEB SITES

1. http://www.cs.cf.ac.uk/Dave/C/CE.html
2. http://www2.its.strath.ac.uk/courses/c/
3. http://www.iu.hio.no/~mark/CTutorial/CTutorial.html
4. http://www.cplusplus.com/doc/tutorial/
5. www.cplusplus.com/
6. www.cppreference.com/

16MMU311	NUMERICAL METHODS (PRACTICAL)	L	T	P	C
		0	0	4	2

Course Objectives

This course enables the students to learn

- Exercise user defined functions to solve real time problems.
- Illustrate flowchart and algorithm to the given problem.
- The basic structure of the programme, declaration and usage of variables.
- The basic MATLAB (matrix laboratory) programme.
- The usage of Matlab in order to facilitate understanding and visualization of mathematical problems
- Practical approach to apply the acquired knowledge and skills in professional and specialist courses.

Course outcomes (COs)

On successful completion of this course, the student will be able to

1. Acquire the basic knowledge of MATLAB and explore the structure of the numerical methods.
2. Use different memory allocation methods.
3. Deal with different input/output methods.
4. Use different data structures.
5. Express their ideas in terms of the syntax of the computer package MATLAB.
6. Apply the MATLAB programme in the real world situation involving numerical problems.

List of Practical (using MATLAB/Mathematica)
(Any 10 Programs)

1. Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/ N.
2. To find the absolute value of an integer.
3. Enter 100 integers into an array and sort them in an ascending order.
4. Bisection Method.
5. Newton Raphson Method.
6. Secant Method.
7. Regulai Falsi Method.
8. LU decomposition Method.
9. Gauss-Jacobi Method.
10. Gauss-Seidel Method.
11. Lagrange Interpolation or Newton Interpolation.
12. Simpson’s rule.

16MMU401	GROUP THEORY II	L	T	P	C
		6	2	0	6

Course Objectives

This course enables the students to learn

- Group homomorphism, isomorphism, automorphism and its related properties.
- Different types of groups such as normal subgroups, factor groups
- Familiar with various direct product of groups.
- Sylow's theorems, Cauchy's theorem and Index theorem.
- The concept of internal and external direct product.
- The applications of group actions and Generalized Cayley's theorem.

Course Outcomes (COs)

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

1. Expertise on fundamental theorems of isomorphism.
2. Know about automorphism and its developments.
3. Understand the concept of internal and external direct product.
4. Acquire the knowledge on basic concepts of group actions and their applications.
5. Apply Sylow's theorems to determine the structure of certain groups of small order.
6. Understand the applications of group actions and Generalized Cayley's theorem.

UNIT I

Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.

UNIT II

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties.

UNIT III

Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental Theorem of finite abelian groups.

UNIT IV

Group actions, stabilizers and kernels, permutation representation associated with a given group action, Applications of group actions: Generalized Cayley's theorem, Index theorem.

UNIT V

Groups acting on themselves by conjugation, class equation and consequences, conjugacy in Sn, *p*-groups, Sylow's theorems and consequences, Cauchy's theorem, Simplicity of An for $n \geq 5$, non-simplicity tests.

SUGGESTED READINGS

TEXT BOOK

1. Fraleigh.J.B., (2004). A First Course in Abstract Algebra , Seventh edition , Pearson Education Ltd, Singapore.

REFERENCES

1. David S. Dummit and Richard M. Foote, (2004)., Abstract Algebra,. Third Edition., John Wiley and Sons (Asia) Pvt. Ltd., Singapore.
2. Herstein.I.N.,(2010). Topics in Algebra ,Second Edition, Willey and sons Pvt Ltd, Singapore.
3. Joseph A. Gallian., (2001). Contemporary Abstract Algebra, Fourth Edition., Narosa Publishing House, New Delhi.
4. Artin.M., (2008). Algebra, Prentice - Hall of India, New Delhi.

Semester – IV

		L	T	P	C
16MMU402	**METRIC SPACES AND COMPLEX ANALYSIS**	**6**	**2**	**0**	**6**

Course Objectives

This course enables the students to learn

- The theory of functions of a complex variable with examples.
- Metric spaces, Continuous mappings and Convergence of sequences and series.
- Techniques of complex analysis that make practical problems easy (e.g. graphical rotation and scaling as an example of complex multiplication)
- Subsets of a metric space are open, closed, connected, bounded, totally bounded and/or compact.
- Function on a Complex number, and differentiability on complex functions.
- The Cauchy's Theorem, Cauchy's integral formula, Liouville's Theorem and Laurent's expansion.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Understand the various properties of metric spaces
2. Definite continuous mappings - sequential criterion.
3. Understand the basic concepts of Riemann equations, sufficient conditions for differentiability.
4. Explore various properties of Analytic functions.
5. Understand the Contour integrals and its examples.
6. Apply the concept Liouville's theorem and the fundamental theorem of algebra.

UNIT I

Metric spaces: definition and examples - Sequences in metric spaces - Cauchy sequences.
Complete Metric Spaces - Open and closed balls – neighbourhood - open set - interior of a set. Limit point of a set - closed set - diameter of a set - Cantor's theorem – Subspaces - dense sets – separable spaces.

UNIT II

Continuous mappings - sequential criterion and other characterizations of continuity – Uniform Continuity – Homeomorphism - Contraction mappings - Banach Fixed point Theorem - Connectedness - connected subsets of R.

UNIT III

Limits - Limits involving the point at infinity - continuity. Properties of complex numbers – regions in the complex plane - functions of complex variable - mappings. Derivatives, differentiation formulas - Cauchy-Riemann equations, sufficient conditions for differentiability.

UNIT IV

Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions.
Contours: Contour integrals and its examples - upper bounds for moduli of contour integrals - Cauchy-Goursat theorem, Cauchy integral formula.

UNIT V

Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples - Laurent series and its examples, absolute and uniform convergence of power series.

SUGGESTED READINGS

TEXT BOOK

1. Satish Shirali., and Harikishan L. Vasudeva., (2006). Metric Spaces, Springer Verlag, London.

REFERENCES

1. Kumaresan S., (2011). Topology of Metric Spaces, Second Edition., Narosa Publishing House, New Delhi.

2. Simmons G.F., (2004).Introduction to Topology and Modern Analysis, McGraw-Hill, New Delhi.

3. James Ward Brown., and Ruel V. Churchill., (2009). Complex Variables and Applications, Eighth Edition., McGraw – Hill International Edition, New Delhi.

4. Joseph Bak., and Donald J. Newman., (2010). Complex Analysis, Second Edition., Undergraduate Texts in Mathematics, Springer-Verlag New York.

Semester – IV

		L	T	P	C
16MMU403	**RING THEORY AND LINEAR ALGEBRA II**	**6**	**2**	**0**	**6**

Course Objectives

This course enables the students to learn

- The behavior of polynomials and operators.
- The Rings and basic properties of rings and ideals.
- The concepts of unique factorization domains, Euclidean domains.
- The transpose of a linear transformation and its matrix in the dual basis.
- The Inner product spaces and norms, Gram-Schmidt orthogonalisation process.
- Least Squares Approximation and Spectral theorem.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Polynomial rings over commutative rings, dual spaces, dual basis, double dual, minimal solutions to systems of linear equations, normal and self-adjoint operators.
2. Understand the Divisibility in integral domains.
3. Study the transpose of a linear transformation and its matrix in the dual basis.
4. Know about the Inner product spaces and norms.
5. Study Least Squares Approximation, minimal solutions to systems of linear equations.
6. Know about the Orthogonal projections and Spectral theorem.

UNIT I

Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, unique factorization in Z[x]**.**

UNIT II

Divisibility in integral domains, irreducibles, primes, unique factorization domains, Euclidean domains.

UNIT III

Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators, Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator.

UNIT IV

Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator.

UNIT V

Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.

SUGGESTED READINGS

TEXT BOOKS

1. Fraleigh.J.B., (2004). A First Course in Abstract Algebra , Seventh Edition , Pearson Education Ltd, Singapore.

REFERENCES

1. Stephen H. Friedberg., Arnold J. Insel., Lawrence E. Spence, (2004) . Linear Algebra, Fourth Edition., Prentice- Hall of India Pvt. Ltd., New Delhi.

2. S. Lang, (2005). Introduction to Linear Algebra, Second Edition., Springer.

Semester – IV

		L	T	P	C
16MMU404A	**GRAPH THEORY**	**4**	**2**	**0**	**4**

Course Objectives

This course enables the students to learn

- Definitions and Basic properties of graphs.
- The fundamental concepts in graph theory.
- A blended method to prove theorems.
- The concept of Trees, spanning trees and its properties.
- Basic concepts in graph theory and a variety of different problems in Graph Theory.
- Gain the knowledge of various graphs algorithms will also be taught along with its analysis.

Course Outcomes (COs)

On successful completion of the course, students will be able to

1. Understand and Apply the fundamental concepts in graph theory.
2. Understand basic results related with Eulerian and Hamiltonian graphs.
3. Study about Chromatic polynomial, Matching and Covering.
4. Know about the fundamental concepts of trees.
5. Understand the Spanning trees, rank and nullity.
6. Mastery in Dijkstra's algorithm-Floyd- Warshall algorithm

UNIT I

Definition, examples and basic properties of graphs, Directed Graphs, Types of Directed Graphs , pseudo graphs, complete graphs, bi- partite graphs, isomorphism of graphs.

UNIT II

Paths and circuits, Strongly Connected Components , Eulerian circuits, Hamiltonian cycles Random graphs,Planar graphs,Networks.

UNIT III

The adjacency matrix, weighted graph, Incidence matrix, Submatrices, Circuit Matrix,Path Matrix ,Chromatic Number ,Chromatic polynomial, Matching , Covering ,Four Color Problem

UNIT IV

Trees: Trees and its properties, minimally connected graph ,Pendant vertices in a tree ,distance and centers in a tree, rooted and binary tree. Levels in binary tree , height of a tree, Spanning trees , rank and nullity.

UNIT V

Travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd- Warshall algorithm.

SUGGESTED READINGS

TEXT BOOK

1. Edgar G.Goodaire., and Michael M. Parmenter., (2003) . Discrete Mathematics with Graph Theory, Second Edition, Pearson Education (Singapore) P. Ltd.

REFERENCES

1. Sundaresan V., Ganapathy Subramanian K.S., and Ganesan K., (2002) . Discrete Mathematics, A.R. Publications, Nagapatinam.

2. Jean Gallier, January 4, (2016) , Discrete Mathematics ., Second Edition, Springer.

3. Grimaldi R.P., (2004) . Discrete Mathematics and Combinatorial Mathematics, Pearson Education.

4. Davey B.A., and Priestley H.A., (2002) . Introduction to Lattices and Order, Cambridge University Press, Cambridge.

Semester – IV

		L	T	P	C
16MMU404B	**OPERATING SYSTEM: LINUX**	**4**	**2**	**0**	**4**

Course Objectives

This course enables the students to learn

- The main components of OS and their working.
- The memory allocation methods, page replacement algorithms, file allocation methods, multi-threading, process synchronization, and CPU scheduling.
- The basic components of a computer operating system, and the interactions among the various components.
- The capabilities and limitations of computer operating systems, process management, processor scheduling, deadlocks, memory management, secondary memory management, file management and I/O systems.
- Introduce the concepts of process and thread and their scheduling policies.
- Design the components of operating system.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Familiar with the memory allocation methods, page replacement algorithms, file allocation methods, multi-threading, process synchronization, and CPU scheduling.
2. Describe the main components of OS and their working.
3. Explain the concepts of process and thread and their scheduling policies.
4. Solve synchronization and deadlock issues.
5. Compare the different techniques for managing memory, I/O, disk and files.
6. Design components of operating system.

UNIT I

Introduction -Mainframe systems Desktop Systems – Multiprocessor systems – distributed systems – real time systems. Process: - Process concepts – Operation on process – cooperation process - Inter process Communication - Mutual Exclusion - Critical sections- primitives – Semaphores – Deadlock: System Model, Deadlock characterization, Deadlock prevention, avoidance, detection, recovery from deadlock.

UNIT II

Storage management: Memory Management - swapping- Contiguous memory allocation – paging, segmentation – segmentation with paging – Virtual memory :Virtual storage organization – Demand Paging, Process Creation – Page replacement – Thrashing.

UNIT III

Processor Scheduling : preemptive scheduling : - Scheduling Criteria – Scheduling Algorithms – FCFS-SJF- Priority – RoundRobin –Multilevel Queue – Multilevel Feedback Queue . Multiprocess schedule: Real time schedule, Algorithm evaluation: Deterministic Modeling, Queue Model, Simulation

UNIT IV

File systems: Introduction – File System Concepts – Access Methods – Directory structure – File Sharing – Allocation Methods – Free space management –Efficiency and performance – Recovery Disk Performance Optimization: Introduction – Disk structure – Disk scheduling – Disk management.

UNIT V

Linux-The Operating System: Linux History, Linux features, Linux distributions, Linux's relationship to Unix, Overview of Linux Architecture, Installation, Start up scripts, system process (an overview), Linux Security, The Ext2 and Ext3 File Systems: General characteristics of the Ext3 File System, File permissions, User Management: Types of users, the powers of Root, Managing users (adding and deleting) : using the command line and GUI Tools.

Resource Management in Linux: File and Directory management, system calls for files process management, Signals, IPC:Pipes, FIFOs, System V IPC, Message Queues, System calls for processes, Memory Management, Library and System calls for Memory.

SUGGESTED READINGS

TEXT BOOK

1. Silberschatz Galvin Gagne. (2012). Operating system concepts, Ninth Edition, Wiley India (pvt), Ltd, New Delhi.

REFERENCES

1. Deitel H.M. (2005). Operating systems, Third Edition, Addision Wesley Publication, New Delhi.

2. Pramod Chandra P. Bhatt. (2007). An Introduction to Operating Systems, Second Edition, Prentice Hall India, New Delhi.

3. Tanenbaum Woodhull. (2005) . Operating Systems., Second Edition, Pearson Education (LPE) , New Delhi.

4. William Stallings. (2010). Operating Systems internals and Design Principles, Sixth Edition, Prentice Hall India, New Delhi.

5. Arnold Robbins., (2008) ., Linux Programming by Examples The Fundamentals, Second Edition., Pearson Education,.

6. Cox K, (2009).Red Hat Linux Administrator's Guide,PHI.

7. Stevens R., (2009). UNIX Network Programming, Third Edition.,PHI.

8. Sumitabha Das, (2009).Unix Concepts and Applications, Fourth Edition., TMH.

9. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, (2009) . Linux in a Nutshell, Sixth Edition,O'Reilly Media.

10. Neil Matthew, Richard Stones, Alan Cox,(2004) Beginning Linux Programming,Third Edition.

WEBSITES

www.cs.columbia.edu/~nieh/teaching/e6118_s00/
www.clarkson.edu/~jnm/cs644
pages.cs.wisc.edu/~remzi/Classes/736/Fall2002/

Semester – V

		L	T	P	C
16MMU501A	**PORTFOLIO OPTIMIZATION**	**6**	**2**	**0**	**6**

Course Objectives

This course enables the students to learn

- The changing domestic and global investment scenario in general and Indian capital market in particular with reference to availability of various financial products and operations of stock exchanges.
- The theory and practice of portfolio management.
- Important theories, techniques, regulations and certain advancements in theory of investment will be covered with an aim of helping the participants make sound investment decisions in the context of portfolio investment.
- The Risk-free assets and one fund theorem, efficient frontier.
- The various strategies followed by investment practitioners.
- The measure and the relationship between risk and return.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Understand the various alternatives available for investment.
2. Learn to measure risk and return.
3. Find the relationship between risk and return.
4. Value the equities and bonds.
5. Gain knowledge of the various strategies followed by investment practitioners.
6. Study Index tracking optimization models.

UNIT I

Financial markets. Investment objectives. Measures of return and risk. Types of risks. Risk free assets. Mutual funds. Portfolio of assets.

UNIT II

Expected risk and return of portfolio. Diversification. Mean-variance portfolio optimization- the Markowitz model and the two-fund theorem.

UNIT III

Risk-free assets and one fund theorem, efficient frontier. Portfolios with short sales.

UNIT IV

Capital market theory.Capital assets pricing model- the capital market line, beta of an asset, beta of a portfolio, securitymarket line.

UNIT V

Index tracking optimization models. Portfolio performance evaluation measures.

SUGGESTED READINGS

TEXT BOOK

1. Reilly . F. K., Keith C. Brown., (2011). Investment Analysis and Portfolio Management, Tenth Edition, South-Western Publishers.

2. Markowitz H.M., (2000). Mean-Variance Analysis in Portfolio Choice and Capital Markets, Blackwell, New York.

3. M.J. Best., (2010). Portfolio Optimization, Chapman and Hall, CRC Press.

4. Luenberger. D.G., (2013). Investment Science, Second Edition., Oxford University Press.

Semester – V

		L	T	P	C
16MMU501B	**NUMBER THEORY**	**6**	**2**	**0**	**6**

Course Objectives

This course enables the students to learn

- Numbers, functions and its properties.
- Beauty and clarity of number theoretic functions.
- The challenging problems in number theory.
- How number theory is related to and used in cryptography.
- The concepts of divisibility, congruence, greatest common divisor, prime, and prime-factorization.
- The Law of Quadratic Reciprocity and other methods to classify numbers as primitive roots, quadratic residues, and quadratic non-residues.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Understand the Linear Diophantine equation,
2. Know about the Fermat's Little theorem.
3. Mastery in the Mobius Inversion formula.
4. Familiar with the concepts of primitive roots
5. Acquire knowledge of the Legendre symbol and its properties.
6. Acquire concepts of Public key encryption, RSA encryption and decryption

UNIT I

Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruences, complete set of residues, Chinese Remainder theorem.

UNIT II

Fermat's Little theorem, Wilson's theorem. Number theoretic functions, sum and number of divisors, Totally multiplicative functions , Definition and properties of the Dirichlet product.

UNIT III

The Mobius Inversion formula, the greatest integer function, Euler's phi- function, Euler's theorem reduced set of residues-some properties of Euler's phi-function.

UNIT IV

Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties.

UNIT V

Quadratic reciprocity-quadratic congruences with composite moduli. Public key encryption, RSA encryption and decryption, the equation $x^2 + y^2 = z^2$, Fermat's Last theorem.

SUGGESTED READINGS

TEXT BOOK

1. David M. Burton, (2007). Elementary Number Theory, Sixth Edition, Tata McGraw- Hill, Delhi.

REFERENCES

1. Neville Robinns, (2007). Beginning Number Theory, 2nd Ed., Narosa Publishing House Pvt. Ltd., Delhi.
2. Neal Koblitz., (2006).A course in Number theory and cryptography,Second Edition, Hindustan Book Agency, New Delhi.

Semester – V

		L	T	P	C
16MMU502A	**INDUSTRIAL MATHEMATICS**	**6**	**2**	**0**	**6**

Course Objectives

This course enables the students to learn

- The basic facts about mathematics.
- Display the knowledge of conventions such annotations, terminology and recognize basic geometrical figures and graphical displays, state important facts resulting from their studies.
- A relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved with mathematical reasoning.
- Translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.
- Application of Fourier and inverse Fourier transforms.
- The concepts of Medical Imaging and Inverse Problems.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Get adequate exposure to global and local concerns so as to explore many aspects of Mathematical Sciences.
2. Apply their skills and knowledge, that is, translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.
3. Know about the X-ray: Introduction, X-ray behavior and Beers Law.
4. Aware of history of mathematics and hence of its past, present and future role as part of our culture.
5. Know the concept of Radon Transform.
6. Use the application of Fourier and inverse Fourier transforms.

UNIT I

Medical Imaging and Inverse Problems: The content is based on Mathematics of X-ray and CT scan based on the knowledge of calculus, elementary differential equations, complex numbers and matrices.

UNIT II

Inverse problems: Introduction , Illustration of Inverse problems through problems taught in Pre-Calculus, Calculus, Matrices and differential equations. Geological anomalies in Earth's interior from measurements at its surface (Inverse problems for Natural disaster) and Tomography.

UNIT III

X-ray: Introduction, X-ray behavior and Beers Law (The fundament question of image construction) Lines in the place.

UNIT IV

Radon Transform: Definition and Examples, Linearity, Phantom (Shepp - Logan Phantom - Mathematical phantoms). Back Projection: Definition, properties and examples.

UNIT V

CT Scan: Revision of properties of Fourier and inverse Fourier transforms and applications of their properties in image reconstruction. Algorithms of CT scan machine. Algebraic reconstruction techniques abbreviated as ART with application to CT scan.

SUGGESTED READINGS

TEXT BOOK

1. Timothy G. Feeman.,(2010). The Mathematics of Medical Imaging, A Beginners Guide, Springer Under graduate Text in Mathematics and Technology, Springer.

REFERENCE

1. Andreas Kirsch., (2011). An Introduction to the Mathematical Theory of Inverse Problems, 2nd Ed., Springer.

2. Groetsch C.W., (1999). Inverse Problems, Activities for Undergraduates, The Mathematical Association of America.

Semester – V

		L	T	P	C
16MMU502B	**BOOLEAN ALGEBRA AND AUTOMATA THEORY**	**6**	**2**	**0**	**6**

Course Objectives

This course enables the students to learn

- Lattice and algebraic system, Basic properties of algebraic systems
- Finite Automata and regular languages
- The foundations of computability theory
- A strong background in reasoning about finite state automata and formal languages.
- Mathematical arguments using logical connectives and quantifiers.
- The various categories of languages and grammars in the Chomsky hierarchy.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Understand how lattices and Boolean algebra are used as tools and mathematical models in the study of networks.
2. Define various categories of automata.
3. Context free grammars and pushdown automata.
4. Understand Turing machine as a model of computation.
5. Define the various categories of Undecidability.
6. Knowledge about Post Correspondence Problem.

UNIT I

Definition of ordered set with examples and basic properties of ordered sets, maps between ordered sets , duality principle, lattices as ordered sets- lattices as algebraic structures, sublattices, products and homomorphisms, modular and distributive lattices.

Boolean algebras: Boolean polynomials, minimal forms of Boolean polynomials, Quinn- McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.

UNIT II

The central concept of Automata: Alphabets, strings, and languages. Finite Automata and Regular Languages: deterministic and non-deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages.

UNIT III

Context Free Grammars and Pushdown Automata: Context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language accepted by PDA, deterministic PDA, Non- deterministic PDA, properties of context free languages, normal forms, pumping lemma, closure properties, decision properties.

UNIT IV

Turing Machines: Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence.

UNIT V

Undecidability: Recursively enumerable and recursive languages, undecidable problems about Turing machines: halting problem, Post Correspondence Problem, and undecidability problems About CFGs.

SUGGESTED READINGS

TEXT BOOKS

4. Davey B A., and Priestley H. A., (2002). Introduction to Lattices and Order, Cambridge University
Press, Cambridge.

5. Hopcroft J. E., Motwani R., and Ullman J.D., (2001). Introduction to Automata Theory, Languages,
and Computation, Second Edition, Addison-Wesley.

REFERENCES

6. Edgar G. Goodaire and Michael M. Parmenter, (2003). Discrete Mathematics with Graph Theory,
Second Edition, Pearson Education P.Ltd., Singapore.

7. Rudolf Lidl and Günter Pilz, (2004). Applied Abstract Algebra, Second Edition , Undergraduate Texts in Mathematics, Springer (SIE).

8. Lewis H.R., Papadimitriou C.H.,and Papadimitriou C.,(2005). Elements of the Theory of Computation, Second Edition ,Prentice-Hall. New Delhi**.**

9. Anderson J.A., (2006). Automata Theory with Modern Applications, Cambridge University Press,
Cambridge.

Semester – V

		L	T	P	C
16MMU503 A	**THEORY OF EQUATIONS**	**6**	**2**	**0**	**6**

Course Objectives

This course enables the students to learn

- The solution of Reciprocal and Binomial Equations and properties of the derived functions.
- About the properties of polynomials**.**
- The concepts of Relations between the roots and coefficients and applications of theorems.
- About algebraic Solution of the Cubic and Biquadratic and Properties of the Derived Functions.
- The algebraic solutions of cubic and biquadratic equations.
- The relation between coefficients of the equation and its roots.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Learn about the properties of polynomials.
2. Find positive, negative and imaginary roots using Descartes rule.
3. Identify the relation between coefficients of the equation and its roots.
4. Familiarize about the transformations of equations.
5. Know about the algebraic solutions of cubic and biquadratic equations.
6. Understand Algebraic Solution of the Cubic and Biquadratic.

UNIT I

General properties of polynomials: Theorem relating to polynomials when the variable receives large values, similar theorem when the variable receives small values.

Continuity of a rational integral function – Form of the quotient and remainder when a polynomial is divided by a Binomial – Tabulation of functions – Graphic representation of a polynomial – Maximum and minimum values of polynomials

UNIT II

General properties of equations: Theorems relating to the real roots of equations - Existence of a root in the general equation. Imaginary roots – Theorem determining the number of roots of an equation.

Descartes' rule of signs for positive roots – Descartes' rule of signs for negative roots – Use of Descartes' rule in proving the existence of imaginary roots – Theorem relating to the substitution of two given numbers for the variable

UNIT III

Relations between the roots and Coefficients-Theorem - Applications of the theorem - Depression of an equation when a relation exists between two of its roots - The cube roots of unity - Symmetric functions of the roots – Examples – Theorems relating to symmetric functions – Examples.

UNIT IV

Transformation of Equations: Transformation of equations - Roots with signs changed - Roots multiplied by a given quantity - Reciprocal roots and reciprocal equations - To increase or diminish the roots by a given quantity - Removal of terms - Binomial coefficients.

Solution of reciprocal and binomial equations: Reciprocal equations - Binomial equations. Propositions embracing their leading general Properties - The special roots of the equation – Solution of binomial equations by circular functions – Examples.

UNIT V

Algebraic Solution Of the Cubic and Biquadratic: On the algebraic solution of equations – The algebraic solution of the cubic equation - Application to numerical equations - Expression of the cubic as the difference of two cubes - Solution of the cubic by symmetric functions of the roots – Examples .

Properties of the Derived Functions: Graphic representation of the derived function - Theorem relating to the maxima and minima of a polynomial - Rolle's Theorem. Corollary - Constitution of the derived functions

SUGGESTED READINGS

TEXT BOOK

1. Burnside W.S., and Panton A.W.,(1954). The Theory of Equations, Eighth Edition ,Dublin University Press.

REFERENCES

1. Leonard Eugene Dickson (2012). First Course in the theory of Equations., , J. Wiley & sons, London: Chapman & Hall,Limited, New York.

2. Turnbull,H.W (2013)., Theory Of Equations, Fourth Edition, Published In Great Britain Bt, Oliver And Boyd Ltd., Edinburgh.

3. James Víctor Uspensky., (2005). Theory of Equations, McGraw-Hill Book Co, New York.

4. MacDuffee C.C., (1962). Theory of Equations, John Wiley & Sons Inc., New York.

		Semester- V L T P C
16MMU503B	**COMPUTER GRAPHICS**	**6 2 0 6**

Course Objectives

This course enables the students to learn

- The scope of this course is to provide students with distinguished knowledge in the field of two- and three-dimensional computer graphics for Animation.
- Different hardware used for graphical requirement.
- How to display 3D objects in a 2D display devices using projection techniques.
- How to create realistic images using color and shading techniques.
- Computer Animation and Design of Animation Sequences.
- Designing and implementing practical graphic solutions to challenging problems in different application domains.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Transfer to the students the skills required for designing and implementing practical graphic solutions to challenging problems in different application domains and make them a competent product.
2. Understand different hardware used for graphical requirement.
3. Perform visual computations for geometrical drawings.
4. Display 3D objects in a 2D display devices using projection techniques.
5. Create realistic images using color and shading techniques.
6. Developed Computer Animation and Design of Animation Sequences.

UNIT I

A Survey of Computer Graphics - Video Display Devices - Refresh Cathode Ray Tubes -Raster Scan Displays - Random Scan Displays - Color CRT Monitors - Direct –View Storage Tubes - Flat Panel Displays - Three Dimensional Viewing Devices – Raster Scan and Random Scan graphic storages Displays processors and Character generators, color display techniques

UNIT II

Input Devices: Keyboards - Mouse –Track Ball and Space ball – Joysticks - Data Glove – Digitizers - Image Scanners - Touch Panels - Light Pens - Voice Systems. Hard Copy Devices: Printers and Plotters, Interactive input/output devices

Point, lines and Curves : Scan conversion, Line Drawing Algorithms: DDA Algorithm - Bresenhams Line Algorithm. Circle Generating Algorithms: Mid Point Circle Algorithm, Ellipse Generating Algorithm, Conic-section generation, polygon filling anti aliasing.

UNIT III

Two Dimensional Geometric Transformations: Basic Transformations: Translation –Rotation – Scaling - Composite Transformations: Translations – Rotations - Scalings. General Pivot Point Rotation - General Fixed Point Scaling. Two – Dimensional Viewing: The Viewing Pipeline - Window to viewport Transformation - Clipping Operations: Point Clipping - Line Clipping Algorithms- Cohen Sutherland Line Clipping - Polygon Clipping: Sutherland – Hodgeman Polygon Clipping Algorithm - Text Clipping.

UNIT IV

Three – Dimensional Display methods, Three – Dimensional Transformations : Translation –Rotation – Scaling, Three Dimensional viewing : Viewing pipeline - Viewing coordinates - Parallel Projection – . Perspective Projections.

UNIT V

Visible Surface Detection Methods: Classification of Visible Surface Detection Algorithms - Back Face Detection - Depth Buffer Method - Area Sub division Method.

Computer Animation : Design of Animation Sequences-General Computer Animation functions – Raster Animations – Computer animation Languages – Key Frame Systems – Motion Specifications

TEXT BOOK

1. Donald Hearn and M. Pauline Baker, (2010).Computer Graphics - C Version, Second Edition, Pearson Education, New Delhi.

REFERENCES

1. Amarendra N. Sinha,(2008). Computer Graphics, First Edition, Tata McGraw Hill, New Delhi.

2. Foley, Vandam, Feiner and Hughes, (1999). Computer Graphics Principles and Practices, Second Edition, Addison Wesley, Singapore.

3. Zhigang Xiang and Roy A. Plastock, (2002). Theory and Problems of Computer Graphics, Second Edition, Tata McGraw-Hill publishers, New Delhi.

4. William M. NewMan and Robert F. Sproull, (2007). Principles of Interactive Computer Graphics, Second Edition, Tata McGraw-Hill Publishers, New Delhi.

5. Rogers D.F., (2001). Procedural Elements in Computer Graphics, Second Edition, McGraw Hill Book Company, New Delhi.
6. Rogers D.F., Adams A.J., (1990). .Mathematical Elements in Computer Graphics, Second Edition, McGraw Hill Book Company, New Delhi.

WEBSITES

http://www.fileformat.info/mirror/egff/ch02_01.html

http://www.rw-designer.com/how-to

http://en.wikipedia.org/wiki/3D_computer_graphics

Semester – V

		L	T	P	C
16MMU504A	**ANALYTICAL GEOMETRY**	**4**	**2**	**0**	**4**

Course Objectives

This course enables the students to learn

- Geometry and its applications in the real world
- Geometric ideas in the language of the mathematician.
- Parabola, Ellipse and Hyperbola.
- The relation between areas of a triangle and its projection, relation between areas of a polygon.
- The General Equations Tracing of Curves.
- The fundamental theorems of isomorphism.

Course Outcomes (COs)

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

1. Acquiring knowledge of straight lines and area of triangle..
2. Know about Reflection properties of parabola.
3. Acquire the knowledge on basic concepts of Hyperbola and their applications.
4. Study the angles between two directed lines, the projection of a segment.
5. Understand the General Equations Tracing of Curves.
6. Know about particular cases of Conic sections.

UNIT I

Coordinates, Lengths of straight lines and areas of triangle, polar coordinates. Locus, equation to a locus. Straight line: Equation of a straight line, angle between two straight line. Length of a perpendicular techniques for sketching parabola, ellipse and hyperbola. Reflection properties of parabola.

UNIT II

Parabola and Ellipse: Classification of quadratic equations representing lines. Parabola : Loci Connected with the parabola ,three normals passing through a given points , parabola referred to two tangent as axes. Ellipse: Auxiliary circle and eccentric angle, equation to a tangent , some properties of Ellipse , poles and polar , conjugate diameters , four normals through any points.

UNIT III

Hyperbola: Asymptotes – equations referred to the asymptotes an axes – one variables examples.
Spheres: The Equation of a sphere - Tangents and tangent plane to a sphere - The radical plane of two spheres Cylindrical surfaces. Illustrations of graphing standard quadric surfaces like cone, ellipsoid.

UNIT IV

The angles between two directed lines, the projection of a segment, relation between a segment and its projection, the projection of a broken line , the angle between two planes , relation between areas of a triangle and its projection , relation between areas of a polygon.

UNIT V

Polar equation to a conic: General Equations Tracing of Curves, particular cases of Conic sections, transformation of equations to center as origin, equations to asymptotes, tracing a parabola , tracing a central conic , eccentricity and foci of general conic.

SUGGESTED READINGS

TEXT BOOK

1. Loney S.L.,(2005). The Elements of Coordinate Geometry, McMillan and Company, London.

REFERENCES

1. Anton H., Bivens I. and Davis S., (2002). Calculus, John Wiley and Sons (Asia) Pvt. Ltd.

2. Thomas G.B., and Finney R.L., (2005). Calculus, Ninth Edition, Pearson Education, Delhi.

3. Fuller, Gordon.,(2000). Analytic Geometry, Addison Wesley Publishing Company Inc. Cambridge.

4. Bill R.J.T., (1994). Elementary Treatise on Coordinate Geometry of Three Dimensions, McMillan India Ltd. New Delhi.

		Semester – V
		L T P C
16MMU504B	**LINEAR PROGRAMMING**	**4 2 0 4**

Course Objectives

This course enables the students to learn

- Fundamental concepts of duality, economic interpretation of dual constraints and game theory.
- The simplex method to solve small linear programming models by hand, given a basic feasible point.
- Formulation of a given simplified description of a suitable real-world problem as a linear programming model.
- Revised Simplex Method, Parametric Linear Programming, Integer Linear Programming: Branch and Bound Method, Cutting Plane Method.
- Mathematical Formulation of LPP, Solution of LPP: Graphical Method with special cases, Simplex Method, Big-M Method, Two Phase method. Special cases in simplex method, Duality theory, Dual Simplex algorithm.
- Solution of Transportation problem and Assignment Problems.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Formulate a LPP and solve it by simplex and graphical method. Also do post optimal analysis of the formulated problem or other application areas.
2. Understand the concepts of Duality, Primal Dual relationship.
3. Solve a Transportation and its types.
4. Analysis Assignment problem and its models.
5. Know the concept of game theory.
6. Study the games with mixed strategies, graphical solution procedure, linear programming solution of games.

UNIT I

Introduction to Linear Programming Problem – Graphical Linear Programming Solution- Theory of Simplex Method-Optimality and unboundedness-the Simplex algorithm –Simplex method in tableau format- Introduction to artificial variables – two –phase method – Big –M method and their comparison.

UNIT II

Duality – Definition of the dual Problems-Formulation of the dual Problem-Primal Dual relationship: Review of simplex matrix Operations –Simplex tableau Layout-Optimal Dual Solution-Simplex Tableau computations. Economic interpretation of the dual: Economic Interpretation of Dual Variables-Economic Interpretation of Dual Constraints.

UNIT III

Transportation Problem: Definition of the Transportation model – Nontraditional Transportation model – The Transportation Algorithm: Determination of the Starting Solution-Northwest –corner method, Least – corner method, Vogel approximation method- Iterative Computations of the Transportation Algorithm.

UNIT IV

The Assignment Model: Introduction to Assignment model- Mathematical Formulation of Assignment model- Hungarian method for solving assignment problem –Simplex Explanation of the Hungarian method.

UNIT V

Game theory: Formulation of two person zero games – Solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.

SUGGESTED READINGS

TEXT BOOK

1. Handy .A. Taha., (2007). Operations Research, Seventh edition, Prentice Hall of India Pvt Ltd, New Delhi .

REFERENCES

1. Hillier F.S., and Lieberman G.J., (2009). Introduction to Operations Research, Ninth Edition, Tata McGraw Hill, Singapore.

2. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, (2004). Linear Programming and Network Flows, Second Edition, John Wiley and Sons, India.

3. Hadley G.,(2002). Linear Programming, Narosa Publishing House, New Delhi.

16MMU601A	MATHEMATICAL MODELING	L	T	P	C
		6	2	0	6

Course Objectives

This course enables the students to learn

- Mathematical models of real-world systems, analyze them and make predictions about behavior of these systems.
- The principles of mathematical modelling to solve a variety of practical problems in sciences and engineering.
- The behavior of a given physical system based on the analysis of its mathematical model.
- Modeling with a Differential Equations.
- Simulation Modeling – Discrete-Event Simulation, Continuous Simulation, Monte Carlo simulation.
- Analytic methods of model fitting.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Know about the power series solution of a differential equation.
2. Understand the basic concepts of Monte Carlo Simulation Modeling.
3. Study the basic concepts of Queueing theory.
4. Knowledge the applications of differential equations.
5. Study the applications to Traffic Flow
6. Understand the concepts of gravitational potential, conservation laws.

UNIT I

Power series solution of a differential equation about an ordinary point, solution about a regular singular point, Bessel's equation and Legendre's equation, Laplace transform and inverse transform, application to initial value problem up to second order.

UNIT II

Monte Carlo Simulation Modeling: simulating deterministic behavior (area under a curve, volume under a surface), Generating Random Numbers: middle square method, linear congruence.

UNIT III

Queuing Models: harbor system, morning rush hour, Overview of optimization modeling, Linear Programming Model: geometric solution algebraic solution, simplex method, sensitivity analysis.

UNIT IV

Applications of differential equations: the vibrations of a mass on a spring, mixture problem, free damped motion, forced motion, resonance phenomena, electric circuit problem, mechanics of simultaneous differential equations.

UNIT V

Applications to Traffic Flow. Vibrating string, vibrating membrane, conduction of heat in solids, gravitational potential, conservation laws.

SUGGESTED READINGS

TEXT BOOKS

1. Shepley L. Ross, (1984). Differential Equations, Fourth Edition, John Wiley and Sons , New York**.(For Unit-I,II & III)**

2. Sneddon I., (2006). Elements of Partial Differential Equations, McGraw-Hill, International Edition, New York. **.(For Unit-IV & V)**

REFERENCES

1. Tyn Myint-U and Lokenath Debnath, (2006). Linear Partial Differential Equation for Scientists and Engineers, Springer.

2. Frank R. Giordano, Maurice D. Weir and William P. Fox, (2003). A First Course in Mathematical Modeling, Thomson Learning, London and New York.

Semester – VI

		L	T	P	C
16MMU601B	**MECHANICS**	**6**	**2**	**0**	**6**

Course Objectives

This course enables the students to learn

- How to use forces, frictions and their applications in real life.
- To solve dynamics problems such as conservation of energy and linear and angular momentum.
- Applications of differential equations in advanced mathematical problems.
- Motion in different curves under central forces.
- Classification of the Couple moment and Moment of a couple about a line.
- The problem of central forces and mechanical systems.

Course Outcomes (COs)

On successful completion of this course students will be able to

1. Understand the concept of the Moment of a force about a point and an axis.
2. Classify the Laws of Coulomb friction.
3. Solve the problems of Conservative force field and conservation for mechanical energy.
4. Solve the Problems of equilibrium under forces including friction.
5. Analyze the Velocity and acceleration of a particle along a curve.
6. Know about the basic concepts of Simple harmonic motion, Simple Pendulum, Projectile Motion.

UNIT I

Moment of a force about a point and an axis, couple and couple moment, Moment of a couple about a line, resultant of a force system, distributed force system, free body diagram, free body involving interior sections, general equations of equilibrium, two point equivalent loading, problems arising from structures, static indeterminacy.

UNIT II

Laws of Coulomb friction, application to simple and complex surface contact friction problems, transmission of power through belts, screw jack, wedge, first moment of an area and the centroid, other centers, Theorem of Pappus-Guldinus, second moments and the product of area of a plane area, transfer theorems, relation between second moments and products of area, polar moment of area, principal axes.

UNIT III

Conservative force field, conservation for mechanical energy, work energy equation, kinetic energy and work kinetic energy expression based on center of mass, moment of momentum equation for a single particle and a system of particles, translation and rotation of rigid bodies, Chasles' theorem, general relationship between time derivatives of a vector for different references, relationship between velocities of a particle for different references, acceleration of particle for different references.

UNIT IV

Conditions of equilibrium of a particle and of coplanar forces acting on a rigid Body, Laws of friction, Problems of equilibrium under forces including friction, Centre of gravity, Work and potential energy.

UNIT V

Velocity and acceleration of a particle along a curve: radial and transverse components (plane curve), tangential and normal components (space curve), Newton's Laws of motion, Simple harmonic motion, Simple Pendulum, Projectile Motion.

SUGGESTED READINGS

TEXT BOOK

1. Shames I.H., and Krishna Mohan Rao G., (2009). Engineering Mechanics: Statics and Dynamics, 4th Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

REFERENCES

1. Hibbeler R.C. and Ashok Gupta.,(2013). Engineering Mechanics: Statics and Dynamics, Eleventh Edition, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

2. Roberts A.P., (2003). Statics and Dynamics with Background in Mathematics, Cambridge University Press, Cambridge

SEMESTER –VI

		L	T	P	C
16MMU602A	**RIEMANN INTEGRATION AND SERIES OF FUNCTIONS**	**6**	**2**	**0**	**6**

Course Objectives

This course enables the students to learn

- The Riemann integration, Point wise and uniform convergence of sequence of functions and Series of functions.
- The concept of continuous functions and their bounded variation property.
- Difference between Riemann Integration and Riemann Stieltjes Integration of functions.
- Fundamental theorems of Calculus and Improper integrals.
- The concept of cauchy criterion for uniform convergence and Weierstrass M-Test.
- About pointwise and uniform convergence of sequence of functions.

Course Outcomes (COs)

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

1. Understand Riemann sum and definition of Riemann integral.
2. Convergence of Beta and Gamma functions
3. Know about Pointwise and uniform convergence of sequence of functions
4. Theorems on the continuity and derivability of the sum function of a series of functions.
5. Understand Cauchy criterion for uniform convergence and Weierstrass M-Test.
6. Limit superior and Limit inferior and integration of power series.

UNIT I

Riemann integration - inequalities of upper and lower sums - Riemann conditions of integrability - Riemann sum and definition of Riemann integral through Riemann sums - equivalence of two definitions- Riemann integrability of monotone and continuous functions, Properties of the Riemann integral

UNIT II

Definition and integrability of piecewise continuous and monotone functions. - Intermediate Value theorem for Integrals - Fundamental theorems of Calculus - Improper integrals - Convergence of Beta and Gamma functions

UNIT III

Pointwise and uniform convergence of sequence of functions - Theorems on continuity - derivability and integrability of the limit function of a sequence of functions.

UNIT IV

Series of functions - Theorems on the continuity and derivability of the sum function of a series of functions - Cauchy criterion for uniform convergence and Weierstrass M-Test.

UNIT V

Limit superior and Limit inferior - Power series - radius of convergence - Cauchy Hadamard Theorem - Differentiation and integration of power series - Abel's Theorem - Weierstrass Approximation Theorem.

SUGGESTED READINGS

1. Ross K.A., (2004). Elementary Analysis, The Theory of Calculus, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint,
2. R.G. Bartle D.R. Sherbert, (2002). Introduction to Real Analysis, Third Edition, John Wiley and Sons (Asia) Pvt. Ltd., Singapore,
3. Charles G. Denlinger, (2011). Elements of Real Analysis, Jones & Bartlett (Student Edition),

Semester -VI

		L	T	P	C
16MMU602B	**PDE AND SYSTEMS OF ODE**	**6**	**2**	**0**	**6**

Course Objectives

This course enables the students to learn

- The various methods of solving Differential equations which is very much used in the field of Engineering.
- The Method of Separation of Variables for solving first order partial differential equations.
- The basic concepts of Reduction of second order Linear Equations to canonical forms
- The Systems of linear differential equations and its applications.
- The concept of second order linear homogeneous, non-homogeneous differential equations with constant coefficients.
- The application of The Euler method-The modified – Euler method -The Runge-Kutta method.

Course Outcomes (COs)

On successful completion of the course, students will be able to

1. Understand the basic concepts partial differential equations.
2. Gain knowledge about forming the differential equations method of separation of Variables, Initial Boundary Value Problems and method of successive approximations.
3. Know about the Reduction of second order Linear Equations to canonical forms.
4. Study the Method of separation of variables and Solving the Vibrating String.
5. Understand the Basic Theory of linear systems in normal form.
6. Use the Numerical methods to solve the real world problems.

UNIT I

Partial Differential Equations – Basic concepts and Definitions -Mathematical Problems. First Order Equations: Classification - Construction and Geometrical Interpretation- Method of characteristics for obtaining General Solution of Quasi Linear Equations- Canonical Forms of First-order Linear Equations.

UNIT II

Method of Separation of Variables for solving first order partial differential equations. Derivation of Heat equation -Wave equation and Laplace equation. - Classification of second order - linear equations as hyperbolic, parabolic or elliptic.

UNIT III

Reduction of second order Linear Equations to canonical forms- The Cauchy problem- The Cauchy-Kowaleewskaya theorem -Cauchy problem of an infinite string - Initial Boundary Value Problems - Semi-Infinite String with a fixed end - Semi-Infinite String with a Free end- Equations with non-homogeneous boundary conditions -Non- Homogeneous Wave Equation.

UNIT I V

Method of separation of variables - Solving the Vibrating String - Problems- Solving the Heat Conduction problem - Systems of linear differential equations - Types of linear systems differential operators - an operator method for linear systems with constant coefficients.

UNIT V

Basic Theory of linear systems in normal form : Homogeneous linear systems with constant coefficients -Two Equations in two unknown functions -The method of successive approximations -The Euler method-The modified – Euler method -The Runge-Kutta method.

SUGGESTED READINGS

TEXT BOOK

1. Tyn Myint-U and Lokenath Debnath., (2006). Linear Partial Differential Equations for Scientists and Engineers, 4th edition, Springer, Indian reprint.

REFERENCES

1. Ross S.L., (2004). Differential equations,Third Edition, John Wiley and Sons, India.
2. Martha L Abell., James P Braselton, (2004). Differential equations with MATHEMATICA, Third Edition Elsevier Academic Press.

Semester – VI

		L	T	P	C
16MMU603A	**PROBABILITY AND STATISTICS**	**4**	**2**	**0**	**4**

Course Objective:

This course enables the students to learn

- Basic concepts in probability theory and statistical measures.
- Commonly used probability distributions (both discrete and continuous).
- Central Limit theorem and their applications in various disciplines.
- The nature of uncertainty and randomness and set up data collection methods that are free of bias.
- Appropriate methods to draw conclusions based on sample data by constructing and/or evaluating tables, graphs, and numerical measures of characteristics of data.
- The foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Understand the basic concepts of Measures of central tendency.
2. Know about the Probability Concepts and its properties.
3. Know about the Discrete distributions and its types.
4. Study the Continuous distributions and its types.
5. Understand the Basic Theory of Chebyshev's inequality.
6. Chapman-Kolmogorov equations, classification of states.

UNIT I

Meaning and definition of statistics, Measures of central tendency: Arithmetic Mean, Median, Mode. Measures of dispersion – Range, Coefficient of range, Quartile deviation, Coefficient of Quartile deviation, Standard deviation and Coefficient of variation.

UNIT II

Probability Concepts – trial, event, Sample space, mutually exclusive event, exclusive and exhaustive events, dependent and independent events, simple and compound events, Mathematical properties, permutation and combination, probability axioms, addition and multiplication theorem, real random variables (discrete and continuous), cumulative distribution function, probability density functions, mathematical expectation, moments, moment generating function, characteristic function.

UNIT III

Discrete distributions: uniform distribution, binomial distribution, Poisson distribution, and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables.

UNIT IV

Continuous distributions: uniform distribution, normal distribution, standard normal distribution, exponential distribution. Joint cumulative distribution function and its properties, joint probability density functions (No derivations) and simple problems. Bivariate distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

UNIT V

Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states.

SUGGESTED READINGS

TEXT BOOK

1. Gupta S.P., (2001). Statistical Methods, Sultan Chand & Sons, New Delhi.

REFERENCES

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig., (2007). Introduction to Mathematical Statistics, Pearson Education, Asia.

2. Irwin Miller and Marylees Miller, John E. Freund, (2006). Mathematical Statistics with Application, Seventh Edition, Pearson Education, Asia.

3. Sheldon Ross., (2007). Introduction to Probability Model, Ninth Edition, Academic Press, Indian Reprint.

4. Pillai R.S.N., and Bagavathi V., (2002). Statistics, S. Chand & Company Ltd, New Delhi.

5. Srivastava T.N., and Shailaja Rego., (2012). 2e, Statistics for Management, Mc Graw Hill Education, New Delhi.

6. Dr.P.N.Arora, (2002). A foundation course statistics, S.Chand & Company Ltd, New Delhi.

Semester – VI

		L	T	P	C
16MMU603B	**DIFFERENTIAL GEOMETRY**	**4**	**2**	**0**	**4**

Course Objective:

This course enables the students to learn

- To get introduced to the concept of a regular parameterized curve in n
- To Understand the concept of curvature of a space curve and signed curvature of a plane curve.
- To be able to understand the fundamental theorem for plane curves.
- To get introduced to the notion of Serret-Frenet frame for space curves and the
- Involutes and evolutes of space curves with the help of examples. To be able to compute the curvature and torsion of space curves.
- The Parallel propagation of vectors, Covariant and intrinsic derivatives

Course Outcomes (COs)

On successful completion of this course, the student will be able to

1. Understand the theory of space curves with examples.
2. Study the concept of parametric curves on surfaces.
3. Know about the torsion of a geodesic and geodesic curvature.
4. Study the Tensors of different type, Algebra of tensors and contraction.
5. Know about the Parallel propagation of vectors.
6. Understand Laplacian operators in tensor form.

UNIT I

Theory of Space Curves: Space curves - Planer curves, Curvature, torsion and Serret-Frenet formulae - Osculating circles, Osculating circles and spheres - Existence of space curves - Evolutes and involutes of curves.

UNIT II

Theory of Surfaces: Parametric curves on surfaces - Direction coefficients -First and second Fundamental forms - Principal and Gaussian curvatures - Lines of curvature - Euler's theorem - Rodrigue's formula - Conjugate and Asymptotic lines.

UNIT III

Developables: Developable associated with space curves and curveson surfaces – Minimal surfaces. Geodesics: Canonical geodesic equations - Nature of geodesics on a surface of revolution -Clairaut's theorem. -Normal property of geodesics -Torsion of a geodesic - Geodesic curvature - Gauss-Bonnet theorem - Surfaces of constant curvature -Conformal mapping. Geodesic mapping- Tissot's theorem.

UNIT IV

Tensors: Summation convention and indicial notation - Coordinate transformation and Jacobian, Contra-variant and Covariant vectors - Tensors of different type - Algebra of tensors and contraction - Metric tensor and 3-index Christoffel symbols.

UNIT V

Parallel propagation of vectors, Covariant and intrinsic derivatives - Curvature tensor and its properties - Curl, Divergence and Laplacian operators in tensor form - Physical components.

SUGGESTED READINGS

TEXT BOOK

1.Willmore T.J., (2012). An Introduction to Differential Geometry, Dover Publications, New York.

REFERENCES

1. B. O'Neill., (2006). Elementary Differential Geometry, 2nd Ed., Academic Press,New Delhi.
2. Weatherburn C.E., (2003). Differential Geometry of Three Dimensions, Cambridge University Press, Cambridge.
3. Struik D.J., (2012). Lectures on Classical Differential Geometry, 2nd Edition, Dover Publications, New York.
4. Lang S., (2001). Fundamentals of Differential Geometry, Springer, New York.
5. Spain B., (2003).Tensor Calculus: A Concise Course, Dover Publications, New York.

Semester -VI

		L	T	P	C
16MMU691	**PROJECT**	**8**	**0**	**0**	**6**