UNITED INSTITUTE OF TECHNOLOGY
(An Autonomous Institution)
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Periyanaickenpalayam, Coimbatore – 641020

# GE3151 – PROBLEM SOLVING AND PYTHON PROGRAMMING

## QUESTION BANK

**I SEMESTER**

**R2021**

**(Common to CSE, CSE(CS), IT & R&A)**

| | | |
|---|---|---|
| **PREPARED BY** | **VERIFIED BY** | **APPROVED BY** |

## UNIT-I

## COMPUTATIONAL THINKING AND PROBLEM SOLVING

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

| S.No | Questions | CO | BTL | Marks |
|---|---|---|---|---|
| **PART-A** | | | | |
| 1 | What is an algorithm? | 1 | 1 | 2 |
| 2 | What are the properties of algorithm? | 1 | 1 | 2 |
| 3 | What are the properties of algorithm? | 1 | 1 | 2 |
| 4 | What is a function? | 1 | 1 | 2 |
| 5 | Define a flowchart. | 1 | 1 | 2 |
| 6 | Compare machine language, assembly language and high-level language. | 1 | 2 | 2 |
| 7 | Define is recursion with an example. | 1 | 1 | 2 |
| 8 | What are advantages and disadvantages of recursion? | 1 | 1 | 2 |
| **PART-B** | | | | |
| 1 | What are the building blocks of an algorithm? Explain in detail. | 1 | 2 | 16 |
| 2 | Draw a flow chart to accept three distinct numbers, find the greatest and print the result. | 1 | 2 | 16 |
| 3 | Write a program to find the minimum number in a list. | 1 | 2 | 16 |
| 4 | State the Towers of Hanoi problem .Outline a solution to the Towers of Hanoi problem with relevant diagrams. | 1 | 2 | 16 |

## UNIT-II

## DATA TYPES, EXPRESSIONS, STATEMENTS

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string , and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

| S.No | Questions | CO | BTL | Marks |
|---|---|---|---|---|
| **PART-A** | | | | |
| 1 | What is meant by interpreter? | 2 | 1 | 2 |
| 2 | List down the basic data types in Python. | 2 | 1 | 2 |
| 3 | Define keyword and enumerate some of the keywords in Python. | 2 | 1 | 2 |
| 4 | Define an expression with example. | 2 | 1 | 2 |
| 5 | What do you mean by an operand and an operator? | 2 | 1 | 2 |
| 6 | Outline the logic to swap the content of two identifiers without using third variable. | 2 | 1 | 2 |
| 7 | What is meant by rule of precedence? Give the order of precedence | 2 | 1 | 2 |
| 8 | List down the different types of operator. | 2 | 1 | 2 |
| **PART-B** | | | | |
| 1 | Illustrate values and different standard data types with relevant examples. | 2 | 2 | 16 |
| 2 | What are the two modes of operation in python? Analyze the differences between them.. | 2 | 2 | 16 |
| 3 | Briefly explain the different types of operators and their function with suitable example. | 2 | 2 | 16 |
| 4 | (i). Write a python program to check whether a given year is a leap year or not.<br>(ii). Write a python program to circulate the values of n variables. | 2 | 2 | 16 |

## UNIT-III

## CONTROL FLOW, FUNCTIONS, STRINGS

Conditionals: Boolean values and operators, conditional (if), alternative (if-else),chained conditional (if-elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices,immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

| S.No | Questions | CO | BTL | Marks |
|---|---|---|---|---|
| | **PART-A** | | | |
| 1 | What are the different types of operators? | 3 | 1 | 2 |
| 2 | Explain modulus operator with example. | 3 | 2 | 2 |
| 3 | Comment with an example on the use of local and global variable with the same identifier name. | 3 | 1 | 2 |
| 4 | Explain ‘for loop’ with example. | 3 | 2 | 2 |
| 5 | What are chained conditionals? | 3 | 1 | 2 |
| 6 | What is range() function? | 3 | 1 | 2 |
| 7 | What is a break statement? | 3 | 2 | 2 |
| 8 | What is dead code? | 3 | 1 | 2 |
| | **PART-B** | | | |
| 1 | List the three types of conditional statements and explain them. | 3 | 2 | 16 |
| 2 | Write a python program to find the factorial of the given number with recursion and without recursion. | 3 | 2 | 16 |
| 3 | Write a short note on operations which are performed on strings in python and write a python script. | 3 | 2 | 16 |
| 4 | Write a user defined Python program to determine the GCD. | 3 | 2 | 16 |

## UNIT-IV

## LISTS, TUPLES, DICTIONARIES

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

| S.No | Questions | CO | BTL | Marks |
|---|---|---|---|---|
| | **PART-A** | | | |
| 1 | What is a list? | 4 | 1 | 2 |
| 2 | Mention any 5 list methods. | 4 | 1 | 2 |
| 3 | State the difference between lists and dictionary. | 4 | 1 | 2 |
| 4 | What is aliasing and cloning in List? Give an example. | 4 | 1 | 2 |
| 5 | What is List mutability in Python? Give an example. | 4 | 1 | 2 |
| 6 | Define key-value pairs. | 4 | 1 | 2 |
| 7 | Define dictionary with an example. And What is mapping? | 4 | 1 | 2 |
| 8 | How list differs from tuple. | 4 | 2 | 2 |
| | **PART-B** | | | |
| 1 | Name the operations that can be performed on a List and outline any four with Example. | 4 | 2 | 16 |
| 2 | Discuss in detail about list methods and list loops with examples. | 4 | 2 | 16 |
| 3 | Define dictionary in Python. Do the following operations on dictionaries.<br>(i). Initialize two dictionaries with Key and Value pair.<br>(ii). Merge two dictionaries and create a new dictionary using single Expression.<br>(iii). Find same Key in two dictionaries. | 4 | 2 | 16 |
| 4 | What is tuple in python? How does it differ from list? | 4 | 2 | 16 |

## UNIT-V

## FILES, MODULES, PACKAGES

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

| S.No | Questions | CO | BTL | Marks |
|---|---|---|---|---|
| | **PART-A** | | | |
| 1 | What is a text file? | 5 | 1 | 2 |
| 2 | What are the two parts in an error message? | 5 | 1 | 2 |
| 3 | What are the different file operations? | 5 | 1 | 2 |
| 4 | What is a pickle? | 5 | 1 | 2 |
| 5 | What are modules? | 5 | 1 | 2 |
| 6 | What is a package? | 5 | 1 | 2 |
| 7 | What is an exception? | 5 | 1 | 2 |
| 8 | How do you use command line arguments to give input to the program? | 5 | 2 | 2 |
| | **PART-B** | | | |
| 1 | Explain about the file reading and writing operations using format operator with python code. | 5 | 2 | 16 |
| 2 | What are modules in python? How will you import them? Explain the concept by creating and importing a module | 5 | 2 | 16 |
| 3 | Write a python program to count number of lines, words and characters in a text file. | 5 | 2 | 16 |
| 4 | Explain how exceptions are handled in python with necessary examples. | 5 | 2 | 16 |

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# CY3151
# ENGINEERING CHEMISTRY

## UNIT 1
## WATER AND ITS TREATMENT

Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

| Q.No | Question | CO | BTL | Marks |
|---|---|---|---|---|
| | **PART A** | | | |
| 1. | Define hardness. How is it classified? | 1 | 1 | 2 |
| 2. | What are BOD and COD? | 1 | 1 | 2 |
| 3. | What is break point chlorination? | 1 | 1 | 2 |
| 4. | Define desalination. | 1 | 1 | 2 |
| 5. | Name any two salts that cause temporary hardness. | 1 | 1 | 2 |
| 6. | Soft water is not demineralised water whereas demineralised water is soft water – Justify. | 1 | 3 | 2 |
| 7. | What is reverse osmosis (RO)? | 1 | 1 | 2 |
| 8. | Compare internal conditioning with external conditioning. | 1 | 2 | 2 |
| | **PART B** | | | |
| 1. | (i) Differentiate scales and sludges. | 1 | 4 | 8 |
| | (ii) Examine the boiler corrosion in detail. | 1 | 4 | 8 |
| 2. | (i) Outline the following terms<br>(a) Priming and Foaming (b) Caustic embrittlement | 1 | 4 | 8 |

| | | | | |
|---|---|---|---|---|
| | (ii) With a neat diagram describe the reverse osmosis method for the desalination of brackish water. | 1 | 4 | 8 |
| 3. | Explain the demineralization or ion exchange process with neat diagram and reactions. | 1 | 2 | 16 |
| 4 | Explain with a neat sketch the various steps in the treatment of water for municipal supply. | 1 | 3 | 16 |

## UNIT2
## NANOCHEMISTRY

**Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.**

| Q.No | QUESTION | CO | BTL | Marks |
|---|---|---|---|---|
| | **PART–A** | | | |
| 1. | Distinguish between bulk particles and nano particles. | 2 | 4 | 2 |
| 2. | What is magic number? | 2 | 1 | 2 |
| 3. | Define electro spinning. | 2 | 1 | 2 |
| 4. | List out any four nano materials. | 2 | 1 | 2 |
| 5. | Mention two applications of nano materials in energy. | 2 | 1 | 2 |
| 6. | What is the basic principle involved in solvothermal synthesis of nano materials. | 2 | 1 | 2 |
| 7. | Mention some uses of carbon nano tubes. | 2 | 1 | 2 |
| 8. | List out two applications of nano materials in catalysis. | 2 | 1 | 2 |

## PART B

| | | | | |
|---|---|---|---|---|
| 1. | (i) Define the terms: nanorods, nanotubes, nanowires and nanoclusters. | 2 | 1 | 8 |
| | (ii) Explain any eight applications of nano materials in various fields. | 2 | 1 | 8 |
| 2. | Explain about size dependent properties of nano materials. | 2 | 1 | 16 |
| 3. | Discuss the CVD and laser ablation methods for the synthesis of nanomaterials. | 2 | 5 | 16 |
| 4 | Describe the preparations of nano materials from Sol-gel and solvo thermal process. | 2 | 5 | 16 |

## UNIT-3

## PHASE RULE AND COMPOSITES

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process. Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

| Q.NO | QUESTION | CO | BTL | Marks |
|---|---|---|---|---|
| | **PART–A** | | | |
| 1. | State phase rule. | 3 | 1 | 2 |
| 2 | Define degree of freedom and components of the system with an example. | 3 | 1 | 2 |
| 3. | What is meant by triple point and eutectic point? | 3 | 1 | 2 |
| 4. | What is matrix phase? | 3 | 1 | 2 |
| 5. | Define a composite. | 3 | 1 | 2 |
| 6. | Mention the characteristics of FRP. | 3 | 1 | 2 |
| 7. | What are hybrid composites? | 3 | 1 | 2 |
| | **PART–B** | | | |
| 1. | Explain the properties and uses of metal-matrix composite. | 3 | 2 | 16 |
| 2. | How to construct the phase diagram using cooling curve. | 3 | 2 | 16 |

| | | | | |
|---|---|---|---|---|
| 3. | Elucidate a neat phase diagram and explain Pattinson's process through Pb-Ag system. | 3 | 2 | 16 |
| 4. | Write notes on (i) Ceramic matrix composites (ii) Hybrid composites. | 3 | 3 | 16 |

## UNIT-4
## FUELS AND COMBUSTION

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO2 emission and carbon footprint.

| Q.NO | QUESTION | CO | BTL | Marks |
|---|---|---|---|---|
| | **PART–A** | | | |
| 1. | Differentiate caking coal and coking coal? | 4 | 2 | 2 |
| 2 | Define octane number. | 4 | 1 | 2 |
| 3. | Distinguish between HCV and LCV. | 4 | 2 | 2 |
| 4. | Define spontaneous ignition temperature. | 4 | 1 | 2 |
| 5. | State the characteristics of a good fuel. | 4 | 1 | 2 |
| 6. | Suggest any two methods of reducing carbon emission. | 4 | 1 | 2 |
| 7. | Mention the Dulong's formula. | 4 | 1 | 2 |
| 8. | Why should leaded petrol not be used? | 4 | 2 | 2 |
| | **PART–B** | | | |

| | | | | |
|---|---|---|---|---|
| 1. | Demonstrate Otto-Hoffman process of conversion of coal to coke and the recovery of byproducts. | 4 | 3 | 16 |
| 2. | Explain the analysis of flue gas by Orsat's apparatus. | 4 | 2 | 16 |
| 3. | Illustrate how synthetic petrol is manufactured by Bergius process. | 4 | 2 | 16 |
| 4. | What is meant by bio-diesel? How is it obtained? Explain its advantages and disadvantages. | 4 | 2 | 16 |

## UNIT-5
## ENERGY SOURCES AND STORAGE DEVICES

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ionbattery; Electric vehicles - working principles; Fuel cells: H2-O2 fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.

| Q.NO | QUESTION | CO | BTL | Marks |
|---|---|---|---|---|
| | **PART–A** | | | |
| 1. | Define nuclear fission with example. | 5 | 1 | 2 |
| 2 | Differentiate fissile and fertile nucleides. | 5 | 1 | 2 |
| 3. | Define geo-thermal energy. | 5 | 1 | 2 |
| 4. | Will the emf of battery vary with size? Give reason for your answer. | 5 | 1 | 2 |
| 5. | Mention some important applications of super capacitors. | 5 | 1 | 2 |
| 6. | Write the charging and discharging reaction of lead accumulator. | 5 | 1 | 2 |
| 7. | Determine the disadvantages of fuel cell. | 5 | 1 | 2 |
| 8. | Give cell representation lead acid battery | 5 | 1 | 2 |

## PART–B

| | | | | |
|---|---|---|---|---|
| 1. | Analyze the components and its functions of a Light water nuclear reactor with a suitable diagram | 5 | 5 | 16 |
| 2. | Describe the construction and working of $H_2$-$O_2$ fuel cell with neat diagram | 5 | 2 | 16 |
| 3. | Describe the construction, principle, working of lead acid storage battery. Give its advantages and disadvantages. | 5 | 2 | 16 |
| 4. | Write notes on recent developments in solar cell materials. | 5 | 3 | 16 |

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# MA3151

# Matrices and Calculus

## UNIT 1
## MATRICES

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Statement and applications of Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms–Applications:Stretchingofanelasticmembrane.

| Q.No | Question | CO | BTL | Marks |
|---|---|---|---|---|

### PART A

| | | | | |
|---|---|---|---|---|
| 1. | Find the characteristic polynomial of $\begin{pmatrix} 1 & 4 \\ 2 & 3 \end{pmatrix}$. | 1 | 1 | 2 |
| 2. | The product of two Eigenvalues of the matrix $A = \begin{pmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{pmatrix}$ is 16. Find the third Eigenvalue. | 1 | 1 | 2 |
| 3. | If $A = \begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}$ then find the eigen values of $A^{-1}$. | 1 | 1 | 2 |
| 4. | If 2 and 3 are the eigenvalues of $A = \begin{pmatrix} 3 & 10 & 5 \\ -2 & -3 & -4 \\ 3 & 5 & 7 \end{pmatrix}$.Find the eigenvalues of $A^{-1}$and $A^3$. | 1 | 1 | 2 |
| 5. | State Cayley – Hamilton Theorem. | 1 | 1 | 2 |
| 6. | Write down the matrix for the following quadratic form: $2x_1^2 - 2x_2^2 + 4x_3^2 + 2x_1x_3 - 6x_1x_3 + 6x_2x_3$ | 1 | 1 | 2 |
| 7. | Prove that $x^2 - y^2 + 4z^2 + 4xy + 2yz + 6xz$ is indefinite. | 1 | 1 | 2 |
| 8. | Discuss the nature of the Q.F. $2x^2 + 6y^2 + 2z^2 + 8xz$ without reducing them to Canonical form. | 1 | 1 | 2 |

### PART B

| | | | | |
|---|---|---|---|---|
| 1. | (i) Find the Eigen values and Eigen vectors of the following matrices $\begin{pmatrix} 7 & -2 & 0 \\ -2 & 6 & -2 \\ 0 & -2 & 5 \end{pmatrix}$. | 1 | 5 | 8 |
| | (ii) Using Cayley -Hamilton theorem, find $A^{-1}$ if $A=\begin{pmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{pmatrix}$ | 1 | 3 | 8 |
| 2. | (i) Find the Eigen values and Eigen vectors of the following matrices $\begin{pmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{pmatrix}$. | 1 | 5 | 8 |
| | (ii) Using Cayley-Hamilton theorem for $A=\begin{pmatrix} 2 & -1 & 2 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{pmatrix}$. Hence find its inverse. | 1 | 3 | 8 |
| 3. | Diagonalize the matrix $A=\begin{pmatrix} 2 & 2 & 0 \\ 0 & 1 & 0 \\ 0 & 1 & 2 \end{pmatrix}$ by orthogonal transformation. | 1 | 5 | 16 |
| 4 | Reduce the quadratic form $x_1^2+5x_2^2+x_3^2+2x_1x_2+2x_2x_3+6x_3x_1$ to the canonical form through orthogonal transformation and find its nature. | 1 | 5 | 16 |
| 5 | Reduce the quadratic form $8x^2+7y^2+3z^2-12xy-8yz+4zx$ to the canonical form by an orthogonal transformation. Also find its rank, index, signature and nature of the quadratic form. | 1 | 5 | 16 |

## UNIT2
## DIFFERENTIAL CALCULUS

Representationoffunctions-Limitofafunction-Continuity-Derivatives-Differentiationrules(sum,product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation -Applications:Maximaand Minima offunctionsofonevariable.

| Q.NO | QUESTION | CO | BTL | Marks |
|---|---|---|---|---|

### PART–A

| | | | | |
|---|---|---|---|---|
| 1. | Define odd and even functions with examples. | 2 | 1 | 2 |
| 2. | Define limit of a function. | 2 | 1 | 2 |
| 3. | Evaluate $\lim_{x\to 4} \frac{x^2-4x}{x^2-3x-4}$ ,if it exists. | 2 | 2 | 2 |
| 4. | Sketch the graph of the function f(x) = $\begin{cases} x^2; if\ -2 \le x \le 0 \\ 2-x; if\ 0 < x \le 2 \end{cases}$ | 2 | 1 | 2 |
| 5. | Find $\frac{dy}{dx}, if y = xe^x sinx.$ | 2 | 2 | 2 |
| 6. | Find $\frac{dy}{dx}, if y = \frac{x^2-1}{x^2+1}.$ | 2 | 2 | 2 |
| 7. | Find the domain of the function $f(x) = \sqrt{5x+10}$ . | 2 | 2 | 2 |
| 8. | Evaluate $\lim_{x\to 5}(2x^2 - 3x + 4).$ | 2 | 2 | 2 |

**PART B**

| | | | | |
|---|---|---|---|---|
| 1. | (i) For what value of the constant c is the function f continuous at $(-\infty, \infty)$<br>f(x)= $\begin{cases} cx^2 + 2x; x < 2 \\ x^3 - cx : x \ge 2 \end{cases}$ . | 2 | 3 | 8 |
| 2. | Find the tangent line to the equation $x^3 + y^3 = 6xy$ at the point (3,3) and at what point the tangent line horizontal in the first quadrant. | 2 | 3 | 8 |
| 3. | Find the absolute maximum and absolute minimum values of the function $f(x) = 3x^4 - 4x^3 - 12x^2 + 1$ on the interval [-2,3]. | 2 | 5 | 16 |
| 4 | If $f(x) = x^4 - 2x^2 + 3$, then (i) find the critical points of f? (ii)On what interval is f increasing or decreasing? (iii) At what points, if any, does f assume local maximum and minimum values? (iv)Find intervals of concavity and the inflection points. | 2 | 5 | 16 |
| 5 | Find the maximum and minimum values of $2x^3 - 3x^2 - 36x + 10.$ | 2 | 5 | 16 |

## UNIT3

## FUNCTIONSOFSEVERALVARIABLES

Partialdifferentiation–HomogeneousfunctionsandEuler'stheorem–Totalderivative–Changeofvariables –Jacobians – Partial differentiation of implicit functions – Taylor's series for functions oftwo variables –Applications:Maxima and minima of functions of two variables and Lagrange'smethodofundeterminedmultipliers.

| Q.NO | QUESTION | CO | BTL | Marks |
|---|---|---|---|---|
| | **PART–A** | | | |
| 1. | If $u = \sin^{-1}\left(\frac{x^3 - y^3}{x + y}\right)$, prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 2\tan u$. | 3 | 1 | 2 |
| 2 | If $u = \frac{y^2}{x}$ , $v = \frac{x^2}{y}$ , find $\frac{\partial(x, y)}{\partial(u, v)}$. | 3 | 1 | 2 |
| 3. | If u=2xy, v = $x^2 - y^2$ , $x = r\cos\theta, y = r\sin\theta$ then compute $\frac{\partial(u, v)}{\partial(r, \theta)}$. | 3 | 1 | 2 |
| 4. | If $x = r\cos\theta, y = r\sin\theta$ , find $\frac{\partial(x, y)}{\partial(r, \theta)}$ and $\frac{\partial(r, \theta)}{\partial(x, y)}$ . | 3 | 1 | 2 |
| 5 | If u = f (y - z, z - x, x - y) find $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$. | 3 | 1 | 2 |
| 6. | Prove that $\frac{\partial^2 f}{\partial x \partial y} = \frac{\partial^2 f}{\partial y \partial x}$ if $f = x^3 + y^3 + z^3 + 3xyz$. | 3 | 1 | 2 |
| 7. | If $z = x^2 + y^2$, and $x = t^2, y = 2at$, find $\frac{dz}{dt}$. | 3 | 1 | 2 |
| | **PART–B** | | | |
| 1. | If $u = x^2 + y^2 + z^2$ and $x = e^{2t}$, $y = e^{2t}\cos 3t$, $z = e^{2t}\sin 3t$ , find $\frac{du}{dt}$. | 3 | 2 | 8 |
| 2. | If $x + y + z = u$, $y + z = uv$, $z = uvw$ prove that $\frac{\partial(x, y, z)}{\partial(u, v, w)} = u^2 v$. | 3 | 2 | 8 |

| | | | | |
|---|---|---|---|---|
| 3. | If $u=\frac{yz}{x}, v=\frac{zx}{y}, w=\frac{xy}{z}$, find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$. | 3 | 2 | 8 |
| 4. | Expand $e^x \log(1+y)$ in powers of x and y upto terms of third degree using Taylor's theorem. | 3 | 3 | 16 |
| 5. | Expand $e^x \cos y$ at (0, π/2) upto the third term using Taylor's series. | 3 | 3 | 8 |
| 6. | Find the extreme value of the function $f(x,y)=x^3+y^3-3x-12y+20$. | 3 | 3 | 8 |
| 7. | A rectangular box, open at the top, is to have a volume of 32cc. Find the dimensions of the box, that requires the least materials for its construction. | 3 | 3 | 16 |

## UNIT4
## INTEGRALCALCULUS

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts,Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partialfraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic forceandpressure,momentsandcentres ofmass.

| Q.NO | QUESTION | CO | BTL | Marks |
|---|---|---|---|---|
| | **PART–A** | | | |
| 1. | Find the derivative of the following fun $f(x)=\int_1^{x^2} cost\, dt$ | 4 | 1 | 2 |
| 2 | Find the derivative of the following fun $\int_0^{\pi} f(x)\, dx$ where $f(x)=$ $\begin{cases} sinx, & if\ 0 \le x \le \frac{\pi}{2} \\ cosx, & if\ \frac{\pi}{2} \le x \le \pi \end{cases}$ | 4 | 1 | 2 |
| 3. | Evaluate $\int \frac{x^3+2x+1}{x^4} dx$. | 4 | 1 | 2 |
| 4. | Evaluate $\int \frac{1}{1-cosx} dx$. | 4 | 1 | 2 |
| 5. | Evaluate $\int_0^{\frac{\pi}{2}} cos^9 x dx$ | 4 | 1 | 2 |
| 6. | Define improper integrals. | 4 | 1 | 2 |

| | | | | |
|---|---|---|---|---|
| 7. | Evaluate $\int sin2xcos3x\,dx$ | 4 | 1 | 2 |
| 8. | Evaluate $\int sin^3 2xdx$ | 4 | 1 | 2 |

**PART–B**

| | | | | |
|---|---|---|---|---|
| 1. | Evaluate $\int_0^3 (x^2 - 2x)dx$ by using Riemann sum by taking right end points as the sample points. | 4 | 5 | 8 |
| 2. | Evaluate $\int_0^{\frac{\pi}{2}} \frac{\sqrt{cosx}}{\sqrt{sinx}+\sqrt{cosx}} dx$ (ii) $\int_0^{\frac{\pi}{2}} \frac{1}{1+\sqrt{tanx}} dx$ | 4 | 5 | 8 |
| 3. | Evaluate $\int \frac{10}{(x-1)(x^2+9)}$ dx | 4 | 5 | 8 |
| 4. | Prove that $\int_0^{\pi} \frac{d\theta}{5+3\cos\theta} = \frac{\pi}{4}$ | 4 | 5 | 8 |
| 4. | Evaluate $\int \cos^n x dx$ by using integration by parts. | 4 | 5 | 8 |
| 5. | Use partial fraction technique, evaluate $\int \frac{3x+1}{(x-1)^2(x+3)} dx$ | 4 | 5 | 16 |

**UNIT5**
**INTEGRAL CALCULUS**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Areaenclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double andtripleintegrals– Applications:Momentsandcentresofmass,momentofinertia.

| Q.NO | QUESTION | CO | BTL | Marks |
|---|---|---|---|---|

**PART–A**

| | | | | |
|---|---|---|---|---|
| 1. | Evaluate $\int x\sin x dx$ by using integration by parts. | 5 | 1 | 2 |
| 2 | Evaluate $\int_1^a \int_2^b \frac{1}{xy} dxdy$. | 5 | 1 | 2 |

| | | | | |
|---|---|---|---|---|
| 3. | Evaluate $\int_0^5 \int_0^2 (x^2 + y^2) dx dy.$ | 5 | 1 | 2 |
| 4. | Sketch the region of integration in $\int_0^1 \int_0^x dy dx.$ | 5 | 1 | 2 |
| 5. | Evaluate $\int_0^1 \int_0^2 \int_0^3 xyz dx dy dz.$ | 5 | 1 | 2 |
| 6. | Evaluate $\int_0^1 \int_0^2 \int_0^3 dx dy dz.$ | 5 | 1 | 2 |
| 7. | Evaluate $\int_0^a \int_0^b \int_0^c e^{x+y+z} dx dy dz$ | 5 | 1 | 2 |
| 8. | Evaluate $\int_0^2 \int_1^3 \int_1^2 x y^2 z dx dy dz$ | 5 | 1 | 2 |

**PART–B**

| | | | | |
|---|---|---|---|---|
| 1. | (i) Use partial fraction technique, evaluate $\int \frac{1+6x}{(4x-3)(2x+5)} dx$<br>(ii) Evaluate $\int x^3 \sin 2x \, dx$ using integration by parts. | 5 | 5 | 16 |
| 2. | Using double integral find the area bounded by the parabolas $y^2 = 4ax$ and $x^2 = 4ay$. | 5 | 3 | 8 |
| 3. | Using double integral find the area bounded by $y = x$ and $y = x^2$. | 5 | 3 | 8 |
| 4. | Find the volume of the sphere $x^2 + y^2 + z^2 = a^2$ using triple integration | 5 | 5 | 16 |
| 5. | Find the volume of the tetrahedron bounded by the coordinate planes and $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1.$ | 5 | 5 | 16 |

**-----END----**