MATH 1002	Mathematics I	L	T	P	C
Version 1.0		3	1	0	4
Pre-requisites/Exposure	Mathematics up to class XII				
Co-requisites	--				

Course Objectives

1. To enable the students to understand the basic concepts of differential and integral calculus.
2. To help the students develop the skills related to mathematical logic.
3. To enable students to understand the matrix theory.
4. To make the students able to understand the basic knowledge of algebraic structure.

Course Outcomes

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

CO1. Develop an understanding of differential calculus, multiple integrals and connect them to the applied problems from other disciplines.
CO2. Examine mathematical arguments using propositional logic.
CO3. Develop an understanding of the fundamental concepts of matrices and solution of a system of linear equations by rank method.
CO4. Demonstrate a working knowledge of fundamental algebraic structures (e.g. groups, rings and fields).

Catalog Description

Mathematics is a natural complementary discipline for learning, understanding and appreciating many fundamental computer science concepts. It helps us to develop logical thinking and also to find the right way to solve problems. The purpose of this course is to provide participants with the skills, knowledge required to perform fundamental mathematical procedures and processes for solution of engineering problems, particularly the use of calculus, mathematical logic, matrices and advanced algebra. Continuous mathematics is an important foundation for engineering disciplines while discrete mathematics and mathematical logic are foundations for computer-based disciplines such as computer science, software engineering and information systems. The basic concepts of modern algebra such as groups and rings play a fundamental role in mathematics itself and in the application to the areas such as computer science, cryptography and engineering.

Course Content

Unit I: Differential Calculus and Multiple Integrals 16 lecture hours

Higher order derivatives, successive differentiation, Leibnitz's theorem, Introduction to partial differentiation, Euler's theorem, Jacobians, Maxima and minima, Double integrals, Change of order of integration, Change of variables, Triple integrals, Applications of double and triple integrals (area, volume, centre of gravity and moment of inertia)

Unit III: Mathematical Logic 6 lecture hours

Proposition, logical connectives, Truth tables, tautology, contradiction, Normal forms (conjunctive and disjunctive), Converse, inverse, contrapositive, Validity of an argument, Universal and existential quantifiers

Unit I: Matrices **9 lecture hours**

Linear independence/dependence of vectors, rank of a matrix, Consistency of system of linear equations and its solution, Eigen values and Eigen vectors, Cayley-Hamilton theorem, Diagonalization

Unit IV: Algebraic Structures **11 lectures hours**

Semi group, monoid, group, abelian group-definitions and properties, Subgroup, cyclic group, Cosets, Lagrange's theorem, Permutation group, alternating group, Normal subgroup, Homomorphism and isomorphism of groups, Rings, integral domains and fields

Text Books:

1. E. Kreyszig, Advanced Engineering Mathematics, Wiley Publications. ISBN: 9788126531356.
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publications. ISBN: 9788184875607.
3. S. Lipschutz and M. Lipson, Discrete Mathematics, Tata Mcgraw Hill Professional, ISBN: 9781259062537.

Reference Books:

1. A. Jeffery, Advanced Engineering Mathematics, Academic Press, ISBN: 9780080522968.
2. M. D. Greenberg, Advanced Engineering Mathematics, Pearson Education, India. ISBN: 9788177585469.
3. B. Kolman, R. C. Busby and S. C. Ross, Discrete Mathematical Structures, PHI Learning, ISBN: 9780132297516.
4. I. N. Herstein, Abstract Algebra, Prentice Hall, ISBN: 9780471368793.

Modes of Evaluation: Class tests/Assignment/ Tutorial Assessment/ Written Examination

Examination Scheme:

Components	Tutorial/Faculty Assessment	Class Tests	MSE	ESE
Weightage (%)	15	15	20	50

Relationship between the Program Outcomes (POs), Program Specific Outcomes and Course Outcomes (COs)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
CO2	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
CO3	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
CO4	3	2	0	0	2	0	0	0	0	0	0	0	0	0	0
Average	**3**	**2**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

1. WEAK 2. MODERATE 3. STRONG

Model Question Paper

Name:

Enrolment No:

UPES

Course: MATH 1002 – Mathematics I

Programme: B.Tech. (All SoCS Programmes) **Semester: I (ODD-2017-18)**

Time: 03 hrs. **Max. Marks:100**

Instructions:

Attempt all questions from **Section A:** (each carrying 4 marks), all questions from **Section B** (each carrying 10 marks) and all questions from **Section C** (each carrying 20 marks)**.**

SECTION A
(Attempt all questions)

1.	If $u=\tan^{-1}x+\tan^{-1}y$ and $v=\dfrac{x+y}{1-xy}$, find $\dfrac{\partial(u,v)}{\partial(x,y)}$. Are u and v functionally related? If so find the relationship.	**[4]**	**CO1**
2.	If $u=\sin^{-1}\left(\dfrac{x^{1/4}+y^{1/4}}{x^{1/6}+y^{1/6}}\right)$, then find xu_x+yu_y .	**[4]**	**CO1**
3.	If p and q are two statement variables, then check whether the given statement formula $\sim(p\vee q)\vee\left[(\sim p\vee q)\wedge p\right]$ is tautology or not?	**[4]**	**CO2**
4.	Using Cayley-Hamilton theorem, find the matrix which is represented by the expression $A^5-4A^4-7A^3+11A^2-A-10I$ where $A=\begin{bmatrix}1 & 4\\ 2 & 3\end{bmatrix}$	**[4]**	**CO3**
5.	Consider the cyclic group $G=\{1,2,3,4,5,6\}$ w.r.t. multiplication modulo 7. Find all the generators of G.	**[4]**	**CO4**

SECTION B
(Q6-Q8 are compulsory and Q9 has internal choice.)

6.	Discuss that the consistency of a system of linear equations $x+y+z=6$, $x+2y+3z=14$ and $x+4y+7z=30$ and hence find its solution.	**[10]**	**CO3**
7.	Consider the following argument: If a student knows Mathematics then he does well in Computer Science. If a student does well in Computer Science, he gets handsome salary in a reputed company. A student is getting handsome salary in a reputed company. _____ Therefore, he knows Mathematics. Is the above argument valid?	**[10]**	**CO2**
8.	Prove that the set $G=\left\{\begin{bmatrix}a & a\\ a & a\end{bmatrix}: a\in\mathbb{R},\ a\neq 0\right\}$ is a group under matrix multiplication.	**[10]**	**CO4**

9.	If $y = \tan^{-1}\left(\frac{x}{a}\right)$, then prove that $y_n = \frac{(-1)^{n-1}(n-1)!\sin(n\theta)}{r^n}$, where $r = \sqrt{x^2 + a^2}$ and $\theta = \tan^{-1}\left(\frac{a}{x}\right)$. **OR** If $\frac{x^2}{a^2+u} + \frac{y^2}{b^2+u} + \frac{z^2}{c^2+u} = 1$, show that $\left(\frac{\partial u}{\partial x}\right)^2 + \left(\frac{\partial u}{\partial y}\right)^2 + \left(\frac{\partial u}{\partial z}\right)^2 = 2\left(x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z}\right)$.	**[10]**	**CO1**
	SECTION C **(Q10 is compulsory, Q11A and Q11B have internal choice.)**		
10.	Show that the matrix $A = \begin{bmatrix} -9 & 4 & 4 \\ -8 & 3 & 4 \\ -16 & 8 & 7 \end{bmatrix}$ is diagonalizable. Also find the diagonal form and a modal matrix P.	**[20]**	**CO3**
11 A	Evaluate $\iint_R xy\,dx\,dy$, over the region R given by $x^2 + y^2 = 2x$, $y^2 = 2x$ and $y = x$. **OR** Find the volume cut off from the sphere $x^2 + y^2 + z^2 = a^2$ by the cylinder $x^2 + y^2 = ax$.	**[10]**	**CO1**
11B	Find the order of each element in the group $\mathbb{Z}_8 = \{0,1,2,3,4,5,6,7\}$ with respect to the operation of addition modulo 8. **OR** Show that $G = (\{0,\ 2,\ 3,\ 4,\ 5\}, +_6)$ is cyclic. Find all the generators of the cyclic group.	**[10]**	**CO4**