ANDHRA MAHILA SABHA
ARTS & SCIENCE COLLEGE FOR WOMEN
Autonomous - NAAC Re-Accredited, O.U.Campus, Hyderabad – 500 007
Tel: 040-27098811.04027070471 (Direct).Fax:04027073346
Email: amsascw1968@gmail.com , ascwams@yahoo.co.in, Website: amsascw.org

SCHEME OF INSTRUCTION AND EVALUATION

BSc (MSCs)Mathematics

I Year I Semester

2025-26

Subject	Course	Hours / Week		Exam Duration	Marks			No Of Credits
		Theory	Practical/Tutorial		Sem	Internal	Total	
English	General English	4 Hrs		3 Hrs	80	20	100	4
II Language	II language Telugu/Hindi/Sanscrit	4 Hrs		3 Hrs	80	20	100	4
Mathematics	DSC 1 A: Differential Equations	4 Hrs		3 Hrs	80	20	100	4
Statistics	DSC2 A Basic Statistics and Probability	4 Hrs		3Hrs	80	20	100	4
Computer Science	DSC 3A:Programming in C	4 Hrs		3Hrs	80	20	100	4
Practicals								
Mathematics	DSC 1 A: Differential Equations		2Hrs	3Hrs	25		25	1
Statistics	DSC 2A: Basic Statistics & Probability Using MSExcel and R:		2Hrs	3Hrs	25		25	1
Computer Science	DSC 3A: Programming using C		2Hrs	3Hrs	25		25	1
								23

***Note: In place of Tutorial practicals are introduced for 4hrs theory(4 credits)+2hrs Practicals (1 Credit) *Problems solving session for each 20 students one batch(Practicals).**

Dr. M.A. SRINIVAS
Professor
Department of Mathematics
College of Engineering
Jawaharlal Nehru Technological University
Hyderabad, Hyderabad-500 085

Dr. N. KISHAN
M.Sc., Ph.D.
Senior Professor of Mathematics
Department of Mathematics
Osmania University, Hyd-07.

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ARTS & SCIENCE COLLEGE FOR WOMEN
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Email: amsascw1968@gmail.com , ascwams@yahoo.co.in, Website: amsascw.org

SCHEME OF INSTRUCTION AND EVALUATION
BSc (MSCs)Mathematics
I Year II Semester
2025-26

Subject	Course	Hours / Week		Exam Duration	Marks			No Of Credits
		Theory	Practical/Tutorial		Sem	Internal	Total	
English	General English	4 Hrs		3 Hrs	80	20	100	4
II Language	II language Telugu/Hindi/Sanscrit	4 Hrs		3 Hrs	80	20	100	4
Mathematics	DSC 1B: Real Analysis	4 Hrs		3 Hrs	80	20	100	4
Statistics	DSC2 B Probability Distributions	4 Hrs		3Hrs	80	20	100	4
Computer Science	DSC3B:Data structures using C	4 Hrs		3Hrs	80	20	100	4
Practicals								
Mathematics	DSC 1 B: Real Analysis		2Hrs	3Hrs	25		25	1
Statistics	DSC 2B: Probability Distributions Using MSExcel and R:1B		2Hrs	3Hrs	25		25	1
Computer Science	DSC 3B: Data structures using C		2Hrs	3Hrs	25		25	1
								23

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Dr. M.A. SRINIVAS
Professor
Department of Mathematics
College of Engineering
Jawaharlal Nehru Technological Univ
Kukatpally, Hyderabad-500 085.

Dr. N. KISHAN
M.Sc., Ph.D.
Senior Professor of Mathematics
Department of Mathematics
Osmania University, Hyd-07.

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SYLLABUS : SEMESTER- I
DSC-I : DIFFERENTIAL EQUATIONS

Subject Code: Mat101	
Instruction	**4 Hrs/Wk**
Credits	**4**
Duration of Semester Examination	**3 Hrs**
Duration of Sessional Examination	**1 Hr**
Semester Examination	**80 Marks**
Sessional Examination	**20Marks**

Course Objectives

After studying this course, students will be able to:

1: Understand the basic concepts, types, and formation of first-order and first-degree differential equations and learn methods for their analytical solutions.

2: Develop problem-solving skills to handle non-linear and higher-order differential equations, particularly those not of the first degree.

3: Acquire techniques for solving higher-order linear differential equations with constant coefficients using standard operator methods.

4: Explore and apply advanced methods such as variation of parameters, Cauchy–Euler, and Legendre's equations, and understand total and simultaneous differential equations.

Course Outcomes

1: Apply various methods to solve first-order and first-degree differential equations, including separable, homogeneous, linear, exact, and reducible forms, using integrating factors and variable transformations.

2: Analyze and solve first-order but not first-degree differential equations such as Clairaut's equation, and apply them to real-life models like growth, decay, radioactivity, and orthogonal trajectories.

3: Solve higher-order linear differential equations with constant coefficients using the operator method and method of undetermined coefficients, and interpret homogeneous and non-homogeneous solutions.

4: Employ variation of parameters and handle linear differential equations with variable coefficients, including Cauchy–Euler and Legendre's equations, as well as total and simultaneous differential equations.

Dr. N. KISHAN
M.Sc, Ph.D
Senior Professor of Mathematics
Department of Mathematics
Osmania University, Hyd-07.

Dr. M.A. SRINIVAS
Professor
Department of Mathematics
College of Engineering
Jawaharlal Nehru Technological University

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UNIT- I

Differential Equations of First Order and First Degree: Introduction- Equations in Which Variables are Separable – Homogeneous Differential Equations - Differential Equations Reducible toHomogeneous Form – Linear Differential Equations - Differential Equations Reducible to Linear Form – Exact Differential Equations – Integrating Factors – Change in Variables (Text Book : 2.1 to 2.9)

UNIT- II

Equations of First Order But Not of The First Degree: Case I: Equations Solvable for p -Case II :Equations Solvable for y - Equations Solvable for x – Equations that do not Contain x (or y) - EquationsHomogeneous in x and y – Equations of First Degree in x and y – Clairaut's Equation.Applications of First Order Differential Equations: Growth and Decay – Dynamics of Tumor Growth– Radioactivity and Carbon Dating – Compound Interest – Orthogonal Trajectories.(Text Book : 3.1 to 3.2 & 4.1 to 4.4 & 4.20)

UNIT- III

Higher Order Linear Differential Equations: Introduction - Solution of Homogeneous Linear Differential Equations of Order n with Constant Coefficients - Solution of the Non-HomogeneousDifferential Equations with Constant Coefficients by Means of Polynomial Operators - Method ofUndetermined Coefficients.
(Text Book : 5.1 to 5.4)

UNIT- IV

Method of variation of Parameters – Linear Differential Equations with Non-Constant Coefficients –The Cauchy – Euler Equation – Legendre's Linear Equations – Miscellaneous Differential Equations.Total Differential Equations – Simultaneous Total Differential Equations – Equations of the form dx/p=dy/q=dz/r. (Text Book : 5.5 to 5.9 & 2.10 to 2.12)

TEXT BOOK:

Zafar Ahsan, Differential Equations and Their Applications (Second Edition)

REFERENCE BOOKS :

1. Frank Ayres Jr, Theory and Problems of Differential Equations.
2. Ford, L.R ; Differential Equations.
3. Daniel Murray, Differential Equations.
4. S. Balachandra Rao, Differential Equations with Applications and Programs.
5. Stuart P Hastings, J Bryce McLead; Classical Methods in Ordinary Differential Equations

Dr. M.A. SRINIVAS
Professor
Department of Mathematics
College of Engineering
Jawaharlal Nehru Technological University

Dr. N. KISHAN M.Sc, Ph.D
Senior Professor of Mathematics
Department of Mathematics
Osmania University, Hyd-07.

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Syllabus for B.Sc I Year
Differential Equations (Practical)
Mathematics- Semester I

Subject Code:Mat101

Instruction	**2 Hrs/Week**
Duration of Semester Examination	**3 Hrs**
Semester Examination	**25 Marks**
Credits	**1**

UNIT-I

1. Solve $(1-x^2)\frac{dy}{dx} + 2xy = x\sqrt{1-x^2}$

2. Solve $(1+e^{\frac{x}{y}})dx+e^{\frac{x}{y}}(1-\frac{x}{y})dy=0$

3. Solve $x^2ydx-(x^3+y^3)dy=0$

4. Solve $(y+z)dx+(x+z)dy+(x+y)dz=0$

5. Solve $y\sin 2xdx-(1+y^2+\cos^2 x)dy=0$

6. Solve $(x^2+y^2+x)dx+xydy=0$

7. Solve $(xy\cos(xy)+\sin(xy))dx+(x^2\cos(xy))dy=0$

8. $dy/dx + y/x\log x = \sin(2x)/\log x$

UNIT-II

9. $y=2px+\text{Tan}^{-1}(xp^2)$

10. $x^2p^2-2xyp+2y^2-x^2=0$

11. $y=2p+3p^2$

12. $\sin(p)x\cos y = \cos(p)x\sin y + p$

13. $(x-a)\,p^2+(x-y)p-y=0$

14. $y+px=p^2x^4$

15. $yp^2+(x-y)p-x=0$

16. Find the orthogonal trajectories of $x^2+y^2=cx$

17. Find the orthogonal trajectories of $r=c_1(1-\sin\theta)$

18. If radioactive carbon-14 has a half-life of 5750..what will remain of one gram after 3000Years

Dr. M. S. SRINIVAS
Professor
Department of Mathematics
College of Science
Jawaharlal Nehru Technological University

Dr. N. KISHAN
M.Sc, Ph.D
Senior Professor of Mathematics
Department of Mathematics
Osmania University, Hyd-07.

ANDHRA MAHILA SABHA
ARTS & SCIENCE COLLEGE FOR WOMEN
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UNIT-III

19. $D^2y + (a + b)Dy + aby = 0$
20. $yy''+ 3y'+ 2y = 2(e^{-2x} + x^2)$
21. $(D^2 + 1)y=e^{-x} + Cos(x)+x^3$
22. $(D^2 + 1)(D^2 + 4)y = \cos (x /3) \cos(3x/2)$
23. $4y'' -5y'=x^2e^x$
24. $(D^2 + 1)y = \cos x + xe^{2x} + e^x \sin x$
25. Solve $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=\sin x$ by method of undetermined coefficients
26. $(D^2-2D-8)y = 9xe^x+10e^{-x}$ undetermined coefficients
27. $(D^2+a^2)y=\sec(ax)$
28. $y^5+ 2y''' + y' = 2x + \sin x + \cos x$

Unit IV

29. $x^2y'' -xy' + 2y = x \log(x)$
30. $x^2y'' -xy'+ 2y = x$
31. $(2x^2 + 1)y'' -4xy'+ 4y = 0$
32. $y'' +2y' +y=x^2e^x$ by the method of variation of parameters
33. $y'' -2y'+y=e^x \log x$
34. $x^2(y-z)p + y^2(z-x)q = z^2(x-y)$
35. $x2y'' + 7xy' + 5y = x$
36. $y'' - \left(\frac{2}{x}\right)y' + \left(\frac{2}{x2}\right)y = 0, y1 = x$
37. $x2y'' + 2xy' - 20y = (x + 1)2$
38. $(x + 3)2y'' - 4(x + 3)y' + 6y = log(x + 3)$
39. $x3y''' - x2y'' + 2xy' - 2y = x3 + 3x$
40. $x2y'' + 2xy' - 20y = (x + 1)2$

Dr. N. KISHAN
M.Sc, Ph D
Senior Professor of Mathematics
Department of Mathematics
Osmania University, Hyd-07.

Dr. M.A. SRINIVAS
Professor
Department of Mathematics
College of Engineering
Jawaharlal Nehru Technological University

ANDHRA MAHILA SABHA
ARTS & SCIENCE COLLEGE FOR WOMEN
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SYLLABUS: SEMESTER- II
DSC-II : REAL ANALYSIS

Subject Code: Mat 15	
Instruction:	**4Hrs/wk**
Credits	**4**
Duration of Semester Examination	**3 Hrs**
Duration of Session Examination	**1 Hr**
Semester Examination	**80 Marks**
Session Examination	**20 Marks**

Course Objectives

After successful completion of this course, the students will be able to

1: Understand the algebraic, order, and completeness properties of real numbers and explore the behaviour of sets and sequences within the real number system.

2: Develop analytical skills to test the convergence and divergence of infinite series and understand the concepts of limits and continuity for real-valued functions.

3: Comprehend and apply the principles of differentiation to analyse the behaviour of functions, proving classical results such as Rolle's, Lagrange's, and Cauchy's Mean Value Theorems.

4: Grasp the theory of Riemann integration, understand conditions of integrability, and establish the connection between integration and differentiation through the Fundamental Theorem of Calculus.

Course Outcomes

1:Explain the field, order, and completeness properties of real numbers, and analyse the properties of open, closed, countable, and uncountable sets along with convergent and monotonic sequences.

2:Apply various tests for convergence of infinite series, including comparison, ratio, root, and integral tests, and examine the limits and continuity of real-valued functions.

3:Demonstrate understanding of differentiability and apply Rolle's, Lagrange's, and Cauchy's Mean Value Theorems to study the behaviour of functions and their higher-order derivatives.)

4: Evaluate Riemann integrals, verify integrability conditions, use Darboux's theorem, and establish the Fundamental Theorem of Calculus linking differentiation and integration.

Dr. N. KISHAN
M.Sc, Ph.D
Senior Professor of Mathematics
Department of Mathematics
Osmania University, Hyd-07.

ANDHRA MAHILA SABHA
ARTS & SCIENCE COLLEGE FOR WOMEN
Autonomous - NAAC Re-Accredited, O.U.Campus, Hyderabad – 500 007
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UNIT-I

Real Numbers: Field Structure and Order Structure-Bounded and Unbounded Sets- Completeness in the Set of Real Numbers- Absolute Value of a Real Number (Text Book : Chapter 1: 2 to 5)Open Sets, Closed Sets and Countable Sets :Limit Points of a Set-Closed Sets-Countable and Uncountable Sets (Text Book : Chapter 2 : 2 to 4)

Real Sequences: Sequences-Limit points of a Sequence-Convergent Sequences-Non-Convergent Sequences (Definitions)-Cauchy's General Principle of Convergence- Algebra of Sequences-Some Important Theorems-Monotonic Sequences.

(Text Book : Chapter 3: 1 to 2 & 4 to 9)

UNIT-II

Infinite Series : Introduction-Positive Term Series- Comparison Tests for Positive Term Series-Cauchy's Root test- D'Alembert's Ratio Test-Integral Test-Alternating Series(Leibnitz Test).(Text Book : Chapter 4 : 1 to 5, 8 & 10.1)

Functions of a Single Variable (I): Limits-Continuous Functions-Functions Continuous on Closed Intervals. (Text Book : Chapter 5: 1 to 3)

UNIT -III

Functions of a Single Variable (II):The Derivative-Increasing and Decreasing Functions- Rolle's Theorem-Lagrange's Mean Value Theorem- Cauchy's Mean Value Theorem- Higher Order Derivatives.(Text Book : Chapter 6: 1, 3 & 5 to 8)

UNIT -IV

The Riemann Integral: Definition and Existence of the Integral-Refinement of Partitions-Darboux's Theorem-Conditions of Integrability-Integrability of the Sum and Difference of Integrable Functions-The Integral as a Limit of Sums-Some Integrable Functions-Integration and Differentiation-The Fundamental Theorem of Calculus.

(Text Book : Chapter 9: 1 to 9)

Dr. N. KISHAN
M.Sc, Ph.D
Senior Professor of Mathematics
Department of Mathematics
Osmania University, Hyd-07.

Dr. M.A. SRINIVAS
Professor
Department of Mathematics
College of Engineering

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ARTS & SCIENCE COLLEGE FOR WOMEN
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Practical Syllabus for B.Sc I Year
Mathematics Semester –II
Real Analysis (Practical)

Subject Code: Mat101

Instruction:	**2 Hrs/week**
Duration of Semester Examination	**3 Hrs**
Semester Examination	**25 Marks**
Credits	**1**

UNIT-I

1.For each sequence below, determine whether it converges and, if it converges, give its limit. No proofs are required.

(a) $an = n/n+1$ (b) $bn = n^2+3/n^2-3$

(c) $cn = 2^{-n}$ (d) $tn = 1 + (2/n)$

(e) $xn = 73 + (-1)^n$ (f) $sn = (2)^{1/n}$

2. Determine the limits of the following sequences, and then prove your claims.

(a) $an = n/(n^2+1)$ (b) $bn = 7n-19/3n+7$

(c) $cn = 4n+3/7n-5$ (d) $dn = 2n+4/5n+2$ (e) $sn = (1/n)\sin n$

3.Which of the following sequences are increasing? decreasing? Bounded?

(a) $1/n$ (b) $(-1)^n/n^2$ (c) n^5

(d) $\sin(n\pi/7)$ (e) $(-2)^n$ (f) $n/3^n$

4. Let $t1 = 1$ and $tn+1 = [1- 1/4n^2].tn$ for $n \geq 1$.

(a) Show lim tn exists. (b) What do you think lim tn is?

5. Let $s1 = 1$ and $sn+1 = 1/3(sn + 1)$ for $n \geq 1$.

(a) Find s2, s3 and s4.

(b) Use induction to show $sn > 1/2$ for all n.

(c) Show (sn) is a decreasing sequence.

(d) Show lim sn exists and find lim sn.

6. Let $an = 3 + 2(-1)^n$ for $n \in N$.

(a) List the first eight terms of the sequence (an).

(b) Give a subsequence that is constant [takes a single value].

Specify the selection function σ.

7. Prove lim sup|sn| = 0 if and only if lim sn = 0.

8. Let (sn) and (tn) be the following sequences that repeat in cycles of four:

Dr. M. A. SARWAS
Professor
Department of
College of

Dr. N. KISHAN
M.Sc, Ph.D
Senior Professor of Mathematics
Department of Mathematics
University, Hyd-07.

(c) lim inf sn + lim sup tn, (d) lim sup(sn + tn),
(e) lim sup sn + lim sup tn, (f) lim inf(sn. tn),
(g) lim sup(sn. tn).

9. Determine which of the following series converge. Justify your answers.

(a) $\sum \frac{n^4}{2^n}$ (b) $\sum \frac{2^n}{n!}$ (c) $\sum \frac{n^2}{3^n}$ (d) $\sum \frac{n!}{n^4+3}$

(e) $\sum \frac{\cos^2 n}{n^2}$ (f) $\sum_{n=2}^{\infty} \frac{1}{\log n}$

10. Determine which of the following series converge. Justify your answers

(a) $\sum_{n=2}^{\infty} \frac{1}{\sqrt{n}\log n}$ (b) $\sum_{n=2}^{\infty} \frac{1\log n}{n}$

(c) $\sum_{n=4}^{\infty} \frac{1}{n(\log n)\,(\log \log n)}$ (d) $\sum_{n=2}^{\infty} \frac{1\log n}{n^2}$

UNIT-II

11. Let $f(x)=2x^2 + 1$ for $x \in R$. Prove f is continuous on R by
(a) Using the definition, (b) Using the ϵ–δ property
12. Let $f(x) = x^2 \sin(1/x)$ for $x \neq 0$ and $f(x)= 0$ if $x=0$.Prove f is continuous on R by
(a) Using the definition, (b) Using the ϵ–δ property
13.Let $f(x) = \sqrt{4 - x}$ for $x \leq 4$ and $g(x) = x^2$ for all $x \in R$.
(a) Give the domains of f + g, fg, f o g and g o f.
(b) Find the values f o g(0), g o f(0), f o g(1), g o f(1), f o g(2) and g ∘ f(2).
(c) Are the functions f o g and g ∘ f equal?
14.Which of the following continuous functions are uniformly continuous
(a) $f(x) = x^{17} \sin x - e^x \cos 3x$ on $[0, \pi]$,
(b) $f(x) = x^3$ on [0, 1]
(c)$f(x) = \sin(1/x^2)$ on (0, 1]
15.Prove each of the following functions is uniformly continuous on the indicated set by directly verifying the –δ property in Definition .
(a) f(x)=3x + 11 on R,
(b) f(x) = x/x+1 on [0, 2]
(c) f(x) = 1/x on [1/2 , ∞).
16. Prove |x| is a continuous function on R.
17.Prove each of the following functions in continuous at x0 by verifyingthe –δ property .
(a) $f(x) = x^2$, x0 = 2;
(b) $f(x) = \sqrt{x}$, x0 = 0

Dr. N. KISHAN
M.Sc, Ph.D
Senior Professor of Mathematics
Department of Mathematics
Osmania University, Hyd-07.

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18.Prove the following functions are discontinuous at the indicated points. You may use either Definition or the $-\delta$ property .

(a) $f(x) = 1$ for $x > 0$ and $f(x) = 0$ for $x \leq 0$, $x0 = 0$;

(b) $g(x) = \sin(\frac{1}{x})$ for $x \neq 0$ and $g(0) = 0$, $x0 = 0$;

19.show that if $f(x) = 1/x^2$ is uniformly continuous on any set of the form $[a,\infty)$ where $a > 0$

20.Is the function $f(x) = x^2$ uniformly continuous on $[-7, 7]$?

UNIT-III

21.Use the definition of derivative to calculate the derivatives of the following functions at the indicated points.

(a) $f(x) = x^3$ at $x = 2$;

(b) $f(x) = x^2 \cos x$ at $x = 0$;

(c)Let $h(x) = \sqrt{x} = x^{1/2}$ for $x \geq 0$

22.Let $f(x) = x^2 \sin(1/x)$ for $x \neq 0$, $f(0) = 0$, and $g(x) = x$ for $x \in R$.

(a) Observe f and g are differentiable on R.

(b) Calculate f(x) for $x = 1/\pi n$, $n = \pm1, \pm2,....$

(c) Explain why $\lim x\to 0 \frac{g(f(x))-g(f(0))}{f(x)-f(0)}$ is meaningless.

23.Let $f(x) = x^2$ for x rational and $f(x) = 0$ for x irrational.

(a) Prove f is continuous at $x = 0$.

(b) Prove f is discontinuous at all $x \neq 0$.

(c) Prove f is differentiable at $x = 0$

24.Determine whether the conclusion of the Mean Value Theorem holds for the following functions on the specified intervals

(a) x^2 on $[-1, 2]$, (b) sin x on $[0, \pi]$,

(c) $|x|$ on $[-1, 2]$ (d) sgn(x) on $[-2, 2]$.

25.Prove $|\cos x - \cos y| \leq |x - y|$ for all $x, y \in R$.

26.Let $f(x) = x^2 \sin(1/x) + x/2$ for $x \neq 0$ and $f(0) = 0$.

(a) Show $f'(0) > 0$.

(b) Show f is not increasing on any open interval containing 0.

Dr. M.A. SRINIVAS
Professor
Department of Mathematics
College of Engineering
Jawaharlal Nehru Technological University
Nalgonda, Hyderabad-500 085

Dr. N. KISHAN
M.Sc, Ph.D
Senior Professor of Mathematics
Department of Mathematics
Osmania University, Hyd-07.

27.Find $\frac{\sin x}{x}$, $\frac{\cos x-1}{x^2}$

28.Show that $\frac{x^2}{e^{3x}}=0$, $x^x=1$

29.Find the following limits if they exist.

a) $\frac{e^{2x}-\cos x}{x}$ b) $\frac{\sqrt{1+x}-\sqrt{1-x}}{x}$

30.Find the following limits if they exist

a) $\frac{x-\sin x}{x}$ b) $\frac{1+\cos x}{e^x-1}$

UNIT-IV

31.Let f(x) = x for rational x and f(x) = 0 for irrational x.

(a) Calculate the upper and lower Darboux integrals for f on the interval [0,b].

(b) Is f integrable on [0,b]?

32. Let f be a bounded function on [a,b]. Suppose there exist sequences (Un) and (Ln) of upper and lower Darboux sums for f such that lim(Un −Ln) = 0. Show f is integrable and $\int_a^b f = \lim Un = \lim Ln$.

33. A function f on [a,b] is called a step function if there exists a partition P = {a = u0 < u1 < ... < um = b} of [a,b] such that f is constant on each interval (uj−1,uj), say f(x) = cj for x in (uj−1,uj).

(a) Show that a step function f is integrable and evaluate $\int_a^b f$.

(b) Evaluate the integral $\int_0^4 P(x)dx$ for the postage-stamp function.

34. Show $\left|\int_{-2\pi}^{2\pi} x^2 \sin^8 e^x \, dx\right| \le 16\pi^3/3$.

35. Let f be a bounded function on[a,b], so that there exists B > 0 such that $|f(x)| \le B$ for all $x \in [a,b]$.

(a) Show $U(f^2,P)-L(f^2,P) \le 2B[U(f,P)-L(f,P)]$ for all partitions P of [a,b]. Hint: $f(x)^2 - f(y)^2 = [f(x) + f(y)].[f(x)-f(y)]$

(b) Show that if f is integrable on [a,b], then f^2 also is integrable on [a,b].

36. Calculate

(a) $\frac{1}{x}\int_0^x e^{t^2} dt$ (b) $\frac{1}{h}\int_3^{3+h} e^{t^2} dt$.

Dr. N. KISHAN
M Sc, Ph.D
Senior Professor of Mathematics
Department of Mathematics
Osmania University, Hyd-07.

Dr. M. A. Srinivas
Professor
Department of
College of
Jawaharlal Nehru Technological University

ANDHRA MAHILA SABHA
ARTS & SCIENCE COLLEGE FOR WOMEN
Autonomous - NAAC Re-Accredited, O.U.Campus, Hyderabad – 500 007

Tel: 040-27098811.04027070471 (Direct).Fax:04027073346

Email: amsascw1968@gmail.com , ascwams@yahoo.co.in, Website: amsascw.org

37. Show that if f is a continuous real-valued function on [a,b] satisfying $\int_a f(x)g(x)dx = 0$ for every continuous function g on [a,b], then f(x) = 0 for all x in [a,b].

38.f(x)=1 for rational f(x)=0 for irrational in [a,b] find U(f,p) , L(f,p)

39.Give an example of a function f on [0,1] that is not integrable for which | f | is integrable.

40.f(x)=sin 1/x for x≠0 f(0)=0 .show that f is integrable on [-1,1]