SYLLABUS BOOKLET

5-Year Integrated Dual Degree (B.Tech.-M.Tech.)Programme in Mathematics & Computing

Degrees to be awarded

B. Tech. in Mathematics & Computing

M. Tech. in Mathematics & Computing

Applicable to Academic Session 2016-17 and onwards

Department Undergraduate Committee (DUGC)

DEPARTMENT OF MATHEMATICAL SCIENCES
INDIAN INSTITUTE OF TECHNOLOGY
(BANARAS HINDU UNIVERSITY)
VARANASI-221005
INDIA

INTRODUCTION OF DEPARTMENT OF MATHEMATICAL SCIENCES

Department of Mathematical Sciences was started as a section to assist engineering departments of the institute which, in the true sense, pioneered engineering education in the Indian Nation. It soon acquired the status of a full-fledged department in 1985. It did not stagnate thereafter. Over the years it underwent several transformations with the passage of time in tune with the global development, grew up with the changing world, and frequently altered its face. But finally, in 2013 after the transformation of the erstwhile Institute of Technology to Indian Institute of Technology, it got reincarnated as "Department of Mathematical Sciences" to serve the humanity with a greater perspective, not only to act as interfaces to several disciplines but also to act as a hub for creating fundamental knowledge. *Upnishadas* too say, "*Charaiveti*", i.e., *keep moving.*

Undoubtedly mathematics, in its purest form, has been the department's prime concern and its growth as the core of the vision. Mathematics is said to be the queen of all sciences. The fact is: it's the nectar that tastes as the science it describes; it's the light that illuminates like the colour it is incident on; and it's the elixir that has kept the laws of nature alive from the moments immemorial and will live through the ages we haven't yet speculated about.

The department aims to give emphasis to research in analysis, algebra, topology, mathematical transforms etc. However, the art of relating the beauty of mathematics to the growth of science to strengthen knowledge with zeal to finally serve the humankind is the face, the department is recognised by. Be it fluid dynamics, biomechanics, fracture mechanics, digital image processing, generalized thermo-elasticity, heat and mass transfer, cosmology, cryptology and many more fields of applied nature, department's contribution is enormous in terms of numerous research papers published in reputed international journals over the past few decades. Computing is the glamour of the department. It annexes several dimensions in terms of new and growing areas of research and further facilitates simulation of mathematical models constructed for interdisciplinary areas.

The department runs an Integrated Dual Degree (IDD)programme in Mathematics & Computing which has been so far known as Integrated Master's Degree (IMD)programmein Mathematics & Computing. This is one of the most sought after courses offered by the institute. The top jobs in terms of annual package are offered for this course, which is a strong indication how popular and useful the course is for the industrial growth, in general, and the software industry, in particular, under present circumstances. Despite the fact that the programme is merely a decade old, some of the students graduating from the department have been offered MS and Ph D programmes in the top universities of the world.

PROGRAMME OBJECTIVE

With the changing face of the world, teaching or learning mathematics in isolation cannot be appreciated. The world is going digital at a tremendous pace seeking even the remote feasibility of automation in order to boost the industrial growth and facilitate the mankind as well. We are heading towards a SMART world with heavenly facilities. This is possible only with the help of mathematics because all algorithms and implementations as well are based on absolute mathematics. It has been therefore planned to equip the engineering students of this Master's programme, who have strong base of mathematics, with the adequate knowledge of computer science and computing skills. Such students are expected to be well prepared for giving breakthroughs and creating new horizons in the knowledge domain. The students learning several institute engineering courses and computing courses offered by department of Computer Science and Engineering are expected to excel as engineers in this field.

The increasing demand of the industry, offering very handsome packages, for this programme has made it one of the most sought after programmes in IITs and IIT (BHU), in particular. The feedback from the industry received from the Training & Placement Cell is full of appreciation and demands an increase in the strength of such students. This is a clear indication that such graduating engineers are competent enough to serve the industry and the nation and thus the entire the humanity.

CURRICULLUM OVERVIEW

With the aforementioned objective, the new curriculum is based on the innovative concept of providing the students with huge opportunity and sufficient flexibility to choose papers of their choice and liking so that they are tempted to excel in learning and rising to the occasion with handful of contribution.

This Integrated Dual Degree programmehasbeen formed under the strict supervision of Under Graduate Curriculum Review Committee under the leadership of the Director of the Institute. The programme is stream based which gives ample opportunity to the students to come up with their innovative ideas right from the beginning while doing exploratory projects. The curriculum is full of varieties such as core courses, departmental core electives, open electives, institute engineering/science courses, multi-departmental core courses, projects, dissertation, practicals, humanities, linguistic, human values and management courses etc. The streams for this programme are (i) mathematical modeling and simulation and (ii) coding and security.

SEMESTER-WISE COURSE STRUCTURE OF
Mathematics and Computing: Structure of 5 Year IDD (B.Tech.-M.Tech.) Programs (I-X Semester); (w.e.f. 2016-17 and onwards)

Semester-I

Category	Course Code	Subject	L-T-P	Credits
IS.PHY 102.14	PHY 102	Physics II : Introduction to Engineering Electromagnetic	3-1-2	13
IS.MA 101.14	MA 101	Engineering Mathematics - I	3-1-0	11
IS.CY 101.14	CY 101	Chemistry - I	2-1-2	10
IE.CSO101.14	CSO101	Computer Programming	3-1-2	13
EP.ME 106.14	ME 106	Manufacturing Practice II	0-0-3	3
EP.ME 104.14	ME 104	Engineering Drawing	1-0-3	6
IH.H 101.14	H 101	Universal Human Value-I: Self and Family	1-1-0	5
		Total credits in the semester	**13-5-12**	**61**
LM.HL 101.14	HL 101	Basic English*	2-0-1	7
		Total	**15-5-13**	**68**
GY.PE 101.14	PE101	Elementary Physical Education	0-1-3	5

L: Lecture hours; T: Tutorial hours; P: Laboratory/ Practical hours; C: Credits
*Students who do not qualify the diagnostic test in English will study Basic English; they will not register for GymkhanaCourse.This requirement of Gymkhana Course will be completed in 2nd and 3rd Semester.

Semester-II

CS. Coursecode.YY	Course Code	Subject	Contact Hours	Credits
IS.MA 102.14	MA 102	Engineering Mathematics - II	3-1-0	11
MC.CSO 102.15	CSO 102	Data Structures	3-0-2	11
IE.EO 102.14	EO 102	Fundamentals of Electronics and InstrumentationEngg.	3-1-2	13
DC.MA 103.14	MA 103	Algebra	3-1-0	11
EP.MA 104.14	MA 104	Information Technology and Computing Workshop	1-0-3	6
EP.ME 105.14	ME 105	Manufacturing Practice-I	0-0-3	3
IH.H 105.14	H 105	(Philosophy /	2-1-0	8
IH.H 106.14	H 106	Education and Self)		
		Total credits in the semester	**15-4-10**	**63**
GY.PE 101.14	PE101	Elementary Physical Education / Creative Practice	0-1-3	5

Semester-III

CS. Coursecode.YY	Course Code	Subject	Contact Hours	Credits
IS.MA 202.14	MA 202	Probability and Statistics	3-1-0	11
IE.ME 102.14	ME 102	Engineering Mechanics	3-1-0	11
MC.CSO 204N.15	CSO 204N	Discrete Mathematics #	3-0-0	09
MC.CSO 211N.15	CSO 211N	Computer System Organization#	3-0-2	11
DP.CSM 291.15	CSM 291	Exploratory Project	0-0-5	5
IH.H 103.14	H 103	(Development of Societies/	2-1-0	8
IH.H 104.14	H 104	History of Civilization)		
		Total credits in the semester	**14-3-7**	**55**
GY. PE 101.14	PE 101	Elementary Physical Education/	0-1-3	5
GY.C P 111.15	C P 111	Music - Instrumental/		
GY.C P 112.15	C P 112	Music – Vocal /		
GY.C P 113.15	C P 113	Dance/		
GY.C P 121.15	C P 121	Painting/		
GY.C P 122.15	C P 122	Sculpture/		
GY.C P 123.15	C P 123	Advertizing)		

Semester-IV

CS. Coursecode.YY	Course Code	Subject	Contact Hours	Credits
IS. MA 201.14	MA 201	Numerical Techniques	3-1-0	11
IS. MA 203.14	MA 203	Mathematical Methods	3-1-0	11
IE.CHO 101.14	CHO 101	Heat and Mass Transfer	3-1-0	11
MC.CSO 221N.15	CSO 221N	Algorithms#	3-0-2	11
MC.CSO 231N.14	CSO 231N	Operating Systems#	3-0-2	11
IH.H 102.14	H 102	Universal Human Value –II (Self, Society and Nature)	1-1-0	5
		Total credits in the semester	**16-4-4**	**60**

Multicore subject offered by CSE to Math Sc.

Streams in Mathematics & Computing

Stream	**Stream Code**	**Stream Title**		
MMS	**X1X**	Mathematical Modeling and Simulation		
CTC	**X2X**	Coding and Security		

Semester-V

CS. Coursecode.YY	Course Code	Subject	Contact Hours	Credits
DC.MA 311.16	MA 311	Linear Algebra	3-0-0	9
MC.CSO 323.16	CSO 323	Graph Theory and Applications	3-0-0	9
OE - 1		Open Elective - 1	3-0-0	9
DC.MA 312.16	MA 312	Differential Equations	3-0-0	9
DE - 1		Departmental Elective-I*	3-0-2	11
HU/LM		# Humanities/Language & Management Course ^^	3-0-0	9
		Total credits in the semester	**18-0-2**	**56**
DP.CSM 391.16	CSM 391	Stream Project	0-0-10	10
		Total	**18-0-12**	**66**

***V Semester Elective/ Stream DE-1 Courses:** Select any one

DE.CSM321.16	CSM 321	Mathematical Modeling and Simulation	3-0-2	11
DE.CSM322.16	CSM 322	Information and Coding Theory	3-0-2	11

+- Multicore subject offered jointly by Math Sc. and CSE.
^^Two LM Courses and Two HU Courses wouldbescheduledin 5-8 semestertotaling 18-22 credit for eachcategory.

Semester-VI

CS. Coursecode.YY	Course Code	Subject	Contact Hours	Credits
DC. MA 313.16	MA 313	Real and Complex Analysis	3-0-0	9
DC. MA 323.16	MA 323	Fluid Dynamics	3-0-0	9
MC.CSO 322.16	CSO 322	Theory of Computation+-	3-0-0	9
OE – 2		Open Elective-2	3-0-0	9
DE – 2		Departmental Elective – 2*	3-0-0/2	9/11
DP.CSM 392.16	CSM 392	Stream or UG Project	0-0-10	10
HU/LM		# Humanities/Language & Management Course ^^	3-0-0	9
		Total credits in the semester	**18-0-10/12**	**64-66**

+- Multicore subject offered jointly by Math Sc. and CSE.

*** Departmental Elective:** Select any one

DE.CSO 324.16	CSO 324	Operation Research	3-0-0	9
DE.MA 341.16	MA 341	Stochastic Process	3-0-2	11
DE.MA 314.16	MA 314	Number Theory	3-0-2	11

^^ Two LM courses and Two HU courses would be scheduled in 5-8 semesters totaling 18-22 credit for each category.
# fixed slot of Semester

Summer Term Programme

DP CSM 393.16	CSM 393	Industrial Training/Project/ Internship	0-0-5	5

Semester-VII

CS. Coursecode.YY	**Course Code**	**Subject**	**Contact Hours**	**Credits**
DC.MA411.16	MA411	Topology and Functional Analysis	3-0-0	9
OE –3		Open Elective-3	3-0-0	9
DE-3		Departmental Elective - 3	3-0-0/2	9/11
DP. CSM 491.16	CSM 491	UG Project / Stream Project	0-0-10/20	10/20
HU/LM		# Humanities/Language & Management Course ^^	3-0-0	9
		Total credits in the semester	**12-0-10/12 or 20/22**	**46-48/56-58**

*** Departmental Elective:** Select any one

DE.CSM 431.16	CSM 431	Fuzzy Set Theory	3-0-0	9
DE.CSM421.16	CSM 421	Numerical Solution of PDE's	3-0-2	11
DE.CSM422.16	CSM 422	Cryptography	3-0-2	11
MC.CSO 351.16	CSO 351	Computer Graphics#	3-0-2	11

Semester-VIII

CS. Coursecode.YY	**Course Code**	**Subject**	**Contact Hours**	**Credits**
DE - 4		Departmental Elective-4	3-0-0	9
DE - 5		Departmental Elective-5	3-0-0/2	9/11
DE - 6		Departmental Elective-6	3-0-0/2	9/11
OE - 4		Open Elective-4	3-0-0	9
DT.CSM 493.16	CSM 493	Master's Thesis	0-0-10	10
HU/LM		# Humanities/Language & Management Course ^^	3-0-0	9
		Total credits in the semester	**15-0-10/14**	**55-59**

*** Departmental Elective:** Select any three

DE.MA 412.16	MA 412	Hilbert Space Techniques	3-0-0	9
DE.MA413.16	MA 413	Distribution Theory	3-0-0	9
DE.MA 423.16	MA 423	Integral Equations and Calculus of Variation	3-0-0	9
DE.MA 414.16	MA 414	Measure Theory	3-0-0	9
DE.CSM433.16	CSM 433	Digital Image Processing	3-0-2	11
OE.ME 522.15/ DE.MA 424.16	ME 522/ MA 424	Finite Element Analysis	3-0-0	9
DE.MA 415.16	MA 415	Finite Field	3-0-0	9
DE.MA 416.16	MA 416	Complex Analysis	3-0-0	9

Semester-IX

CS. Coursecode.YY	Course Code	Subject	Contact Hours	Credits
DE - 7		Departmental Elective-7	3-0-0/2	9/11
OE - 5		Open Elective-5	3-0-0	9
OE - 6		Open Elective-6	3-0-0	9
DT.CSM 593.16	CSM 593	Master's Thesis	0-0-10	10
HU/LM		#Language & Management Course ^^	3-0-0	9
		Total credits in the semester	**12-0-10/12**	**46-48**

* **Departmental Elective:** Select any one

DE.MA 511.16	MA 511	Theory of Rings and Modules	3-0-0	9
DE.MA 512.16	MA 512	Approximation Theory	3-0-0	9
DE.MA 513.16	MA 513	Wavelet Analysis and Applications	3-0-0	9
DE.CSM 521.16	CSM 521	Computational Fluid Dynamics	3-0-2	11
DE.MA 522.16	MA 522	Solid Mechanics	3-0-0	9
DE.MA 523.16	MA 523	Bio Mechanics	3-0-0	9
DE.MA 524.16	MA 524	Time Frequency Analysis	3-0-2	11
DE.MA 525.16	MA 525	Financial Mathematics	3-0-2	11
DE.MA 526.16	MA 526	Optimization Techniques	3-0-2	11
DE.MA 531.16	MA 531	Bio Informatics	3-0-2	11
DE.MA.528.16	MA 528	Advanced topics in PDE's	3-0-2	11

Semester-X

CS. Coursecode.YY	Course Code	Subject	Contact Hours	Credits
DT.CSM 594.16	CSM 594	Master's Thesis	0-0-50	50
		Total		**50**
		Total credits in the semester		**50**

^^ Three LM courses and Two HU courses should be schedules in these semester totaling 27-31 and 18-22 credits respectively.

 # Fixed slot of Semester

Master Thesis can be started in the 8th Semester itself so that summer term can be utilized towards fruitful thesis work.

Total Credits in IDD (Mathematics & Computing) Programme (Semester I-X)=561-572

= 581-592 (Hons.)/Stream

SUMMARY OF COURSE &CREDIT ALLOCATION
5-Year Integrated Dual Degree (B.Tech.-M.Tech.)Programme
(Mathematics and Computing)

S. No.	**Category**	**Type of Course**	**Prescribed Course and Credits**	**Allocated Course and Credits**
1.	HU	Humanities and Social Sciences*	4-5(41-46)	6 (44)
2.	IS	Science*	6-7 (62-84)	7 (78)
3.	IE	Institute Requirement Engineering*	4-5 (41-60)	4 (48)
4.	EP	Engineering Drawing (Manual and Computer Aided), Manufacturing Practices and Practice course of Department/School*	2 (20-24)	4 (18)
5.	LM	Language and Management*	2-3 (27-31)	3 (27)
6.	DC/MC	Department /Programme Core (Includes Stream Courses)	10-13 (105-155)	13 (127)
7.	DE/BE	Department /Programme Elective (Includes Stream Courses)	6-8 (60-90)	7 (65/75)
8.	OE	Open Elective (Interdiscplinary Stream courses from Science/Engineering) Room for Minor with some additional Credits)	5-8 (55-100)	6 (54)
9.	DP	Project/Industrial visit/ Training	5-10 unit (20-50)	4 (30)
10.	DT	Dissertation	14-16 unit (70-80)	3 (70)
11.	GY	Gymkhana Courses		
			Total Credits:	**561-572**
			Total credits (including stream projects):	**581-592 (Hons.)**

Engineering Mathematics – I

1. GENERAL

1.1 TITLE:: Engineering Mathematics - I

1.2 COURSE NUMBER::IS.**MA 101.**14

1.3 CREDITS:: 3-1-0: **Credits** 11

1.4 SEMESTER -OFFERED:: Both

1.5 Prerequisite: None

1.6Syllabus Committee Members: Prof. T. Som (Convener), Dr. V.K. Singh

2. OBJECTIVE

This novel course is designed to cater to the needs of foundation in modern technology.

3. COURSE CONTENT

UNIT I: Sequences and Continuous Functions (10 Lectures)

Real number system : Completeness axiom, density of rationals (irrationals) in R, Convergence of a sequence, Sandwich theorem, Monotone sequences.

Limits and Continuity of functions, Intermediate value property, Differentiability, Necessary condition for local maxima, Rolle's theorem and Mean value theorem, Cauchy mean value theorem, L'Hospital rule, Increasing and decreasing functions, Convexity, Second derivative test for max and min, Point of inflection, curve sketching.

UNIT II: Power Series Expansions (4 Lectures)

Taylor's theorem with remainder, Convergence of series, Absolute convergence, Comparison test, Ratio test, Root test, Power series, Radius of convergence, Taylor series, Maclaurin series.

UNIT III: Riemann Integration, Surface Area & Volume (7 Lectures)

Introduction to Riemann integration, Elementary properties of integral, Fundamental Theorems of calculus, Improper integral of first & second kind, Comparison test, Absolute convergence, Applications of definite integral: Polar coordinates, Graphs in polar coordinates, Area between two curves when their equations are given in polar coordinates, Volumes by slicing, Length of a curve.

UNIT IV: Multi-variable Calculus (6 Lectures)

Functions of several variables, Continuity, Partial derivatives, Total derivative, Increment theorem, Chain rule, Gradient, Directional derivatives, Tangent plane and Normal line, Mixed derivative theorem, Necessary and sufficient conditions for Maxima, Minima and Saddle point, The method of Lagrange multipliers.

UNIT V: Vector Calculus (4Lectures)

Review of vector algebra, Equations of lines and planes, Continuity and Differentiability of vector functions, Arc length for space curves, Unit tangent vector, Unit normal and Curvature to plane and space curves,

UNIT VI: Multiple Integrals (8 Lectures)

Double integral, Fubini's theorem, Volumes and Areas, Change of variable in a double integral, special case: Polar coordinates, Triple integral, Applications, Change of variables in a triple integral, Surface area, Surface area (contd.), Line integrals, Surface integrals, Green's Theorem, Vector fields, Divergence and Curl of a vector field, Stokes' Theorem, The divergence theorem.

4. READINGS

4.1 TEXTBOOK:

Advanced Engineering Mathematics by Erwin Kreyszig, Wiley

4.2 REFERENCE BOOKS: Calculus by Thomas and Finney.

5. OTHER SESSIONS

5.1 *TUTORIALS:: One tutorial session in groups of maximum 30 students for clearing doubts and class assignments etc.

5.2 *LABORATORY::NA

5.3 *PROJECT:: None

6. ASSESSMENT (indicative only)

6.1 HA::	0%
6.2 QUIZZES-HA::	20%
6.3 Class and Lab Assignments::	0%
6.4 PERIODICAL EXAMS::	40%
6.5 *PROJECT:: N.A.	
6.6 FINAL EXAM::	40%

7. OUTCOME OF THE COURSE

Every student in Engineering & Technology will be able to understand the contents of topics being covered in his branch.

Engineering Mathematics-II

1. GENERAL

1.1 TITLE:: Engineering Mathematics - II

1.2 COURSE NUMBER::IS.MA 102.14

1.3 CREDITS:: 3-1-0: **Credits** 11

1.4 SEMESTER -OFFERED:: Both

1.5 Prerequisite: None

1.6Syllabus of Committee Members: Prof. O.P. Singh (Convener), Prof. S.K. Pandey

2. OBJECTIVE:: The contents of this course fulfill the fundamental requirements of knowledge of Mathematics for learning Engineering subjects.

3. COURSE CONTENT

Unit 1: Vector spaces (5 Lectures)

Sets, Relations, equivalence relation, functions, partition of set, Cartesian product of Set, Binary operations, examples.Definition and examples ofGroups (stress on additive and multiplicative), Subgroups, Fields.Vector Spaces over real and complex fields.Subspaces.Some properties of subspaces.Finite linear combinations Dependent and independent vectors.Basis and Dimension of vector space. Basis and dimension (contd.), The infinite dimensional vector spaces Ck[a, b], Lp[a, b], k = 0, 1, 2,… and p >0.

Unit 2: Linear Transformations (7 Lectures)

Linear transformations, Kernel and Range of a linear transformation, nullity theorem., Matrix of a linear transformation over finite basis, Matrix of change of basis, Similar matrices, rank of a matrix. Solution of system of linear equations, Eigen values and eigen vectors, eigen space, Caley-Hamilton theorem and its implications. Inner product spaces, Matrix of inner product, norm induced by an inner product, parallelogram law.

Unit 3: Orthogonal Expansion (5 Lectures)

Orthogonal and orthonormal vectors and systems, Gram Schmidt orthogonalization process. Orthogonal expansion of function in L2[a, b]. Expansion of function in Fourier series (real and complex form), examples in 0,2π , –l,l , 0,l , Convergence and sum of Fourier series, Even and odd functions, half range expansions, Half range Fourier series , odd and even extensions, Gibbs phenomenon, Trigonometric approximation, Parseval's relation, Bessel inequality, Fourier integrals, Fourier sine and cosine transforms.

Unit 4: Holomorphic Functions (3 Lectures)

Planer sets, curves, domains and regions in the complex plane, continuous and differential functions of complex variables, Holomorphic functions, C-R equations, Laplace equation, Harmonic functions and their applications.

Unit 5: Complex Integration (8 Lectures)

Line integral, bound for the absolute value of integrals, Cauchy integral theorem, Cauchy integral formula,

Derivatives of holomorphic functions, Cauchy inequality, Liouville's theorem (with proof), morra's theorem

(statement), fundamental theorem of algebra, Power series, radius of convergence and Taylor's series. Laurent Series, Laurent series (contd.), Singularities and Zeros, behavior of f(z) at infinity, Residues, Residue theorem, residue integration method, Evaluation of real integrals.

Unit 6: Differential Equations (10 Lectures)

Basic concepts and ideas of first order differential equations, geometrical meaning of y'=f(x, y), direction fields, Exact differential equations, Integrating factors, Linear differential equations. Bernoulli equation, Existence and Uniqueness of solutions, Wronskian, Homogeneous linear equations of second order. Second-order Homogeneous equations with constant coefficients, Cases of complex roots, complex exponential functions Euler –Cauchy equation, Non homogeneous equations, Solution by undetermined coefficients, Solution by variation of parameters, System of differential equations: introductory examples-mixing problem involving two tanks, model of an electrical network, Conversion of an nth order differential equation to a system, linear systems.

4. READINGS

4.1TEXTBOOK:

Advanced Engineering Mathematics by Erwin Kreyszig, Wiley

4.2 REFERENCE BOOKS:

1. Linear Algebra by K. Hoffman and Ray Kunz

5. OTHER SESSIONS

5.1 *TUTORIALS:: One tutorial session in groups of maximum 30 students for clearing doubts and class assignments etc.

5.2 *LABORATORY::NA

5.3 *PROJECT:: None

6. ASSESSMENT (indicative only)

6.1 HA:: 0%

6.2 QUIZZES-HA:: 20%

6.3 Class and Lab Assignments: :0%

6.4 PERIODICAL EXAMS:: 40%

6.5 *PROJECT:: N.A.

6.6 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE

Every student in Engineering & Technology will be able to understand the contents of topics being covered in his branch.

ALGEBRA

1. GENERAL

1.1 TITLE:: ALGEBRA

1.2 *COURSE NUMBER (if known)::DC.MA 103.14

1.3 CREDITS::3-2-0 (11)

1.4 SEMESTER-OFFERED:: SECOND

1.5 PREREQUISITE:

1.6 Syllabus Committee Members:

2. OBJECTIVE:: This course aims to provide a initial approach to the subject of Algebra, which is one of the basic foundation of modern mathematics. The focus of the course is to study the certain algebraic structures like Groups, Rings, fields and their properties.

3. COURSE TOPICS::

Unit I:: **(5 lectures)**

Introduction to groups, symmetries of square, the dihedral groups.Defnition and example of groups, elementary properties of groups.

Unit II:: **(22 lectures)**

Finite groups, subgroups and their examples.Cyclic groups. Permutation groups, Caley theorem, cosets, Lagrange's theorem, Normal subgroups and factor groups. Isomorphisms and homomorphisms.**Unit III::**

(12 lectures)

Defnition and examples of rings, Properties of rings.Subrings.Integral domains.Fields, characteristic of rings.Ideals, prime ideals and maximal ideals. Ring homomorphism and quotient rings.

4. READINGS

4.1 TEXTBOOK:: "Topics in Algebra" by I. N. Herstein, John Wiley & Sons

4.2 *REFERENCE BOOKS::(i) "Contemporary Abstract Algebra"4th Ed. By J. A. Gallian, Narosa Publishing house.

(ii) Basic Abstract Algebra" 2nded. By P.B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Cambridge University Press.

5. OTHER SESSIONS

5.1 *TUTORIALS:: 1

5.2 *LABORATORY:: Nil

5.3 *PROJECT:: Nil

6. ASSESSMENT (indicative only)

6.1 HA:: Nil

6.2 QUIZZES-HA:: 20%

6.3 PERIODICAL EXAMS:: 30%

6.4 *PROJECT:: Nil

6.5 FINAL EXAM:: 50%

7. OUTCOME OF THE COURSE:: The student will understand and be able to apply the basic principles of algebraic structures.

Information Technology and Computing Workshop

1. GENERAL
1.1 TITLE:: Information Technology and Computing Workshop
1.2 *COURSE NUMBER (if known):: EP. MA 104. 14
1.3 CREDITS::1-0-3 (6)
1.4 SEMESTER-OFFERED:: Second
1.5 PRE-REQUISITES:: Nil
1.6 Syllabus Committee Members:: Prof. L. P. Singh

2. OBJECTIVE::

To introduce students to application development using object oriented programming. 2. To introduce students to the idea of GUI programming.

3. COURSE TOPICS::

Unit 1: **(5 lectures)**

Detailed introduction to Java.Common libraries ofJava.Scientific computing with Java.Making applications with Java.

Unit 2: **(5 lectures)**

Introduction to Python.Common libraries of Python.Scientific computing with Python.Making applications with Python.

Unit 3: **(3 lectures)**

GUI forms and designing GUIs.Using Java and Python to create GUI applications.

4. READINGS

4.1 TEXTBOOK:: There is no single textbook. Please see the list of reference books.
4.2 *REFERENCE BOOKS::

(a) Programming with Java. E Balagurusamy.Tata McGraw Hill Edition.

(b) Java the Complete Reference. Herbert Schildt. Tata McGraw Hill Edition.

(b) Introduction to Computation and Programming Using Python. John V. Guttag. MIT Press.

5. OTHER SESSIONS

5.1 *TUTORIALS::Nil
5.2 *LABORATORY:: One laboratory session for practice and practical assessments etc.
5.3 *PROJECT:: Preparation of an application using Java or Python.

6. ASSESSMENT (indicative only)

6.1 HA::	0 %
6.2 QUIZZES-HA::	10%
6.3 Class and Lab Assignments:	20%
6.4 PERIODICAL EXAMS::	0 %
6.5 *PROJECT::	20%
6.6 FINAL EXAM::	50%

7. OUTCOME OF THE COURSE::

1. Students should be able to learn the languages like Java and Python. 2. They should be able to write Object Oriented applications using above languages. 3. They should be able to build simple GUIs.

Probability and Statistics

1. GENERAL

1.1 TITLE:: Probability and Statistics

1.2 COURSE NUMBER::IS.MA 202.14

1.3 CREDITS:: 3-1-0: Credits 11

1.4 SEMESTER -OFFERED:: Odd

1.5 Prerequisite: Mathematics I

1.6**Syllabus of Committee Member:** Dr. Subir Das, Dr. Anuradha Banerjee

2. OBJECTIVE:

The objective of the course is to get adequate knowledge of the distribution of various kinds of functions and their hypothetical testing.

3. COURSE CONTENT

UNIT I: Probability **(4 Lectures)**

Classical, Relative Frequency and Axiomatic definitions, Properties of Probability Function, ConditionalProbability, Independence of Events, Theorem of Total Probability, Bayes' Theorem.

UNIT II: Random Variable and Its Distribution **(4 Lectures)**

Definition of Random Variable, Distribution Function and Its Properties, Types of Probability Distributions (Discrete, Continuous, Absolutely Continuous and Mixed Type), Probability Mass Function, Probability Density Function, Mathematical Expectation, Moments, Probability and Moment Generating Functions and Their Properties, Characteristics of Probability Distributions (Measures of Central Tendency, Measures of Skewness and Kurtosis), Markov and Chebychev Inequality.

UNIT III: Special Discrete Distributions **(2 Lectures)**

Bernoulli and Binomial Distribution, Geometric and Negative Binomial Distribution, Hyper-Geometric Distribution, Poisson Distribution, Discrete Uniform Distribution.

UNIT IV: Special Absolutely Continuous Distributions **(3 Lectures)**

Uniform Distribution, Exponential and Gamma Distributions, Beta Distribution, Cauchy Distribution and Its Moments, Normal Distribution and Its Properties.

UNIT V: Function of Random Variables and Its Distribution **(3 Lectures)**

Function of Random Variable, Methods to Find Distribution of Function of a random Variable (Distribution Function, Jacobian and M.G.F Methods) and Their Expectations.

UNIT VI: Random Vector and Its Joint Distribution **(4 Lectures)**

Definition of Random Vector, Distribution Function of a Random Vector and Its Properties, Joint, Marginal and Conditional Distributions, Product Moments, Covariance and Correlation, Joint Moment Generating Function and Its Properties, Multinomial Distribution, Bivariate Normal Distribution.

UNIT VII: Function of Random Vector and Its Distribution **(4 Lecture)**

Function of Random Vectors, Methods to Find Distribution of Function of a Random Variable (Distribution Function, Jacobian and M.G.F Methods) and Their Expectations.Distribution of Order Statistics.

UNIT VIII: Sampling Distributions and Asymptotic Distributions **(3 Lectures)**

Joint Distribution of Sample Mean and Sample Variance Based on a Random Sample From Normal Distribution,Chi-Squared,Student's t and Snedcor's F-Distributions and Their Relation to NormalDistribution, Weak Law of Large Numbers, Central Limit Theorem.

UNIT IX: Statistics **(3 Lectures)**
Introduction to Statistical Inference Problems, Random Sample, Statistic, Population, Parameters.

UNIT X: Point Estimation **(3 Lectures)**
Point estimation problems, Method of Moments; Method of Maximum Likelihood, Invariance of Maximum Likelihood Estimators, Unbiased Estimators, Consistent Estimators, Criteria for Comparing Estimators.

UNIT XI: Interval Estimation **(3 Lectures)**
Interval Estimation Problems, Confidence Intervals, Confidence intervals for normal population(s): mean, difference of means, variance and ratio of variance, Confidence intervals for proportion and difference of proportions.

UNIT XII: Testing of Hypotheses **(3 Lectures)**
Null and Alternative Hypotheses, Simple and Composite Hypotheses, Critical Regions, Neyman-Pearson lemma, Most Powerful and Uniformly Most powerful Tests and their Examples, p-value, Likelihood ratio tests; Likelihood ratio tests for Statistical Hypotheses in One and Two Sample Problems Involving Normal Populations, Tests for Proportions, Chi-Square Goodness of Fit Test, Contingency Tables.

4. READINGS

4.1 TEXTBOOK:

1. M.R.Spiegel, J. J. Schiller, R.Srinivasan, Probability and Stastistics, McGraw Hill.
2. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Stastistic, Sultan Chand & Sons, New Delhi.

4.2 *REFERENCE BOOKS:

1. Sheldon M. Ross, Introduction to Probability Models , Academic Press.
2. A. N.Kolmogorov, Foundation of the theory of probability, Chelsea, New York.

5. OTHER SESSIONS

5.1 *TUTORIALS:Tutorial will be arranged for clearing the doubts.

5.2 *LABORATORY:NA

5.3 *PROJECT::NA

6. ASSESSMENT	(indicative only)
6.1 HA:	10%
6.2 QUIZZES-HA:	10%
6.3 PERIODICAL EXAMS:	40%
6.4 *PROJECT:	0%
6.5 FINAL EXAM:	40%

7. **OUTCOME OF THE COURSE:**Having done this course the student will be able to easily apply the statistical and deterministic approaches to model the engineering problems having stochastic nature.

Discrete Mathematics

1. GENERAL

1.1 TITLE::	Discrete Mathematics
1.2 COURSE NUMBER (if known):	MC.CSO204N.15
1.3 CREDITS::	3-0-0(9 Credits)
1.4 SEMESTER-OFFERED::	3rd
1.5 PRE-REQUISITES::	None
1.6 Course Committee Members::	

2. OBJECTIVE:

This course aims to provide mathematical logic, knowledge of set theory and Boolean algebra.

3. COURSE TOPICS:

UNIT 1

Statements: Defines, notion of propositions and examples.

Connectives: Negation, disjunction, conjunction, conditional and bi-conditional.Statement formulas and truth tables. Programming on mathematical logic.

Formulas and tautologies: Well-formed formulas, tautologies, equivalence of formulas, duality laws andtautological implications, truth table.

Functionally complete sets of connectives: Functionally complete sets of connectives some other connectives, two state device and statement logic, logic GATES. ***(1+4+5+3 Lectures)***

UNIT 2

Normal forms: Disjunctive normal form, conjunctive normal form, principal disjunctive normal form,principal conjunctive normal form, ordering and uniqueness of normal forms. Different Notations: Completely parenthesized infix notation and Police notation.

Theory of inference for the statement calculus: validity using truth tables, rules of inference, consistencyof premises and indirect method of proof, automatic theorem proving. ***(3+1+6 Lectures)***

UNIT 3

Predicate calculus: Predicates, statement function, variables, and quantifiers, predicate formulas, free andbound variables, universe of discourse.

Inference theory of predicate calculus: Valid formulas and equivalences, valid formulas involvingquantifiers, special valid formulas involving quantifiers, theory of inference of predicate calculus, formulas involving more than one quantifier.

Zorn's lemma and theory of mathematical induction.***(3+3+1 Lecture)***

UNIT 4

A brief recap of Relations and ordering: Relations, binary relations, equivalence relations, partial ordering,partially ordered sets.

Lattices: Definitions and examples, Lattices as partially ordered sets, some properties of lattices, lattices asalgebraic systems, sub-lattices, direct product and homomorphism. ***(1+2 Lectures)***

UNIT 5

Boolean algebra: Definition and examples, sub-algebra, direct product and homomorphism. Boolean functions: Boolean forms, values of Boolean expressions and Boolean functions. Disjunctive andconjunctive normal forms. Boolean, expansion theorem, Representation and minimisation of Boolean functions, design examples using Boolean algebra, equivalence of finite state machines.

(2+5 Lectures)

4. READINGS

4.1 TEXTBOOK: Discrete Mathematical Structure with Application to ComputerScience.By J. P. Tramblay and R Manohar (Tata-McGraw-Hill)

4.2 *REFERENCE BOOKS:

5. OTHER SESSIONS

5.1 *TUTORIALS:	No
5.2 *LABORATORY:	No
5.3 *PROJECT::	No

6. ASSESSMENT	(indicative only)
6.1 HA:	[10%
6.2 QUIZZES-HA:	[10%
6.3 PERIODICAL EXAMS:	[40%
6.4 *PROJECT:	
6.5 FINAL EXAM:	[40%

7. OUTCOME OF THE COURSE: This one semester course in Discrete Mathematics is designed to introduce the students of mathematics and computing to mathematical logic and a brief application of logic to two state devices. In order to enable the student to read technical articles and books in computer science, the knowledge of predicate calculus is essential. The knowledge of Boolean algebra and its application to switching theory and sequential machines is a basic requirement for such students. Minimization of Boolean functions is required in the logical design of digital computer systems. Taking into consideration the large size of the contents a separate one semester course on graph theory is recommended, which is not possible to club with it.

Computer System Organization

1. GENERAL

1.1 TITLE:: Computer System Organization

1.2 COURSE NUMBER (if known):: MC.CSO211N.15

1.3 CREDITS:: 3-0-2 (11 Credits)

1.4 SEMESTER-OFFERED:: III

1.5 PRE-REQUISITES:: - Computer Programming

1.6 Course Committee Members::

2. OBJECTIVE:

1. Basic understanding of Digital logic and computer design, understanding the concepts and design aspects of combinational and sequential circuit design.

2. Computer organization: roles of processors, main memory, and input/output devices. Understanding the concept of programs as sequences of machine instructions. Understanding simple data path and control designs for processors. Understanding memory organization, including cache structures and virtual memory schemes.

3. COURSE TOPICS::

UNIT-I

Fundamentals of digital logic and Computer Design:

Switching devices, logic gates, digital integrated circuits technologies. Combination Logic Analysis Procedure, Design Procedure, Study of Different Combinational Circuits, HDL for Combinational Circuits. Synchronous Sequential Logic Sequential Circuits, Flip Flops, State Reduction and Assignment. Registers and Counters, Ripple Counters, Synchronous Counters. Memory and Programming Logic Introduction, Random Access Memory, Memory Decoding, Error Detection and Correction. Read Only Memory, Programmable Logic Array, Programmable Array Logic. Asynchronous Sequential Logic: Introduction, Analysis Procedure, Circuits with Latches, Design Procedure, Race Free State Assignment, Hazards. (13 lectures)

UNIT-II

Introduction to computers, Register Transfer and Micro-operations, Computer Arithmetic: Addition and subtraction with signed magnitude, BCD addition and subtraction, Multiplication: Multiplication algorithm, Booth's multiplication, Array multiplier, Division algorithm: restoring and non-restoring division, array divider, Floating point arithmetic. Programming the basic computer.

Organization of a simple stored-program computer: Central Progressing Unit (CPU), Stack Organization, Register Stack, Memory Stack, Reverse Polish Notation. Instruction Formats, Three-Address, Two-Address, One- Address, and Zero-Address Instructions, Instruction cycle, Addressing Modes, Reduced Instruction Set Computer (RISC), CISC Characteristics RISC Characteristics.

(13 lectures)

UNIT-III

Memory Organization: Primary and auxiliary memory, Hierarchical memory organization, Cache memory concepts and cache mapping techniques, Associative Memory.

Control Unit: Hardwired and micro-programmed control unit.

Input-Output organization: Modes of transfer, Priority Interrupt, Direct memory access (DMA), Input-Output Processor (IOP), CPU-IOP Communication. (13 lectures)

4. READINGS

4.1 TEXTBOOK::

1. Digital logic and computer design: M. Morris Mano, PHI

2. Computer System Architecture M. Morris Mano.

3. Computer Architecture and Organization, J.P. Hayes.

4.2 *REFERENCE BOOKS:

1. Computer Organization, 5-th edition, Carl Hamacher, ZvonkoVranesic, SafwatZaki,
2. Advanced Computer Architecture, Kai Hwang

5. OTHER SESSIONS

5.1 *TUTORIALS::NIL

5.2 *LABORATORY:: 02 Hours

5.3 *PROJECT::- Nil

6. **ASSESSMENT (indicative only)**

6.1 HA:: 10%

6.2 QUIZZES-HA:: 0%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: 0%

6.5 FINAL EXAM:: 50%

7. OUTCOME OF THE COURSE:: The specific course outcomes supporting the program outcomes are:

Students will be able to understand the basic concepts of digital logic and design, computer organization, basic components of computer and their design aspects. Basic concepts of pipelining and parallel processing will also be introduced. should be able to solve basic binary math operations using the computer.

Exploratory Project

1. GENERAL

1.1 TITLE:: Exploratory Project

1.2 COURSE NUMBER (if known)::DP.CSM291.15

1.3 CREDITS:: [0-0-5] 5 Credits

1.4 SEMESTER-OFFERED::EVEN

1.5 PRE-REQUISITES:: Computer Programming

1.6 Course Committee Members: Prof. L. P. Singh

2. **OBJECTIVE::**

The specific objectives of the course could depend on the problem definition for the project but the overall performance will be measured on the following criteria.

3. COURSE CONTENTS:

a. Problem statement and literature survey- Students should be able to define the problem statement with clearly specified inputs and outputs. Goals for complex problems could evolve over time but it is necessary to have one in the beginning. A brief survey of the available literature and an initial draft of possible directions should suffice.

b. Modeling or Theoretical results- An appropriate model should be chosen for the problem. They should be able to reason the pros and cons of various models and choose a suitable one. It is important that they be in a position to defend their choices. The model should also involve the criteria by which they will quantify and test its performance. In case of theoretical work one should be able to describe the underlying mathematical basis of such problems in the literature.

c. Engineering or Mathematical tools- Numerous available methods could be put to use in implementing and testing the described model. They should demonstrate the ability to learn and put various methods to use. In theoretical study, grasp of mathematical tools used to put together a coherent argument or proof deriving the necessary results should be demonstrated.

d. Demonstration and Presentation- A model designed and implemented (or results derived or proved in case of theory) should be convincingly presented to showcase its positive and negative aspects. A demonstration to this end where applicable or a presentation in case of theoretical contributions should clearly describe the work. The work need not necessarily be novel or original and could be a clear exposition of otherwise hard concepts or a new perspective. The purpose is to measure understanding of the techniques and methods used and to appreciate the results in the larger context of their applicability in science and engineering. It is important to emphasize early on, the effort and time it takes to make a work presentable which is usually underestimated by most students.

A combination of the above criteria can be used to grade the work. Typically the following guidelines could be helpful for projects taken up as part of different semesters.

Evaluation procedure: Statement and Survey 25%, Engineering/Math Tools/Derivations 40%, Demonstration and Presentation 35%.

3. **COURSE TOPICS::**Choice of student and the instructor.

4. READINGS

4.1 TEXTBOOK:: Instructor's choice.

4.2 *REFERENCE BOOKS:: Instructor's choice.

5. OTHER SESSIONS

5.1 *TUTORIALS::	No
5.2 5.2 *LABORATORY::	Yes
5.3 5.3 *PROJECT::	Yes

6. ASSESSMENT (indicative only)

6.1 HA::	0%

6.2 QUIZZES-HA:: 0%
6.3 PERIODICAL EXAMS:: 0%
6.4 *PROJECT:: 100%
6.5 FINAL EXAM:: 0%
7. **OUTCOME OF THE COURSE::**Project goals as defined by the instructor.

Numerical Techniques

1. GENERAL

1.1 TITLE:: Numerical Techniques

1.2 COURSE NUMBER::IS.MA 201.14

1.3 CREDITS:: 3-1-0: Credits 11

1.4 SEMESTER -OFFERED:: Both

1.5 PREREQUISITE: Engg. Mathematics I; Desirable Engg. Mathematics II & Computer Programming

1.6Syllabus of Committee Members: Prof. O.P. Singh, Prof. L.P. Singh

2. OBJECTIVE:: It is not always possible to find exact solutions of algebraic and differential equations. Therefore it is numerical techniques that are an alternative way to find solutions to most of the physical engg. Problems. The course aims to provide engineering students with adequate knowledge of numerical techniques.

3. COURSE CONTENT

UNIT I: Errors in Numerical Methods (2 Lectures)

Approximate numbers and Significant figures; Rouding-off numbers; Errors: Absolute, Relative and Percentage; Error in Arithmetical operations; A General Error Formula; Errors in Numerical Computations; Inverse Problems.

UNIT II: Solution of equations in one variable (6 Lectures)

Bisection method; Iteration method; Regula-Falsi method; Convergence of Regula-Falsi method; Secant method; Newton-Raphson method; Generalised Method for multiple roots; Rate of Convergence of Newton‘s square root formula; Newton‘s Inverse formula; Graffe‘s Root-Squaring method; Ramanujan‘s method; Rate of Convergence and. Computer Programmes for the above methods;

UNIT III: Numerical solution of system of equations (4 Lectures)

Gauss elimination method; Gauss-Jordan method; Jacobi‘s iteration method; Gauss Sidel method; Ill conditioned problems; Error analysis; Computer programs based for the above methods.

UNIT IV: Operators and Difference Equations (5 Lectures)

Forward difference operator, Backward difference operator, Shift operator, Average operator, Central difference operator and their relations; Factorial Notation; Synthetic division; Missing Term Technique; Basic ideas of Difference Equations.

UNIT V: Interpolation (6 Lectures)

Newton‘s forward interpolation formula; Newton‘s backward interpolation formula; Stirling‘s Formula; Bessel formula; Lagrange‘s interpolation formula; Divided differences; Newton‘s divided difference formula; Numerical differentiation and applications; Central Difference Interpolation Formulae; Gauss‘ Forward central Difference Formula; Gauss‘ Backward central Difference Formula; Computer Programs for the above formulas.

UNIT VI: Numerical integration (8 Lectures)

A general quadrature formula for equidistant nodes; Trapezoidal rule; Simpson‘s one-third rule, Simpson‘s three-eight rule; Wedddle‘s rule; Inherent errors in numerical integrations; Newton-Cotes quadrature formula; Euler-Maclaurin formula; Gaussian quadrature formula; Flow charts, Algorithms and Computer Programs to implement the above techniques.

UNIT VII: Numerical Methods of Solution of O.D.E (8 Lectures)

Picard‘s Method of Successive Approximations ; Picard‘s Method for Simultaneous First Order Differential Equations; Euler‘s Method;; Modified Euler‘s Method; Runge-Kutta method; Flow-charts, algorithms and computer programs for the above methods.

4. READINGS

4.1 TEXTBOOK:

1. Numerical Methods For Scientific And Engineering Computation M. K. Jain, S. R. K. Iyengar And R. K. Jain

4.2 REFERENCE BOOK:

1.An Introduction to Numerical Analysis, Kendall Atkinson

5. OTHER SESSIONS

5.1 *TUTORIALS:: Tutorial will be arranged to clear the doubts.

5.2 *LABORATORY:: Nil

5.3 *PROJECT:: Nil

6. ASSESSMENT (indicative only)

6.1 HA:: Nil

6.2 QUIZZES-HA:: 20%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: Nil

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE:: Having done this course the students will be at ease to find numerical solutions to most of the engineering problems.

Mathematical Methods

1. GENERAL

1.1 TITLE:: Mathematical Methods

1.2 COURSE NUMBER::IS.MA 203.14

1.3 CREDITS:: 3-1-0: Credits 11

1.4 SEMESTER -OFFERED:: Even

1.5 Prerequisite: Engineering Mathematics I

1.6Syllabus of Committee Members: Dr. Subir Das, Dr. Rajeev

2. OBJECTIVE:: The course aims to provide engineering students with adequate knowledge of methods to find the exact/approximate analytical solution of the engineering problems.

3. COURSE CONTENT

UNIT I:

Fourier transform, Laplace transform, Solution of differential equations by Laplace and Fourier transform methods, Applications of Laplace and Fourier transforms to Boundary value problems arising in Engineering Sciences. (12 Lectures)

UNIT II:

Hankel transform, Applications. (4 Lectures)

UNIT III:

Solutions of Laplace, Wave and Heat Conduction Equations. (4 Lectures)

UNIT IV:

Basic ideas of Discrete Fourier transform (DFT) and Finite Fourier transform (FFT), Z-transform, and Applications. (8 Lectures)

UNIT V:

Ordinary Differential Equations: Power series and Frobenius methods, Hermitefunctions, Bessel functions, Modified Bessel functions, Applications. Legendre polynomials, Associated Legendre polynomials, Rodrigues formula, Orthogonality of Legendre polynomials, Hermite functions and Bessel functions, Sturm-Liouville problem. (7 Lectures)

UNIT VI:

Concept and calculation of Green's function, Approximate Green's function, Green's function method for differential equations. (4 Lectures)

3. READINGS

4.1 TEXTBOOK:

1. G. S. Rao and K. K. Reddy, Mathematical Methods, I.K.International Pvt. Ltd., 2009.
2. W.W.Bell, Special functions for scientists and engineers, D.VanNostrand Company Ltd., London, 1968.

4.2 REFERENCE BOOKS:

1. O. Scherzer (Ed.), Handbook of Mathematical Methods in Imaging, Springer, 2011.
2. G. N. Watson, A Treatise on the Theory of Bessel Functions, Cambridge University Press, 1944.
3. G. F. Roach, Green's Functions, Cambridge University Press, 1995.
4. A. D. Poularikas, The Transforms and Applications Handbook, CRC Press, 1996.

5. OTHER SESSIONS

5.1 *TUTORIALS::	Tutorials will be arranged to clear the doubts.
5.2 *LABORATORY::	Nil
5.3 *PROJECT::	Nil

6. ASSESSMENT (indicative only)

6.1 HA::	Nil

6.2 QUIZZES-HA:: 20%
6.3 PERIODICAL EXAMS:: 40%
6.4 *PROJECT:: Nil
6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE::

Having done this course the students will be at ease to find analytical/semianalytical solutions to most of the science and engineering problems.

Algorithms

1. GENERAL

1.1 TITLE:: Algorithms

1.2 COURSE NUMBER (if known)::MC.CSO 221N.15

1.3 CREDITS:: 3-0-2 (11 Credits)

1.4 SEMESTER-OFFERED:: Semester IV

1.5 PRE-REQUISITES:: Computer Programming, Data Structures.

1.6 Syllabus of Committee Member:

2. OBJECTIVE:: Upon completion of this course, students will be able to do the following: Analyze the asymptotic performance of algorithms. Demonstrate a familiarity with major algorithms.

Apply important algorithmic design paradigms and methods of analysis.Synthesize efficient algorithms in common engineeringdesign situations.

3. COURSE TOPICS::

UNIT-I

Algorithms, problems and instances, average and worst case analysis, elementary operations, Specifying an algorithm, Euclid's algorithm, data structures, asymptotic notation, Recursion and iteration, recurrence equation, Master's theorem.

UNIT-II

Divide and conquer: Sorting-Quick sort, Heap sort, Merge sort, Searching, binary search, changing two section of an array, finding the Median, matrix multiplication, string processing algorithms.

Greedy algorithms-Minimal spanning tree, shortest path, scheduling, and knapsack problem.

UNIT-III

Dynamic Programming: Shortest paths and 0/1 Knapsack, Traveling Salesman problem. Graphical algorithms-Traversing trees, Depth–First and Breadth–First search.

Backtracking-8–queens' problem, sum of subsets.

Problems classes P, NP and NP–completeness.

4. READINGS

4.1 TEXTBOOK:: Introduction to algorithms by Coreman, PHI, IIIrd Edition.

4.2 *REFERENCE BOOKS::

2. Computer Algorithms by Hoeowitz, Sahanai, and Rajashekaran,

3. Data Structures and Algorithm Analysis in C, by Mark Allen Weiss, 2nd edition, 1997, Addison-Wesley, ISBN 0-201-49840-5, Kleinberg and Tardos, Algorithm Design, 2005.

5. OTHER SESSIONS

5.1 *TUTORIALS::	01 Hour
5.2 *LABORATORY::	02 Hours
5.3 *PROJECT::	NIL

6. ASSESSMENT (indicative only)

6.1 HA::	10%
6.2 QUIZZES-HA::	10%
6.3 PERIODICAL EXAMS::	40%
6.4 *PROJECT::	0%
6.5 FINAL EXAM::	40%

7. OUTCOME OF THE COURSE::

Students who complete the course will have demonstrated the ability to do the following:

Analyze worst-case running times of algorithms using asymptotic analysis.

Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.

Describe the greedy paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize greedy algorithms, and analyze them.

Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize dynamic-programming algorithms, and analyze them.

Explain the major graph algorithms and their analyses.

8. ***EXPECTED ENROLLMENT FOR THE COURSE:**: 90

9. ***DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::** Maths and Computing

10. ***ANY OTHER REMARKS**:: None

Operating System

1. General

1.1 Title: Operating System

1.2 Course No: MC.CSO 231N.14

1.3 Objective: To give knowledge about fundamentals of operating system.

1.4 Credits: [3-0-2] 11

1.5 Semester offered: IV

1.6 Prerequisite: Data Structure and Algorithm, Computer System Organization

1.7 Course Topics:

UNIT-I:

Computer System Structures. Operating System Structure- System Components, System Calls. Processes-Process Scheduling, Operation on Processes, Cooperating Processes.Threads. Scheduling-Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling. Real-Time Scheduling. Process Synchronization- The Critical-Section Problem, Semaphores, Classic Problems of Synchronization, Monitors.

UNIT-II

Deadlocks- System Model, Deadlock Characterization, Methods for Handling Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Starvation.

Memory Management- Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging. Virtual Memory- Demand Paging, Page Replacement, Allocation of Frames, thrashing.

UNIT-III

File-System Interface and Implementation- File Concept, Directory Structure, Directory Implementation, Allocation Methods, Free-space Management, Efficiency and Performance, Recovery. I/O Systems- I/O

Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O to Hardware Operations, STREAMS, Performance.Mass Storage Structure- Disk Structure, Disk Scheduling, Disk Management, Swap-Space Management, RAID Structure, Disk Attachment, Stable-Storage Implementation, Tertiary-Storage Structure.Protection and Security. A case study of modern operating systems

1.8 Text books:

1. "Operating System Concepts", 6th ed., Silberschatz-Galvin-Gagne, John Wiley & Sons.
2. "Operating System: A Modern Perspective", 2nd ed., Garry Nutt, Pearson Education.

Linear Algebra

1. GENERAL

1.1 TITLE:: Linear Algebra

1.2 *COURSE NUMBER (if known)::DC.MA 311.16

1.3 CREDITS::3-0-0 (9)

1.4 SEMESTER-OFFERED::V

1.5 PREREQUISITE: Engineering Math-2

1.6 Course Committee Member:

2. OBJECTIVE:: Main objective of this course is to study about matrix theory through linear transformation.

3. COURSE TOPICS::

UNIT I.

Review of vector spaces over arbitrary fields and linear transformation. Characteristic and minimal polynomials.Diagonalization of linear transformations, the primary decomposition theorem, the rational and Jordan canonical forms and some applications. (17 Lectures)

UNIT II.

Linear functional and dual spaces.Bilinear, Quadratic and Hermitian forms. Best approximation, Cauchy –Schwarz inequality, structure theory for normal operators: adjoint, self adjoint, normal, unity and positive definite operator and their properties. (15 Lectures)

UNIT III.

Modules: motivation, modules, submodules, quotient modules and cyclic modules. Homomorphism, fundamental homomorphism theorem, Simple modules, direct sum and product of modules.The module associated with linear operator. (7 Lectures)

4. READINGS

4.1 TEXTBOOK::Linear Algebra by Kenneth Hoffman, Ray Kunze, PHI learning

4.2 *REFERENCE BOOKS::

1.Linear Algebra & Its Applications by Gilbert Strang

2. Linear Algebra ,schaum's outline series.

3. Advanced Linear Algebra ,Steven Roman, Third edition, Springer.

5. OTHER SESSIONS

5.1 *TUTORIALS:: Nil

5.2 *LABORATORY:: Nil

5.3 *PROJECT:: Nil

6. ASSESSMENT (indicative only)

6.1 HA:: Nil

6.2 QUIZZES-HA:: 20%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: Nil

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE:: The student will understand and be able to apply the basics of Matrix Theory.

8. *EXPECTED ENROLLMENT FOR THE COURSE::40

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::Physics and others they need matrix theory.

10. *ANY OTHER REMARKS::

Graph Theory and Applications

1. GENERAL

1.1TITLE:: Graph Theory and Applications

1.2COURSE NUMBER (if known)::MC.CSO 323.16

1.3CREDITS::3-0-0 (9)

1.4SEMESTER-OFFERED:: Vth

1.5PRE-REQUISITES:: Abstract & Linear Algebras and Computer Programming

1.6 Course Committee Member:

2. OBJECTIVE::

Graph theory is relatively a new branch of mathematics with tremendous applications. This provides incredible solutions to many a daily life situation which either remained unsolved for ages or had solutions with no proof. Its growth solved several puzzles such as seven bridge problem as well. This has led the scientific world to revisit the beauty of mathematics. This has added glamour to mathematics of modern times. This does not only acquaint the student to the changing face of mathematics but also makes him familiar with the flavour of smart solutions to problems related to electrical networks, operations research, statistics, computer programming, chemistry, mathematical modelling of traffic control, , colouring, covering, partitioning and many more miscellaneous problems by providing algorithms. Some more problems expected to be covered are irrigation, joining of rivers etc.

3. COURSE TOPICS::

UNIT I.GRAPHS

Introduction to graph theory; applications of graph; finite and infinite graphs; incidence and degree; isolated vertex; pendant vertex; null graph. (Lectures: 2)

UNIT II. Paths and Circuits

Isomorphism; sub-graphs; walks, paths, circuits; connected graphs, disconnected graphs and components; Euler graphs; operations on graphs; Hamiltonian paths and circuits. (Lectures: 4)

UNIT III. Trees and Fundamental Circuits

Trees; properties of trees; pendant vertices in a tree; distance and centres in a tree; rooted and binary trees; counting of trees; spanning tree; spanning trees in a weighted graph. (Lectures: 4)

UNIT IV. Cut-sets and Cut-vertices

Cut-sets; properties of cut-sets; all cut-sets in a graph; fundamental circuits and cut-sets; connectivity and reparability; network flows; 1-isophorphism; 2-isomorphism. (Lectures: 4)

UNIT V. Planar and dual graphs

Combinatorial vs. Geometric graphs; planar graphs; Kurotovski's two graphs; different representations of a planar graph; detection of planarity; geometric dual; combinatorial dual; thickness and crossings; (Lectures: 3)

UNIT VI. Vector space of a graph

Vector spaces associated with a graph; basic vectors of a graph; circuit and cut-set subspaces; orthogonal vectors and spaces; intersection and join (Lectures: 3)

UNIT VII. Matrix representation of graphs

Incidence matrix; sub-matrices; circuit matrix; fundamental circuit matrix and rank; application to switching networks; cut-set matrix; path matrix; adjacency matrix (Lectures: 3)

UNIT VIII. Colouring covering and partitioning

Chromatic number; chromatic portioning; chromatic polynomial; matching covering; the four colour problem (Lectures: 4)

UNIT IX. Directed graphs

Directed graph; types of digraphs; digraphs and binary relations; directed paths and connectedness; Euler digraphs; trees with directed edges; fundamental circuits in digraphs; matrices A, B and C of digraphs; adjacency matrix of a digraph; paired comparison and tournaments; acyclic digraphs and decyclization (Lectures: 4)

UNIT X. Enumeration of graphs

Types of enumarations; counting labelled trees; counting unlabelled trees; Polya's counting theorem; graph enumeration with Polya's theorem. (Lectures: 3)

UNIT XI. Graph theoretic algorithms and computer programmes

Some basic algorithms: connectedness and components, spanning tree, fundamental circuits, cut-vertices and separability, directed circuits; shortest path algorithm; planarity testing; isomorphism algorithm etc. (Lectures: 5)

4.READINGS

4.1 TEXTBOOK::Graph Theory with applications to computer science(by**NarsinghDeo**)PHI Learning Private Limited.

4.2 *REFERENCE BOOKS:: Introduction to Graph Theory(by**Douglas B**.)West, Pearson.

5. OTHER SESSIONS

5.1 *TUTORIALS::	NO TUTORIALS
5.2 *LABORATORY::	OPTIONAL
5.3 *PROJECT::	OPTIONAL

6. ASSESSMENT (indicative only)

6.1 HA::	10%	(COMPUTER PROGRAMMES)
6.2 QUIZZES-HA::	0%	
6.3 PERIODICAL EXAMS::	40%	
6.4 *PROJECT::	10%	
6.5 FINAL EXAM::	40%	

7. OUTCOME OF THE COURSE:: The student will be able to provide solutions to rather complex problems as described in the section "OBJECTIVE". Since computation is an integral part of the course designed, he will be able to handle time consuming situations by using sophisticated algorithms and eventually his knowledge will give him an edge in research and development in various ares including science and engineering.

8. *EXPECTED ENROLLMENT FOR THE COURSE:: 60

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::

(i) Computer Engineering,

(ii)Civil Engineering,

(iii) Electrical Engineering,

(iv) Chemistry.

10. *ANY OTHER REMARKS:: ----------

Differential Equations

1. GENERAL

1.1 TITLE:: Differential Equations

1.2 COURSE NUMBER (if known)::DC.MA 312.16

1.3 CREDITS::3-0-0 (09)

1.4 SEMESTER-OFFERED:: V

1.5 PRE-REQUISITES:: : Mathematics-1 & 2, Mathematical Methods

1.6 Course Committee Member:

2. OBJECTIVE::

Differential equations play a very important role in science, engineering and social sciences, as many phenomena in these branches have mathematical models in terms of differential equations. It is, therefore very much necessary to teach its theory and applications to the students for their advanced knowledge in applied sciences. The objective of this course is to bring together the qualitative theory of differential equations systematically. The contents of this course would familiarise the students with fundamentals, principles, methods of modern theory of differential equations and fairly broad spectrum of qualitative properties of solutions of linear and non-linear differential equations.

3. COURSE TOPICS:

UNIT-I: System of linear differential equations

System of first order equations, Existence and uniqueness theorem, Gronwall inequality and other inequalities. (4 Lectures)

UNIT-II: Existence and uniqueness of solutions

Preliminaries, Successive approximations, Picard's theorem, Continuous dependence of solutions on initial conditions, Existence of the solution in the large, Fixed point method. (5 Lectures)

UNIT-III: Analysis and methods of non-linear differential equations

Existence theorem, Extremal solutions, Upper and lower solutions, Monotone iterative method and method of Quasi-linearization, Bihari's inequality, Variation of parameters (A non-linear version).
(6 Lectures)

UNIT-IV: Boundary value problems

Sturm-Liouville problem, Green's function, Applications of boundary value problems (BVP), Picard's theorem (BVP). (4 Lectures)

UNIT-V: Classification of PDEs (Linear, Semi linear, Nonlinear), Examples of important classes of PDEs and utility. Transport equations, Nonlinear first order PDEs, method of characteristics.
(7 Lectures)

UNIT-VI: Classification of second order PDEs (elliptic, hyperbolic, parabolic), Representation formulae for Laplace equation, Heat equation, wave equation.
(7 Lectures)

UNIT-VII: Harmonic function, mean value formula, regularity of Harmonic function, Maximum principle, uniqueness, Green's function. (6 lectures).

4. READINGS

4.1 TEXTBOOK::

1. S.G.Deo, V. Raghvendra. "Ordinary Differential Equations and Stability Theory", Tata McGraw Hill.
2. George F. Simmons and John S. Robertson, "Differential equations with applications", McGraw Hill Education Pvt. Ltd. (New Delhi),
3. Phoolan Prasad and R. Ravindran – Partial Differential Equation.
4. Fritz John- Partial Differential Equation

4.2 *REFERENCE BOOKS::

[1]S G Deo, V Lakshmikantham, V Raghavendra, "Text Book of ordinary differential equations", McGraw-Hill Education (India).

[2] E. A. Coddington and N. Levinson, "Theory of ordinary differential equations", McGraw-Hill, NewYork.

[3] W. Kalplan, "Ordinary differential equations", Addition-Wesley, Reading, Massachusetts.

[4] L.C. Evans-Partial Differential Equation, Berkley math lecture notes.
[5] R. Courant and D. Hilbert-Methods of Mathematical Physics (Vol. 1).
[6] G.F. Folland-Introduction to Partial Differential Equation

5. OTHER SESSIONS

5.1 *TUTORIALS:: 0
5.2 *LABORATORY:: 0
5.3 *PROJECT:: 0

6. ASSESSMENT (indicative only)

6.1 HA:: 10%
6.2 QUIZZES-HA:: nil
6.3 PERIODICAL EXAMS:: 40%
6.5 FINAL EXAM:: 50%

7. OUTCOME OF THE COURSE::

After completion of this course, the students are expected to have knowledge of qualitative theories of differential equations and of various methods of modern theory of ordinary and partial differential equations. They will have concept of broad spectrum of qualitative properties of solutions of linear and non-linear differential equations and their applications in real world problems.

8. *EXPECTED ENROLLMENT FOR THE COURSE:: 20

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::*Any department but the student needs to have adequate knowledge of mathematics.*

Mathematical Modelling and Simulation

1. GENERAL

1.1 TITLE:: Mathematical Modelling and Simulation

1.2 *COURSE NUMBER (if known)::DE.CSM321.16

1.3 CREDITS::3-0-2 (11)

1.4 SEMESTER-OFFERED:: Vth

1.5 PRE-REQUISITES:: Engineering Mathematics I &II, Probability & Statistics, Mathematical Methods, Numerical Methods, Fluid Dynamics.

1.6 Course Committee Member:

2. OBJECTIVE::

Mathematical modelling is probably the most versatile and appropriate mechanism to catch the scientific flavour of any process in any area of study. It has widespread applications, ranging from physics, chemistry, engineering, biology, medicine, social sciences to even languages and literature. It is the process to formulate the properties and characteristics of processes mathematically. Since only the closed systems can be formulated, many a time a system, which is generally open, is formulated considering only the most significant parameters and keeping aside the non-significant ones. Due to the involved complexity, most of the time, it is not the system but a particular aspect of the system which is modelled. Despite all its limits, the contribution of mathematical modelling to human civilisation has been immense; and its study is very much required to create new horizons of knowledge.

3. COURSE TOPICS::

UNITI :Mathematical modelling concepts:

Concepts of mathematical modelling; open and closed systems; limitations of mathematical modelling; properties of mathematical modelling; needs and techniques used; areas of applications; discussion on non-uniqueness of models. (3 lectures)

UNITII :Classification of Mathematical modelling:

Classification of mathematical models in terms of areas of application; Classification in terms of the types of mathematics used: Graphical models, models using algebra, models using differential equations (ordinary and partial both); models using difference equations; models using calculus of variations and dynamic programming, etc. (3 lectures)

UNITIII :Procedure and techniques of Mathematical modelling:

Real problems, identification of parameters, significant parameters, parameters of importance, reduction of an open problem to a closed form, conversion of a real problem into a mathematical problem; identification of problem to be modelled; quest for a mathematical technique for solution; importance of numerical techniques; computer simulation; physical interpretation; illustrations.

(4 lectures)

UNITIV : Mathematical models in different fields

Classical and continuous models, Deterministic, probabilistic and stochastic models; Case studies in problems of physics, chemistry, engineering, biological sciences, genetics, economics, defence, meteorology, music, languages and literature, chaos, synchronization, sports etc. (20 lectures)

UNITV : Simulation

Barterning model, Basic optimization, Basic probability, Monte-Carlo simulation, Approaches to differential equation: Heun method, Local stability theory: Bernoulli Trials, General techniques for simulating continuous random variables, simulation from Normal and Gamma distributions, simulation from discrete probability distributions, simulating a non – homogeneous Poisson Process and queuing system. (9 lectures)

4. READINGS

4.1 TEXTBOOK::

1. J. N. Kapoor, Mathematical Modelling, Wiley Eastern Limited.
2. J. N. Kapoor, Mathematical Modelling in biology and medicine, Affiliated East-West Press Pvt. Ltd.
3. Edward A. Bender., An Introduction to Mathematical Modelling.
4. S.M. Ross, Simulation, India Elsevier Publication.

4.2 *REFERENCE BOOKS::

1. C. Fowler..Mathematical Models in Applied Sciences, Cambridge University Press.
2. A.M.Law and W.D.Kelton.. Simulation Modeling and Analysis, T.M.H. Edition.

5. OTHER SESSIONS

5.1 *TUTORIALS::	0
5.2 *LABORATORY::	One laboratory session for practice and practical assessments etc.
5.3 *PROJECT::	0

6. ASSESSMENT (indicative only)

6.1 HA:: 10%	
6.2 QUIZZES-HA::	nil
6.3 PERIODICAL EXAMS::	40%
6.4 *PROJECT::	10%
6.5 FINAL EXAM::	40%

7. OUTCOME OF THE COURSE::

The student taking this course is expected to be well versed with the concept and techniques of mathematical modelling so that he is a in a position to mathematically model any real problem required to be solved during dissertation/research work or any real problem in an industry, defence etc.

8. *EXPECTED ENROLLMENT FOR THE COURSE:: 20

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::*Any department but the student needs to have adequate knowledge of mathematics.*

Information and Coding Theory

1. GENERAL

1.1 TITLE:: Information and Coding Theory

1.2 COURSE NUMBER (if known)::DE.CSM322.16

1.3 CREDITS:: 3-0-2 (11)

1.4 SEMESTER-OFFERED::Vth

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

2. OBJECTIVE::

To introduce an introductory knowledge of information theory including the fundamentals of error correcting codes and their applications.

3. COURSE TOPICS::

UNIT I : Overview of Shannon theory, Source coding and Channel coding, Uniquely decodable codes, Instantaneous codes, Kraft's and McMillan's inequality, Binary Huffman codes, Average word-length of Huffman codes, extensions of sources. (Lectures-7)

UNITII : Information and entropy, properties of the entropy function, entropy and average word length, Shannon-Fano coding, Shannon's first theorem, Binary symmetric channel, system entropies, Mutual Information and channel capacity. (Lectures-6)

UNIT III : Error correcting codes: maximum likelihood decoding, Hamming distance and distance of a code, minimum distance decoding rule, Linear codes, minimum distance of linear codes, Hamming weight, Bases for linear codes, Generator matrix and parity-check matrix, equivalence of linear codes, (Slepian) standard array and syndrome decoding. (Lectures-15)

UNITIV : Hamming's sphere-packing bound, the Gilbert-Varshamov bound. Perfect codes, The Hamming codes and the Golay codes, Singleton bound and MDS codes, Hadamard matrices and codes. (Lectures-11)

4. READINGS

4.1 TEXTBOOK::Information and Coding Theory: *Gareth A. Jones and J. Mary Jones*, Springer;

4.2 *REFERENCE BOOKS::(i) Coding Theory: *San Ling and Chaoping Xing*, Cambridge University Press.

(ii) Introduction to Coding Theory: *J.H.Van Lint*, Springer.

5. OTHER SESSIONS

5.1 *TUTORIALS:: Nil

5.2 *LABORATORY:: One laboratory session for practice and practical assessments etc

5.3 *PROJECT:: Nil

6. ASSESSMENT (indicative only)

6.1 HA:: Nil

6.2 QUIZZES-HA:: 10%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: Nil

6.5 FINAL EXAM:: 50%

7. OUTCOME OF THE COURSE:: At the conclusion of the course, students will be introduced to the basic notions of information and channel capacity. Also students will be understood how error control coding techniques are applied in communication systems.

8. *EXPECTED ENROLLMENT FOR THE COURSE::25

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::Computer science and Engineering,

10. *ANY OTHER REMARKS:: Nil

Real and Complex Analysis

1. GENERAL

1.1 TITLE:: Real and Complex Analysis

1.2 COURSE NUMBER (if known)::DC. MA 313.16

1.3 CREDITS::3-0-0 (9)

1.4 SEMESTER-OFFERED:: Vth

1.5 PRE-REQUISITES:: Engg Mathematics I & II

1.6 Course Committee Member:

2. OBJECTIVE::

The course aims to provide the students an indepth knowledge of real and complex functions concerning differentiation and integration.

3. COURSE TOPICS::

UNIT I. Metric spaces, Compactness, Connectedness (with emphasis on $\mathbb{R}^n$). (4 Lectures)

UNIT II. Measurable sets, Lebesgue measure and its properties, Product measure spaces, Fubini's theorem. (5 Lectures)

UNIT III. Simple and step functions, Lebesgue integral of step function, Upper functions, Lebesgue integral of upper functions, Lebesgue Integral functions, Fatou's Lemma, Dominated convergence Theorem, Monotone Convergence Theorem, Riemann integral as a Lebesgue integral, Lebesgue-vitali Theorem, Application of Lebesgue Integral. (9 Lectures)

UNIT IV. Jensen, Holder and Minkowski inequalities, Completeness, Duality of L^p and L^q for $\frac{1}{p}+\frac{1}{q}=1$, Bounded functionals, Weak convergence on L^p, Uniform boundedness principal for $L^p(X,\mu)$, Approximation of L^pfunctions on $\mathbb{R}^n$ by smooth functions, Weak compactness of unit ball in L^p.(8 Lectures)

UNIT V. Zeros of holomorphic functions, Rouches theorem, Hurwitzs theorem, Maximum modulus principle, Open mapping theorem, Conformal mapping, Schwarz lemma, Normal families, Reimann mapping theorem. (6 Lectures)

UNIT VI. Harmonic function: Poisson integral formula, subhormonic functions, Dirichlet problem. (4 Lectures)

4. READINGS

4.1 TEXTBOOK::

1. H.L.Royden, Real Analysis, 3th ed., Macmillan.
2. W. Rudin, Real and Complex Analysis, McGraw-Hill.

4.2 *REFERENCE BOOKS::

1. G. de Barra, Measure Theory and Integration, New Age Publishers.
2. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House.

5. OTHER SESSIONS

5.1 *TUTORIALS:: 0

5.2 *LABORATORY:: 0

5.3 *PROJECT:: 0

6. ASSESSMENT (indicative only)

6.1 HA:: 20%

6.2 QUIZZES-HA:: 0%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: 0%

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE:: Having done this course the student will be able to understand and adequately model physical and engineering problems.

8. *EXPECTED ENROLLMENT FOR THE COURSE:: 20

Fluid Dynamics

1. GENERAL

1.1 TITLE:: Fluid Dynamics
1.2 COURSE NUMBER (if known)::DC. MA 323.16
1.3 CREDITS:: 3-0-0 (9)
1.4 SEMESTER-OFFERED:: VI
1.5 PRE-REQUISITES:: Knowledge of integration, vector calculus
1.6 Course Committee Member:

2. OBJECTIVE:

The course on fluid dynamics is an introductory course designed for the students graduating in mathematics and computing (IDD, Mathematics & Computing). The amalgamated programme on mathematics and computing has been conceptualised to bridge the gap between the two major subjects. A graduate of mathematics without an adequate knowledge of computing is stuck when he is required to provide a solution when an analytical solution is neither available nor possible. On the other hand, a computer graduate without in-depth knowledge of mathematics lacks to properly handle the situation. Thus a student who has to later learn computational fluid mechanics course is required to opt for such a fundamental course at least. The two are complementary to each other. Moreover, fluid mechanics has huge applications in aerodynamics, biomechanics, space research, meteorology for weather forecast etc.

3. COURSE TOPICS::

UNIT I: KINEMATICS OF FLUIDS IN MOTION

Tensor notations; real fluids and ideal fluids; velocity of a fluid at a point; streamlines and pathlines; steady and unsteady flows; the velocity potential; the vorticity vector; local and particle rates of change; the equation of continuity; acceleration of a fluid; conditions at a rigid boundary; general analysis of fluid motion. (8 lectures)

UNIT II: EQUATIONS OF MOTION OF A FLUID

Pressure at a point in a fluid at rest; pressure at a point in a moving fluid; conditions at a boundary of two inviscid immiscible fluids; Euler's equation of motion; Bernouli's theorem; discussion of the case of steady motion under conservative body forces; potential theorems; flows involving axial symmetry; some special two-dimensional flows; impulsive motion. (7 lectures)

UNIT III: THREE DIMENTIONAL FLOWS

Sources, sinks and doublets; images in a rigid infinite plane; images in solid spheres; axi-symmetric flows; Stokes's stream functions. (5 lectures)

UNIT IV: TWO-DIMENSIONAL FLOWS

Meaning of two dimensional flow; the stream function; the complex potential for two dimensional irrotational incompressible flows; uniform stream, line sources and line sinks; line doublets; line vortices; two-dimensional image systems; the theorem of Blasius. (5 lectures)

UNIT V: VISCOUS FLOW

Stress components in a real fluid; relation between Cartesian components of stress; translation motion of fluid element; the rate of strain quadric and principal stresses; stress analysis in fluid motion; relation between stress and rate of strain; the coefficient of viscosity and laminar flow; the Navier stokes equations of motion of a viscous fluid; solvable problems in viscous flows; steady flow in tubes of uniform cross-section; definition of vorticity; energy dissipation due to viscosity; steady flow past a fixed sphere; Prandtl's boundary layer. (8 lectures)

UNIT VI: GAS DYNAMICS

Compressible effects in real fluids; the elements of wave motion; the speed of sound in a gas; equations of motion of a gas; subsonic, sonic and supersonic flows; isentropic gas flow; reservoir discharge through a channel of varying section; shock waves; use of characteristic coordinates; flow round a sharp convex corner. (6 lectures)

4. READINGS

4.1 TEXTBOOK::

Textbook of Fluid DynamicsbyF. Chorlton, CBS Pub.and Distributors

4.2 *REFERENCE BOOKS::

Boundary Layer Theory byH. Schlichting McGraw Hill

5. OTHER SESSIONS

5.1 *TUTORIALS::	No tutorials
5.2 *LABORATORY::	No laboratory classes
5.3 *PROJECT::	

6. ASSESSMENT (indicative only)

6.1 HA::	10%
6.2 QUIZZES-HA::	10% (if HA is not given)
6.3 PERIODICAL EXAMS::	40%
6.4 *PROJECT::	10%
6.5 FINAL EXAM::	40%

7. OUTCOME OF THE COURSE::

The course on fluid dynamics will enable the students understand why learning of computational fluid dynamics is indispensible. It will subsequently develop clarity of concepts dealing with the various situations, circumstances and innovative artificial concepts encountering problems of various types related to aerodynamics, gas dynamics, biomechanics and many more problems of engineering background.

8. *EXPECTED ENROLLMENT FOR THE COURSE:: 60

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::Mechanical Engineering, Chemical Engineering,Physics

10. *ANY OTHER REMARKS::

Theory of Computation

GENERAL

1.1 TITLE: Theory of Computation

1.2 COURSE NUMBER (if known):MC.CSO322.16

1.3 CREDITS: 3-0-0(09)

1.4 SEMESTER-OFFERED::VI

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

2. OBJECTIVE::This course aims to introduce an idea of Automata, Formal languages and computability.

3. COURSE TOPICS::

UNIT-1. Finite Automata: Basic Definition of an automaton, Description of a finite automata Deterministic finite automata (DFA), Non-deterministic finite automata (NFA), transition systems, Acceptability of a string by a finite automation, The equivalence of DFA and NFA, Construction of minimum automaton. Lectures :6

UNIT-2. Formal Languages: Basic definitions, Chomsky classification of languages, Languages and their relations, Operations on languages, Languages and automata. Lectures : 4

UNIT-3. Regular Grammars: Identities and regular expressions, Finite automata and regular expressions, Conversion of non-deterministic systems to deterministic systems, Algebraic method using Arden's theorem, Construction of finite automata equivalent to regular expression, Pumping lemma for regular sets, Applications of pumping lemma. Lectures :7

UNIT-4. Context-free Grammer: Context-free grammars, Parse trees, Ambiguity in context-free grammars, Simplification of context-free grammars, Normal forms of context-free grammars, Pumping lemma, Decision algorithms. Lectures :5

UNIT-5. Pushdown Automata: Basic definitions, Acceptance by pushdown automata, Pushdown automata and context-free languages. Lectures :4

UNIT-6. Turing Machines and Linear Bounded Automata (LBA): Turing Machines Model, Representation of a Turing machine, Language acceptability by Turing machines, Design of Turing Machines, Universal Turing Machines and other modifications, Model of linear bounded Automaton, Turing machines and type- 0 Grammars, Linear bounded automata and languages, Halting problem of Turing machines, NP Completeness. Lectures :8

UNIT-7. Computability: Introduction and basic concepts, Primitive recursive functions, Recursive functions, Partial recursive functions and Turing machines. Lectures :5

4. READINGS

4.1 TEXTBOOK::

1. J. E. Hopcroft, J. Motwani and J. D. Ull man, Introduction to Automata Theory, Languages and Computation, Pearson Education, Asia, 2002.

2. J. H. Martin, Introduction of Languages and the Theory of Computation, McGraw-Hill International Edition, New York, 1991.

4.2 *REFERENCE BOOKS::

1. Z. V. I. Kohavi, Switching and Finite Automata Theory, Tata McGraw-Hill, New Delhi, 1972.

2. H. R. Lewis and C. H. Papadimitrou, Elements of the Theory of Computation, Pearson Education.

5. OTHER SESSIONS

5.1 *TUTORIALS::

5.2 *LABORATORY::

5.3 *PROJECT::

6. ASSESSMENT (indicative only)

6.1 HA:: 20%

6.2 QUIZZES-HA:: 0%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: 0%

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE::

Studying Automata theory students will gain knowledge in effectivealgorithm , text processing, compilers, and hardware design. programming languages and artificial intelligence, and the human languages. Automata theory will be useful towards handing problems like mollusk and pine cones growth and pigmentation patterns in biology. Ideas of Turing machine will provide the students of getting knowledge about the structures of machine design.

8. *EXPECTED ENROLLMENT FOR THE COURSE::100

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::Computer Science & Engineering

10. *ANY OTHER REMARKS:: None

NAME OF DEPT/SCHOOL: Department of Mathematical Sciences, IIT(BHU)

Operations Research

1. GENERAL

1.1 TITLE:: Operations Research

1.2 COURSE NUMBER (if known)::DE.CSM324.16

1.3 CREDITS::3-0-0 (9)

1.4 SEMESTER-OFFERED::

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

2.COURSE OBJECTIVE:: The objective of this course is to make the students acquainted with various optimization techniques to solve linear and nonlinear programming problems arising in industrial and management fields.

3. COURSE TOPICS:

UNIT 1 : Introduction to LPP: Formulation of LP models, Graphical procedure of solution, Convex functions and their properties, Basic feasible solution, Optimal solution Lectures 4

UNIT 2 : Simplex Algorithm: Simplex method, Big M method, Two phase Method, Degenerate LPP, Revised simplex method, Duality Theorem, Dual Simplex Method, Sensitivity analysis Lectures 14

UNIT 3 : Transportation Problems: North West Corner Method, Matrix minima Method, VAM Method, Optimality Test, Degeneracy, Unbalanced Transportation problem Lectures 5

UNIT 4 : Assignment problems Lectures 2

UNIT 5 : Travelling salesman problems Lectures 2

UNIT 6 : Integer LPP: Branch and Bound Algorithm, Cutting Plane Algorithm Lectures 2

UNIT 7 : Network flow: Shortest path problem, Maximal flow problem, CPM, PERT Lectures 4

UNIT 8 : Introduction to Game Theory:Strategy, Minimax and MaximinCriterion, Existence of saddle point, Game without saddle point, Mixed strategies, Solution of 2x2 games, Rectangular games, symmetric games, Concept and general rules for dominance, Two person zero sum game. Fundamental Theorem.Solution of a game by simplex method. Lectures 6

4. READINGS

4.1 Text Books:

- Rao S. S., Optimization, Wiley Eastern India.
- Taha H. A., Operation Research, Macmillan India.

4.2 Reference Books:

- Hadley G., Linear Programming, Addison-Wesley.
- Hillier F.S. and Lieberman G.J., Introduction to Operation Research, McGraw Hill.
- Ravindran, A., Philips, D.T., and Solberg, J.J., Operations research, John Wiley and Sons.

5. OTHER SESSIONS

5.1 *TUTORIALS:: nil

5.2 *LABORATORY:: nil

5.3 *PROJECT:: nil

6. ASSESSMENT (indicative only)

6.1 HA::	20%
6.2 QUIZZES-HA::	0%
6.3 PERIODICAL EXAMS::	40%
6.4 *PROJECT::	0%
6.5 FINAL EXAM::	40%

7. OUTCOME OF THE COURSE:: The students with the skills gained out of this course will be able to solve several problems arising in industrial fields.

Stochastic Processes

1. GENERAL

1.1 TITLE:: Stochastic Processes

1.2 COURSE NUMBER (if known)::DE.CSM341.16

1.3 CREDITS::3-0-2 (11)

1.4 SEMESTER-OFFERED::VIth

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

2. COURSE OBJECTIVE:: The objective of this course is to make the students acquainted with various techniques to solve linear and nonlinear programming problems arising in industry.

3. COURSE TOPICS:

UNIT 1 : Review of Probability Theory: Axiomatic definition of probability, random variables and vectors, probability distributions, functions of random variables, mathematical expectations, generating functions, modes of convergence of sequences of random variables, laws of large numbers, central limit theorem. (Lectures 2)

UNIT 2 : Introduction to stochastic processes (SP):Definition and examples of SP, classification of random processes according to state space and parameter space, types of SP, elementary problems. (Lectures 2)

UNIT 3 : Stationary Processes: Weakly stationary and strongly stationary process, moving average and auto regressive processes. (Lectures 2)

UNIT 4 : Discrete-time Markov Chain (DTMC): Definition and examples of MC, transition probability matrix, Chapman-Kolmogorov equation; calculation of n-step transition probabilities, limiting probabilities, classification of states, ergodicity, stationarydistribution, transient MC; random walk and gambler's ruin problem, applications. Wald's equations and Wald's identity. (Lectures 8)

UNIT 5 : Continuous-time Markov Chain (CTMC): Kolmogorov- Feller differential equations, infinitesimal generator, Poisson process, Yule-Furry process, birth-death process,applications to queueing theory. (Lectures 10)

UNIT 6 : Brownian Motion: Wiener process as a limit of random walk; process derived from Brownian motion, stochastic differentialequation, stochastic integral equation, Ito formula, Some important SDEs and their solutions, applications. (Lectures 6)

UNIT 7 : Renewal Processes: Renewal function and its properties, central limit theorem for renewal processes, cost/rewards associated with renewals, Markov renewal and regenerative processes, non Markovian queues, applications of Markov regenerative processes. (Lectures 7)

UNIT 8 : Branching Processes: Definition and example of branching process, probability generating function, mean and variance,Galton-Watson branching process,probability of extinction. (Lectures 2)

4. Books:

- J. Medhi, Stochastic Processes, 3rd Edition, New Age International, 2009.
- S.M. Ross, Stochastic Processes, 2nd Edition, Wiley, 1996.
- S Karlin and H M Taylor, A First Course in Stochastic Processes, 2nd edition, Academic Press, 1975.

5. OTHER SESSIONS

5.1 *TUTORIALS::	nil
5.2 *LABORATORY::	Yes (2 hrs.)
5.3 *PROJECT::	Nil

6. ASSESSMENT (indicative only)

6.1 HA::	20%
6.2 QUIZZES-HA::	0%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: 0%

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE:: The students with the skills gained out of this course will be able to solve several problems arising in industrial fields.

Number Theory

1. GENERAL

1.1 TITLE:: Number Theory

1.2 COURSE NUMBER (if known)::DE.CSM 314.16

1.3 CREDITS:: 3-0-2(11)

1.4 SEMESTER-OFFERED::VI

1.5 PREREQUISITE: Algebra

1.6 Course Committee Member:

2. OBJECTIVE::

The students will study the basic concepts in number theory applied to cryptography.

3. COURSE TOPICS::

UNIT I:

Primes, Divisibility, primality testing and factorization methods, Euclidean Algorithm, Extended Euclidean algorithm, Congruences, Ring of Integers mod n, Chinese Remainder Theorem (16 Lectures)

UNIT II:

Arithmetic Functions, Fermat's little theorem, Primitive roots, Fermat's Last Theorem, Quadratic Residues, Quadratic Reciprocity Law, Binary Quadratic Forms, Continued Fractions (16 Lectures)

UNIT III:

Pell's Eqn, Diophantine Eqns, Some applications of number theory in algebraic coding theory andcryptography (7 Lectures)

4. READINGS

4.1 TEXTBOOK:: 1. Burton, David M. Elementary Number Theory. Allyn and Bacon, 1976.

2. Ireland, Kenneth F., and Michael I. Rosen, A classical Introduction to Modern Number Theory, Springer 1990.

4.2 *REFERENCE BOOKS::

1. G.A. Jones & J.M. Jones, Elementary Number Theory, Springer, UTM, 2007.

2. Neal Koblitz, A Course in Number Theory and Cryptography, Springer, Verlag - New york Inc., May 2001.

5. OTHER SESSIONS

5.1 *TUTORIALS:: Nil

5.2 *LABORATORY:: Yes (2 hrs.)

5.3 *PROJECT:: Nil

6. ASSESSMENT (indicative only)

6.1 HA::

6.2 QUIZZES-HA:: 20%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: 0%

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE:: Having done this course the students will be able to understand the algebraic number theory and will be able to in cryptography.

8. *EXPECTED ENROLLMENT FOR THE COURSE:: 30

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST:: Computer Science &Engg.

Topology and Functional Analysis

1. GENERAL

1.1 TITLE:: Topology and Functional Analysis

1.2 COURSE NUMBER (if known):: DC.MA 411.16

1.3 CREDITS:: 3-0-0 (9)

1.4 SEMESTER-OFFERED::VIIth

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

2. OBJECTIVE::

The objective of this course is to equip the student with basics of topology and functional analysis so that he is capable of higher learning.

3. COURSE TOPICS::

UNIT I:

Definition and Examples of Topological spaces and properties. (4 lectures)

UNIT II:

Subspaces, Product topology, Quotient topology. (4 lectures)

UNIT III:

Separation axiomsT_0, $T_1, T_2, T_3, T_{3\frac{1}{2}}$and T_4, their characterizations and basic properties. (5 lectures)

UNIT IV:

Compactness and its properties, Localcompactness, One point compactification. (4 lectures)

UNIT V:

Connected spaces and their basic properties, Components. (2 lectures)

UNIT VI:

Normed and Banackh space: definitions and elementary properties, some concrete normed and Banach spaces, subspaces, quotient spaces, completion of normed spaces. (3 lectures)

UNIT VII:

Definition, examples and basic properties of bounded linear operators, equivalent norms, finite dimensional normed spaces and compactness, open mapping theorem and its consequences, closed graph theorem and its consequences, uniform bounded theorem. Definitions, examples and basic properties ofbounded Linear Functionals, the form of some dual spaces, hann-Banch Theorem and its consequences, Embedding and Reflexivity of normed spaces, adjoint of bounded linear operations, weak convergence. (10 lectures)

UNIT VIII:

Definitions and basic properties of inner product spaces and Hilbert space, completion of inner product spaces, orthogonality of vectors, orthogonal compliment and projection theorem, orthonormal sets and Fourier analysis, complete orthonormal sets. Bounded linear functionals, Hilbert-adjoint operators, self-adjoint operators, normal operators, unitary operators, orthogonal projections operators.

(8 lectures)

4. READINGS

4.1 TEXTBOOK::

1. Introduction to Topology and Modern Analysis, George F. Simmons, Robert E. Krieger Publishing Company.
2. Functional Analysis, P.K. Jain, O.P. Ahuja, Khalil Ahmad, New Age International
3. Functional Analysis, B V Limayee
4. S. Willard, General Topology, Addison Wesley, 1970
5. J. R. Munkres, Topology, Pearson Education(India), 2001
6. K. D. Joshi, Introduction to General Topology, New Age International, New Delhi, 2000

4.2 *REFERENCE BOOKS::

1. Functional Analysis, Walter Rudin, McGraw-Hill, Inc.
2. J. L. Kelley, General Topology, Van Nostrand, Princeton, 1955
3. G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw- Hill, New York, 1963

5. OTHER SESSIONS

5.1 *TUTORIALS:: nil

5.2 *LABORATORY:: nil

5.3 *PROJECT:: nil

6. ASSESSMENT (indicative only)

6.1 HA:: 0%

6.2 QUIZZES-HA:: 10%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: 0%

6.5 FINAL EXAM:: 50%

7. OUTCOME OF THE COURSE:: After studying this course the students will be able to develop theories in Engineering and Science.

8. *EXPECTED ENROLLMENT FOR THE COURSE::25

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::Computer science and Engineering.

10. *ANY OTHER REMARKS::

Fuzzy Set Theory

1. GENERAL

1.1 TITLE:: Fuzzy Set Theory

1.2 COURSE NUMBER ::DE.CSM431.16

1.3 CREDITS:: 3-0-0 (9)

1.4 SEMESTER-OFFERED:: Sem VII

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

2. OBJECTIVE:: To equip the students with the basics of fuzzy set theory and its technique.

3. COURSE TOPICS::

UNIT I:BASIC IDEAS AND OPERATIONS ON FUZZY SETS

Basic concepts of fuzzy sets, Membership functions, Types of operations: fuzzy complements, fuzzy intersections: t-norms, fuzzy unions: t-conorms, combinations of operations, aggregation operations (6Lectures)

UNIT II:FUZZY ARITHMETICS

Fuzzy numbers, triangular, trapezoidal fuzzy numbers, linguistic variables, arithmetic operations on intervals, arithmetic operations on fuzzy numbers, lattice of fuzzy numbers, fuzzy equations (6Lectures)

UNIT III:FUZZY RELATIONS

Crisp versus fuzzy relations, projections and cylindric extensions, binary fuzzy relations,binaryrelations on a single set, fuzzy equivalence relations, fuzzy compatibility relations, applications (6Lectures)

UNIT IV:FUZZY RELATION EQUATIONS

General discussion, problem partitioning, solution method, fuzzy relation equations based on sup-I compositions, fuzzy relation equations based on inf- w_i compositions, approximate solutions (6Lectures)

UNIT V:POSSIBILITY THEORY

Fuzzy measures, evidence theory, possibility theory, fuzzy sets and possibility theory, possibility theory versus probability theory, applications (6Lectures)

UNIT VI:PATTERN RECOGNITION

Introduction, models for pattern recognition, Classification, fuzzy clustering, different clustering algorithms, examples, validation (6Lectures)

4. READINGS

4.1 TEXTBOOK ::

1. Fuzzy Sets and Applications, Klir and Folger, Prentice Hall
2. Fuzzy Set Theory and Its Applications, H J Zimmermann, Allied Publishers
3. First Course I Fuzzy Set Theory and Applications, K H Lee, Springer-Verlag

4.2 *REFERENCE BOOKS :: Suggested Books

4. Fuzzy Sets and Systems-Theory and Applications, D Dubois and H Prade, Academic Press

5. OTHER SESSIONS

5.1 *TUTORIALS ::	Nil
5.2 *LABORATORY ::	Nil
5.3 *PROJECT ::	With above knowledge students will be equipped to apply them to the project on pattern recognition problems, data clustering problems etc in forthcoming semester

6. ASSESSMENT (indicative only)

6.1 HA ::	20%
6.2 QUIZZES-HA ::	Nil
6.3 PERIODICAL EXAMS ::	40%
6.4 *PROJECT ::	0%
6.5 FINAL EXAM ::	40%

7. OUTCOME OF THE COURSE :: The students will be able to apply the learnt techniques of the fuzzy sets to various fields of social science, physical sciences medical science and engineering.

8. *EXPECTED ENROLLMENT FOR THE COURSE :: 30

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST :: CSE,EnvironmentalEngg. Etc.

10. *ANY OTHER REMARKS ::

Numerical Solution of Partial Differential Equations

1. GENERAL
1.1 TITLE:: Numerical Solution of Partial Differential Equations
1.2 COURSE NUMBER (if known)::DE.CSM421.16
1.3 CREDITS:: 3-0-2 (11)
1.4 SEMESTER-OFFERED::VII
1.5 PRE-REQUISITES:: None
1.6 Course Committee Member:

2. OBJECTIVE::
Develop an understanding of Numerical methods for partial differential equations. Learn to determine the stability criterion for a numerical scheme. Learn to apply the methods to solve problems.

3. COURSE TOPICS::

UNIT I: Parabolic equations in one space variable:

Introduction, A model problem, Series approximation, An explicit scheme for the model problem, Difference notation and truncation error, Convergence of the explicit scheme, Fourier analysis of the error, An implicit method, The Thomas algorithm, The weighted average or θ-method, A maximum principle and convergence for $\mu(1-\theta) \leq 1$, A three-time-level scheme, 2-D and 3-D parabolic equations 62 3.1 The explicit method in a rectilinear box, An ADI method in two dimensions.
(12 lectures)

UNIT II: Hyperbolic equations in one space dimension:

Characteristics, The CFL condition, Error analysis of the upwind scheme, Fourier analysis of the upwind scheme, The Lax–Wendroff scheme, The Lax–Wendroff method for conservation laws.
(9 lectures)

UNIT III: Stability Criterion:

Consistency, convergence and stability, Definition of the problems considered, The finite difference mesh and norms, Finite difference approximations, Consistency, order of accuracy and convergence, Stability and the Lax Equivalence Theorem, Calculating stability conditions . (9 lectures)

UNIT IV: Linear second order elliptic equations in two dimensions:

A model problem, Error analysis of the model problem, The general diffusion equation, Boundary conditions on a curved boundary, Error analysis using a maximum principle, Asymptotic error estimates. (9 lectures)

4. READINGS
4.1 TEXTBOOK::

1. K. W. Morton and D. F. Mayers, Numerical Solution of Partial Differential Equations, Cambridge University Press.
2. W F Ames, Numerical Methods for Partial Differential Equations, 3rd edn. Boston, Academic Press.

4.2 *REFERENCE BOOKS::

1. Courant, R. and Hilbert, D., Methods of Mathematical Physics, Vol2: Partial Differential Equations, New York, Wiley-Interscience.

5. OTHER SESSIONS

5.1 *TUTORIALS::	Nil
5.2 *LABORATORY::	02 hrs.
5.3 *PROJECT::	Nil

6. ASSESSMENT (indicative only)

6.1 HA::	20%
6.2 QUIZZES-HA::	
6.3 PERIODICAL EXAMS::	40%

6.4 *PROJECT:: 0%
6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE::

Develop an understanding of Numerical methods for partial differential equations. Learn to determine the stability criterion for a numerical scheme. Learn to apply the methods to solve problems.

1. An understanding of Numerical methods for partial differential equations.
2. An ability to determine the stability criterion for a numerical scheme.
3. An ability to apply the methods to solve problems.

8. *EXPECTED ENROLLMENT FOR THE COURSE:: 40

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::

Civil Engineering, Mechanical Engineering

10. *ANY OTHER REMARKS::

Cryptography

1. GENERAL

1.1 TITLE:: Cryptography

1.2 COURSE NUMBER (if known)::DE.CSM422.16

1.3 CREDITS::3-0-2 (11)

1.4 SEMESTER-OFFERED::VII

1.5 PRE-REQUISITES::Algebra

1.6 Course Committee Member:

2. OBJECTIVE::

To introduce basic cryptography**.** The objective of the course is to provide a basic understanding of the various issues related to information systems security.

3. COURSE TOPICS::

UNIT I:

Introduction: History and overview of cryptography, Simple classical cryptosystems Cryptanalysis, symmetric cryptography, stream and block ciphers, Attacks on block ciphers. Perfect Secrecy, One time pad, DES, AES. (Lectures-15)

UNIT II:

Introduction to public-key cryptography, RSA cryptosystem, Attacks on RSA, discrete logarithms problem, Diffie-Hellman key exchange, ElGamal cryptosystem, Hash functions and Data Integrity, security of Hash functions, Message authentication codes, Digital Signatures, security requirements for signature schemes. (Lectures-24)

4. READINGS

4.1 TEXTBOOK::Johanes A. Buchmann, Introduction to Cryptography, Springer;

4.2 *REFERENCE BOOKS

I. Douglas R. Stinson, Cryptography theory and practice, Chapman & Hall/CRC;
II. William Stallings, Cryptography and network security, Pearson Education;
III. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone , Handbook of Applied Cryptography, CRC Press.

5. OTHER SESSIONS

5.1 *TUTORIALS:: Nil

5.2 *LABORATORY:: Yes(2 Hrs.)

5.3 *PROJECT:: Nil

6. ASSESSMENT (indicative only)

6.1 HA:: Nil

6.2 QUIZZES-HA:: 20%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: Nil

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE::Students will understand the basic concepts of cryptography.

8. *EXPECTED ENROLLMENT FOR THE COURSE::25

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::Computer science and Engineering,

10. *ANY OTHER REMARKS:: Nil

Hilbert Space Techniques

1. GENERAL

1.1 TITLE:: Hilbert Space Techniques

1.2 COURSE NUMBER (if known)::DE.CSM412.16

1.3 CREDITS::3-0-0 (9)

1.4 SEMESTER-OFFERED::VIII

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

2. OBJECTIVE::

To introduce basic concepts of Hilbert Space Techniques**.**

Prerequisite: Calculus (Mathematics-I, MA-101), Mathematics-II (MA-102), Linear Algebra (MA-301)

3. COURSE TOPICS::

UNIT I: Normed spaces and a brief treatment of integration

- Norms an inner products on vector spaces, bounded linear operators, completeness
- Sequences and limits in normed spaces
- Introduction to measure and Lebesgue integration
- Step functions, covering lemma, Fatou'slemma, dominated convergence. (Lectures: 13)

UNIT II: Hilbert space

- Definition of Hilbert space,
- Example of l^2, example of $L^2[0,1]$ as the completion of $C[0,1]$.
- Sequential compactness, weak convergence, uniform boundeness, examples.
- The projection Theorem, Riesz representation theorem
- Cauchy's inequality, Bessel's inequality, orthonormal bases and Gram-Schmidt process.
- Isomorphism of separable spaces with l^2, examples of Fourier series. (Lectures: 8)

UNIT III: Operators on Hilbert space

- Bounded operators and the operators norm
- Invertibility of operators, Self adjoint operator, unitary operator, normal operator
- Daigonalisation, Finite rank and compact operators
- Spectral theorem for compact self-adjoint operators
- Banach Isomorphism theorem, Closed graph theorem to determine whether operators are bounded
- Index of an operator in simple cases and derive basic properties.
- Fredholm operators, Spectral theory for differential operators.
- Fourier series,Plancherel theorem, Fourier inversion
- Dirichlet problem on the interval, completeness of eigenfunctions (Lectures: 18)

4. READINGS

4.1 TEXTBOOK::

1. N, Young, An introduction to Hilbert space

*REFERENCE BOOKS

1. N Aronszajn, Introduction to theory of Hilbert spaces

5. OTHER SESSIONS

5.1 *TUTORIALS:: Nil

5.2 *LABORATORY:: Nil

5.3 *PROJECT:: Nil

6. ASSESSMENT (indicative only)

6.1 HA:: Nil

6.2 QUIZZES-HA:: 20%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: Nil

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE::Students will understand the basic concepts of Hilbert Space Techniques.

8. *EXPECTED ENROLLMENT FOR THE COURSE::25

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::

10. *ANY OTHER REMARKS:: Nil

DISTRIBUTION THEORY

1. GENERAL

1.1 TITLE::DISTRIBUTION THEORY AND APPLICATIONS

1.2 COURSE NUMBER (if known)::DE.MA 413.16

1.3 CREDITS:: 3-0-0 (9)

1.4 SEMESTER-OFFERED::

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

2. OBJECTIVES::

The course aims to introduce the concepts involved distribution of mathematical functions involved in higher mathematics.

3. COURSE TOPICS:

UNIT I: Test Function and Distributions

Introduction, Test Functions, Convergence in $\mathfrak{D}(\Omega)$, Distribution, Operations on Distributions, Multiplication and Division of Distributions, Local properties of Distributions , A Boundedness Property. (5 Lectures)

UNIT II: Convergence of Distributions

Introduction, Convergence of a sequence of Distributions, Convergence of a series of Distributions. (4 Lectures)

UNIT III: Differentiation of Distributions

Introduction, Distributional Derivative, Derivative of the product $f\psi$, Derivative of a locally Integrable function. (5 Lectures)

UNIT IV: Convolution of Distributions

Introduction, Distribution of Compact Support, Direct Product of Distributions, Some Properties of the Direct product, Convolution , Properties of Convolution, Regularization of Distributions, Fundamental Solutions of Linear Differential Operators. (8 Lectures)

UNIT V: Tempered Distribution and Fourier transforms

Introduction, The Space of Rapidly Decreasing Functions, The Space of Tempered Distributions, Multipliers in $\mathcal{S}'(\mathbb{R}^n)$, The Fourier Transform on $L^1(\mathbb{R})$, The Fourier Transform on $\mathcal{S}(\mathbb{R})$, The Fourier Transform on $\mathcal{S}'(\mathbb{R}^n)$, Properties of the Fourier Transform on $\mathcal{S}'(\mathbb{R}^n)$, Convolution Theorem in $\mathcal{S}'(\mathbb{R}^n)$, The Fourier Transform on $\xi'\mathbb{R}^n)$, Applications. (8 Lectures)

UNIT VI: Sobolev Spaces

Introduction, Hilbert Space, The SobolevSapce$H^{m,p}$ (Ω), The Sobolev Space $H^s(\mathbb{R}^n)$, Product and Convolution in $H^s(\mathbb{R}^n)$, The Space H^{-s}, The Sobolev Space H^1 (Ω), L^p Sobolev Space of Order s. (9 Lectures)

4. READINGS

4.1 TEXTBOOK::

1. A Course in Distribution Therory and Applications by R.S.Pathak.

*REFERENCE BOOKS

1. Distribution Theory and Transform Analysis byA.H.Zemanian.

5. OTHER SESSIONS

5.1 *TUTORIALS:: nil

5.2 *LABORATORY:: Nil

5.3 *PROJECT:: Nil

6. ASSESSMENT (indicative only)

6.1 HA:: Nil
6.2 QUIZZES-HA:: 20%
6.3 PERIODICAL EXAMS:: 40%
6.4 *PROJECT:: Nil
6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE::Students will understand the concepts involved in learning the higher mathematics.

8. *EXPECTED ENROLLMENT FOR THE COURSE::25

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::

10. *ANY OTHER REMARKS:: Nil

Integral Equations and Calculus of Variations

1. GENERAL

1.1 TITLE:: Integral Equations and Calculus of Variations

1.2 COURSE NUMBER (if known)::DE.CSM 423.16

1.3 CREDITS::3-0-0 (9)

1.4 SEMESTER-OFFERED::VIII

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

Prerequisites: Students need basic idea about functional analysis, linear algebra and ordinary differential equations.

2. COURSE OBJECTIVE:

The main goal of this course is to introduce fundamental concepts and some standard results of the integral equations and calculus of variations without using deep knowledge of functional analysis. We will start this course with some basic introduction of functional analysis which is essential for understanding this course.

3. COURSE TOPICS:

UNIT-1:

Inner Product spaces, Norm, Hilbert space, Regularity Conditions, Special kinds of Kernel, Classification of integral equation,Convolutionintegral,Relation between differential and integral equations,Classification, Conversion of Volterra Equation to ODE, Conversion of IVP and BVP to Integral Equation (6 Lectures)

UNIT-2:

Fredholm integral equations, Solution of Fredhlom integral equation using decomposition method, direct computation, Adomaindecomposition,successive approximation and successive substitutionmethods. (5 Lectures)

UNIT-3:

Volterra Integral equations, Solution of Volterra integral equation using successive approximation method, Adomian decomposition method, series solution, successive substitution method, resolvent kernel, Volterra integral equation of first kind, Integral equations with seperable kernels. (6 Lectures)

UNIT 4:

Fredholm's first, second and third theorem, Integral Equations with symmetric kernel, Eigenfunction expansion, Hilbert-Schmidt theorem,Fredholm and VolterraIntegro-Differential equation, Operator method in the theory of integral equations, Rayleigh-Ritz method for finding eigenvalue,Singular Integral Equation. Numerical Methods for solving Integral equations (Collocation method, least square method) (7 Lectures)

UNIT 5: (8 Lectures)

Introduction, problem of Brachistochrone, Isoperimetric problem, Variation and its properties, functions and functionals, Variational problems with the fixed boundaries, Euler's equation, Functionals in the form of integrals, special cases containing only some of the variables, Functionals involving more than one dependent variables and their first derivatives, the system of Euler's equations, Functionals depending on the higher derivatives of the dependent variables, Functionals containing several independent variables, Variational problems in parametric form (8 Lectures)

UNIT 6:

Variational problems with moving boundaries, one sided variations, variational problems with subsidiary conditions, Isoperimetric problems, Numerical methods for solving varitional problems, Rayleigh – Ritz method, Galerkin’s Method. (7 Lectures)

4. READINGS

4.1 TEXTBOOK::

1. Ram P. Kanwal, Linear Integral Equations Theory and Technique, Birkhauser, 1997

*REFERENCE BOOKS

1. I. M. Gelfand, S. V., Fomin, Calculus of variations. Prentice-Hall, 1963.

5. OTHER SESSIONS

5.1 *TUTORIALS:: Nil

5.2 *LABORATORY:: Nil

5.3 *PROJECT:: Nil

6. ASSESSMENT (indicative only)

6.1 HA:: Nil

6.2 QUIZZES-HA:: 20%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: Nil

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE::Students will understand the concepts involved in learning the higher mathematics.

8. *EXPECTED ENROLLMENT FOR THE COURSE::25

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::

10. *ANY OTHER REMARKS:: Nil

Measure Theory

1. GENERAL

1.1 TITLE:: Measure Theory

1.2 COURSE NUMBER (if known)::DE.MA414.16

1.3 CREDITS::3-0-0 (9)

1.4 SEMESTER-OFFERED:: VIII

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

2. COURSE OBJECTIVE::

The objective of the course to provide the intensive knowledge of real functions.

3. COURSE TOPICS:

UNIT 1:

Construction of Lebesgue Measure on R by outer measure, measurable sets, regularity, measurable functions (7 lectures)

UNIT 2:

Existence of non-measurable sets, Integration of nonnegative functions, the general integral (6 lectures)

UNIT 3:

Fatou's Lemma, Monotone convergence theorem, Dominated convergence theorem, Applications (6 lectures)

UNIT 4:

Relation between Riemann and Lebesgue Integration, Criteria for a function to be Riemann integrable, Examples. (4 lectures)

UNIT 5:

General Measure spaces, Sigma algebra, Integration with respect to a measure (5 lectures)

UNIT 6:

Product measure, Fubini theorem, Change of variable formula(statement only), Examples. (5 lectures)

UNIT 7:

Convergence in measure, almost uniform convergence, Egrof's Theorem. (3 lectures)

UNIT 8:

L^P spaces (3 lectures)

4. READINGS

4.1 TEXTBOOK::

1. G. De Barra- Measure theory and Integration
2. H. L. Royden- Real Analysis

*REFERENCE BOOKS

1. W. Rudin- Real and Complex Analysis
2. E. Hewitt and K. Stromberg- Real and Abstract Analysis

5. OTHER SESSIONS

5.1 *TUTORIALS::	nil
5.2 *LABORATORY::	Nil
5.3 *PROJECT::	Nil

6. ASSESSMENT (indicative only)

6.1 HA::	Nil
6.2 QUIZZES-HA::	20%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: Nil

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE::Students will understand the concepts involved in learning the higher mathematics.

8. *EXPECTED ENROLLMENT FOR THE COURSE::**25**

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::

10. *ANY OTHER REMARKS:: Nil

DIGITAL IMAGE PROCESSING

1. GENERAL
1.1 TITLE::DIGITAL IMAGE PROCESSING
1.2 COURSE NUMBER (if known)::DE.CSM 433.16
1.3 CREDITS:: 3:0:2 (11)
1.4 SEMESTER-OFFERED::VIII
1.5 PRE-REQUISITES:: Nil
1.6 Course Committee Member:

2. OBJECTIVE::
The objective of this to provide the student with the knowledge of various techniques and algorithms to process the digital images.
3. COURSE TOPICS::
UNIT I:
Introduction: The origin of digital image processing; Examples of fields that use digital image processing; Fundamental steps in digital image processing; components of an image processing system. (Lectures 3)
UNIT II:
Digital image fundamentals: Elements of visual perception; Light and the electromagnetic spectrum; Image sensing and acquisition; Image sampling and quantization; Some basic relationships between pixels; An introduction to the mathematical tools used in digital image processing. (Lectures 3)
UNIT III:
Intensity transformations and spatial filtering: Background; Some basic intensity transformation functions; Histogram processing; Fundamental of spatial filtering; Smoothing spatial filters; Sharpening spatial filters ; Combining spatial enhancement methods; Using fuzzy techniques for intensity transformations and spatial filtering (Lectures 3)
UNIT IV:
Filtering in the frequency domain: Preliminary concepts; sampling and Fourier transform of sampled functions; Discrete Fourier transform; Extension of functions of two variables; Some properties of the 2-D discrete Fourier transform; The basic of filtering in the frequency domain; Image smoothing using frequency domain filters; Image sharpening using frequency domain filters; Selective filtering; Implementation. (Lectures 4)
UNIT IV:
Image restoration and reconstruction: A model of the image degradation /restoration process; noise models; restoration in the presence of noise only-spatial filtering; periodic noise reduction by frequency domain filtering; linear, position-invariant degradations; estimation of degrading function, inverse filtering and some more filtrings; image reconstruction from projections. (Lectures 3)
UNIT V:
Colour image processing: Colour fundamentals, colour models; pseudo-colour image processing; basics of full colour image processing; colour transformations; smoothing and sharpening; image segmentation based on clour; noise in colour images; colour image compression. (Lectures 3)
UNIT VI:
Wavelets and multi-resolution processing: Background; multi-resolution expansions. Wavelettransformations in one dimension; fast wavelet transformation; wavelet transformation in two dimensions; wavelet packets. (Lectures 3)
UNIT VII:
Image compression: Fundamentals; Some basic compression methods; digital image watermarking. (Lectures 3)
UNIT VIII:
Morphological image processing: Preliminaries; erosion and dilation; opening and closing; The hit-or-miss transformation; some basic morphological algorithms;gray-scale morphology. (Lectures 5)
UNIT IX:

Image segmentation: Fundamentals; point, line, edge detection; thresholding; region-based segmentation; Segmentation using morphological watersheds; Use of motion in segmentation.
(Lectures 3)

UNIT X:

Representation and description: Representation, boundary descriptions, regional descriptions, use of principal components for description. (Lectures 3)

UNIT XI:

Object recognition: Pattern and pattern classes, recognition based on decision theoretic methods, structural methods. (Lectures 3)

4. READINGS

4.1 TEXTBOOK::Digital Image Processing by Rafael C. Gonzalez and Richard E. Woods,Pearson Education

4.2 *REFERENCE BOOKS::

5. OTHER SESSIONS

5.1 *TUTORIALS::	no tutorials
5.2 *LABORATORY::	Yes (2 hrs.)
5.3 *PROJECT::	nil

6. ASSESSMENT (indicative only)

6.1 HA::	
6.2 QUIZZES-HA::	
6.3 PERIODICAL EXAMS::	40%
6.4 *PROJECT::	20%
6.5 FINAL EXAM::	40%

7. OUTCOME OF THE COURSE:: Having done this course the student will be able to efficiently process digital images and can further develop new techniques to do so.

8. *EXPECTED ENROLLMENT FOR THE COURSE::40

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST:: CSE

10. *ANY OTHER REMARKS::

Finite Element Analysis

1. GENERAL

1.1 TITLE: Finite Element Analysis

1.2 COURSE NUMBER: DE.CSM424.16

1.3 CREDITS: 3-0-0: Credits 09

1.4 SEMESTER –OFFERED:VIII

1.5 PREREQUISITE: Numerical Analysis

1.6Syllabus of Committee Member: Dr. Rajeev, Prof. S.K. Pandey

2. OBJECTIVES

1.To introduce the general steps of finite element method and the basic finite element formulation techniques for 1D and 2D problems.

2. To teach how to formulate and solve basic problems in heat transfer and solid mechanics

3. COURSE CONTENTS

UNIT I

Introduction: Basic concepts of Finite Element Method (FEM), Concepts of Rayleigh-Ritz method, Method of weighted residuals: Collocation method, Galerkin's method and method of least square.

(4 Lectures)

UNIT II

FEM in One Dimension: Finite element modelling, Coordinates and shape functions. Derivation of element matrices and vectors for boundary value problems by Ritz method and Galerkin's approach.Assembly of element matrices and vectors. Derivation of finite element equation, Treatment of boundary conditions: elimination and Penalty Approaches. (8 Lectures)

UNIT III

Applications to Solid and Structural Mechanics: Finite element modelling, Concept of element stiffness matrix, Body force vector, Traction force vector and Point load vectors, Derivation of finite element equations for bars and cables by potential energy method and Galerkin's technique. Numerical examples. Thermally induced stresses and strains(temperature effect). (8 Lectures)

UNIT IV

Plane trusses:Local and global coordinate systems of a truss element, Element stiffness matrix in local coordinate system and coordinate transformation, Stress calculation, Temperature effect on truss element. Problems of plane trusses and its solutions by FEM. (5 Lectures)

UNIT V

FEM for Heat Transfer Problems: One dimensional heat conduction equation, Boundary conditions, Formulation of finite element equations by Galerkin's method and Rayleigh-Ritz approach. Various types of numerical examples.Finite element method to one dimensional heat transfer in thin fins.

(6 Lectures)

UNIT VI

FEM in Two Dimensions: Types of 2D elements: Linear and quadratic triangular elements, linear and quadratic rectangular elements. Various shape functions, coordinate transformations, Isoparametrization of 2D elements, Finite element method to problems of solid & structural mechanics and Heat transfer in two dimensions. (8 Lectures)

4. READINGS

4.1 TEXTBOOKS:

1. J.N. Reddy, An Introduction To The Finite Element Method, McGraw-Hill.

2.SSRao, The Finite Element Method in Engineering, Pergamon Press, New York.

*REFERENCE BOOKS

5. OTHER SESSIONS

5.1 *TUTORIALS:: Nil

5.2 *LABORATORY:: Nil

5.3 *PROJECT:: Nil

6. ASSESSMENT (indicative only)

6.1 HA:: Nil

6.2 QUIZZES-HA:: 20%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: Nil

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE::Students will understand the numerical techniques to solve the structural problems arising in Engineering and Science.

8. *EXPECTED ENROLLMENT FOR THE COURSE::25

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::

10. *ANY OTHER REMARKS:: Nil

Finite Field

1. GENERAL

1.1 TITLE:: Finite Field

1.2 COURSE NUMBER (if known)::DE.MA415.16

1.3 CREDITS::3-0-0 (9)

1.4 SEMESTER-OFFERED::VIII

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

2. OBJECTIVE::

This course aims to provide basic of finite field, which is one of the basic requirement of modern applied algebra like Coding theory and Cryptography

3. COURSE TOPICS::

UNIT I:

Fields, Characteristic and prime subfields, Field extensions, Finite, algebraic and finitely generated field extensions, primitive elements and related properties, (10 Lectures)

UNIT II:

Classical ruler and compass constructions, Splitting fields and normal extensions, algebraic closures. Cyclotomic fields, Separable and inseparable extensions. (15 Lectures)

UNIT III:

Fundamental Theorem of Galois Theory, Composite extensions, Examples (including cyclotomic extensions and extensions of finite fields). (14 Lectures)

4. READINGS

4.1 TEXTBOOK::

Rudolf Lidl, HaraldNiederreiter, Finite Fields, Cambridge University Press, 1997.

4.2 *REFERENCE BOOKS::

1.D. Dummit and R. Foote, Abstract Algebra, Wiley, 2004;

2. J. A. Gallian, Contemporary Abstract Algebra, Narosa Publishing house, 1998;

5. OTHER SESSIONS

5.1 *TUTORIALS:: nil

5.2 *LABORATORY:: nil

5.3 *PROJECT:: nil

6. ASSESSMENT (indicative only)

6.1 HA:: 0%

6.2 QUIZZES-HA:: 20%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: 0%

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE:: Students will learn the basic concepts of finite field and its applications will be find in the area of Coding and Cryptography

8. *EXPECTED ENROLLMENT FOR THE COURSE::40

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST:: Computer science and Engineering.

10. *ANY OTHER REMARKS::

Complex Analysis

1. GENERAL

1.1 TITLE:: Complex Analysis

1.2 COURSE NUMBER (if known)::DE.MA416.16

1.3 CREDITS:: 3-0-0 (9)

1.4 SEMESTER-OFFERED::VIII

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

2. OBJECTIVE:: This course aims to provide advanced concepts of complex functions.

3. COURSE TOPICS::

UNIT I:

Complex numbers, Derivative of a functions, Comparison between differentiability in real and complex senses, Cauchy-Riemann Equation, Necessary and sufficient criterion for complex differentiability, Analytic function, Entire functions, Harmonic functions and Harmonic conjugates.

(4 Lectures)

UNIT II:

Polynomial functions, Rational functions, Power series, Exponential, Logarithmic, Trigonometric and Hyperbolic functions, Branch of a logarithm, Analytic functions as mappings, Conformal maps, Mobius transformations and its basic properties. (4 Lectures)

UNIT III:

The complex integral, Cauchy-Goursat's Theorem, Simply connected domains, Consequence of Simply connectivity, Index of a closed curve, Contour, Index of a contour, Cauchy's Theorem for simply connected domain, Cauchy's Theorem and Integral Formula, Power series representation of analytic functions, Morera's Theorem, Taylor's Theorem, Laurent series , Maximum modulus Principle and its applications, Schwarz Lemma and its consequences, Liouville's Theorem, Fundamental Theorem of Algebra, Zeros of analytic functions, Identity Theorem, Weierstrass Convergences Theorem. (10 Lectures)

UNIT IV:

Definitions and Classification of singularities of complex functions, Isolated and non-isolated singularities, Casorati-Weierstrass Theorem, Residues, Residues theorem and its applications to contour integrals, Meromorphic functions, Essential singularities and Picard's Theorem, Argument Principle, Rouche's Theorem, Evaluation of integrals of following type:

$\int_{\alpha}^{2\pi+\alpha} R(\cos\theta, sin\theta)\, d\theta$, $\int_{-\infty}^{\infty} f(x)dx$, $\int_{-\infty}^{\infty} g(x)\cos mxdx$, singularities on the Real axis.

(11 Lectures)

UNIT V:

Direct Analytic Continuation, Monodromy Theorem, Poission Integral Formula, Analytic Continuation via reflection. (5 Lectures)

UNIT VI:

Open Mapping Theorem and Hurwitz Theorem, Basic results on univalent functions, The Riemann mapping theorem. (5 Lectures)

4. READINGS

4.1 TEXTBOOK::

1. L.V. Ahlfors, Complex Analysis. An introduction to the theory of analytic functions of one complex variable, McGraw-Hill.
2. S. Ponnusamy, Foundations of Complex analysis, Narosa Publication.

4.2 *REFERENCE BOOKS::

1. J.B. Conway, Functions of one complex variable, GTM (159), Springer- Veriag.
2. W. Rudin, Real and complex analysis, McGraw-Hill.

5. OTHER SESSIONS

5.1 *TUTORIALS:: nil

5.2 *LABORATORY:: nil

5.3 *PROJECT:: nil

6. ASSESSMENT (indicative only)

6.1 HA::

6.2 QUIZZES-HA:: 20%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: 0%

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE:: Students will learn the Advanced concepts of complex functions.

8. *EXPECTED ENROLLMENT FOR THE COURSE::40

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::

10. *ANY OTHER REMARKS::

Theory of Rings and Modules

1. GENERAL

1.1 TITLE:: Theory of Rings and Modules

1.2 COURSE NUMBER (if known):: DE.MA511.16

1.3 CREDITS:: 3-0-0 (9)

1.4 SEMESTER-OFFERED::IX

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

2. OBJECTIVE::The student will study the advanced topics in rings and modules.

3. COURSE TOPICS::

UNIT I:

Basic definition and examples of modules.Exact sequences of modules.Short exact sequences, splitting of short exact sequences. (Lectures 8)

UNIT II:

cyclic modules, simple modules, free modules, bases of free modules, Tensor product of modules. Projective modules and their properties.Projective cover of a module.Essential extensions of a module. (Lectures 15)

UNIT III:

Injective module and their properties. Injective hull of modules. Indecomposable module, completely reducible module, Schur's lemma, Jacobson redical of a module and Soc(M). Semi prime ideal and the prime radical. Perfect rings and semi-perfect rings. (Lectures 16)

4. READINGS

4.1 TEXTBOOK::

1. Rings and category of modules by F. W. Anderson and K. R. Fuller, Springer Verlag, New York.

4.2 *REFERENCE BOOKS::

1. Commutative algebra, Vol. 1 by O. Zariski and P. Samuel, Von Nostrand Co., New York.
2. Injective module by D. W. Sharpe and P. Vamos, Cambridge University press.
3. Lecture on rings and modules by J. Lambek, Blaisdell publishing company.

5. OTHER SESSIONS

5.1 *TUTORIALS::	nil
5.2 *LABORATORY::	nil
5.3 *PROJECT::	nil

6. ASSESSMENT (indicative only)

6.1 HA::	0%
6.2 QUIZZES-HA::	20%
6.3 PERIODICAL EXAMS::	40%
6.4 *PROJECT::	0%
6.5 FINAL EXAM::	40%

7. OUTCOME OF THE COURSE:: After studying the course the student will be able to understand the applications of rings and modules in graph theory, coding theory and cryptography etc.

8. *EXPECTED ENROLLMENT FOR THE COURSE::40

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::

10. *ANY OTHER REMARKS::

Approximation Theory

1. GENERAL

1.1 TITLE:: Approximation Theory

1.2 COURSE NUMBER::DE.MA512.16

1.3 CREDITS:: 3-0-0 (9)

1.4 SEMESTER-OFFERED:: IX

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

2. OBJECTIVE::

This course provides a study on Approximation Theory with some applications

3. COURSE TOPICS::

UNIT I:

Basic concepts, the best approximation, Linear approximation and projection, Degree of approximation, The Weierstrass theorems (6Lectures)

UNIT II:

Linear positive operators, Korovkin theorem, Bernstein polynomials, Fejer sums, The Weierstrass theorems (6Lectures)

UNIT III:

Existence and unicity of best approximation, Finite-dimensional subspaces. Strictly convex spaces, Examples of nonexistence. (6Lectures)

UNIT IV:

Best approximation in C(K), Kolmogorov criterion and Haar spaces, Chebyshev alternation theorem, Haarunicity theorem, Chebyshev polynomials (6Lectures)

UNIT V:

Estimates outside the interval, Application to the iterative methods, Lagrange interpolation, Polynomials with interlacing zeros (6Lectures)

UNIT VI:

Inequalities for derivatives, Markov inequality, Duffin-Schaeffer refinement, Error bounds for Lagrange interpolation, Peano kernel (6Lectures)

4. READINGS

4.1 TEXTBOOK ::

1. Approximation Theory and Methods, M J D Powell, OUP

4.2 *REFERENCE BOOKS :: Suggested Books

1. A short course on Approximation Theory, N L Carother
2. A course on Approximation Theory, Ward Cheney and Will Light

5. OTHER SESSIONS

5.1 *TUTORIALS ::	Nil
5.2 *LABORATORY ::	Nil
5.3 *PROJECT ::	With above knowledge students will be equipped to apply them to different projects on approximation analysis.

6. ASSESSMENT (indicative only)

6.1 HA ::	20%
6.2 QUIZZES-HA ::	0%
6.3 PERIODICAL EXAMS ::	40%
6.4 *PROJECT ::	0%
6.5 FINAL EXAM ::	40%

7. OUTCOME OF THE COURSE ::

i)Understand fundamental concepts in approximation theory

ii) have an overview of different important techniques that are used

iii) appreciate the need for methods to be accurate and efficient

iv) be able to implement some of the techniques to engineering problems

8. *EXPECTED ENROLLMENT FOR THE COURSE :: 30

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST :: CSE, Mech. Engg., Civil Engg., Physics etc.

10. *ANY OTHER REMARKS ::

Wavelet Analysis and Applications

1. GENERAL

1.1 TITLE: Wavelet Analysis and Applications

1.2 COURSE NUMBER (if known)::DE.MA513.16

1.3 CREDITS:: 3-0-2(11)

1.4 SEMESTER-OFFERED::IX

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

2. OBJECTIVE::

The course aims to provide concepts of wavelets and their applications to various disciplines.

3. COURSE TOPICS::

UNIT I: Fourier Transform :

Properties of Fourier Transform, inversion of Fourier Transform, relation between Fourier Transform and DFT (Discrete Fourier Transform), Convolution-an introduction, Fourier Transform in L^2(IR), Parseval formula, Plancherel relation, Poission summation formula, summation kernels arising from Poission summation. (10 lectures)

UNIT II: Wavelet Transform

The continuous wavelet transform, personal formula for wavelet transform, inversion formula, properties of Wavelet Transform, discrete Wavelet Transform, frames, frame operator and its properties, orthonormal Wavelets, definition of multiresolution analysis and examples, properties of scaling functions and orthonormal Wavelet bases, construction of Wavelets, (15 lectures)

UNIT III: Applications:

Basic aspects of Fourier series, definition of Fourier series, examples of Fourier series, Fourier series of real functions, pointwise convergence of Fourier series, further aspects of convergence of Fourier series, Fourier since series, Fourier cosine series, convergence of Fourier sine & cosine series.

Some application of Fourier series, Heat equation, the wave equation, Schrodinger's equation of free particles, Filters used in signal processing, designing filter, convolution and point spread function.

(14 lectures)

4. READINGS

4.1 TEXTBOOK::

4.2 *REFERENCE BOOKS::

1. A First Course in Wavelets with Fourier Analysis, Albert Boggers, Francis J. Norcowich, Prentice Hall.
2. Wavelet Trnasform and Their Applications, LokenathDebnath, Birkhauser.
3. Ten Lectures on Wavelets, Ingrid Daubechies, SIAM.

5. OTHER SESSIONS

5.1 *TUTORIALS:: No tutorials

5.2 *LABORATORY::Yes (2 hrs.)

5.3 *PROJECT::Nil

6. ASSESSMENT (indicative only)

6.1 HA:: 0

6.2 QUIZZES-HA:: 10%

6.3 PERIODICAL EXAMS:: 30%

6.4 *PROJECT:: 20%

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE:: After attending this course the student will be able to understand the concepts of wavelets and their applications to various disciplines.

8. *EXPECTED ENROLLMENT FOR THE COURSE::40

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::

10. *ANY OTHER REMARKS:: nil

Computational Fluid Dynamics

1. GENERAL

1.1 TITLE:: Computational Fluid Dynamics

1.2 COURSE NUMBER (if known)::DE.CSM521.16

1.3 CREDITS:: 11 (3-0-2)

1.4 SEMESTER-OFFERED:: ODD

1.5 PRE-REQUISITES:: Fluid Dynamics, Partial Differential Equation

1.6 Course Committee Member:

2. OBJECTIVE::

The course aims to provide an understanding of basic concepts and introduces the fundamentals of finite difference methods and the notion of stability, accuracy and convergence of the methods. It is also aimed to develop an ability to use the techniques, skills, & engineering tools necessary for engineering practice by applying numerical methods to a "real-world" fluid-flow problem, integrating various numerical techniques in formulating a numerical solution method for that problem.

3. COURSE TOPICS::

UNIT I: Partial Differential Equations

Physical and Mathematical Classification, The Well-Posed Problem, System of Equations.
(03 Lectures)

UNIT II: Discretization Methods

Finite differences, Difference Representation of Partial differential Equations, Errors, Consistency, Stability, Convergence for Marching Problems, Conservation Form, Fourier or von Neumann Stability Analysis. (06 Lectures)

UNIT III: Methods for Hyperbolic Partial Differential Equations

Euler Explicit and Implicit Methods, Upstream Differencing Method, Lax Method, Leap-Frog Method, Lax-Wendroff Method, McCormack Method, Rusanov Method. (06 Lectures)

UNIT IV: Methods for Parabolic Partial Differential Equations

Simple Explicit and Implicit Method, Richardson's Method, Crank-Nikolson Method, ADI and ADE Methods. (05 Lectures)

UNIT V: Methods for Elliptic Partial Differential Equations

Finite-Difference Representations of Laplace's Equation, Direct and Iterative Methods for Solving System of Linear Algebraic Equations. (05 Lectures)

UNIT VI: Governing Equations of Fluid Mechanics and Heat Transfer

Continuity Equation, Momentum Equation, Energy Equation, Equation of State, Boundary Layer Approximation for Steady Incompressible Flow, Euler Equations, Shock Equations.(05 Lectures)

UNIT VII: Numerical Methods for Inviscid Flow Equations

Method of Characteristics for Linear and Nonlinear System of Equations, Shock Capturing Methods.
(05 Lectures)

UNIT VIII: Numerical Methods for Boundary Layer Type Equations

Explicit and Implicit Methods, Crank Nicolson and DuFort-Frankel Methods. (04 Lectures)

4.READINGS

4.1 TEXTBOOK::

1. Dale A. Anderson, John C. Tannehill and Richard H. Platcher.. Computational Fluid Mechanics and Heat Transfer; McGraw Hill Book Company.

2. C.A.J. Fletcher. Computational Techniques for Fluid dynamics: Vol – I & II, Springer-Verlag, Berlin.

4.2 *REFERENCE BOOKS::

W.F.Ames.. Numerical Method for Partial Differential Equation, Academic Press.

5. OTHER SESSIONS

5.1 *TUTORIALS::	Nil
5.2 *LABORATORY::	Yes (2 hrs.)
5.3 *PROJECT::	To demonstrate the use of methods in real life engineering problems.

6. ASSESSMENT (indicative only)

6.1 HA::	0%
6.2 QUIZZES-HA::	0%
6.3 PERIODICAL EXAMS::	40%
6.4 *PROJECT::	20%
6.5 FINAL EXAM::	40%

7. OUTCOME OF THE COURSE::

At the end of the course the students should be able to

- apply knowledge of math and science to engineering by describing a continuous fluid-flow phenomena in a discrete numerical sense.
- use the techniques, skills, & engineering tools necessary for engineering practice by applying numerical methods to a "real-world" fluid-flow problem, integrating various numerical techniques in formulating a numerical solution method for that problem.
- analyze and interpret data obtained from the numerical solution of fluid flow problems.
- communicate effectively by writing the term project in a structured technical report format.

8. *EXPECTED ENROLLMENT FOR THE COURSE::40

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::Civil Engineering, Mechanical Engineering, Chemical Engineering.

10. *ANY OTHER REMARKS::

Solid Mechanics

1. GENERAL

1.1. TITLE: Solid Mechanics

1.2 COURSE NUMBER::DE.MA522.16

1.3 CREDITS:: 3-0-0: Credits 09

1.4 SEMESTER -OFFERED:: IX

1.5 PREREQUISITE: Engineering Mathematics-I, Engineering Mathematics-II, Engineering Mechanics, Linear Algebra

1.6 Course Committee Member:

2. Course Objective :

The course explores fundamentals of kinematics of solid bodies; displacement and strain measures, introductionto statics of solid bodies, stress tensor, equilibrium equations. Topics include analysis of columns,beams and beams on elastic foundations.

3. Course Topics:

UNIT-I:

Introduction:Free body diagram, Modeling of supports, Conditions for Equilibrium; Friction Force-deformation relationship;Axial force, shear force, bending momentand twisting moment diagrams of slender members. (5 Lectures)

UNIT-II:

Concept of Tensor: Tensor as a generalized concept of a vector in an Euclidean space E^n. Transformation of co-ordinates in E^n (n = 2, 3 as example); Summation convention;Contravariant and covariant vectors; Invariants. Contravariant, covariant and mixed tensors; Symmetric and skew-symmetric tensors;Algebra of tensors: Addition and scalar multiplication. Contraction. Outer and Inner products of tensors; Quotient law;Calculus of tensors: Covariant differentiation of vectors and tensors. Gradientanddivergence of tensors. (5 Lectures)

UNIT-III:

Introduction to stress and strain:Concept of stress and strain at a point;Transformationof stresses and strain at a point;Normal Stress in axially loaded Bar; Stress on inclined sections in axially loaded bar; Shear Stress;Analysis of normal and shear stress;Tensiontest and normal strain. (5 Lectures)

UNIT-IV:

Stress as a tensor:Components of stress at point; Cauchy stress tensor; Equilibrium equations, analysis of deformation and definition of strain components. (3 Lectures)

UNIT-V:

Some properties of Stress and Strain Tensor:Principal stresses and strains, stress and strain invariants; Mohr's circle representation. (3 Lectures)

UNIT-V:

Compatibility relations and Constitutive relations: One-to-one deformation mapping, invertibility of deformation gradient; Compatibility condition;An short introduction to material symmetry transformations;Hooke's law; Poisson's ratio, Thermal strain and deformation;Isotropic material, true and engineering stress-straincurves; Material properties for isotropic materials and their relations; Theories of failures for isotropic materials. (7 Lectures)

UNIT-VI:

Application of Mechanics of Material in Different Problems:Shear Force and Bending Moment diagrams; Axially loaded members; Torsion of circular shafts; Stresses due tobending: pure bending theory, combined stresses; Deflections due to bending: moment-curvature relation, loaddefectiondifferential equation, area moment method, and superposition theorem; Stresses and deflections due totransverse shears. (7 Lectures)

UNIT-VII:

Energy Methods:Strain energy due to axial, torsion, bending and transverse shear;Castigliano's theorem, reciprocity theorem etc. (4 Lectures)

Readings::

Text Books:

1. S. C. Crandall, N. C. Dahl, and T. J. Lardner, An Introduction to the Mechanics of Solids, 2nd Ed, McGrawHill, 1978.
2. E. P. Popov, Engineering Mechanics of Solids, Prentice Hall, 1990.

Reference Books:

1. S. P. Timoshenko, J.N. Goodier, Theory of elasticity, Tata McGraw-Hill.
2. Y.C. Fung, Foundations of Solid Mechanics, Prentice Hall
3. A.E.H. Love, A treatise on the Mathematical theory of Elasticity, Dover books

5. OTHER SESSIONS

5.1 *TUTORIALS :: Nil
5.2 *LABORATORY :: Nil
5.3 *PROJECT :: Nil

6. ASSESSMENT (indicative only)

6.1 HA :: 20%
6.2 QUIZZES-HA :: 0%
6.3 PERIODICAL EXAMS :: 40%
6.4 *PROJECT :: 0%
6.5 FINAL EXAM :: 40%

7. OUTCOME OF THE COURSE ::

Having done this course the student will have adequate knowledge of mechanics of solids so that he can apply his skills to solve practical problems and can pursue research in this area.

8. *EXPECTED ENROLLMENT FOR THE COURSE :: 30

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST :: Mech. Engg., Civil Engg., Physics etc.

10. *ANY OTHER REMARKS ::

BIOMECHANICS

1. GENERAL

1.1 TITLE::BIOMECHANICS

1.2 COURSE NUMBER (if known)::DE.MA 523.16

1.3 CREDITS::3-0-0 (9)

1.4 SEMESTER-OFFERED::IX

1.5 PRE-REQUISITES:: Fluid Dynamics

1.6 Course Committee Member:

2. OBJECTIVE::

This is intended that student acquires adequate knowledge to carry out research in Biomechanics.

3. COURSE TOPICS::

UNIT I:

Introduction to biomechanics: Historical background, an introduction to mechanics in physiology, its contribution to health science, topics of biomechanics. (2 lectures)

UNIT II:

The meaning of constitutive equations: Stress, strain, strain rate, constitutive equations, Non-viscous fluid, Newtonian viscous fluid, Hookian elastic solid, effect of temperature, materials with more complex mechanical behaviour, visco-elasticity, its response to harmonic excitation, visco-elastic models. (4 lectures)

UNIT III:

The flow properties of blood: Blood rheology, Constitutive equation, laminar flow of blood in a tube, blood viscosity, fluid mechanical interaction of red blood cells with a solid wall, coagulation, medical applications of blood rheology. (3 lectures)

UNIT IV:

Red blood cells and their deformability: Human blood cell, dimensions and shape, extreme value distribution, deformability of red blood cells, elasticity of red cells, cell membrane experiments, elasticity of red cell membrane, red cell membrane model. (4 lectures)

UNIT V:

Rheology of blood in micro vessels: Apparent viscosity and relative viscosity, effect of the size of blood vessel on the apparent viscosity, distribution of suspended particles in fairly narrow rigid tubes, motion of red cells in tightly fitting tubes. (3 lectures)

UNIT VI:

Bio-viscoelastic fluids: Bio-viscoelsticity, protoplasm, mucus from respiratory tract, cervical mucus and semen, synovial fluid. (4 lectures)

UNIT VII:

Mechanical properties of blood vessels: Correlation of the mechanical properties of a vessel with the content and structure of its material composition, behaviour of arteries under uni-axial loading, stresses in arteries under biaxial loading, mathematical representation of pseudo-elastic stress-strain relationship, dynamic testing, capillary blood vessels, veins, long term response to stress.

UNIT VIII: (5 lectures)

Skeletal muscle: Fundamental arrangement of muscles, structure of skeletal muscle, sliding element theory of muscle action, single twitch and wave summation, contraction of skeletal muscle bundles, Hill's equation for tetanised muscle, other approaches. (4 lectures)

UNIT IX:

Heart muscle: Myocardial and skeletal muscle cells, properties of unstimulated heart muscles, behaviour of active myocardium, active muscles at shorter length with negligible resting tension, stimulated papillary muscle, heart muscle mechanics and whole heart behaviour. (4 lectures)

UNIT X: ` Smooth muscle: Types of smooth muscles, contractile machinery, rhythmic contraction of smooth muscles, properties of resting smooth muscles, ureter. (2 lectures)

UNIT XI:

Bone and cartilage: Mechanical properties of bone, bone as a living organ, functional adaptation of bone, blood circulation in bone, cartilage, visco-elastic properties of articular cartilage, lubrication quality of articular cartilage surfaces. (4 lectures)

4. READINGS

4.1 TEXTBOOK:: Biomechanics, Mechanical Properties of living tissues by Y. C. Fung

4.2 *REFERENCE BOOKS::

5. OTHER SESSIONS

5.1 *TUTORIALS:: No tutorials

5.2 *LABORATORY:: No lab component

5.3 *PROJECT:: Nil

6. ASSESSMENT (indicative only)

6.1 HA::

6.2 QUIZZES-HA:: 0%

6.3 PERIODICAL EXAMS:: 40%

6.4 *PROJECT:: 20%

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE:: Having done this course a student will be able to carry out research in various fields of biomechanics.

8. *EXPECTED ENROLLMENT FOR THE COURSE:: 20

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::

10. *ANY OTHER REMARKS::

Time-Frequency Analysis

1. GENERAL

1.1 TITLE:: Time-Frequency Analysis

1.2 COURSE NUMBER (if known)::DE.MA524.16

1.3 CREDITS:: 03-0-2(11)

1.4 SEMESTER-OFFERED::IX

1.5 PRE-REQUISITES:: Students need understanding of linear algebra and vector spaces. Idea of the Fourier analysis (Fourier series and Fourier transforms) may be useful.

1.6 Course Committee Member:

2. Course Objectives:

The main goal of this course is to introduce fundamental concepts and visualization of the time frequency analysis and have some idea of filter design. We will start this course with some basic introduction of innerproduct spaces and Fourier transform which is essential for understanding this course. The focus is to have understanding of the time and frequency domains analysis of signals and its advantages. Further, the idea of filters will be introduced. Students learn how to perform fundamental digital filtering with classical filter design methods, realizations of finite impulse response (FIR) filters, and infinite impulse response (IIR) filters.

Course Topics:

UNIT-1:

Review of Inner Product Spaces, Norm, Hilbert Space, Fourier and Inverse Fourier Transforms, Discrete Time Fourier transforms,Spectral Theory, Fundamentalsof Time Frequency Analysis, Instantaneous Frequency and Analytic Signals. (7 Lectures)

UNIT-2:

Uncertainty Principle, The requirement for Time-Frequency Analysis, Gabor Transform, The Short-Time Fourier transform/Spectrogram, Time-Frequency Localization. (7 Lectures)

UNIT-3:

Wavelet Transforms, Continuous and Discrete Wavelet Transform/Scalogram,
Multiresolution Analysis, Quadratic Time Frequency Transform, Wigner-Ville Distribution, Discrete WVD, Cohen Class. (8Lectures)

UNIT 4:

Review of Laplace Transform and Z-Transforms, Analog Filter, Digital Filter (IIR Filter and FIR Filter), Types of FIR Filter (Type I, II, III,IV),Design of FIR and IIR Filters, Introduction to 2-channel Filter Bank, M-channel Filter Bank, Wavelet Filters. (9Lectures)

UNIT 5: Applications

Some State of Art Problems in Signal Processing Frequency Domain Analysis, Time Frequency Algorithm Implementation, Filter Designing Algorithms with Applications.

(5Lectures)

4. READINGS

4.1 TEXTBOOK::

1. L. Cohen, Time-Frequency Analysis, Prentice Hall, 1995.
2. S. Mallat, A wavelet Tour of Signal Processing, Academic Press USA 2009

4.2 *REFERENCE BOOKS:: Suggested Books

1. S.K.Mitra, Digital Signal Processing: A Computer Based Approach, Mc-Graw-Hill,2006.
2. LokenathDebnath, Wavelet Transforms and Their Applications, Birkhauser 2002.

5. OTHER SESSIONS

5.1 *TUTORIALS:: Nil
5.2 *LABORATORY:: Yes (2 hrs.)
5.3 *PROJECT:: Nil

6. ASSESSMENT (indicative only)

6.1 HA:: 10%
6.2 QUIZZES-HA:: 10%
6.3 PERIODICAL EXAMS:: 30%
6.4 *PROJECT:: 0%
6.5 FINAL EXAM:: 50%

7. OUTCOME OF THE COURSE::

After doing this course the student will have understanding of the time and frequency domains analysis of signals and its advantages.

8. *EXPECTED ENROLLMENT FOR THE COURSE::30

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::

10. *ANY OTHER REMARKS::

Financial Mathematics

1. GENERAL

1.1 TITLE:: Financial Mathematics

1.2 COURSE NUMBER::DE.MA525.16

1.3 CREDITS:: 3-0-2: Credits::11

1.4 SEMESTER -OFFERED:: IX

1.5 PREREQUISITE: Engineering Mathematics-I, Engineering Mathematics-II, Numerical Techniques and Probability & Statistics

1.6 Course Committee Member:

2. COURSE OBJECTIVE::

The course explores fundamentals of mathematical finances through basic concepts and some important theories. Building on mathematical models of bond and stock prices, the course presents theories lead in different directions like, Black–Scholes arbitrage pricing of options and other derivative securities, Markowitz portfolio optimisation, the Capital Asset Pricing model, models based on the principle of no arbitrage etc. that are major areas of mathematical finance, all having an enormous impact on the way modern financial markets operate.

3. COURSE TOPICS:

UNIT-I (Asset Pricing in Continuous Time):

Fundamental concepts of important financial notions such as returns, arbitrage, reserving, valuation, pricing, asset/liability management, investment income, capital budgeting, and valuing contingent cash flows. Concept of one period model, securities and their Par-Offs, concept of no-arbitrage, Options contracts and strategies for speculation and hedging. (12 Lectures)

UNIT-II:(Stochastic Differential Equations):

Random Walks and Brownian Motion , Concept of Stochastic Differential Equations (SDEs) - drift, diffusion, Ito calculus: Itos Lemma, Ito Integral and Ito Isometry. (5 Lectures)

UNIT-III (Interest Rates and Credit Modelling):

Basic notions on interest rates and bond markets.Short-rate models. Black-Scholes-Merton model: Solution of the Black–Scholes Equation, Derivatives of Black–Scholes Option Prices. Hazard function approach: hazard function and hazard rate. (5 Lectures)

UNIT-IV (Fixed-Income Products):

Introduction to the properties and features of fixed income products; yield, duration & convexity; yield curves & forward rates; zero coupon bonds. Stochastic interest rate models; bond pricing PDE; popular models for the spot rate (Vasicek, CIR and Hull & White); solutions of the bond pricing equation. Calibration/yield curve fitting: the importance of matching theoretical and market prices; time dependent one factor models (Ho & Lee, extended Vasicek). Multi-factor interest rate modelling: Two-factor Interest rate models and Bond pricing equation. (8 Lectures)

UNIT-V (Introduction to Exotic Options and Computational Finance):

Extensions, including stochastic volatility models.The Feynman- Kac connection.

Basic features and classification of exotics.Barriers, Asians and Lookbacks.Solving the pricing PDEs numerically using Explicit Finite Difference Scheme.Introduction to Monte Carlo technique for derivative pricing. (9 Lectures)

4. READINGS

4.1 TEXTBOOK::

1. Ales Cerny: "Mathematical techniques in Finance: Tools for incomplete markets", Princeton University Press
2. S.R. Pliska, "Introduction to Mathematical Finance: Discrete time models"
3. Karatzas and S. Shreve, "Methods of Mathematical Finance", Springer, New York

4.2 *REFERENCE BOOKS::

1. MarekCapinski and Tomasz Zastawniak, “Mathematics for Finance: An Introduction to Financial Engineering”, Springer, London

5. OTHER SESSIONS

5.1 *TUTORIALS:: Nil
5.2 *LABORATORY:: Yes (2 hrs.)
5.3 *PROJECT:: Nil

6. ASSESSMENT (indicative only)

6.1 HA:: 0%
6.2 QUIZZES-HA:: 10%
6.3 PERIODICAL EXAMS:: 30%
6.4 *PROJECT:: 20%
6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE::

This Financial Mathematics course draws on tools from probability, statistics, stochastic processes, and economic theory and deals with the problems onfinance and related areas. It aims to develop students' understanding of the foundations of financial mathematics, and to equip them with the knowledge of a range of mathematical and computational techniques that are required for a variety of problems in the financial sector.

8. *EXPECTED ENROLLMENT FOR THE COURSE::30

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::

10. *ANY OTHER REMARKS::

Optimization Techniques

1. GENERAL

1.1 TITLE: Optimization Techniques

1.2 COURSE NUMBER (if known)::DE.MA 526.16

1.3 CREDITS::3-0-2 (11)

1.4 SEMESTER-OFFERED::IX

1.5 PRE-REQUISITES:: None

1.6 Course Committee Member:

2. OBJECTIVE:: The objective of this course to make the students acquainted to various optimization techniques required to get solution to problems in various fields.

3. Course Topics:

UNIT 1 : Convex Sets and Convex Functions (Lectures 2)

UNIT 2 : Unconstrained Optimization: Basic properties ofsolutions and algorithms, Global convergence (Lectures 4)

UNIT 3 : Basic Descent Methods: Line search methods,Steepest descent and Newton methods (Lectures 4)

UNIT 4 : Constrained Optimization: First order necessary conditions, second order necessary conditions,KKT conditions, Constraint qualification (Lectures 6)

UNIT 5 : Convex Programming Problem: (Lectures 3)

UNIT 6&7 : Dynamic Programming:Quadratic Programming: Active set methods,Gradient projection methods and sequentialquadratic programming (Lectures 4)

UNIT 8 : Goal Programming: Concept of goal programming, Model formulation, Graphical solution method. (Lectures 2)

UNIT 9 &10 : Multiobjective Programming, Interior Point Methods, Karmarkar'salgorithm (Lectures 10)

4. READINGS

4.1 TEXTBOOK::

1. Mokhtar S. Bazaaraa, Hanif D. Shirali and M.C.Shetty, Nonlinear Programming, Theory and Algorithms, John Wiley & Sons, New York (2004).

4.2 *REFERENCE BOOKS::

1. D. G. Luenberger, Linear and Nonlinear Programming, Second Edition, Addison Wesley (2003).
2. R. E. Steuer, Multi Criteria Optimization, Theory, Computation and Application, John Wiley and Sons, New York (1986).

5. OTHER SESSIONS

5.1 *TUTORIALS:: No tutorials

5.2 *LABORATORY:: 02hrs.

5.3 *PROJECT::

6. ASSESSMENT (indicative only)

6.1 HA:: Nil

6.2 QUIZZES-HA:: 10%

6.3 PERIODICAL EXAMS:: 30%

6.4 *PROJECT:: Nil

6.5 FINAL EXAM:: 40%

7. OUTCOME OF THE COURSE:: Having done this course the student will be able to apply his skill to find optimal solution of the problems arising in industry.

8. *EXPECTED ENROLLMENT FOR THE COURSE::40

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::

10. *ANY OTHER REMARKS:: nil

Bio informatics

1. GENERAL

1.1 TITLE:: Bioinformatics

1.2 COURSE NUMBER ::DE.MA531.16

1.3 CREDITS:: 3-0-2 (11)

1.4 SEMESTER-OFFERED::IX

1.5 PRE-REQUISITES::

1.6 Course Committee Member:

2. OBJECTIVE::

This course provides an introduction to key concepts and methods in bioinformatics. Emphasis will be put on efficient algorithms and techniques used in common applications for the analysis of genetic sequences.

3. COURSE TOPICS::

UNIT I:

Basic concepts of molecular biology (6Lecture)

UNIT II:

DNA sequences, Comparison and alignment of two or more sequences (6Lecture)

UNIT III:

Indexing and searching of sequence databases (6L) (7Lecture)

UNIT IV:

Motif discovery, searching with sequence patterns (6L) (7 Lecture)

UNIT V:

Gene prediction as well as mapping (6L) (6 Lecture)

UNIT VI:

assembly of data from genome sequencing(5L) (6 Lecture)

4. READINGS

4.1 TEXTBOOK::

1. Introduction to Bioinformatics, Arthur M. Lesk
2. Essential Bioinformatics, Jin Xiong
3. Introduction to Bioinformatics Algorithms, Neil C Jones

4.2 *REFERENCE BOOKS:: Suggested Books

1. Bioinformatics : Sequences and Genome Analysis, David W Mount
2. Bioinformatics Computing, Bryan Bergeron

5. OTHER SESSIONS

5.1 *TUTORIALS:: Nil

5.2 *LABORATORY:: Yes (2 hrs.)

5.3 *PROJECT::With above knowledge students will be equipped to apply them to different projects on bioinformatics

6. ASSESSMENT (indicative only)

6.1 HA:: 10%

6.2 QUIZZES-HA:: 10%

6.3 PERIODICAL EXAMS:: 30%

6.4 *PROJECT:: 100% (in semesters IX-X)

6.5 FINAL EXAM:: 50%

7. OUTCOME OF THE COURSE::

i)Understand fundamental concepts in bioinformatics

ii) have an overview of the most important methods and tools that are used

iii) understand how some of the basic methods for biological sequence analysis works

iv) appreciate the need for methods to be accurate and efficient

v) be able to implement some of the algorithms

vi) be capable of performing simple sequence analyses using existing tools

8. *EXPECTED ENROLLMENT FOR THE COURSE::30

9. *DEPARTMENTS OTHER THAN YOUR OWN TO WHICH THIS COURSE WOULD BE OF INTEREST::CSE, Biomedical Engg.,ElectricalEngg. etc.

10. *ANY OTHER REMARKS::