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CENTRAL UNIVERSITY OF KARNATAKA

(Established by an Act of the Parliament in 2009)
Kadaganchi, Aland Road, Kalaburagi Dist-585367
Website: www.cuk.ac.in

School	Physical Sciences
Department	Mathematics
Program	B.Sc.
Semester	I

END SEMESTER EXAMINATIONS, MONTH : JANUARY, YEAR : 2025 (Regular)

Course: Minor-I, Elementary Calculus Course Code: UMACM10100	Max. Marks:60	Duration: 2.5 Hr.	Credits: 04

INSTRUCTIONS: *** To answer all the following questions is compulsory.**

Answer the following :

Q1. A)Give $\varepsilon - \delta$ definition of convergence of sequence. Verify 5+5+5

$$\lim_{n->\infty} \frac{3+2\sqrt{n}}{\sqrt{n}} = 2.$$

B)Show that the series $\sum_{n=1}^{\infty} \frac{3.6.9...3n}{7.10.13...(3n+4)} x^n,\ x > 0$, converges for $x \leq 1$, and diverges for $x > 1$.

C) State Lagranges mean value theorem . Verify it for $x^3 - x^2 - 5x + 3\ in\ [0,4]$.

Q2. A) Write Maclaurin's theorem for a function f(x) with Lagrange's form of remainder hence find Maclaurin's series expansion for $f(x) = \text{Cos } x$. 5+5+5

B) Given $u = \frac{x+y}{1-xy}$ and $\theta = \tan^{-1}x + \tan^{-1}y$, compute $J(\frac{u,\theta}{x,y})$. Are u and θ functionally dependent.

C) Find stationary points for the function $f(x,y) = x^3 + y^3 - 3axy$. Hence find extremas of $f(x,y)$, if exists.

Q3. A) Evaluate the integral $\int_0^5 \int_0^{x^2} x(x^2 + y^2)\ dxdy$. 3+6+6

B) Change the order of integration and evaluate $\int_0^a \int_{x/a}^{\sqrt{x/a}} (x^2 + y^2)\ dxdy$.

C) Write the integral $\int_0^1 x^3(1-x^2)^{3/2}\, dx$ in form of B(m, n) and compute.

Q4. A) If $a = x + y + z, b = x^2 + y^2 + z^2, c = xy + yz + zx$, prove that [grad a, grad b, grad c]=0. 5+5+5

B) Find the directional derivative of $f = xy + yz + zx$ in the direction of vector $(\hat{\imath} + 2\hat{\jmath} + 2\hat{k})$ at the point (1, 2, 0).

C) i) Given $\vec{f} = xy^2\hat{\imath} + 2x^2yz\,\hat{\jmath} - 3yz^2\hat{k}$, find div $\vec{f}$ at $(1,-1,1)$.
ii) Prove that curl(grad φ) =0.

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School	Physical Sciences
Department	Mathematics
Program	B.Tech (Mathemetics & Computing)
Semester	1st Semester

END SEMESTER EXAMINATION, MONTH JANUARY, YEAR 2025.

Course: Introduction to Computing (ICP)	**Max. Marks:** 30	**Duration:** 1.30 hrs.
Course Code: UMACC10103	**Credits:** 04	

INSTRUCTIONS:

1. Answer any 5 questions. (First Question is Mandatory).

(5*2= 10 Marks)

1.1) Consider a single dimensional array A[1..1000]. Base address 2000 and the size of each element is 4. Find the location of A[50]

a) 2186 b) 2126 c) 2096 d) 2196

1.2) Which type of traversal of binary search tree outputs the value in sorted order?

a) Pre order b) In order c) Post order d) None

1.3)Predict the output of the following program

```
#include<iostream>
using namespace std;

void myrecursivefunction(int n){
if(n==0)
return;
cout<< n;
myrecursivefunction(n-1);
}

int main(){
myrecursivefunction(10);
return 0;
}
```

a) 10 b) 1
c) 10 9 8 7 6 5 4 3 2 1 0
d) 10 9 8 7 6 5 4 3 2 1

1.4) Predict the output of the following program

```
#include<iostream>
using namespace std;
int main()
{
  int arr[]={0,10,20,30,40};
  int i=1, *ptr;
  ptr=arr+2;

  cout<<ptr[i];
  cout<<ptr[i+1];
  cout<<ptr[-i];
  cout<<ptr[-i+1];

 return 0;
}
```

a) 10, 20, 30,40 b) 20, 10,30, 40
c) 30, 40, 10, 20 d) 40,30,20,10

1.5) A linked list has O (1) time complexity for the following operation.
a) Insertion at the middle b) Deletion at the end
c) Insertion at the beginning d) None of these

School	Physical Sciences
Department	Mathematics
Program	B.Tech (Mathemetics & Computing)
Semester	1st Semester

(2*2.5=5 Marks)

2 (a) What are conditional statements? Explain the else-if statement, nested if statement, and switch statement with examples?
(b) What is a function? Explain recursive functions with an example. Differentiate between call by value and call by reference?

(2*2.5=5 Marks)

3 (a) Define an array? Explain a one-dimensional array and write a C++ program for the addition of two matrices?
(b) What are user-defined data types? Explain structures and union data types with examples?

(2*2.5=5 Marks)

4 (a) What is a data structure? Explain the linked list data structure. What are circular linked lists and doubly linked lists?
(b) Write down the differences between arrays and linked lists?

(2*2.5=5 Marks)

5 (a) What is a stack data structure? How do you implement a stack data structure? Write the pseudo code for the push and pop operations?
(b) Consider the expression a + b * c / d ^ e ^ f * d - c + b and convert it to both prefix and postfix expressions?

(2*2.5=5 Marks)

6 (a) The pre-order traversal of a Binary search tree is given by 12, 8, 6, 2, 7, 9, 10, 16, 15, 19, 17, 20. What is the post-order traversal of this tree?
(b) Write the C++ program for Binary search?

---ALL THE BEST---

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School	Physics Sciences
Department	Mathematics and computing
Program	UG
Semester	B.Tech 1st Sem
Course Code	UMACC10102

END SEMESTER EXAMINATIONS, MONTH FEBRUARY, YEAR 2025

Course: Introduction to Electrical Engineering	Max. Marks:30	Duration: 10:00 AM to 11:30 AM	Credits:02

Note: Answer any Five Questions

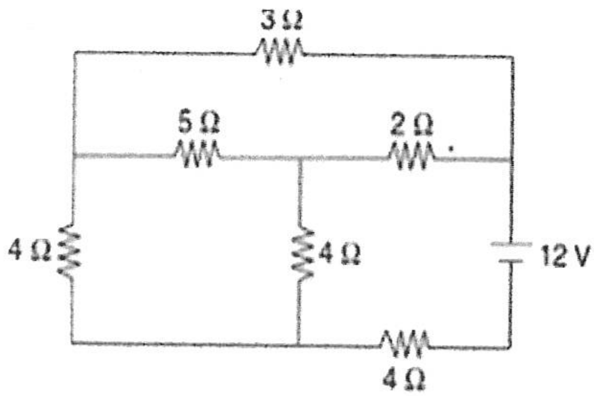
1. a) Explain the types of voltage and current source — 4M

   b) State Faradays law of electromagnetic Induction — 2M

2. a) State Fleming's right hand and left hand rule — 4M

   b) Describe Form Factor and peak factor — 2M

3. a) Find the current delivered by the 12 V battery. — 3M



   b) Explain the types of DC generator — 3M

4. Define RMS value and derive an expression for RMS value of Voltage and current — 6M

5. Explain the construction and working principle of DC Generator — 6M

6. Explain the construction and working principle of single phase transformer — 6M

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School	School of Physical Sciences
Department	Department of Mathematics
Program	B.Tech.(Mathematics & Computing)
Semester	I

END SEMESTER EXAMINATIONS, MONTH February YEAR 2025

Course: Differential Calculus Code: UMATC10106	Max. Marks:60	Duration: 2 hours- 30 Minutes	Credits: 04

INSTRUCTIONS: Answer all the questions.

1. (a) Define the following terms

(i) Sequence (ii) Cauchy sequence (iii) Continuity of a function at point (iv) Archimedean property (v) Curvature (vi) Asymptotes (vii) Convergence of a series (viii) Total differentiation.

(b) Discuss about the convergence of series (i) $x+\frac{1}{2}.\frac{x^3}{3}+\frac{1.3}{2.4}.\frac{x^3}{5}+\frac{1.3.5}{2.4.6}.\frac{x^5}{5}+....$

(ii) $\sum(\frac{n}{n+1})^{n^2}$ (iii) $\sum_{n=2}^{\infty}\frac{(-1)^n}{n(\log n)^2}$. (4M+6M)

2. (a) By definition show that the sequence $\{a_n\}$ convergence to 0, where $a_n=\sqrt{n+1}-\sqrt{n}$.

(b) Find the limit of a sequence (i) $\left\{[\frac{(3n)!}{(n!)^3}]^{1/n}\right\}$ (ii) $\left\{\frac{1}{\sqrt{n^2+1}}+\frac{1}{\sqrt{n^2+2}}+...+\frac{1}{\sqrt{n^2+n}}\right\}$.

(c) Prove that the sequence $\{a_n\}$ defined by $a_1=\sqrt{2},\ a_{n+1}=\sqrt{2+a_n}$ convergence to the root of the equation $x^2-x-2=0$. (3M+4M+3M)

3. (a) Discuss the continuity of f at *x=0,1*, where $f(x)=|x|+|x-1|$. (3M+4M+3M)

(b) Show that $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=3\tan u,\ where\ \sin u=\frac{x^2y^2}{x+y}$.

(c) Verify Cauchy's mean value theorem for $f(x)=\frac{x^3}{3}-4x,\ g(x)=x^2$ in [0, 3]

4. (a) Consider the function $f:\mathbb{R}^2\rightarrow\mathbb{R}$ defined by

$$f(x,y)=\begin{cases}\frac{x^2y^2}{x^2y^2+(x-y)^2}, & (x,y)\neq(0,0)\\ 0, & (x,y)=(0,0)\end{cases}$$

Show that the function satisfy the following

(i) The iterated limits $\lim_{x\to 0}[\lim_{y\to 0} f(x,y)]$, $\lim_{y\to 0}[\lim_{x\to 0} f(x,y)]$ are exists and equal to 0

(ii) $\lim_{(x,y)\to(0,0)} f(x,y)$ does not exist

(iii) $f(x, y)$ is not continuous at (0, 0)

(iv) the partial derivatives exist at (0, 0). (6M+4M)

(b) Prove that $\frac{\pi}{3}-\frac{1}{5\sqrt{3}} > \cos^{-1}\frac{3}{5} > \frac{\pi}{3}-\frac{1}{8}$ using Lagrange Mean Value Theorem.

5. (a) Find the linear and the quadratic Taylor series polynomial approximations to the function $f(x,y)=x^2+y^2-xy$ about the point (1, 2). Obtain the maximum absolutely error in the region $|x-2|<0.1, |y-3|<0.1$. (5M+5M)

(b) Find the shortest distance between the line $y=10-2x$ and the ellipse $\frac{x^2}{4}+\frac{y^2}{9}=1$.

6. (a) Find the coordinates of the centre of curvature and circle of curvature for the curve $x^3+y^3=3xy$ at $(\frac{3}{2},\frac{3}{2})$.

(b) Trace the curve $y=(x-1)(x-2)(x-3)$. (5M+5M)

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SCHOOL OF PHYSICAL SCIENCES
DEPARTMENT OF PHYSICS
B.Tech. Mathematics
Semester - 1 (Regular)
Course Code: UMATC10101

END SEMESTER EXAMINATIONS JANUARY 2025

Course	Max. Marks	Duration	Credits
Engineering Physics	45	2.0 h	3

Instructions to candidates

- Section A consists of 6 questions of 3 marks each. Answer any **FIVE** questions.
- Section B consists of 4 questions of 10 marks each. Answer any **THREE** questions.
- In a single question part (a) and (b) are independent.

Section A

1. The position of a particle is given by $r = A\,(e^{\alpha t}\,\hat{i} + e^{-\alpha t}\,\hat{j})$, where α is a constant. Find the speed of the particle.
2. Define angular momentum and give its units?
3. State the Newton's second laws of motion and mention its two limitations?
4. State the Kepler's laws of planetary motion?
5. Two point masses $3kg$, $5kg$ are at a distance $4m$, $8m$ from origin on x axis. Locate the center of mass of the two point masses from origin?
6. A metallic cube of side $100\,cm$ is subjected to a uniform force acting normal to the whole surface of the cube. The pressure is 106 pascal. If the volume changes by $1.5 \times 10^{-5}\,m^3$, calculate the bulk modulus of the material.

Section B

7. (a) What is a central force and give one example? State the important properties of the motion under central force?
(b) Find the force law for a central force field that allows a particle to move in a spiral orbit given by $r = k\,\theta^2$, where k is constant. $(2 + 2 + 6 = 10$ Marks)
8. (a) Define the modulus of rigidity and give its units? A 5 cm cube of substance has its upper face displaced by 0.65 cm by a tangential force of 0.25 N. Calculate the modulus of rigidity of the substance.
(b) Derive the expression for the work done in twisting a wire. $(2 + 2 + 6 = 10$ Marks)
9. (a) Show that a rocket travelling horizontally in empty space has the following equation of motion: $v(t) = v_0 + u\,log(m_0/m(t))$, where, v_0, $v(t)$ are the velocities of rocket with mass m_0 and $m(t)$. u is velocity of the ejected gasses from rocket.
(b) A rocket in a gravity-free space along a straight path when its pilot decides to accelerate forward. He turns on the thrusters, and burned fuel is ejected at a constant rate of 2×10^2 kg/sec, at a speed of 2.5×10^2 m/sec. The initial mass of rocket with unburnt fuel is 2×10^4 kg and the thrusters are on for 30 seconds. What is the thrust on the rocket and its acceleration as a function of time? $(6 + 4 = 10$ M)
10. (a) Define moment of inertia and give its units?
(b) Calculate the moment of inertia of thin uniform rod of mass M, length L and axis passing through the midpoint and perpendicular to the rod?
(c) State theorem of parallel axes and theorem of perpendicular axes about moment of inertia? $(2 + 4 + 4 = 10$ Marks)

—End-of-paper—

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School	Physical Sciences
Department	Mathematics
Program	B.Tech. in Mathematics and Computing
Semester	I
Course Code	UMATC10107

END SEMESTER EXAMINATIONS, MONTH January YEAR 2025

Course: Integral Calculus	Max. Marks: 30	Duration: 90min	Credits: 2

INSTRUCTIONS:

1. Answer ALL the questions
2. Each question carries 6 Marks

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1. Answer the following:
   (i) Write the relationship between Beta and Gamma functions.
   (ii) What is the purpose of changing the order of integration in double integrals?
   (iii) State the physical meaning of divergence of a vector field.
   (iv) What is the condition for a vector field to be irrotational?
   (v) Give the statement of Green's theorem in the plane.
   (vi) What is the method to convert Cartesian coordinates to polar coordinates?
2. State and prove Fundamental theorem of integral calculus.
3. Evaluate the following:
   (i) B (2,3)
   (ii) $\frac{d}{dx}\int_0^\infty e^{-xt}\,dt$
   (iii) Change the order of integration of $\int_0^1\int_0^{1-x^2}(x+y)\,dy\,dx$.
4. (i) Prove that $\nabla r^n = nr^{n-2}R$, where $R = xi+yj+zk$.
   (ii) Find the directional derivative of $f = x^2+y^2$ at (1,2) in the direction of the vector (3,4).
5. Verify Green's theorem in the plane for $\int_C -ydx+xdy$, where C is the region enclosed by the circle $x^2+y^2=1$.

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School	Physical Science
Department	Mathematics
Program	U.G.
Semester	I Semester

END SEMESTER EXAMINATIONS, MONTH: JANUARY YEAR: 2024

Minor Course: Elementary Calculus Code: UMATM10100	Max. Marks: 90	Duration:180 Minutes	Credits: 06

INSTRUCTIONS:

1. Answer**All** questions compulsorily.

Section -A

1. A) Define limit of a sequence. Verify $\lim_{n->\infty}\frac{3+2n}{n}$ =2 using definition of limit of sequence. [5]

   B) Show that the sequence $\{r^n\}$ converges iff |r|<1. [5]

   C) Write one divergent and one convergent sequence such that there product is [5]
   i) divergent ii) convergent iii) oscillating.

2. A) Define a homogeneous function. [8]

   Let Z be a homogeneous function of degree n in x and y then state and prove Euler's theorem. Hence verify for $u = \frac{x^4+y^4}{x+y}$. Show that $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y} = 3u$.

   B) State and prove Rolle's Theorem. [7]

3. A) Define maxima and minima of a curve. Find maxima and minima of the function

   $f(x,y) = x^3 + y^3 - 3axy$, if exists. [6]

   B) Find Maclaurin's expansion for the function $f(x,y)=e^x$ [6]

   C) If $x = r\cos\theta$, $y = r\sin\theta$, find $J\left(\frac{x,y}{r,\theta}\right)$. [3]

4. A) State Lagrange's mean value theorem. Determine a c lying between a and b for [7]
$f(x) = x^3 - x^2 - 5x + 3$, given a=0, b= 4.

   B) Define double point on a curve.Trace the curve $y^2(a-x) = x^2(a+x), a > 0$. [8]

Section - B

1. Define Directional derivative. If $\frac{d\vec{a}}{dt} = \vec{w} \times \vec{a}$ and $\frac{d\vec{b}}{dt} = \vec{w} \times \vec{b}$ then show that $\frac{d}{dt}(\vec{a} \times \vec{b}) = \vec{w} \times (\vec{a} \times \vec{b})$. [5]

2. Evaluate the integral $\int_0^5 \int_0^{x^2} x(x^2+y^2)\ dxdy$. [5]

3. Find the volume of the ellipsoid $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$ [5]

4. Write the integral $\int_0^1 x^3(1-x^2)^{3/2}\,dx$ in form of B(m, n) and compute. [5]

5. Apply Stoke's theorem to evaluate $\int_C (ydx + zdy + xdz)$ where C is the curve of intersection of $x^2+y^2+z^2=a^2$ and $x+z=a$. [5]

5. State and Prove that Gauss Divergence theorem. [5]

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School	Physical Sciences
Department	Mathematics
Program	UG
Semester	I
Course Code	UMATS10100

END SEMESTER EXAMINATIONS, MONTH: January, YEAR: 2025 (Repeaters)

Course: **'Differential Calculus'**	Max. Marks: **45**	Duration: **2 Hours**	Credits: **03**

INSTRUCTIONS: **1) All Questions are compulsory. (5Qx9M=45M)**

2) All main questions carry equal marks, Figures to the right side indicate marks intended.

Q 1. **a)** State Lagrange's Mean value theorem explain geometrical interpretation of it. Verify Lagrange's Mean Value for function $f(x)=x^2-3x+2$ in [-2, 3] hence find point 'c' in given interval. [5]

b) State Rolle's theorem , what is geometrical interpretation of Rolle's theorem . Verify Rolle's theorem for $f(x) = x(x-3)^2$, on the interval [0, 3] [4]

Q 2. a) Define the following : [2]

1) Least upper bound of a sequence
2) Limit of a sequence

b) Using definition of sequences show that, the sequence $\left\{ 1/n^2 \right\}$ converges to 0. [4]

c) Define absolute value or modulus of a real number and prove that, $|x-y| \ge |x|-|y|$ [3]

Q 3. **a)** Find the extreme values of the function $f(x, y) = x^3+3xy^2-3x^2-3y^2+4$ [3]

b) Expand $\log\sin(x+h)$ in the powers of 'h' by Taylor's theorem [6]

Q 4. **a)** Evaluate the limit i) $k = \lim_{x\to 0} \log_{\sin x} \sin 2x$ ii) $k = \lim_{x\to 0} \dfrac{x^2+2\cos x-2}{x\sin^3 x}$, applying L'Hospital's Rule. [4]

b) Explain about the continuity at a point, continuity in a closed interval also discuss the types of discontinuities. Using the ε - ∂ definition, prove that $f(x)=\begin{cases} \dfrac{x^2-4}{x-2}, & if\ x\neq 2 \\ 4, & if\ x=2 \end{cases}$, is continuous at x = 2 [5]

Q 5. a) If $x = r\sin\theta\cos\varphi$, $y = r\sin\theta\sin\varphi$, $z=\cos\theta$; show that $\dfrac{\partial(x,y,z)}{\partial(r,\theta,\varphi)} = r^2\sin\theta$. [6]

b) If $f(x, y) = \dfrac{1}{x^2}+\dfrac{1}{xy}+\dfrac{\log x-\log y}{x^2+y^2}$, show that $x\dfrac{\partial f}{\partial x}+y\dfrac{\partial f}{\partial y}+2f = 0$, by using Euler's theorem. [3]

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