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No.AC.2(S)/384/14-15 Dated: 10-06-2015

NOTIFICATION

Sub: Introduce Soft skill syllabus and practical component with Free and Open Source Software (FOSS) tools for program to B.Sc. graduate courses.

Ref: 1.Proceedings of Faculty of Science & Technology Meeting held on 02-02-2015.
2. Proceedings of the Meeting of Academic Council held on 27-03-2015.

The Board of Studies in **Mathematics (UG)** at its meeting held on 19-11-2014 has resolved to introduce soft skills to B.Sc undergraduate courses, BOS had a discussion on the draft syllabus for three years of B.Sc (six semesters) prepared by teachers and unanimously approved the same by introducing Mathematics practical component with Free and Open Source Software (FOSS) tools for programming in each semester. Further the BOS resolved to change the list of practical experiments each year according to needs.

The Faculty of Science and Technology and the Academic Council at their meetings held on 02-02-2015 and 27-03-2015 respectively have approved the above proposals and the same is notified.

The copy of Soft skill syllabus and practical component with Free and Open Source Software (FOSS) tools for program to B.Sc. graduate courses is annexed.

DRAFT APPROVED BY THE REGISTRAR

16/6.

REGISTRAR.

To

1. The Registrar (Evaluation), University of Mysore, Mysore.
2. The Chairperson, BOS/DOS in microbiology, MGM.
3. The Dean, Faculty of Science & Technology, DOS in Earth Science, MGM.
4. The Director, College Development Council, UOM, Mysore
5. The Coordinator, Online & Outreach programme, Parakalamatta, MGM.
6. The Principals of the Affiliated Colleges running B.Sc. course.
7. The Director of Collegiate education, K.R. Circle, Bangalore-01.
8. The Deputy/Assistant Registrar (Evaluation), University of Mysore, Mysore.
9. The Supdt, A.B., Academic Section / PMEB, UOM., Mysore.
10. The P.A. to the Vice-Chancellor/Registrar/Registrar(Evaluation), UOM., Mysore.
11. The Case Worker, AC.7, Academic Section, University of Mysore, Mysore.
12. The Section Guard File(Supdt.AC.2), A.B., A.C., UOM.
13. The Schedule File.

Aims and objectives of introducing new syllabus

- To set up a mathematical laboratory in every college in order to help students in the exploration of mathematical concepts through activities and experimentation.
- To enable the teacher to demonstrate, explain and reinforce abstract mathematical ideas by using concrete objects, models charts, graphs pictures, posters with the help of FOSS tools on a computer.
- To develop a spirit of enquiry and mathematical skills in the students.
- To prepare students to face new challenges in mathematics as per modern requirement.
- To make the learning process student – friendly.
- To provide greater scope for individual participation in the process of learning and becoming autonomous learners.
- To foster experimental, problem-oriented and discovery learning of mathematics.
- To help the student to build interest and confidence in learning the subject.
- To remove maths phobia through various illustrative examples and experiments.

SUPPORT FROM THE GOVT FOR STUDENTS AND TEACHERS IN UNDERSTANDING AND LEARNING FOSS TOOLS:

As a national level initiative towards learning FOSS tools, IIT Bombay for MHRD,government of India is giving free training to teachers interested in learning ope source software's like scilab, maxima, octave, geogebra and others.

(Website: http://spoken-tutorial.org;)
(email: info@spokentutorial.org; contact@spoken-tutorial.org)

Structure of B.Sc Mathematics papers

Semester	Title of the paper		Teaching hrs/week	Duration of Exam (hrs)	IA MARKS	EXAM MARKS	TOTAL MARKS	Semester Total
I	Paper I	Theory	4 hrs	3 hrs	10	60	70	100
		Practicals	3 hrs	3 hrs	10	20	30	
II	Paper II	Theory	4 hrs	3 hrs	10	60	70	100
		Practicals	3 hrs	3 hrs	10	20	30	
III	Paper III	Theory	4 hrs	3 hrs	10	60	70	100
		Practicals	3 hrs	3 hrs	10	20	30	
IV	Paper IV	Theory	4 hrs	3 hrs	10	60	70	100
		Practicals	3 hrs	3 hrs	10	20	30	
V	Paper V	Theory	4 hrs	3 hrs	20	80	100	300
		Practicals	3 hrs	3 hrs	15	35	50	
	Paper VI	Theory	4 hrs	3 hrs	20	80	100	
		Practicals	3 hrs	3 hrs	15	35	50	
VI	Paper VII	Theory	4 hrs	3 hrs	20	80	100	300
		Practicals	3 hrs	3 hrs	15	35	50	
	Paper VIII	Theory	4 hrs	3 hrs	20	80	100	
		Practicals	3 hrs	3 hrs	15	35	50	

Total marks 1000

NEW SYLLABUS
FIRST SEMESTER MATHEMATICS
PAPER – I (ALGEBRA I AND DIFFERENTIAL CALCULUS I)

(4 lecture hours per week + 3 hours of practical/week per batch of not more than 15 students)

(56 HOURS)

THEORY

Matrices (14 hrs)

Rank of a matrix – Elementary row/column operations – Invariance of rank under elementary operations – inverse of a non-singular matrix by elementary operations.

System of m linear equations in n unknowns – matrices associated with linear equations – trivial and non trivial solutions – criterion for existence of non-trivial solution of homogeneous and non-homogeneous systems – Criterion for uniqueness of solutions – Problems.

Eigen values and eigenvectors of a square matrix – Properties – Diagonalization of a real symmetric matrix – Cayley - Hamilton theorem – Applications to determine the powers of square matrices and inverses of non-singular matrices.

Theory of Equations (14 hrs)

Theory of equations – Euclid's algorithm – Polynomials with integral coefficients – Remainder theorem – Factor theorem – Fundamental theorem of algebra(statement only) – Irrational and complex roots occurring in conjugate pairs – Relation between roots and coefficients of a polynomial equation – symmetric functions – transformation – Reciprocal equations – Descartes' rule of signs – multiple roots – solving cubic equations by Cardon's method – solving quartic equations by Descarte's Method.

Differential Calculus (28 hrs)

Recapitulation of limits, Continuity and differentiability - Derivatives of higher order – n^{th} derivatives of the functions: e^{ax}, $(ax + b)^n$, log(ax + b), sin(ax + b) , cos(ax + b), e^{ax} *sin*(bx+ c), e^{ax} cos(bx + c) – Problems, Leibnitz theorem (with proof) – Monotonic functions – Maxima and Minima – Concavity Convexity and points of inflection.

Polar coordinates – angle between the radius vector and the tangent at a point on a curve – angle of intersection between two curves – Pedal equations – Derivative of arc length in Cartesian, parametric and polar form, Coordinates of center of curvature – radius of curvature – circle of curvature – evolutes.

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Reference Books

1. Natarajan, Manicavasagam Pillay and Ganapathy – Algebra
2. Serge Lang – First Course in Calculus
3. Lipman Bers – Calculus, Volumes 1 and 2
4. N. Piskunov – Differential and Integral Calculus

5. B S Vatssa, Theory of Matrices, New Delhi: New Age International Publishers, 2005.
6. A R Vashista, Matrices, Krishna Prakashana Mandir, 2003.
7. G B Thomas and R L Finney, Calculus and analytical geometry, Addison Wesley, 1995.
8. J Edwards, An elementary treatise on the differential calculus: with Applications and numerous example, Reprint. Charleston, USA BiblioBazaar, 2010.
9. N P Bali, Differential Calculus, India: Laxmi Publications (P) Ltd.., 2010.
10. S Narayanan & T. K. Manicavachogam Pillay, Calculus.:S. Viswanathan Pvt. Ltd., vol. I & II 1996.
11. Frank Ayres and Elliott Mendelson, Schaum's Outline of Calculus, 5th ed.USA: Mc. Graw Hill., 2008.
12. Shanti Narayan and P K Mittal, Text book of Matrices, 5^{th} edition, New Delhi, S Chand and Co. Pvt. Ltd.,2013.
13. Shanthi Narayan and P K Mittal, Differential Calculus, Reprint. New Delhi: S Chand and Co. Pvt. Ltd., 2014.

PRACTICALS – I

Mathematics practical with Free and **o**pen **S**ource **S**oftware **(FOSS) tools for computer programs (3 hours/ week per batch of not more than 15 students)**

LIST OF PROBLEMS

1. Introduction to Scilab and commands connected with matrices.
2. Computations with matrices.
3. Row reduced echelon form and normal form.
4. Establishing consistency or otherwise and solving system of linear equations.
5. Introduction to Maxima and commands for derivatives and n^{th} derivatives.
6. n^{th} derivative without Leibnitz rule.
7. n^{th} derivative with Leibnitz rule.
8. Scilab and Maxima commands for plotting functions.
11. Plotting of standard Cartesian curves using Scilab/Maxima.
12. Plotting of standard Cartesian curves using Scilab/Maxima.
13. Plotting of standard Polar curves using Scilab/Maxima.
14. Plotting of standard parametric curves using Scilab/Maxima.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

SECOND SEMESTER MATHEMATICS – PAPER – II
(DIFFERENTIAL CALCULUS II AND INTEGRAL CALCULUS I)

(4 lecture hours per week+3 hours of practical/week per batch of not more than 15 students)

(56 HOURS)

THEORY

Limits, Continuity and Differentiability (28 hrs)

Limit of a function – properties and problems, Continuity of functions – properties and problems – Infimum and supremum of a function – Theorems on continuity – Intermediate value theorem.

Differentiability – Rolle's theorem – Lagrange's Mean Value theorem – Cauchy's mean value theorem – Taylor's theorem – Maclaurin's theorem – Generalised mean value theorem – Taylor's infinite series and power series expansion – Maclaurin's infinite series – indeterminate forms.

Partial Derivatives (14 hrs)

Functions of two or more variables – Explicit and implicit functions – The neighbourhood of a point – The limit of a function – Continuity – Partial derivatives — Homogeneous functions – Euler's theorem – chain rule – change of variables – Directional derivative – Partial derivatives of higher order – Taylor's theorem for two variables – Derivatives of implicit functions – Jacobians – Some illustrative examples.

Integral Calculus (14 hrs)

Reduction formulae for $\int sin^n x\,dx$, $\int cos^n x\,dx$, $\int tan^n x\,dx$, $\int cot^n x\,dx$, $\int sec^n x\,dx$, $\int x^n sin\,x\,dx$, $\int x^n cos\,x\,dx$, $\int cosec^n x\,dx$, $\int sin^m x\,cos^n x\,dx$, with definite limits.

Books for Reference

1. Serge Lang – First Course in Calculus
2. Lipman Bers – Calculus Volumes 1 and 2
3. Shanthinarayan – Integral Calculus, New Delhi: S. Chand and Co. Pvt. Ltd.
4. Shanthinarayan and P K Mittal, Integral Calculus, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.
5. N P Bali, Differential Calculus, India: Laxmi Publications (P) Ltd.., 2010.
6. S. Narayanan & T. K. Manicavachogam Pillay, Calculus, S. Viswanathan Pvt. Ltd., vol. I & II 1996.
7. G B Thomas and R L Finney, Calculus and analytical geometry, Addison Wesley, 1995.

PRACTICALS –II

Mathematics practical with FOSS tools for computer programs (3 hours/ week per batch of not more than 15 students)

LIST OF PROBLEMS

1. Creating a Scilab program (simple examples).
2. Creating a Maxima program (simple examples).
3. Verification of Euler's theorem, its extension and Jacobian.
4. Scilab/Maxima programs to illustrate left hand and right hand limits for discontinuous functions.
5. Scilab/Maxima programs to illustrate continuity of a function.
6. Scilab/Maxima programs to illustrate differentiability of a function.
7. Scilab/Maxima programs to verify Rolle's Theorem and Lagrange's theorem.
8. Scilab/Maxima programs to verify Cauchy's mean value theorem and finding Taylor's theorem for a given function.
9. Evaluation of limits by L'Hospital's rule using Scilab/Maxima.
10. Obtaining partial derivatives of some standard functions
11. Maxima commands for reduction formula with or without limits.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

THIRD SEMESTER MATHEMATICS – PAPER – III
(ALGEBRA II AND DIFFERENTIAL EQUATIONS I)

(4 lecture hours per week+3 hours of practical/week per batch of not more than 15 students)

(56 HOURS)

THEORY

Group Theory (28 hrs)

Definition and examples of groups – Some general properties of Groups, Group of permutations - cyclic permutations – Even and odd permutations. Powers of an element of a group – Subgroups – Cyclic groups problems and theorems.

Cosets, Index of a group, Langrange's theorem, consequences. Normal Subgroups, Quotient groups – Homomorphism. – Isomorphism - Automorphism – Fundamental theorem of homomorphism,

Differential Equations-I (28 hrs)

Recapitulation **of** Definition, examples of differential equations, formation of differential equations by elimination of arbitrary constants, **Differential equations of first order-** separation of variables, homogeneous differential equations. Exact differential equations, reducible to exact, Linear differential equations. The general solution of a linear equation – Integrating factors found by inspection. The determination of integrating factors, Bernoulli's equation.

Ordinary Linear differential equations with constant coefficients – complementary function – particular integral – Inverse differential operators. Cauchy – Euler differential equations – Simultaneous differential equations (two variables with constant coefficients)

Books for References:

1. Daniel A Murray – Introductory Course to Differential equations
2. Earl David Rainville and Philip Edward Bedient – A short course in Differential equations, Prentice Hall College Div; 6th edition.
3. I. N. Herstien – Topics in Algebra.
4. Joseph Gallian – Contemporary Abstract Algebra, Narosa Publishing House, New Delhi, Fourth Edition.
5. G. D. Birkhoff and S Maclane – A brief Survey of Modern Algebra.
6. J B Fraleigh – A first course in Abstract Algebra.
7. Michael Artin – Algebra, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.
8. Vashista, A First Course in Modern Algebra, 11th ed.: Krishna Prakasan Mandir, 1980.
9. R Balakrishan and N.Ramabadran, A Textbook of Modern Algebra, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
10. M D Raisinghania, Advanced Differential Equations, S Chand and Co. Pvt. Ltd., 2013.

11. F.Ayres, Schaum's outline of theory and problems of Differential Equations, 1st ed. USA McGraw-Hill, 2010.
12. S Narayanan and T K Manicavachogam Pillay, Differential Equations .: S V Publishers Private Ltd., 1981.
13. G F Simmons, Differential equation with Applications and historical notes, 2nd ed.: McGraw-Hill Publishing Company, Oct 1991.

PRACTICALS –III

Mathematics practical with FOSS tools for computer programs (3 hours/ week per batch of not more than 15 students)

LIST OF PROBLEMS

1. Verifying whether given operator is binary or not.
2. To find identity element of a group.
3. To find inverse element of a group.
4. Finding all possible subgroups of a finite group.
5. Examples to verify Lagrange's theorem.
6. Illustrating homomorphism and isomorphism of groups.
7. Verification of Normality of a given subgroup.
8. Verifying Cayley's theorem and isomorphism theorems.
9. Examples for finding left and right coset and finding the index of a group.
10. Solution of Differential equation using Scilab/Maxima and plotting the solution-I.
11. Solution of Differential equation using Scilab/Maxima and plotting the solution-II.
12. Solution of Differential equation using Scilab/Maxima and plotting the solution-III.
13. Solution of Differential equations using Scilab/Maxima and Plotting the solution-IV.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of scilab/maxima

FOURTH SEMESTER MATHEMATICS – PAPER – IV

(DIFFRENTIAL EQUATIONS II AND INTEGRAL CALCULUS II)

(4 lecture hours per week+3 hours of practical/week per batch of not more than 15 students)

(56 HOURS)

THEORY

Linear differential equations (14 hrs)

Solution of ordinary second order linear differential equations with variable coefficient by the following methods:

(i) When a part of complementary function is given.
(ii) Changing the independent variable
(iii) Changing the dependent variable.
(iv) By method of variation of parameters.
(v) Exact equations.

Total differential equations – Necessary and sufficient condition for the equation Pdx + Qdy + Rdz = 0 to be exact (proof only for the necessary part) – Simultaneous equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$.

Partial differential equations (14 hrs)

Basic concepts – Formation of a partial differential equations by elimination of arbitrary constants and functions – Solution of partial differential equations – Solution by Direct integration, Lagrange's linear equations of the form Pp + Qq = R , Standard types of first order non-linear partial differential equations – Charpit's method – Homogenous linear equations with constant coefficient – Rules for finding the complementary function – Rules for finding the particular integral, Method of separation of variables (product method).

Line and Multiple Integrals (28 hrs)

Definition of a line integral and basic properties – Examples on evaluation of line integrals – Definition of a double integral – Conversion to iterated integrals – Evaluation of double integrals under given limits - Evaluation of double integrals in regions bounded by given curves – Changing the order of integration, Change of variables from Cartesian to polar - Surface areas.

Definition of a triple integral – Evaluation – Change of variables (Cylindrical and Spherical) – Volume as a triple integral.

Books for References:

1. G. Stephonson – An introduction to Partial Differential Equations.

2. B. S. Grewal – Higher Engineering Mathematics
3. E. Kreyszig – Advanced Engineering Mathematics
4. E. D. Rainville and P E Bedient – A Short Course in Differential Equations
5. D. A Murray – Introductory Course in Differential Equations.
6. G. P. Simmons – Differential Equations
7. F. Ayres – Differential Equations (Schaum Series)
8. Martin Brown – Application of Differential Equations.
9. S. C. Malik –Real Analysis

PRACTICALS –IV

Mathematics practical with FOSS tools for computer programs (3 hours/ week per batch of not more than 10 students)

LIST OF PROBLEMS

1. Finding complementary function and particular integral of constant coefficient second and higher order ordinary differential equations.
2. Solving second order linear partial differential equations in two variables with constant coefficient.
3. Solutions to the problems on total and simultaneous differential equations.
4. Solutions to the problems on different types of Partial differential equations.
5. Evaluation of the line integral with constant limits.
6. Evaluation of the line integral with variable limits.
7. Evaluation of the double integral with constant limits.
8. Evaluation of the double integral with variable limits.
9. Evaluation of the triple integral with constant limits.
10. Evaluation of the triple integral with variable limits.
11. Scilab/Maxima programs for area and volume.

Note: The above list may be changed annually with the approval of the BOS in UG Mathematics). Geogebra/Octave may also be used in place of scilab/maxima.

FIFTH SEMESTER MATHEMATICS – PAPER – V
(REAL ANALYSIS AND APPLIED MATHEMATICS)

(4 lecture hours per week + 3 hours of practical/week per batch of not more than 15 students)

(56 HOURS)

THEORY

Real Sequences (14 hrs)

Sequence of real numbers – Bounded and unbounded sequences – Infimum and supremum of a sequence – Limit of a sequence – Sum, product and quotient of limits – Standard theorems on limits – Convergent , divergent and oscillatory sequences – Standard properties – Monotonic sequences and their properties – Cauchy's general principle of convergence.

Infinite Series (14 hrs)

Infinite series of real numbers – Convergence – divergence and oscillation of series – Properties of convergence – Positive term series – Geometric series – p series- Comparison tests – D'Alembert's ratio test – Raabe's test – Cauchy's root test – Leibnitz's test for alternating series.

Laplace Transforms (14 hrs)

Definition and basic properties – Laplace transforms of e^{kt}, cos kt, sin kt, a^t, t^n, cosh kt and sinh kt – Laplace transform of e^{at} F(t), t^n F(t), F(t)/t – problems – Laplace transform of derivatives of functions – Laplace transforms of integrals of functions – Laplace transforms of α-functions – Inverse Laplace transforms – problems.

Convolution theorem – Simple initial value problems – Solution of first and second order differential equations with constant coefficients by Laplace transform method .

Fourier series (14 hrs)

Introduction – Periodic functions – Fourier series and Euler formulae (statement only) – Even and odd functions – Half range series – Change of interval.

Reference:

1. S.C Malik –Real Analysis
2. Murray R Speigel – Laplace Transforms
3. S.C.Malik and Savita Arora, *Mathematical Analysis*, 2nd ed. New Delhi, India: New Age international (P) Ltd., 1992
4. Richard R Goldberg, Methods of Real Analysis, Indian ed.
5. Asha Rani Singhal and M .K Singhal, A first course in Real Analysis
6. E.Kreyszig- Advanced Engineering Mathematics, Wiely India Pvt. Ltd.
7. Raisinghania M. D., Laplace and Fourier Transforms S. Chand publications.

PRACTICALS –V

Mathematics practical with FOSS tools for computer programs (3 hours/ week per batch of not more than 10 students)

LIST OF PROBLEMS

1. Illustration of convergent, divergent and oscillatory sequences using Scilab/Maxima.
2. Using Cauchy's criterion to determine convergence of a sequence (simple examples).
3. Illustration of convergent, divergent and oscillatory series using Scilab/Maxima.
4. Scilab/Maxima programs to find the sum of the series and its radius of convergence.
5. Using Cauchy's criterion on the sequence of partial sums of the series to determine convergence of series.
6. Testing the convergence of binomial, exponential and logarithmic series and finding the sum.
7. To plot periodic functions with period 2π and $2L$.
8. To find full range trigonometric Fourier series of some simple functions with period 2π and $2L$.
9. Plotting of functions in half-range and including their even and odd extensions.
10. To find the half-range sine and cosine series of simple functions.
11. Finding the Laplace transforms of some standard functions.
12. Finding the inverse Laplace transform of simple functions.
13. Implementing Laplace transform method of solving ordinary linear differential equations of first and second order with constant coefficient.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of scilab/maxima.

FIFTH SEMESTER MATHEMATICS – PAPER – VI
(ALGEBRA III AND NUMERICAL ANALYSIS)
(4 lecture hours per week+3 hours of practical/week per batch of not more than 15 students)

(56 HOURS)

THEORY

Rings and Fields (28 hrs)

Rings – Examples – Integral Domains – Division rings – Fields – Subrings. Subfields – Characteristic of a ring – Ordered integral domain – Imbedding of a ring into another ring – The field of quotients – Ideals – Algebra of Ideals – Principal ideal ring – Divisibility in an integral domain – Units and Associates – prime Elements – Polynomial rings – Divisibility – Irreducible polynomials – Division Algorithm – Greatest Common Divisors – Euclidean Algorithm – Unique factorization theorem – Prime fields – Quotient rings – homomorphism of rings – Kernel of a ring homomorphism – Fundamental theorem of homomorphism – Maximal ideals – Prime ideals – Properties – Eisensten's Criterion of irreducibility.

Riemann integration (28 hrs)

The Riemann integral – Upper and lower sums – Criterion for integrability – Integrability of continuous functions and monotonic functions – Fundamental theorem of Calculus – Change of variables – Integration by parts – First and second mean value theorems of integral calculus.

Books for References:

1. I. N. Herstien – Topics in Algebra.
2. G. D. Birkhoff and S Maclane – A brief Survey of Modern Algebra.
3. T. K. Manicavasagam Pillai and K S Narayanan – Modern Algebra Volume 2
4. J B Fraleigh – A first course in Abstract Algebra.
5. S.C Mallik – Real Analysis.
6. Leadership project – Bombay university- Text book of mathematical analysis
7. S. S. Bali – Real analysis.

PRACTICALS –VI

Mathematics practical with FOSS tools for computer programs (3 hours/ week per batch of not more than 15 students)

LIST OF PROBLEMS

1. Examples on different types of rings.

2. Examples on integral domains and fields.

3. Examples on subrings, ideals and subrings which are not ideals.

4. Homomorphism and isomorphism of rings- illustrative examples.

5. Solving polynomial equations using Scilab/Maxima.

6. Finding G.C.D of polynomials.

7. Finding units and associates

8. Test for rational roots.

9. Implementing vector form of line.

10. Implementing vector form of plane.

11. Implementing intersection of planes and distance of a point from a plane

12. Plotting of ruled surfaces. Ellipsoid, Hyperboloid of one sheet, Hyperboloid of two sheets.

13. Plotting of cylinders and cones.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of scilab/maxima.

SIXTH SEMESTER MATHEMATICS – PAPER – VII
(ALGEBRA IV AND CALCULUS III)

(4 lecture hours per week+3 hours of practical/week per batch of not more than 15 students)

(56 HOURS)

THEORY

Vector Spaces (14 hrs)

Vector Spaces – Introduction – Examples – Vector subspaces – Criterion for a subset to be a subspace – Algebra of Subspaces – Linear Combination – Linear Span – Linear dependence and linear Independence of vectors – Theorems on linear dependence and linear independence – Basis of a vector space – Dimension of a vector space — Some properties – Quotient spaces - Homomorphism of vector spaces– Isomorphism of vector spaces – Direct Sums

Linear Transformations (14 hrs)

Linear transformation – Linear maps as matrices – Change of basis and effect of associated matrices – Kernel and image of a linear transformation - Rank and nullity theorem – Eigenvalues and eigen vectors of a linear transformation.

Improper Integrals (14 hrs)

Improper Integrals (definition only) – Gamma and Beta functions and results following the definitions – Connection between Beta and gamma functions – applications of evaluation of integrals – Duplication formula.

Vector Calculus (14 hrs)

Vectors – Scalars – Vector Field – Scalar field – Vector differentiation – The vector differential operator Gradient – Divergence – Curl – Standard derivations –vector integration-Green's theorem in plane.

Books for References:

1. I. N. Herstien – Topics in Algebra.
2. Stewart – Introduction to Linear Algebra
3. T. K. Manicavasagam Pillai and K S Narayanan – Modern Algebra Volume 2
4. S. Kumaresan – Linear Algebra
5. G. D. Birkhoff and S Maclane – A brief Survey of Modern Algebra.
6. Gopalakrishna – University Algebra
7. Saymour Lipschitz – Theory and Problems of Linear Algebra.
8. S.C Mallik –Real Analysis.
9. B.S Grewal – Higher engineering mathematics.
10. Murray R Spiegel – Theory and problems of vector calculus.
11. Shanthinarayan and J N Kapur – A text book of Vector calculus.

PRACTICALS –VII

Mathematics practical with FOSS tools for computer programs (3 hours/ week per batch of not more than 15 students)

LIST OF PROBLEMS

1. Vector space, subspace – illustrative examples.
2. Expressing a vector as a linear combination of given set of vectors.
3. Examples on linear dependence and independence of vectors.
4. Basis and Dimension – illustrative examples.
5. Verifying whether a given transformation is linear.
6. Finding matrix of a linear transformation.
7. Problems on rank and nullity.
8. To demonstrate the physical interpretation of gradient, divergence and curl.
9. Writing gradient, divergence, curl and Laplacian in cylindrical coordinates.
10. Writing gradient, divergence, curl and Laplacian in spherical coordinates.
11. Using cyclic notations to derive different vector identities.
12. Using cyclic notations to derive some more vector identities.

13. Verifying Green's theorem.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of Scilab/maxima.

SIXTH SEMESTER MATHEMATICS – PAPER – VIII
(COMPLEX ANALYSIS AND NUMERICAL ANALYSIS)
(4 lecture hours per week+3 hours of practical/week per batch of not more than 15 students)

(56 HOURS)

THEORY

Functions of a Complex Variable (14 hrs)

Equation to a circle and a straight line in complex form Limit of a function – Continuity and differentiability – Analytic functions – Singular points – Cauchy-Riemann equations in Cartesian and polar forms – Necessary and sufficient condition for function to be analytic – Harmonic functions – Real and Imaginary parts of an analytic function are harmonic – Construction of analytic function i) Milne Thomson Method – ii) using the concept of Harmonic function.

Complex Integration (14 hrs)

The complex Line integral – Examples and Properties – Proof of Cauchy's Integral theorem using Green's Theorem – Direct consequences of Cauchy's theorem – The cauchy's integral formula for the function and the derivatives – Applications to the evaluations of simple line integrals – Cauchy's Inequality – Liouville's theorem – Fundamental theorem of Algebra.

Numerical Analysis (28 hrs)

Numerical solutions of Algebraic and transcendential equations – Bisection method – The method of false position – Newton – Raphson method .

Numerical solutions of first order linear differential equations – Euler – Cauchy method – Euler's modified method – Runge -Kutta fourth order method – Picard's method.

Finite differences – Forward and backward differences – shift operator – Interpolation – Newton – Gregory forward and backward interpolation formulae – Lagrange's interpolation formula

Numerical integration – General quadrature formula – Trapezoidal Rule – Simpson's 1/3 rule – Simpson's 3/8 th rule, Weddle's rule.

Books for References:

1. L. V. Ahlfors – Complex Analysis
2. Bruce P. Palica – Introduction to the Theory of Function of a Complex Variable

3. Serge Lang – Complex Analysis
4. Shanthinarayan – Theory of Functions of a Complex Variable
5. S. Ponnuswamy – Foundations of Complex Analysis
6. R. P. Boas – Invitation to Complex Analysis.
7. R V Churchil & J W Brown, Complex Variables and Applications, 5th ed.:McGraw Hill Companies., 1989.
8. A R Vashista, Complex Analysis, Krishna Prakashana Mandir, 2012.
9. B. D Gupta – Numerical Analysis
10. H. C Saxena – Finite Difference and Numerical Ana;ysis
11. S. S. Shastry- Introductory Methods of Numerical Analysis
12. B. S. Grewal – Numerical Methods for Scientists and Engineers
13. E. Ksreyszig – Advanced Engineering Mathematics.
14. M K Jain, S R K Iyengar, and R K Jain, Numerical Methods for Scientific and Engineering Computation, 4th ed. New Delhi, India: New Age International, 2012.
15. S S Sastry, Introductory methods of Numerical Analysis, Prentice Hall of India,2012.

PRACTICALS –VIII

Mathematics practical with FOSS tools for computer programs (3 hours/ week per batch of not more than 10 students)

LIST OF PROBLEMS

1. Some problems on Cauchy-Riemann equations (polar form).

2. Implementation of Milne-Thomson method of constructing analytic functions(simple examples).

3. Illustrating orthogonality of the surfaces obtained from the real and imaginary parts of an analytic function.

4. Verifying real and imaginary parts of an analytic function being harmonic (in polar coordinates).

5. Illustrating the angle preserving property in a transformation.

6. Illustrating that circles are transformed to circles by a bilinear transformation.

7. Examples connected with Cauchy's integral theorem.

8. Scilab/Maxima programs on Interpolations with equal intervals.

9. Scilab/Maxima programs on Interpolations with unequal intervals.

10. Solving algebraic equation (Bisection method).
11. Scilab/Maxima programs to evaluate integrals using Simpson's $\frac{1}{3}^{rd}$ rule.
12. Scilab/Maxima programs to evaluate integrals using Simpson's $\frac{3}{8}^{th}$ rule.
13. Solving algebraic equation (Regular-Falsi and Newton-Raphson methods).
14. Solving ordinary differential equation by modified Euler's method.
15. Solving ordinary differential equation by Runge-Kutta method of 4^{th} order.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in Place of scilab/maxima.

Useful web links for students:

1. http://www.cs.columbia.edu/~zeph/3203s04/lectures.html
2. http://home.scarlet.be/math/matr.htm
3. http://www.themathpage.com/
4. http://www.abstractmath.org/
5. http://ocw.mit.edu/courses/mathematics/
6. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
7. http://mathworld.wolfram.com/
8. http://www.univie.ac.at/future.media/moe/galerie.html
9. http://www.mathcs.org/
10. http://www.amtp.cam.ac.uk/lab/people/sd/lectures/nummeth98/index.htm
11. http://math.fullerton.edu/mathews/numerical.html
12. http://www.onesmartclick.com/engineering/numerical-methods.html
13. http://www.math.gatech.edu/~harrell/calc/
14. http://tutorial.math.lamar.edu/classes/de/de.aspx
15. http://www.sosmath.com/diffeq/diffeq.html
16. http://www.analyzemath.com/calculus/Differential_Equations/applications.html
17. http://www.math.gatech.edu/~harrell/calc/
18. http://www.amtp.cam.ac.uk/lab/people/sd/lectures/nummeth98/index.htm
19. http://www.fourier-series.com/
20. http://www.princeton.edu/~rvdb
21. http://www.zweigmedia.com/RealWorld/Summary4.html
22. http://www.math.unl.edu/~webnotes/contents/chapters.htm
23. http://www-groups.mcs.st-andrews.ac.uk/~john/analysis/index.html
24. http://web01.shu.edu/projects/reals/index.html

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Pattern of Question Paper

(For the semester I)

(Paper-I)

(Duration of Exam 3 Hrs) Max marks 60

Part A

Answer any six questions 6×2 =12

1-2 Matrices

3-4 Theory of Equations

5-8 Differential calculus

Part B

Answer any six questions 6×4 =24

1-4 Matrices

5-8 Theory of Equations

Part C

Answer any six questions 6×4 =24

1-8 Differential calculus

(For the semester II)

(Paper-II)

(Duration of Exam 3 Hrs) Max marks 60

Part A

Answer any six questions 6×2 =12

1-4 Limits, Continuity and Differentiability

5-6 Partial derivatives

7-8 Integral calculus

Part B

Answer any six questions 6×4 =24

1-8 Limits, Continuity and Differentiability

Part C

Answer any six questions 6×4 =24

1-4 Partial derivatives

5-8 Integral calculus

(For the semester III)

(Paper-III)

(Duration of Exam 3 Hrs) Max marks 60

Part A

Answer any six questions 6×2 =12

1-4 Group Theory

5-8 Differential equations

Part B

Answer any six questions 6×4 =24

1-8 Group Theory

Part C

Answer any six questions 6×4 =24

1-8 Differential equations

(For the semester IV)

(Paper-IV)

(Duration of Exam 3 Hrs) Max marks 60

Part A

Answer any six questions 6×2 =12

1-2 Linear differential equations

3-4 Partial differential equations

5-8 Line and multiple integrals

Part B

Answer any six questions 6×4 =24

1-4 Linear differential equations

5-8 Partial differential equations

Part C

Answer any six questions 6×4 =24

1-8 Line and multiple integrals

(For the semester V)

Paper-V

(Duration of Exam 3 Hrs) Max marks 80

Part A

Answer any eight questions 8×2 =16

1-3 Real sequences

4-6 Infinite series

7-9 Laplace transforms

10-12 Fourier series

Part B

Answer any eight questions 8×4 =32

1-5 Real sequences

6-10 Infinite series

Part C

Answer any eight questions 8×4 =32

1-5 Laplace transforms

6-10 Fourier series

(For the semester V)

Paper-VI

(Duration of Exam 3 Hrs) Max marks 80

Part A

Answer any eight questions 8×2 =16

1-6 Rings and Fields

7-12 Riemann integration

Part B

Answer any eight questions 8×4 =32

1-10 Rings and Fields

Part C

Answer any eight questions 8×4 =32

1-10 Riemann integration

(For the semester VI)

Paper-VII

(Duration of Exam 3 Hrs) Max marks 80

Part A

Answer any eight questions 8×2 =16

1-3 Vectorspaces

4-6 Linear transformations

7-9 Improper Integrals

10-12 Vector Calculus

Part B

Answer any eight questions 8×4 =32

1-5 Vectorspaces

6-10 Linear transformations

Part C

Answer any eight questions 8×4 =32

1-5 Improper Integrals

6-10 Vector Calculus

(For the semester VI)

Paper-VIII

(Duration of Exam 3 Hrs) Max marks 80

Part A

Answer any eight questions 8×2 =16

1-3 Functions of complex variable

4-6 Complex integration

7-12 Numerical Analysis

Part B

Answer any eight questions 8×4 =32

1-5 Functions of complex variable

6-10 Complex integration

Part C

Answer any eight questions 8×4 =32

1-10 Numerical Analysis