

# **SYLLABUS FOR**

**THE FOUR –YEAR UNDERGRADUATE PROGRAMME**

**(FYUGP) IN MATHEMATICS (MAJOR,MINOR)**

**AND MULTIDISCIPLINARY COURSE (MDC)**

**As Per Provision of NEP -2020 to be implemented  
from academic year -2023 onwards.**



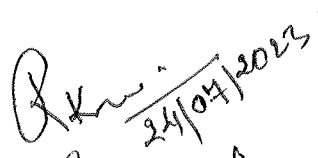
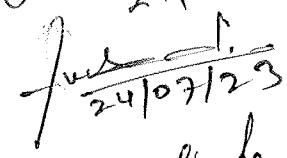
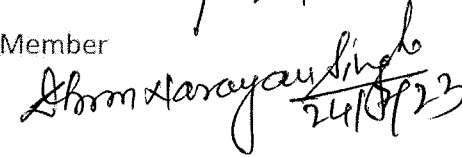
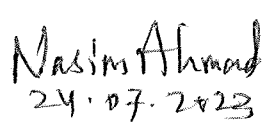
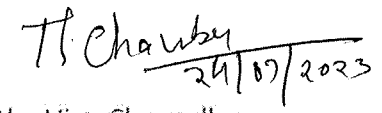
**for**

**All Constituent / Affiliated Colleges Under  
Binod Bihari Mahto Koyalanchal University,  
Dhanbad (Jharkhand).**



### Notification

In exercise of the powers vested in him under the Jharkhand State Universities Act 2000 as amended up-to-date, the Vice-Chancellor is pleased to constitute a Board of Studies (BOS) for the Department of Mathematics at Under Graduate Level, comprising of following members for a period of one year from the date of notification :

1. Dr. R.K. Tiwari  
Head, University Department of Mathematics,  
BBMKU - Chairman  24/07/2023
2. Dr. Shiv Prasad  
University Department of Mathematics, BBMKU. -Member  24/07/23
3. Dr. D.N. Singh  
Head, Department of Mathematics  
Chas College, Chas. -Member  24/07/23
4. Dr. Nasim Ahmad (Retd.)  
Ex- Head, Department of Mathematics,  
P.K. Roy Memorial College, Dhanbad. - Special Invitee  24.07.2023
5. Dr. T.P. Choubey (Retd.),  
Ex- Head, Department of Mathematics,  
Chas College, Chas. -Special Invitee  24/07/2023

By order of the Vice-Chancellor

Sd/-


Registrar

Date ..... 14/07/2023

Memo No. BBMKU/R/1229/2022

Copy to: -

1. Persons concerned.
2. Dean, Faculty of Science, BBMKU.
3. Head, University Department of Mathematics.
4. Establishment Section, BBMKU, Dhanbad.
5. P.A. to VC/PVC/R for information to VC/PVC/R.
6. Guard File.

  
Registrar  
BBMKU, Dhanbad.

  
14/07/23

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**COURSE OF STUDY FOR FOUR YEAR UNDERGRADUATE PROGRAMME 2023 ONWARDS**

**Semester wise Course code and Credit Points for Single Major**

Semester	Common , Introductory, Major, Minor, Vocational & Internship Courses		
	Code	Papers	Credits
I	AEC-1	Language and Communication Skills (MIL-1: Modern Indian language including TRL)	2
	VAC-1	Value Added Course -1	4
	SEC-1	Skill Enhancement Course -1	3
	MDC-1	Multi- disciplinary Course-1	3
	MN-1A	Minor from Discipline-1	4
	MJ-1	Major Paper 1 ( disciplinary Interdisciplinary Major)	4
II	AEC-2	Language and Communication Skills (English)	2
	SEC-2	Skill Enhancement Course -2	3
	MDC-2	Multi-Disciplinary Course-2	3
	MN-2A	Minor from Vocational Studies /Discipline-2	4
	MJ-2	Major Paper 2 (Disciplinary/Interdisciplinary Major)	4
	MJ-3	Major paper 3 (Disciplinary/Interdisciplinary Major)	4
III	AEC-3	Language and Communication Skills (MIL-2, Modern Indian language including TRL)	2
	SEC-3	Skill Enhancement Course -3	3
	MDC-3	Multi-Disciplinary Course-3	3
	MN-1B	Minor for Discipline-1	4
	MJ-4	Major Paper 4 (Disciplinary/Interdisciplinary Major)	4
	MJ-5	Major paper 5 (Disciplinary/Interdisciplinary Major)	4

IV	AEC-3	Language and Communication Skills (MIL-2/ English-2)	4
	VAC-2	Value Added Course -2	2
	MN-2B	Minor from Vocational Studies Discipline-2	4
	MJ-6	Major paper 6(Disciplinary /Interdisciplinary Major)	4
	MJ-7	Major paper 7(Disciplinary /Interdisciplinary Major)	4
	MJ-8	Major Paper 8 ( disciplinary Interdisciplinary Major)	4
V	MN IC	Minor fom Discipline-1	
	MJ-9	Major Paper 9 (Disciplinary/Interdisciplinary Major)	4
	MJ-10	Major paper 10 (Disciplinary/Interdisciplinary Major)	4
	MJ-11	Major paper 11 (Disciplinary/Interdisciplinary Major)	4
	IAP	Internship / Apprenticeship/field Work / Dissertation/ Project.	4
VI	MN-2C	Minor from Vocational Studies/ Discipline-2	4
	MJ-12	Major Paper 12 (Disciplinary/Interdisciplinary Major)	4
	MJ-13	Major paper 13 (Disciplinary/Interdisciplinary Major)	4
	MJ-14	Major paper 14 (Disciplinary/Interdisciplinary Major)	4
	MJ-15	Major paper 15 (Disciplinary/Interdisciplinary Major)	4

VII	MN-1D	Minor from Discipline-1	4
	MJ-16	Major Paper 16 (Disciplinary/Interdisciplinary Major)	4
	MJ-17	Major paper 17 (Disciplinary/Interdisciplinary Major)	4
	MJ-18	Major paper 18 (Disciplinary/Interdisciplinary Major)	4
	MJ-19	Major paper 19 (Disciplinary/Interdisciplinary Major)	4
VIII	MN-2D	Minor from vocational studies / Discipline-2	4
	MJ-20	Major Paper 20 (Disciplinary/Interdisciplinary Major)	4
	RC/ or	Research Internship / Field Work /Dissertation	12/ 4
	AMJ 1	Advanced Major Paper-1(Disciplinary/ Interdisciplinary Major )	4
	AMJ2	Advanced Major Paper-2(Disciplinary/ Interdisciplinary Major )	4
	AMJ3	Advanced Major Paper-3(Disciplinary/ Interdisciplinary Major )	
		<b>Total Credit</b>	<b>160</b>

## NUMBER OF CREDITS BY TYPE OF COURSE

The hallmark of the new curriculum framework is the flexibility for the students to learn courses of their choice across various branches of undergraduate programmes. This requires that all departments prescribe a certain specified number credits for each course and common instruction hours (slot time).

### Overall Course Credit Points for Single Major

Courses	Nature of Courses	3yr UG Credits	4 yr UG Credits
Major	Core courses	60	80
Minor	i. Discipline/Interdisciplinary courses and ii. Vocational Courses	24	32
Multidisciplinary	3 courses	9	9
AEC	Language course	8	8
SEC	Courses to be developed by the University	9	9
Value Added Course	Understanding India, Environmental Studies, Digital Education, Health & wellness , summer Internship/ Apprenticeship/ Community outreach activities, etc.	6	6
Internship(In any Semester –V)	summer vacation for Exit points or in	4	4
Research /Dissertation/ Advance Major Courses	Research Institutions/3 courses		12
	<b>Total Credits</b>	<b>120</b>	<b>160</b>

## Overall Course Code and Additional Credit Points for Double Major

Courses	Nature of Courses	3yr UG Credits	4 yr UG Credits
Major-1	Core courses	60	80
Major-2	Core Courses	48	64
Minor	i. Discipline/Interdisciplinary courses and ii. Vocational Courses	24	32
Multidisciplinary	3 courses	9	9
AEC	Language course	8	8
SEC	Courses to be developed by the University	9	9
Value Added Course	Understanding India, Environmental Studies, Digital Education, Health & wellness, summer Internship Apprenticeship/Community outreach activities, etc.	6	6
Internship(In any Semester -V)	any summer vacation for Exit points or in	4	4
Research /Dissertation/ Advance Major Courses	Research Institutions/3 courses		12
	Total Credits	168	224



**Semester wise Course Code and Additional Credit Points for Double Major :**

Semester	Common , Introductory, Major, Minor, Vocational & Internship Courses		Credits
	Code	Papers	
I	DMJ-1	Double Major Paper -1( Disciplinary /Interdisciplinary Major)	4
	DMJ-2	Double Major Paper -2( Disciplinary /Interdisciplinary Major)	4
II	DMJ-3	Double Major Paper -3( Disciplinary /Interdisciplinary Major)	4
	DMJ-4	Double Major Paper -4 (Disciplinary /Interdisciplinary Major)	4
III	DMJ-5	Double Major Paper -5 (Disciplinary /Interdisciplinary Major)	4
	DMJ-6	Double Major Paper -6 (Disciplinary /Interdisciplinary Major)	4
IV	DMJ-7	Double Major Paper -7 (Disciplinary /Interdisciplinary Major)	4
	DMJ-8	Double Major Paper -8 (Disciplinary /Interdisciplinary Major)	
V	DMJ-9	Double Major Paper -9 (Disciplinary /Interdisciplinary Major)	4
	DMJ-10	Double Major Paper -10 (Disciplinary /Interdisciplinary Major)	4
VI	DMJ-11	Double Major Paper -11 (Disciplinary /Interdisciplinary Major)	4
	DMJ-12	Double Major Paper -12` (Disciplinary /Interdisciplinary Major)	4

VII	DMJ-13	Double Major Paper -13 (Disciplinary /Interdisciplinary Major)	4
	DMJ-14	Double Major Paper -14 (Disciplinary /Interdisciplinary Major)	4
VIII	DMJ-15	Double Major Paper -15 (Disciplinary /Interdisciplinary Major)	4
		Total Credit	64

**Abbreviations:-**

AEC	Ability Enhancement Courses
SEC	Skill Enhancement Courses
IAP	Internship /Appenticeship /Project
MDC	Multidisciplinary Courses
MJ	Major Disciplinary/ Interdisciplinary Courses
DMJ	Double Major Disciplinary/Interdisciplinary Courses
MN	Minor Disciplinary/Interdisciplinary Courses
AMJ	Advance Major Disciplinary/Interdisciplinary Courses
RC	Research Courses

## **Marks Distribution for Examinations for U.G. Major and Minor Programme of 160 Credits .**

- 1) There will be only one Semester Internal Examination in Major and Minor.
- 2) 25 Marks in theory Examination may include 20 Marks questions from written Examination on/ Assignment / Project/Tutorial Wherever applicable whereas 5 marks will be awarded on the attendance / overall class performance in the semester.
- 3) To convert attendance into marks a suggestive range is provided here. However, institutions may develop its own reange:  
[Attendance: upto 45% -1 Mark; 45 <Attd. < 55-2 2 Marks; 55<Attd. <65 -3 Marks ; 65 <Attd. <75-4 Marks, 75 < Attd. -5 Marks ]

### **4) Guidelines for Question Setter:-**

- i) Question paper shall show full Maks (FM), Pass Maks (PM) and Maximum Time allowed (in Hrs. ) of the top of the Question paper
- ii) There will be two categories of Questions Namely Group A & Group –B.  
Gropup –A will be of very short answer type of (consisting objective type excluding multiple choice questions ) of 1 mark & Short answer type of 5 marks and questions in this group will be all compulsory .  
Group –B will contain long answer type questions

**iii) For Semester Internal Examination ( SIE 20 Marks, 1 Hr. Exam):**

There will be two group of questions.

**Group A** is compulsory which will contain two questions.

**Question No. 1** will be very short answer type consisting of five questions of 1 mark each.

**Question No. -2** will be short answer type consisting of one question of 5 marks.

**Group -B** will contain descriptive type two questions of ten(10) marks each out of which any one to answer .

**iv) For End Semester Examination ( ESE-75 Maks, 3 Hrs. Exam.)**

There will be two group of questions.

**Group A** is Compulsory which will contain three (03) questions Question No. -1 will be very short answer type consisting of five (05) questions of 1 mark each Question No. 2 and 3 will be short answer type of 5 marks.

**Group -B** will contain descriptive type Six (6). Questions of fifteen marks each, out of which any four are to answer.

Marks distribution pattern [25 Marks for each credit)

Subjects	Credits	FM	Semester			End Semester University Examination
			Internal Examination			
Ability Enhancement Courses	2	50	----			50
Value Added Courses	2	50	---			50
Skill Enhancement Courses	3	75	---			75
Multidisciplinary Courses	3	75	---			75
Minor Courses	4	100	25			75
Advanced Major	4	100	25			75
Research Courses						
i. Research Methodology (FM.=100)	12	100+ 200	25+, .....			75+200
ii. Synopsis, Thesis & others(F.M.=200)						
Vocational Courses Including Internship	4	100	--	100/(Grade point awarded by the concerned organization)		
Non-Practical Subjects (MJ/MN)	4	100	25			75
Practical subjects(MJ/MN)	4	T	P	T	T	P
		75	25	15	60	25

### Pass Marks in 160 Credit Course [40% of F.M.]

- i. The pass marks in 160 Credit courses will be 40% of the total marks obtained in each Course offered by the student.
- ii. To Pass in **MIL / Non-Hindi** subject, a student must obtain minimum 20 marks out of 50 marks in 2 credit courses.

### Full Marks (FM) & Pass Marks (PM) Pattern for Subject

Subjects	F.M.	P M
MIL Hindi	50	20
Other Language	50	20
Non- Practical Subjects	100	40
Non- Practical Subjects	75	30
Non Practical Subjects:	50	20
Practical Subjects: Theory Paper	75	30
Practical Subjects : Paractical Paper	25	10
Practical Subjects: Practical Paper	50	20
Practical Subjects: Practical Paper	75	30
Practical Subjects: Practical Paper	100	40

**CHOOSING PROGRAMME/ STUDY COURSES IN THE FOUR -YEAR  
UNDERGRADUATE PROGRAMME IPMPLEMENTED UNDER NEP**

**2023 onwards**

Option to select subject combination from Disciplinary / Interdisciplinary programmes.

**NATURAL AND PHYSICAL SCIENCE :**

S.NO.	Major	Minor
'01	Botany	Chemistry
		Geology
		Zoology
		Economics
		Geography

S.NO.	Major	Minor
'02	Chemistry	Botony
		Mathematics
		Physics
		Zeology
		Economics

S.NO.	Major	Minor
'03	Physics	Chemistry
		Statistics
		Mathmatics
		Economics
		Geography
		Philosophy

S.NO.	Major	Minor
'04	Geology	Botany
		Chemistry
		Mathmatics
		Physics
		Zoology
		Anthropology
		Economics
		Geography



**MATHEMATICS , STATISTICS, AND COMPUTE APPLICATION**

S.NO.	Major	Minor
1	Mathematics	Chemistry
		Physics
		Geology
		Statistics
		Economics
		Commerce
		Cyber Defense

S.NO.	Major	Minor
2	Statistics	Mathematics
		Economics
		Geography
		History
		Practical Science
		Commerce

## LIBRARY, INFORMATION AND MEDIA SCIENCES

S.NO.	Major	Minor
1	Cyber Defense	Mathematics
		Statistics

## COMMERCE AND MANAGEMENT

S.NO.	Major	Minor
1	COMMERCE	Mathematics
		Statistics
		Anthropology
		Economics
		Geography
		History
		Home Science
		Political Science
		Psychology
		Sociology
		Philosophy

## SEMESTER -I

### MAJOR COURSE –MJ-1

Credits -04 (60 Hs.), (Credits: Lecture-03 Tutorial-01)

Full Marks: 25(SIE:1 Hs) +75(ESE:3Hrs)=100 Pass Marks(SIE:10+ESE:30)=40

***Instruction to Question Setter for :***

#### ***Semester Internal Examination (SIE):***

*There will be two group of questions. Group A is compulsory and will contains two questions in which question No. 1 contains five questions of very short type consisting of 1 mark each , and question No. 2 have one question of short answer type 5 maks . Group B will contain descriptive type two questions of 10 marks each, out of which any one is to answer.*

#### ***End Semester Examination (ESE):***

*There will two group of questions. Group A is compulsory and will contain three questions. Question No. 1 will be very short answer type consisting of five questions of 1 mark each Question No. 2 and 3 will be short answer type consisting two questions of 5 maks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to be answer.*

**Note:** *There may be subdivisions in each question asked in End Semester Examinations.*

# **DIFFERENTIAL CALCULUS , INTEGRAL CALCULUS, ANALYTICAL GEMOETRY 2D & VECTOR CALCULUS:**

## **UNIT-I**

*Successive Differentiation, Expansion, L' Hospital rule, Asymptotes.*

15 Lectures(1 Question)

## **UNIT-II**

*Reduction formulae, derivations and illustrations of reduction formulae of the type  $\int \sin^n x dx$ ,  $\int \cos^n x dx$ ,  $\int \tan^n x dx$ ,  $\int \sin^n x \cos^m x dx$ ,  $\int \sin n x dx$ ,  $\int \cos n x dx$ ,  $\int (\log x)^n dx$ , parametric equations, parameterizing a curve, arc length, arc length of poarametric curves , volume and area of surface of revolution.*

15 Lectures(2 Questions)

## **UNIT-III**

*General equation of the second degree, General conic, polar equation of conics.*

15 Lectures(1 Question)

## **UNIT-IV**

*Triple product, introduction to vector functions , operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration.*

15 Lectures(2 Questions)

## **Books Recommended**

1. G.B. Thomas and R.L. Finney, Calculus , 9<sup>th</sup> Ed., Pearson Education , Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K.J. Smith, Calculus, 3<sup>rd</sup> Ed., Dorling Kindersley (India)P. Ltd. (Pearson Education), Delhi, 2007 .
3. H.Anton, I. Bivens and S.Davis, Calculus, 7<sup>th</sup> Ed., John Widley and Sons ( Asia) P.Ltd., Singapore, 2002.
4. R. Courant and F.John, Introduction to Calculus and Analysis ( Volume I & II), Springer Velag, New York,Inc., 1989

**SEMESTER -II**  
**MAJOR COURSE –MJ-2**

Credits -04 (60 Hs.), (Credits: Lecture-03 Tutorial-01)

Full Marks: 25(SIE:1 Hs) +75(ESE:3Hrs)=100 Pass Marks(SIE:10+ESE:30)=40

***Instruction to Question Setter for :***

**Semester Internal Examination (SIE):**

*There will be two group of questions. Group A is compulsory and will contains two questions in which question No. 1 contains five questions of very short type consisting of 1 mark each , and question No. 2 have one question of short answer type 5 maks . Group B will contain descriptive type two questions of 10 marks each, out of which any one is to answer.*

**End Semester Examination (ESE):**

*There will two group of questions. Group A is compulsory and will contain three questions. Question No. 1 will be very short answer type consisting of five questions of 1 mark each Question No. 2 and 3 will be short answer type consisting two questions of 5 maks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to be answer.*

**Note:** *There may be subdivisions in each question asked in End Semester Examinations.*

## **REAL ANALYSIS-I**

### **UNIT-I**

*Idea of countable sets, uncountable sets and uncountability of  $\mathbb{R}$ . Bounded above sets, bounded below sets, Bounded sets, Unbounded sets, Suprema and Infima, Intervals, limits points of a set, Isolated points, Illustration of Bolzano- Weierstrass theorem for sets.*

10 Lectures(1 Question)

### **UNIT-II**

*Sequences, Bounded sequences, Convergent sequence, Limit of a sequence. Limits theorems, Monotone sequences, Monotone Covergence theorem, Subsequences, Divergence Criteria, Monotone Subsequences theorem (statement only), Bolzano- Weierstrass Theorem for Squences, Cauchy sequences, Cauchy's Convergence Criterion.*

20 Lectures(2 Questions)

### **UNIT-III**

*Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Test for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth root test, Rabbe's test, De-Morgan's and Bertrand's test, Alternative series, Leibnitz test, Absolute and Conditional convergence, Kummer's test, logartithmic test.*

30 Lectures(3 Questions)

### **Books Recommended**

1. R.G. Bartle and D.R. Sherbert, Introduction to Real Analysis, 3<sup>rd</sup> Ed., John Wiley and Sons ( Asia) Pvt. Ltd., Singapore, 2002.
2. Gerald G. Bilodeau, Paul R. Thie, G.E. Keough, An Introduction to Analysis , 2<sup>nd</sup> Ed., Jones & Bartlett, 2010.
3. Brain S. Thmson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
4. S.K. Berberian , A First Course in in Real Analysis , Springer Verlag, New York , 1994.
5. , New York,Inc., 1989

## MAJOR COURSE –MJ-3

Credits -04 (60 Hs.), (Credits: Lecture-03 Tutorial-01)

Full Marks: 25(SIE:1 Hs) +75(ESE:3Hrs)=100 Pass Marks(SIE:10+ESE:30)=40

***Instruction to Question Setter for :***

### **Semester Internal Examination (SIE):**

*There will be two group of questions. Group A is compulsory and will contains two questions in which question No. 1 contains five questions of **very short type** consisting of 1 mark each , and question No. 2 have one question of short answer type 5 maks . Group B will contain descriptive type two questions of 10 marks each, out of which any one is to answer.*

### **End Semester Examination (ESE):**

*There will two group of questions. Group A is compulsory and will contain three questions. Question No. 1 will be very short answer type consisting of five questions of 1 mark each Question No. 2 and 3 will be short answer type consisting two questions of 5 maks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to be answer.*

**Note:** *There may be subdivisions in each question asked in End Semester Examinations.*

## HIGHER ALGEBRA & TRIGONOMETRY

### UNIT-I

Polar representation of complex numbers,  $n$ th roots of unity, De Moivre's theorem for rational indices and its applications, logarithmic of complex numbers.

20 Lectures(2 Questions)

### UNIT-II

System of linear equations, row reduction and echelon forms, vector equations, the matrix equation  $Ax=b$ , solution set of linear system, applications of linear systems, linear independence.

20 Lectures(2 Questions)

### UNIT-III

Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of  $\mathbb{R}^n$ , dimension of subspaces of  $\mathbb{R}^n$ , and rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix.

20 Lectures(2 Questions)

### **Books Recommended**

1. Titu Andreescu and Dorin Andrica, *Complex Number from A to Z*, Birkhauser, 2006.
2. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory*, 3d Ed., Pearson Education (Singapore)P.Ltd., Indian Reprint, 2005.
3. David C. Lay, *Linear Algebra and its Applications*, 3<sup>rd</sup> Ed., Pearson Education Asia, Indian Reprint, 2007.



**SEMESTER –III**  
**MAJOR COURSE-MJ-4**

Credits -04 (60 Hs.), (Credits: Lecture-03 Tutorial-01)  
25(SIE:1 Hs) +75(ESE:3Hrs)=100 Pass Marks(SIE:10+ESE:30)=40

Full Marks:

***Instruction to Question Setter for :***

**Semester Internal Examination (SIE):**

*There will be two group of questions. Group A is compulsory and will contains two questions in which question No. 1 contains five questions of very short type consisting of 1 mark each , and question No. 2 have one question of short answer type 5 maks . Group B will contain descriptive type two questions of 10 marks each, out of which any one is to answer.*

**End Semester Examination (ESE):**

*There will two group of questions. Group A is compulsory and will contain three questions. Question No. 1 will be very short answer type consisting of five questions of 1 mark each Question No. 2 and 3 will be short answer type consisting two questions of 5 maks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to be answer.*

**Note:** *There may be subdivisions in each question asked in End Semester Examinations.*

## **DIFFERENTIAL EQUATION::**

### **UNIT-I**

*Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.*

*20 Lectures(2 Questions)*

### **UNIT-II**

*General solution of linear homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and Non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.*

*20 Lectures(2 Questions)*

### **UNIT-III**

*Bessel's equation and Legendre's equation, recurrence formulae, orthogonal properties, generating function, Laplace transform and inverse transform, properties, application to initial value problem upto Second order ODE*

*20 Lectures(2 Questions)*

### **Books Recommended**

1. *Belinda Barnes and Glenn R. Fulford, Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab, 2<sup>nd</sup> Ed., Taylor and Francis group. London and New York, 2009.*
2. *C.H. Edwards and D.E. Penny, Differential Equations and Boundary Value problems computing and Modeling, Pearson Education India, 2005*
3. *S.L. Ross, Differential Equations, 3<sup>rd</sup> Ed., John Wiley and Sons, India, 2004*
4. *Martha L Abell, James P Braselton, Differential Equations with MATHEMATICA, 3d Ed., Elsevier Academic Press, 2004*

## MAJOR COURSE-MJ-5

Credits -04 (60 Hs.), (Credits: Lecture-03 Tutorial-01)

Full Marks: 25(SIE:1 Hs) +75(ESE:3Hrs)=100 Pass Marks(SIE:10+ESE:30)=40

**Instruction to Question Setter for :**

### Semester Internal Examination (SIE):

There will be **two** group of questions. **Group A is compulsory** and will contains two questions in which question No. 1 contains five questions of **very short type** consisting of 1 mark each , and question No. 2 have one question of short answer type 5 maks . **Group B will contain descriptive type** two questions of 10 marks each, out of which any one is to answer.

### End Semester Examination (ESE):

There will **two** group of questions. **Group A is compulsory** and will contain three questions. **Question No. 1 will be very short answer type** consisting of five questions of 1 mark each **Question No. 2 and 3 will be short answer type** consisting two questions of 5 maks. **Group B will contain descriptive type** six questions of fifteen marks each, out of which any four are to be answer.

**Note:** There may be subdivisions in each question asked in End Semester Examinations.

## **THEORY OF REAL FUNCTIONS:**

### **UNIT-I**

*Limits of functions ( $\varepsilon - \delta$  approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity, Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval , intermediate value theorem, location of roots theorem. Uniform continuity , non-uniform continuity criteria, uniform continuity theorem.*

*20 Lectures(2 Questions)*

### **UNIT-II**

*Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem. Rolle's Theorem, Mean value theorem, intermediate value property of derivatives, Darboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Talyor's theorem to inequalities. .*

*20 Lectures(2 Questions)*

### UNIT-III

*Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, Application of Taylor's theorem to convex functions, relative extrema. Taylor's series and Maclaurin's series expansion of exponential and trigonometric function,  $1/(1+x)^n$ ,  $1/(ax+b)$  and  $(1+x)^n$*

*20 Lectures(2 Questions)*

### **Books Recommended**

1. R. Bartle and D.R. Sherbert, Introduction to Real Analysis , John Wiley and Sons, 2003.
2. K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer , 2004.
3. A Mattuck, Introduction to Analysis, Prentice Hall, 1999.
4. S.R. Ghorpade and B.V. Limaye, A Course in Calculus and Real Analysis, Pringer, 2006.

NEP - 2020: Syllabus of UG Mathematics (Minor)

Undergraduate Certificate Courses in Mathematics (Minor)

Year	Semester	Paper Title	Study Materials	Credit
First (Introductory Courses)	I	Minor - 01 (Matrices & Trigonometry)	<p>Unit - I: Rank of a matrix, elementary transformations of a matrix and invariance of rank through elementary transformations, normal form of a matrix, elementary matrices, rank of the sum and product of two matrices, inverse of a non-singular matrix through elementary row transformations, equivalence of matrices.</p> <p>Unit - II: Solutions of a system of linear equations, condition of consistency and nature of the general solution of a system of linear and nonhomogeneous equations.</p> <p>Unit - III: Trigonometric or circular and hyperbolic function of complex variable together with their inverses, De Moivre's Theorem and its applications, Euler's theorem, relation between trigonometric and hyperbolic function, Exponential function of a complex variable,</p> <p>Unit - IV: Logarithms of complex variable, Properties of logarithmic function, Separation into real and imaginary parts. Gregory's series, Value of <math>\pi</math> by different series, Summation of Trigonometric series by C+iS method based on Arithmetic Progression, Geometric Progression, Logarithms and Binomial expansions, Summation of Trigonometric series by difference method.</p>	4

Undergraduate Diploma Courses in Mathematic (Minor)

Second (Intermediate Level Courses)	III	Minor - 02 (Differential Calculus)	<p>Unit - I: Functions of one variable, Limit of a function (<math>\epsilon</math>-<math>\delta</math> Definition), Continuity of a function, Properties of continuous functions, Intermediate value theorem, Classification of discontinuities, Differentiability of a function, Jacobians, maxima and minima of single variable function, Rolle's Theorem, Mean value theorems and their geometrical interpretations, Applications of mean value theorems.</p> <p>Unit - II: Successive Differentiation, nth Differential coefficient of functions, Leibnitz Theorem, Taylor's Theorem, Maclaurin's Theorem, Taylor's and Maclaurin's series expansions.</p> <p>Unit - III: Geometrical meaning of tangent, Definition and equation of Tangent, Tangent at origin, Angle of intersection of two curves, Definition and equation of Normal, Cartesian sub tangent and subnormal, Tangents and normals of polar curves, Angle between radius vector and tangent, Perpendicular from pole to tangent, Pedal equation of curve, Polar sub tangent and polar subnormal, Derivatives of arc (Cartesian and polar formula).</p> <p>Unit - IV: Curvature, Radius of curvature, Cartesian, Polar and pedal formula for radius of curvature, Tangential polar form, Centre of curvature, Asymptotes of algebraic curves, Methods of finding asymptotes, Parallel asymptotes, existence and classification of singular points, points of inflection.</p>	4
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# MULTIDISCIPLINARY COURSE (MATHEMATICS)

## Subject Code – MDC

Course Credit :03  
F.M. – 75 , P.M.-30

Total Lecture Hours:45  
Time: 03Hrs.

Instruction to Question Setter for :

### End Semester Examination (ESE):

*There will two group of questions. Group A is compulsory and will contain three questions. Question No. 1 will be very short answer type consisting of five questions of 1 mark each Question No. 2 and 3 will be short answer type consisting two questions of 5 marks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to be answer.*

**Note:-** There may be subdivisions in each question asked in End Semester Examination .

### CALCULUS :

#### UNIT-I

Limit and Continuity(  $\epsilon$  and  $\delta$  definition ) , types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions.

(2 questions )

## **UNIT-II**

Tangents and normals, Curvature, Asymptotes, Singular points, Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.

(2 questions )

## **UNIT-III**

Reduction formulae , length of curves, volume and area of surface of revolution .

(2 questions )

## **Books Recommended :**

1. G.B. Thomas and R.L. Finney, Calculus, 9<sup>th</sup> Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K.J. Smith, Calculus, 3<sup>rd</sup> Ed., Dorling Kindersley (India) P.Ltd. (Pearson Education), Delhi, 2007
3. H.Anton, I, Bivens and S. Davis, Calculus, 7<sup>th</sup> Ed., John Wiley and Sons ( Asia) P. Ltd., Singapore, 2002.
4. R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer Verlag, New York , Inc., 1989.



**Question format for Semester Internal Examination 20 marks:**

F.M.=20 + 5 =25

Subject / Code

Time: 1 Hr.

Exam year

**General Instruction:**

- 1) Group A carries very short answer type compulsory Question
- 2) Answer 1 out of 2 subjective/ descriptive questions given in Group B
- 3) Answer in your own words as far as practicable.
- 4) Answer all sub parts of a question at one place.
- 5) Numbers on the right indicate full marks of the question.

**Group A**

[5 x 1=5]

1. i. ....  
ii. ....  
iii. ....  
iv. ....  
v. ....

2. ....

[5]

**Group B**

3. ....

[10]

4. ....

[10]

**Note : There may be subdivisions in each question asked in Theory Examination**

Question format for End Semester Theory Examination 75 marks:

F.M.= 75

Subject / Code

Time: 3 Hrs.

Exam year

General Instruction:

- 1) Group A carries very short answer type compulsory Question
- 2) Answer 4 out of 6 subjective/ descriptive questions given in Group B
- 3) Answer in your own words as far as practicable.
- 4) Answer all sub parts of a question at one place.
- 5) Numbers on the right indicate full marks of the question.

Group A

[5 x 1=5]

1. i. ....
- ii. ....
- iii. ....
- iv. ....
- v. ....

2. .... [5]

3. .... [5]

Group B

4. .... [15]

5. .... [15]

6. .... [15]

7. .... [15]

8. .... [15]

9. .... [15]

Note : There may be subdivisions in each question asked in Theory Examination