Telangana State
Council of Higher Education

Government of Telangana

Mathematics Course Structure

(B.Sc. Common Core Syllabus for All Universities in Telangana with effect from 2016-17)

Contents

B.Sc. Course Structure Template

B.Sc. PROGRAMME

FIRST YEAR SEMESTER-I				
Code	Course Title	Course Type	HPW	Credits
BS101	Communication	AECC-1	2	2
BS102	English	CC-1A	5	5
BS103	Second Language	CC –2A	5	5
BS104	Optional - I **Differential Calculus**	DSC-1A	4 T + 2P = 6	4+1=5
BS105	Optional - II	DSC-2A	4 T + 2P = 6	4+1=5
BS106	Optional – III	DSC-3A	4 T + 2P = 6	4+1=5
			30	27
SEMESTER-II				
BS201	Environmental Studies	AECC-2	2	2
BS202	English	CC-1B	5	5
BS203	Second Language	CC –2B	5	5
BS204	Optional - I **Differential Equations**	DSC-1B	4 T + 2P = 6	4+1=5
BS205	Optional - II	DSC-2B	4 T + 2P = 6	4+1=5
BS206	Optional – III	DSC-3B	4 T + 2P = 6	4+1=5
			30	27

B.Sc. PROGRAMME

SECOND YEAR SEMESTER-III				
BS301	A/B **Logic& Sets/Theory of Equations**	SEC-1	2	2
BS302	English	CC-1C	5	5
BS303	Second Language	CC-2C	5	5
BS304	Optional - I **Real Analysis**	DSC-1C	4 T + 2P = 6	4+1=5
BS305	Optional - II	DSC-2C	4 T + 2P = 6	4+1=5
BS306	Optional – III	DSC-3C	4 T + 2P = 6	4+1=5
			30	27
SEMESTER-IV				
BS401	C/D **Transportation & Game Theory/ Number Theory**	SEC-2	2	2
BS402	English	CC -1D	5	5
BS403	Second Language	CC-2D	5	5
BS404	Optional - I **Algebra**	DSC-1D	4 T + 2P = 6	4+1=5
BS405	Optional - II	DSC-2D	4 T + 2P = 6	4+1=5
BS406	Optional – III	DSC-3D	4 T + 2P = 6	4+1=5
			30	27

B.Sc. Course Structure Template

B.Sc. PROGRAMME

THIRD YEAR SEMESTER-V				
Code	Course Title	Course Type	HPW	Credits
BS501	E/F Probability and Statistics/Mathematical Modelling	SEC-3	2	2
BS502	Lattice Theory	GE-1	2 T	2
BS503	Optional - I Linear Algebra	DSC-1E	3 T + 2P = 5	3+1=4
BS504	Optional –II	DSC-2E	3 T + 2P = 5	3+1=4
BS505	Optional –III	DSC-3E	3 T + 2P = 5	3+1=4
BS506	Optional –I A/B/C Slid Geometry/ Integral Calculus	DSE- 1E	3 T + 2P = 5	3+1=4
BS507	Optional – II A/B/C	DSE-2E	3 T + 2P = 5	3+1=4
BS508	Optional – III A/B/C	DSE-3E	3 T + 2P = 5	3+1=4
			34	28
SEMESTER-VI				
BS601	G/H Boolean Algebra/Graph Theory	SEC-4	2	2
BS602	Elements of Number Theory	GE-2	2 T	2
BS603	Optional - I Numerical Analysis	DSC-1F	3 T + 2P = 5	3+1=4
BS604	Optional –II	DSC-2F	3 T + 2P = 5	3+1=4
BS605	Optional –III	DSC-3F	3 T + 2P = 5	3+1=4
BS606	Optional –I A/B/C Complex Analysis/ Vector Calculus	DSE- 1F	3 T + 2P = 5	3+1=4
BS607	Optional – II A/B/C	DSE-2F	3 T + 2P = 5	3+1=4
BS608	Optional – III A/B/C	DSE-3F	3 T + 2P = 5	3+1=4
			34	28
	TOTAL Credits			164

SUMMARY OF CREDITS

B.Sc. PROGRAMME

Sl. No.	Course Category	No. of Courses	Credits Per Course	Credits
1	AECC	2	2	4
2	SEC	4	2	8
3	CC	8	5	40
	Language	12	5	60
	DSC	6	4	24
	DSC			
4	DSE	6	4	24
5	GE	2	2	4
	TOTAL	**40**		**164**
	Optionals Total	24		108

Syllabus

DSC-1A DIFFERENTIAL CALCULUS BS:104

Theory: 4 credits and Practicals: 1 credits
Theory: 4 hours /week and Practicals: 2 hours /week

Objective: The course is aimed at exposing the students to some basic notions in differential calculus .

Outcome: By the time students completes the course they realize wide ranging applications of the subject.

Unit- I

Successive differentiation- Expansions of Functions- Mean value theorems

Unit – II

Indeterminate forms – Curvature and Evolutes

Unit – III

Partial differentiation – Homogeneous functions- Total derivative

Unit – IV

Maxima and Minima of functions of two variables – Lagrange's Method of multipliers –Asymptotes- Envelopes

Text : Shanti Narayan and Mittal, *Differential Calculus*

References: William Anthony Granville, Percey F Smith and William Raymond Longley; *Elements of the differential and integral calculus*

Joseph Edwards , *Differential calculus for beginners*

Smith and Minton, *Calculus*

Elis Pine, *How to Enjoy Calculus*

Hari Kishan ,*Differential Calculus*

Differential Calculus

Practicals Question Bank

UNIT-I

1. If $u=\tan^{-1} x$, prove that

$$(1+x^2)\frac{d^2u}{dx^2}+2x\frac{du}{dx}=0$$

and hence determine the values of the derivatives of u when $x=0$

2. If

$$y=\sin(m\sin^{-1}x), \text{ show that}$$

$$(1-x^2)y_{n+2}=(2n+1)xy_{n+1}+(n^2-m^2)y_n$$

and find $y_n(0)$.

3. If U_n denotes the nth derivative of $(Lx+M)/(x^2-2Bx+C)$., prove

$$\frac{x^2-2Bx+C}{(n+1)(n+2)}U_{n+2}+\frac{2(x-B)}{n+1}U_{n+1}+U_n=0.$$

4. If $y=x^2e^x$, then

$$\frac{d^ny}{dx^n}=\frac{1}{2}n(n-1)\frac{d^2y}{dx^2}-n(n-2)\frac{dy}{dx}+\frac{1}{2}(n-1)(n-2)y.$$

5. Determine the intervals in which the function

$$(x^4+6x^3+17x^2+32x+32)e^{-x}$$

is increasing or decreasing.

6. Separate the intervals in which the function

$$(x^2+x+1)/(x^2-x+1)$$

is increasing or decreasing.

7. Show that if $x>0$,

(i) $x-\frac{x^2}{2}<\log(1+x)<x-\frac{x^2}{2(1+x)}$.

(ii) $x-\frac{x^2}{2}+\frac{x^3}{3(1+x)}<\log(1+x)<x-\frac{x^2}{2}+\frac{x^3}{3}$.

8. Prove that

$$e^{ax}\sin bx=bx+abx^2+\frac{3a^2b-b^3}{3!}x^3+\dots$$

$$+\frac{(a^2+b^2)^{\frac{1}{2}n}}{n!}x^n\sin\left(n\tan^{-1}\frac{b}{a}\right)+\dots$$

9. Show that $\cos^2 x=1-x^2+\frac{1}{3}x^4-\frac{2}{45}x^6\dots\dots$

10. Show that

$$e^{m\tan^{-1}x}=1+mx+\frac{m^2}{2!}x^2+\frac{m(m^2-2)}{3!}x^3+\frac{m^2(m^2-8)}{4!}x^4+\dots.$$

UNIT-II

1. Find the radius of curvature at any point on the curves

(i) $y=c\cosh(x/c)$ (*Catenary*).

(ii) $x=a(\cos t+t\sin t)$, $y=a(\sin t-t\cos t)$.

(iii) $x^{\frac{2}{3}}+y^{\frac{2}{3}}=a^{\frac{2}{3}}$. (Astroid)

(iv) $x=(a\cos t)/t$, $y=(a\sin t)/t$.

2. Show that for the curve

$$x=a\cos\theta\,(1+\sin\theta),\ y=a\sin\theta\,(1+\cos\theta),$$

the radius of curvature is, a, at the point for which the value of the parameter is $-\pi/4$.

3. Prove that the radius of curvature at the point $(-2a, 2a)$ on the curve $x^2y=a(x^2+y^2)$ is, $-2a$.

4. Show that the radii of curvature of the curve

$$x=ae^{\theta} (\sin \theta-\cos \theta), y=ae^{\theta} (\sin \theta+\cos \theta),$$

and its evolute at corresponding points are equal.

5. Show that the whole length of the evolute of the ellipse

$$x^2/a^2+y^2/b^2=1$$

is $4(a^2/b-b^2/a)$.

6. Show that the whole length of the evolute of the astroid

$$x=a \cos^3\theta, y=a \sin^3\theta$$

is $12a$.

7. Evaluate the following :

(i) $\lim\limits_{x \to 0} \dfrac{xe^x-\log(1+x)}{x^2}$. (*D.U. 1952*) (ii) $\lim\limits_{x \to 0} \dfrac{x \cos x-\log(1+x)}{x^2}$.

(*D. U. Hons. 1951, P.U. 1957*)

(iii) $\lim\limits_{x \to 0} \dfrac{e^x \sin x-x-x^2}{x^2+x \log(1-x)}$. (*D.U. 1953*) (iv) $\lim\limits_{x \to 0} \left\{\dfrac{1}{x}-\dfrac{1}{x^2} \log(1+x)\right\}$.

(*D.U. 1955*)

8. If the limit of

$$\frac{\sin 2x+a \sin x}{x^3},$$

as x tends to zero, be finite, find the value of a and the limit.

9. Determine the limits of the following functions :

(i) $x \log \tan x$, $(x \to 0)$. (ii) $x \tan(\pi/2-x)$, $(x \to 0)$.

(iii) $(a-x) \tan(\pi x/2a)$, $(x \to 0)$.

10. Determine the limits of the following functions :

i. $\dfrac{e^x-e^{-x}-x}{x^2 \sin x}$, $(x \to 0)$. ii. $\dfrac{\log x}{x^3}$, $(x \to \infty)$.

iii. $\dfrac{1+x \cos x-\cosh x-\log(1+x)}{\tan x-x}$, $(x \to 0)$.

iv. $\dfrac{\log(1+x) \log(1-x)-\log(1-x^2)}{x^4}$, $(x \to 0)$.

UNIT-III

1. If $z=xy f(x/y)$, show that

$$x\frac{\partial z}{\partial x}+y\frac{\partial z}{\partial y}=2z.$$

2. If $z(x+y)=x^2+y^2$, show that

$$\left(\frac{\partial z}{\partial x}-\frac{\partial z}{\partial y}\right)^2=4\left(1-\frac{\partial z}{\partial x}-\frac{\partial z}{\partial y}\right).$$

3. If $z=3xy-y^3+(y^2-2x)^{\frac{3}{2}}$, verify that

$$\frac{\partial^2 z}{\partial x\partial y}=\frac{\partial^2 z}{\partial y\partial x} \text{ and } \frac{\partial^2 z}{\partial x^2}\frac{\partial^2 z}{\partial y^2}=\left(\frac{\partial^2 z}{\partial x\partial y}\right)^2.$$

4. If $z=f(x+ay)+\varphi(x-ay)$, prove that

$$\frac{\partial^2 z}{\partial y^2}=a^2\frac{\partial^2 z}{\partial x^2}.$$

5. If $u=\tan^{-1}\dfrac{x^3+y^3}{x-y}$, find

$$x^2\frac{\partial^2 u}{\partial x^2}+2xy\frac{\partial^2 u}{\partial x\partial y}+y^2\frac{\partial^2 u}{\partial y^2}.$$

6. If $f(x, y)=0$, $\varphi(y, z)=0$, show that

$$\frac{\partial f}{\partial y}\cdot\frac{\partial \varphi}{\partial z}\cdot\frac{dz}{dx}=\frac{\partial f}{\partial x}\cdot\frac{\partial \varphi}{\partial y}.$$

7. If $x\sqrt{(1-y^2)}+y\sqrt{(1-x^2)}=a$, show that

$$\frac{d^2y}{dx^2}=\frac{a}{(1-x^2)^{\frac{3}{2}}}.$$

8. Given that

$$f(x, y)\equiv x^3+y^3-3axy=0, \text{ show that}$$

$$\frac{d^2y}{dx^2}\cdot\frac{d^2x}{dy^2}=\frac{4a^6}{xy(xy-2a^2)^3}.$$

9. If u and v are functions of x and y defined by

$$x=u+e^{-v}\sin u,\ y=v+e^{-v}\cos u,$$

prove that

$$\frac{\partial u}{\partial y}=\frac{\partial v}{\partial x}.$$

10. *If $H=f(y-z,\ z-x,\ x-y)$; prove that,*

$$\frac{\partial H}{\partial x}+\frac{\partial H}{\partial y}-\frac{\partial H}{\partial z}=0.$$

UNIT-IV

1. Find the minimum value of $x^2+y^2+z^2$ when
   (*i*) $x+y+z=3a$.
   (*ii*) $xy+yz+zx=3a^2$.
   (*iii*) $xyz=a^3$.
2. Find the extreme value of xy when

$$x^2+xy+y^2=a^2.$$

3. In a plane triangle, find the maximum value of

$$\cos A\cos B\cos C.$$

4. ***Find the envelope of the family of semi-cubical parabolas***

$$y^2-(x+a)^3=0.$$

5. *Find the envelope of the family of ellipses*

$$x^2/a^2+y^2/b^2=1,$$

where the two parameter a, b, are connected by the relation

$$a+b=c\ ;$$

c, being a constant.

6. *Show that the envelope of a circle whose centre lies on the parabola $y^2=4ax$ and which passes through its vertex is the cissoid*

$$y^2(2a+x)+x^3=0.$$

7. Find the envelope of the family of straight lines $x/a+y/b=1$ where a, b are connected by the relation
   (*i*) $a+b=c$. (*ii*) $a^2+b^2=c^2$. (*iii*) $ab=c^2$,
   c is a constant.
8. *Find the asymptotes of*

$$x^3+4x^2y+4xy^2+5x^2+15xy+10y^2-2y+1=0.$$

9. *Find the asymptotes of*

$$x^3+4x^2y+4xy^2+5x^2+15xy+10y^2-2y+1=0.$$

10. Find the asymptotes of the following curves
    i. $xy(x+y)=a(x^2-a^2)$.
    ii. $(x-1)(x-2)(x+y)+x^2+x+1=0$.
    iii. $y^3-x^3+y^2+x^2+y-x+1=0$.

DSC- 1B DIFFERENTIAL EQUATIONS BS:204

Theory: 4 Credits and Practicals: 1 credits
Theory: 4 hours /week and Practicals: 2 hours /week

Objective: The main aim of this course is to introduce the students to the techniques of solving differential equations and to train to apply their skills in solving some of the problems of engineering and science.

Outcomes: After learning the course the students will be equipped with the various tools to solve few types differential equations that arise in several branches of science.

Unit – I

Differential Equations of first order and first degree:
Exact differential equations – Integrating Factors – Change in variables – Total Differential Equations – Simultaneous Total Differential Equations – Equations of the form $dx/P = dy/Q = dz/R$
Differential Equations first order but not of first degree: Equations Solvable for y – Equations Solvable for x – Equations that do not contain x (or y) – Clairaut's equation

Unit – II

Higher order linear differential equations: Solution of homogeneous linear differential equations with constant coefficients – Solution of non-homogeneous differential equations P(D)y= Q(x) with constant coefficients by means of polynomial operators when $Q(x)=bx^k, be^{ax}, e^{ax}V, b\cos(ax), b\sin(ax)$

Unit – III

Method of undetermined coefficients – Method of variation of parameters – Linear differential equations with non constant coefficients – The Cauchy – Euler Equation

Unit – IV

Partial Differential equations- Formation and solution- Equations easily integrable – Linear equations of first order – Non linear equations of first order – Charpit's method – Non homogeneous linear partial differential equations – Separation of variables

Text: Zafar Ahsan, *Differential Equations and Their Applications*

References: Frank Ayres Jr, *Theory and Problems of Differential Equations*

Ford, L.R, *Differential Equations.*

Daniel Murray, *Differential Equations*

S. Balachandra Rao, *Differential Equations with Applications and Programs*

Stuart P Hastings, J Bryce McLead; *Classical Methods in Ordinary Differential Equations*

Differential Equations
Practicals Question Bank

Unit-I

Solve the following differential equations:

1. $y' = \sin(x+y) + \cos(x+y)$

2. $xdy - ydx = a(x^2 + y^2)dy$

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

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

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

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

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

8. $\dfrac{dx}{y - zx} = \dfrac{dy}{yz + x} = \dfrac{dz}{x^2 + y^2}$

9. $\dfrac{dx}{x(y^2 - z^2)} = \dfrac{dy}{y(z^2 - x^2)} = \dfrac{dz}{z(x^2 - y^2)}$

10. Use the transformation $x^2 = u$ and $y^2 = v$ to solve the equation

$axyp^2 + (x^2 - ay^2 - b)p - xy = 0$.

Unit-II

Solve the following differential equations:

1. $D^2 y + (a+b)Dy + aby = 0$

2. $D^3 y - D^2 y - Dy - 2y = 0$

3. $D^3 y + Dy = x^2 + 2x$

4. $y'' + 3y' + 2y = 2(e^{-2x} + x^2)$

5. $y^{(5)} + 2y''' + y' = 2x + \sin x + \cos x$

6. $(D^2 + 1)(D^2 + 4)y = \cos\dfrac{x}{2}\cos\dfrac{3x}{2}$

7. $(D^2 + 1)y = \cos x + xe^{2x} + e^x \sin x$

8. $y'' + 3y' + 2y = 12e^x$

9. $y'' - y = \cos x$

10. $4y'' - 5y' = x^2 e^x$

Unit-III

Solve the following differential equations:

1. $y'' + 3y' + 2y = xe^x$

2. $y'' + 3y' + 2y = \sin x$

3. $y'' + y' + y = x^2$

4. $y'' + 2y' + y = x^2 e^{-x}$

5. $x^2 y'' - xy' + y = 2\log x$

6. $x^4 y''' + 2x^3 y'' - x^2 y' + xy = 1$

7. $x^2 y'' - xy' + 2y = x\log x$

8. $x^2 y'' - xy' + 2y = x$

Use the reduction of order method to solve the following homogeneous equation whose one of the solutions is given:

9. $y'' - \dfrac{2}{x}y' + \dfrac{2}{x^2}y = 0$, $y_1 = x$

10. $(2x^2 + 1)y'' - 4xy' + 4y = 0$, $y_1 = x$

Unit-IV

1. Form the partial differential equation , by eliminating the arbitrary constants from $z=(x^2+a)(y^2+b)$.

2. Find the differential equation of the family of all planes whose members are all at a constant distance r from the origin.

3. Form the differential equation by eliminating arbitrary function F from

$F(x^2+y^2, z-xy)=0$.

Solve the following differential equations:

4. $x^2(y-z)p+y^2(z-x)q=z^2(x-y)$

5. $x(z^2-y^2)p+y(x^2-z^2)q=z(y^2-x^2)$

6. $\left(p^2-q^2\right)z=x-y$

7. $z=px+qy+p^2q^2$

8. $z^2=pqxy$

9. $z^2(p^2+q^2)=x^2+y^2$

10. $r+s-6t=\cos(2x+y)$