FACULTY OF SCIENCES

SYLLABUS

Master of Science (Mathematics) (FYIP)

(Semester: I -VIII)

(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)

Session: 2026-27

The Heritage Institution

KANYA MAHA VIDYALAYA JALANDHAR

(Autonomous)

Master of Science (Mathematics) (FYIP)

Session: 2026-27

Programme Specific Outcomes

Upon successful completion of this course, students will be able to:

PSO1: Acquire a strong foundation in core areas of mathematics such as Algebra, Real and Complex Analysis, Topology, Differential Equations, and Mathematical Modelling.

PSO2: Develop the ability to think logically and critically, formulate and solve complex mathematical problems using appropriate techniques and tools.

PSO3: Apply mathematical concepts in research-oriented activities, undertake projects, and contribute to the advancement of knowledge in mathematics and allied disciplines.

PSO4: Gain hands-on experience in using computational software such as Excel, Scilab, Python, and R for solving mathematical problems and analyzing data.

PSO5: Effectively communicate mathematical ideas, theories, and results through well-structured reports, presentations, and discussions suitable for academic and professional platforms.

PSO6: Demonstrate readiness for pursuing higher studies, qualifying competitive exams, and taking up careers in academics, research, data science, actuarial sciences, and the financial sector.

PSO7: Integrate modern and ancient mathematical knowledge with other disciplines such as physics, computer science, economics, geography, astronomy and engineering to solve interdisciplinary problems.

PSO8: To Demonstrate awareness of ethical issues, professional responsibilities, and the societal impact of mathematical modelling and data analysis.

PSO9: To Demonstrates continuous learning by regularly updating mathematical knowledge through emerging areas such as Artificial Intelligence (AI), Web Technologies, and Cryptography. Integrates modern mathematical applications and digital tools into teaching and research to remain aligned with evolving technological advancements.

PSO10: Develop the ability to work effectively both independently and as part of a team, taking initiative and leadership roles in collaborative mathematical projects and research work.

Kanya Maha Vidyalaya, Jalandhar (Autonomous)
Scheme and Curriculum of Examinations of Five Year Integrated Programme
(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)
Master of Science (Mathematics) (FYIP)
Semester-I
Session- 2026-27

Master of Science (Mathematics) (FYIP) Semester-I										
Course Code	Course Type	Course Title	Hours Per Week L-T-P	Credits L-T-P	Total Credits	Max. Marks				Examination Time in Hours
						Total	TH	P	CA	
FMAL-1421/ FMAL-1031/ FMAL-1431	C	[1]Punjabi (Compulsory)/ [2] Basic Punjabi/ [3] Punjab History and Culture	2-0-0	2-0-0	2	50	35	-	15	3
FMAL - 1102	AEC	Communicative English-I	2-0-0	2-0-0	2	50	35	-	15	3
FMAL-1333	DSC	Calculus	4-1-0	4-1-0	5	100	70	-	30	3
FMAL - 1334	DSC	Theory of Equations	4-1-0	4-1-0	5	100	70	-	30	3
FMAM-1135	C	Programming Language - I	3-0-2	3-0-1	4	100	40	30	30	3+3
FMAP-1336	DSC	Calculus Laboratory	0-0-4	0-0-2	2	50	-	35	15	3
FMAL-1330	SEC	Statistical Analysis Using Spreadsheet	2-0-0	2-0-0	2	50	35	-	15	3
FMAP-1330	SEC	Statistical Analysis Using Laboratory	0-0-8	0-0-4	4	100	-	70	30	3
USEP-0001	SEC	Business Class	0-0-4	0-0-2	2	50	-	50	-	
VACF-1491	VAAC	*Foundation Course	2-0-0	2-0-0	2	50	35	-	15	1
Total					30					

C-Compulsory Course

AEC-Ability Enhancement Course

DSC-Discipline Specific Course

SEC-Skill Enhancement Course

VAAC-Value Added Audit Course

Note:

[1]Domicle / Non Domicile of Punjab students who have studied Punjabi till 8th/ 10th class will study Punjabi (compulsory)

[2,3]The Non-Domicile of Punjab Students who have not studied Punjabi till 8th/10th class can choose either Basic Punjabi or Punjab History and Culture (PHC)

[2]Domicile of Punjab students who studied out of Punjab and did not study Punjabi till 8th / 10th class will have to study Basic Punjabi

[2]Domicile of Punjab students who have studied in Kendriya Vidyalaya of Punjab or any other school and due to any reason did not study Punjabi till 8th/10th class will have to study Basic Punjabi

* Credits/grades points of these courses will not be included in the calculation of SGPA/CGPA of the semesters/programme.

Kanya Maha Vidyalaya, Jalandhar (Autonomous)
Scheme and Curriculum of Examinations of Five Year Integrated Programme
(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)
Master of Science (Mathematics) (FYIP)
Semester-II
Session- 2026-27

Master of Science (Mathematics) (FYIP) Semester-II										
Course Code	Course Type	Course Title	Hours Per Week L-T-P	Credits L-T-P	Total Credits	Max. Marks				Examination Time in Hours
						Total	TH	P	CA	
FMAL-2421/ FMAL-2031/ FMAL-2431	C	[1]Punjabi (Compulsory)/ [2] Basic Punjabi/ [3] Punjab History and Culture	2-0-0	2-0-0	2	50	35	-	15	3
FMAL-2102	AEC	Communicative English-II	2-0-0	2-0-0	2	50	35	-	15	3
FMAL-2333	DSC	Sequences and Series	4-1-0	4-1-0	5	100	70	-	30	3
FMAL -2334	DSC	Algebra	4-1-0	4-1-0	5	100	70	-	30	3
FMAM-2135	C	Object Oriented Programming C++	3-0-2	3-0-1	4	100	40	30	30	3+3
FMAP-2336	DSC	Algebra Laboratory	0-0-4	0-0-2	2	50	-	35	15	3
FMAM-2330	SEC	Numerics Using SCILAB	3-0-2	3-0-1	4	100	40	30	30	3+3
USEP-0002	SEC	Business Class	0-0-4	0-0-2	2	50	-	50	-	
VACD-S2161	VAC	Drug Abuse and Ethical Education	4-0-0	4-0-0	4	100	70	-	30	3
Total					30					

C-Compulsory Course

AEC-Ability Enhancement Course

DSC-Discipline Specific Course

SEC-Skill Enhancement Course

VAC-Value Added Course

Note:

[1]Domicle / Non Domicile of Punjab students who have studied Punjabi till 8th/ 10th class will study Punjabi (compulsory)

[2,3]The Non-Domicile of Punjab Students who have not studied Punjabi till 8th/10th class can choose either Basic Punjabi or Punjab History and Culture (PHC)

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Kanya Maha Vidyalaya, Jalandhar (Autonomous)
Scheme and Curriculum of Examinations of Five Years Integrated Programme
(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)
Master of Science (Mathematics) (FYIP)
Semester-III
Session- 2026-27

Master of Science (Mathematics) (FYIP) Semester-III										
Course Code	Course Type	Course Title	Hours Per Week L-T-P	Credits L-T-P	Total Credits	Max. Marks				Examination Time in Hours
						Total	Th	P	CA	
FMAL-3331	DSC	Theory of Real Functions	4-0-0	4-0-0	4	100	70	-	30	3
FMAL – 3332	DSC	Applied Differential Equations	4-0-0	4-0-0	4	100	70	-	30	3
FMAL-3333	MDC	Logic and Reasoning	4-0-0	4-0-0	4	100	70	-	30	3
FMAM-3334	C	Basics of Python Programming	3-0-2	3-0-1	4	100	40	30	30	3+3
FMAP-3335	DSC	Applied Differential Equations Laboratory	0-0-4	0-0-2	2	50	-	35	15	3
FMAL-3330	SEC	Graph Theory	4-0-0	4-0-0	4	100	70	-	30	3
VACE-3221	VAC	Environmental Studies	2-0-0	2-0-0	2	50	35	-	15	3
Total					24					

C-Compulsory Course

VAC-Value Added Course

SEC-Skill Enhancement Course

DSC-Discipline Specific Course

MDC-Multi Disciplinary Course

Kanya Maha Vidyalaya, Jalandhar (Autonomous)
Scheme and Curriculum of Examinations of Five Years Integrated Programme
(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)
Master of Science (Mathematics) (FYIP)
Semester-IV
Session- 2026-27

Master of Science (Mathematics) (FYIP) Semester-IV										
Course Code	Course Type	Course Title	Hours Per Week L-T-P	Credits L-T-P	Total Credits	Max. Marks				Examination Time in Hours
						Total	TH	P	CA	
FMAL-4331	DSC	Number Theory	4-0-0	4-0-0	4	100	70	-	30	3
FMAL-4332	DSC	Numerical Analysis	4-0-0	4-0-0	4	100	70	-	30	3
FMAL-4333	MDC	Quantitative Aptitude for Banking	4-0-0	4-0-0	4	100	70	-	30	3
FMAM-4134	C	Statistical Computing Using R Programming	3-0-2	3-0-1	4	100	40	30	30	3+3
FMAP-4335	DSC	Numerical Analysis Laboratory	0-0-4	0-0-2	2	50	-	35	15	3
FMAM-4330	SEC	Statistical Methods	3-0-2	3-0-1	4	100	40	30	30	3+3
VACP-4511	VAAC	*Personality Development and Gender Sensitization	2-0-0	2-0-0	2	50	35	-	15	1
Total					24					

C-Compulsory Course

VAAC-Value Added Audit Course

SEC-Skill Enhancement Course

DSC-Discipline Specific Course

MDC-Multi Disciplinary Course

* Credits/grades points of these courses will not be included in the calculation of SGPA/CGPA of the semesters/programme.

Kanya Maha Vidyalaya, Jalandhar (Autonomous)
Scheme and Curriculum of Examinations of Five Years Integrated Programme
(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)
Master of Science (Mathematics) (FYIP)
Semester-V
Session- 2026-27

Master of Science (Mathematics) (FYIP) Semester-V										
Course Code	Course Type	Course Title	Hours Per Week L-T-P	Credits L-T-P	Total Credits	Max. Marks				Examination Time in Hours
						Total	TH	P	CA	
FMAL-5331	DSC	Group Theory -I	4-1-0	4-1-0	5	100	70	-	30	3
FMAL-5332	DSC	PDE's and System of ODE's	4-1-0	4-1-0	5	100	70	-	30	3
FMAL-5133	C	Machine Learning	4-0-0	4-0-0	4	100	70	-	30	3
FMAM-5334	MDC	Sawai Jai Singh and his Astronomy	3-0-2	3-0-1	4	100	40	30	30	3+3
FMAP-5335	DSC	PDE's and System of ODE's Laboratory	0-0-4	0-0-2	2	50	-	35	15	3
FMAI-5336	DSC	Internship	0-0-4	0-0-2	2	50	-	50	-	
FMAM-5330	SEC	Technical Writing and Latex	3-0-2	3-0-1	4	100	40	30	30	3+3
VACJ-5551	VAAC	* Job Readiness	2-0-0	2-0-0	2	50	35	-	15	1
Total					28					

C-Compulsory Course
VAAC-Value Added Audit Course
SEC-Skill Enhancement Course
DSC-Discipline Specific Course
MDC-Multi Disciplinary Course
* Credits/grades points of these courses will not be included in the calculation of SGPA/CGPA of the semesters/programme.

Kanya Maha Vidyalaya, Jalandhar (Autonomous)
Scheme and Curriculum of Examinations of Five Years Integrated Programme
(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)
Master of Science (Mathematics) (FYIP)
Semester-VI
Session- 2026-27

Master of Science (Mathematics) (FYIP) Semester-VI										
Course Code	Course Type	Course Title	Hours Per Week L-T-P	Credits L-T-P	Total Credits	Max. Marks				Examination Time in Hours
						Total	TH	P	CA	
FMAL-6331	DSC	Group Theory-II	4-1-0	4-1-0	5	100	70	-	30	3
FMAL-6332	DSC	Riemann Integration and Series of Function	4-1-0	4-1-0	5	100	70	-	30	3
FMAL-6333	DSC	Multivariate Calculus	4-1-0	4-1-0	5	100	70	-	30	3
FMAL-6134	C	Data and File Structures	4-0-0	4-0-0	4	100	70	-	30	3
FMAP-6335	DSC	Multivariate Calculus Laboratory	0-0-4	0-0-2	2	50	-	35	15	3
VACH-6401	VAC	Human Rights and Constitutional Duties	2-0-0	2-0-0	2	50	35	-	15	3
Total					23					

C-Compulsory Course
VAC-Value Added Course
DSC-Discipline Specific Course

Kanya Maha Vidyalaya, Jalandhar (Autonomous)
Scheme and Curriculum of Examinations of Five Years Integrated Programme
(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)
Master of Science (Mathematics) (FYIP)
Semester-VII
Session- 2026-27

Master of Science (Mathematics) (FYIP) Semester-VII										
Course Code	Course Type	Course Title	Hours Per Week L-T-P	Credits L-T-P	Total Credits	Max. Marks				Examination Time in Hours
						Total	TH	P	CA	
FMAL-7331	DSC	Algebra-I	4-1-0	4-1-0	5	100	80	-	20	3
FMAL-7332	DSC	Mathematical Programming-I	4-1-0	4-1-0	5	100	80	-	20	3
FMAL-7333	DSC	Real Analysis	4-1-0	4-1-0	5	100	80	-	20	3
FMAL-7134	C	Machine Learning	4-0-0	4-0-0	4	100	80	-	20	3
FMAM-7335	DSC	Technical Writing and Latex	3-0-2	3-0-1	4	100	50	30	20	3+3
FMAL-7376	VAC	Universal Human Values-II: Understanding Harmony	3-0-0	3-0-0	3	100	70	-	30	3
Total					26					

C-Compulsory Course
DSC-Discipline Specific Course
VAC-Value Added Course

Kanya Maha Vidyalaya, Jalandhar (Autonomous)
Scheme and Curriculum of Examinations of Five Years Integrated Programme
(Under Credit Based Continuous Evaluation Grading System) (CBCEGS)
Master of Science (Mathematics) (FYIP)
Semester-VIII
Session- 2026-27

Master of Science (Mathematics) (FYIP) Semester-VIII										
Course Code	Course Type	Course Title	Hours Per Week L-T-P	Credits L-T-P	Total Credits	Max. Marks				Examination Time in Hours
						Total	TH	P	CA	
FMAL-8331	DSC	Algebra-II	4-1-0	4-1-0	5	100	80	-	20	3
FMAL-8332	DSC	Mathematical Programming-II	4-1-0	4-1-0	5	100	80	-	20	3
FMAL-8333	DSC	History of Mathematics in India	4-1-0	4-1-0	5	100	80	-	20	3
FMAL-8134	C	Data and File Structures	4-0-0	4-0-0	4	100	80	-	20	3
FMAD-8335	C	Project	0-0-12	0-0-6	6	100	-	80	20	3
Total					25					

C-Compulsory Course
DSC-Discipline Specific Course

Master of Science (Mathematics)(FYIP)
Semester–I

Session- 2026-27
Course Title: Basic Punjabi
Course Code: FMAL-1031
Course Outcomes

CO1:ਮੁੱਢਲੀ ਪੰਜਾਬੀ ਪੜ੍ਹਾਉਣ ਦਾ ਮਨੋਰਥ ਵਿਦਿਆਰਥੀਆਂ ਨੂੰ ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਨੂੰ ਸਿਖਾਉਣ ਦੀ ਪ੍ਰਕਿਰਿਆ ਵਿਚ ਪਾ ਕੇ ਇਕ ਹੋਰ ਭਾਸ਼ਾ ਸਿੱਖਣ ਦਾ ਮੌਕਾ ਪ੍ਰਦਾਨਕਰਨਾ ਹੈ।ਵਿਦਿਆਰਥੀਆਂ ਨੂੰਪੈਂਤੀਅੱਖਰੀ, ਅੱਖਰਕ੍ਰਮ, ਪੈਰਬਿੰਦੀਵਾਲੇ ਵਰਣ ਅਤੇ ਪੈਰ ਵਿਚ ਪੈਣ ਵਾਲੇ ਵਰਣ ਅਤੇ ਮਾਤਰਾਵਾਂ (ਮੁੱਢਲੀਜਾਣਪਛਾਣ) ਲਗਾਖ਼ਰ (ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ) ਦੀ ਪਛਾਣ ਅਤੇ ਵਰਤੋਂ ਤੋਂਜਾਣੂ ਕਰਵਾਇਆਜਾਵੇਗਾ।

CO2:ਵਿਦਿਆਰਥੀਆਂ ਨੂੰ ਪੰਜਾਬੀਸ਼ਬਦਬਣਤਰ ਦੀ ਮੁੱਢਲੀਜਾਣਪਛਾਣ (ਸਾਧਾਰਨਸ਼ਬਦ, ਸੰਯੁਕਤ ਸ਼ਬਦ, ਮਿਸ਼ਰਤ ਸ਼ਬਦ,ਮੂਲ ਸ਼ਬਦ,ਅਗੇਤਰ ਅਤੇ ਪਿਛੇਤਰ) ਤੋਂਜਾਣੂ ਕਰਵਾਇਆਜਾਵੇਗਾ।

CO3:ਵਿਦਿਆਰਥੀਆਂ ਨੂੰਨਿੱਤਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀਸ਼ਬਦਾਵਲੀ : ਬਾਜ਼ਾਰ, ਵਪਾਰ, ਰਿਸ਼ਤੇਨਾਤੇ, ਖੇਤੀ ਅਤੇ ਹੋਰਧੰਦਿਆਂਆਦਿ ਨਾਲ ਸੰਬੰਧਤ ਤੋਂਜਾਣੂ ਕਰਵਾਇਆਜਾਵੇਗਾ।

CO4:ਵਿਦਿਆਰਥੀਆਂ ਨੂੰ ਪੰਜਾਬੀਵਿਚਹਫ਼ਤੇ ਦੇ ਸੱਤਦਿਨਾਂ ਦੇ ਨਾਂ, ਬਾਰ੍ਹਾਂਮਹੀਨਿਆਂ ਦੇ ਨਾਂ, ਰੁੱਤਾਂ ਦੇ ਨਾਂ, ਇਕਤੋਂ ਸੌ ਤੱਕਗਿਣਤੀਸ਼ਬਦਾਂਵਿਚਸਿਖਾਉਣਾ ਹੈ।

Master of Science (Mathematics) FYIP)
Semester–I
Session- 2026-27
Course Title: Basic Punjabi
Course Code: FMAL-1031

ਸਮਾਂ : 3 ਘੰਟੇ Maximum Marks: 50

L-T-P Theory : 35

2-0-0 CA : 15

ਅੰਕ ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. **ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਸੈਕਸ਼ਨ ਹੋਣਗੇ।ਸੈਕਸ਼ਨ ੍ਣ ਤੱਕ ਦੇ ਪ੍ਰਸ਼ਨ ਯੂਨਿਟ ਜ਼੍ਜ਼ੜ ਵਿਚੋਂ ਪੁੱਛੇ ਜਾਣਗੇ। ਹਰ ਸੈਕਸ਼ਨ ਵਿਚ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।**

2. **ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਸੈਕਸ਼ਨ ਵਿਚੋਂ ਇਕ ਪ੍ਰਸ਼ਨ ਕਰਨਾ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਸੈਕਸ਼ਨ ਵਿਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।**

3. **ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ 7 ਅੰਕ ਹਨ।**

4. **ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ ਪ੍ਰਸ਼ਨਾਂ**

ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

ਪਾਠਕ੍ਰਮ

ਯੂਨਿਟ-I

ਪੈਂਤੀਅੱਖਰੀ, ਅੱਖਰਕ੍ਰਮ, ਪੈਰਬਿੰਦੀਵਾਲੇ ਵਰਣ ਅਤੇ ਪੈਰਵਿਚਪੈਣਵਾਲੇ ਵਰਣ ਅਤੇ ਮਾਤ੍ਰਵਾਂ (ਮੁੱਢਲੀ ਜਾਣਪਛਾਣ) ਲਗਾਖ਼ਰ (ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ) : ਪਛਾਣ ਅਤੇ ਵਰਤੋਂ .

ਯੂਨਿਟ-II

ਪੰਜਾਬੀਸ਼ਬਦਬਣਤਰ : ਮੁੱਢਲੀਜਾਣਪਛਾਣ (ਸਾਧਾਰਨਸ਼ਬਦ, ਸੰਯੁਕਤਸ਼ਬਦ, ਮਿਸ਼ਰਤਸ਼ਬਦ, ਮੂਲ ਸ਼ਬਦ, ਅਗੇਤਰ ਅਤੇ ਪਿਛੇਤਰ)

ਯੂਨਿਟ-III

ਨਿੱਤਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀਸ਼ਬਦਾਵਲੀ : ਬਾਜ਼ਾਰ, ਵਪਾਰ, ਰਿਸ਼ਤੇਨਾਤੇ, ਖੇਤੀ ਅਤੇ ਹੋਰਧੰਦਿਆਂਆਦਿਨਾਲ ਸੰਬੰਧਤ।

ਯੂਨਿਟ-IV

ਹਫ਼ਤੇ ਦੇ ਸੱਤਦਿਨਾਂ ਦੇ ਨਾਂ, ਬਾਰ੍ਹਾਂਮਹੀਨਿਆਂ ਦੇ ਨਾਂ, ਰੁੱਤਾਂ ਦੇ ਨਾਂ, ਇਕਤੋਂ ਸੌ ਤਕ ਗਿਣਤੀਸ਼ਬਦਾਂਵਿਚ ।

Master of Science (Mathematics)(FYIP)
Semester–I
Session- 2026-27
Course Title: Punjabi Compulsory
Course Code: FMAL-1421
Course Outcomes

CO1: **‘ਸਾਹਿਤ ਦੇ ਰੰਗ’ ਪੁਸਤਕ ਦੇ ਕਵਿਤਾਭਾਗਨੂੰ ਪੜ੍ਹਾਉਣ ਦਾਮਨੋਰਥਵਿਦਿਆਰਥੀਆਂਅੰਦਰਕਵਿਤਾਪ੍ਰਤੀਦਿਲਚਸਪੀ, ਸੂਝ ਨੂੰ ਪੈਦਾਕਰਨਾ ਹੈ ਤਾਂਕਿ ਉਹ ਆਧੁਨਿਕਦੌਰਵਿਚਚਲਰਹੀਆਂਕਾਵਿਧਾਰਾਵਾਂ ਅਤੇ ਕਵੀਆਂਬਾਰੇ ਗਿਆਨਹਾਸਲਕਰ ਸਕਣ।ਇਸ ਦਾਹੋਰਮਨੋਰਥਕਵਿਤਾ ਦੀ ਵਿਆਖਿਆ, ਵਿਸ਼ਲੇਸ਼ਣ ਤੇ ਮੁਲੰਕਣ ਦੀ ਪ੍ਰਕਿਰਿਆਤੋਂਜਾਣੂ ਕਰਾਉਣਾਵੀ ਹੈ ਤਾਂਕਿ ਉਹ ਸਮਕਾਲੀ ਸਮਾਜਦੀਆਂ ਸਮੱਸਿਆਵਾਂਨੂੰ ਸਮਝ ਸਕਣ ਅਤੇ ਆਲੋਚਨਾਤਮਕਦ੍ਰਿਸ਼ਟੀਬਣਾ ਸਕਣ।**

CO2**ਯਸਾਹਿਤ ਦੇ ਰੰਗ’ ਪੁਸਤਕ ਦੇ ਕਹਾਣੀਭਾਗ ਨੂੰ ਸਿਲੇਬਸ ਵਿਚਸ਼ਾਮਿਲਕਰ ਕੇ ਵਿਦਿਆਰਥੀਆਂਅੰਦਰਕਹਾਣੀਪੜ੍ਹਣ ਦੀ ਰੁਚੀ ਨੂੰ ਪੈਦਾਕਰਨਾ ਹੈ ਅਤੇ ਕਹਾਣੀਜਗਤਨਾਲਜੋੜਣਾ ਹੈ।**

CO3:**ਪੈਰ੍ਹਾ ਰਚਨਾ ਅਤੇ ਪੈਰ੍ਹਾਪੜ੍ਹ ਕੇ ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉਤਰ ਦੇਣ ਦਾਮਨਰੋਥਵਿਦਿਆਰਥੀਆਂ ਦੀ ਬੁੱਧੀ ਨੂੰ ਤੀਖਣਕਰਦਿਆਂ ਉਨਾਂ ਦੀ ਲਿਖਣਪ੍ਰਤਿਭਾ ਨੂੰ ਉਜਾਗਰਕਰਨਾ ਹੈ।**

CO4 :**ਧੁਨੀਵਿਉਂਤ ਪੜ੍ਹਣਨਾਲਵਿਦਿਆਰਥੀ ਧੁਨੀਆਂ ਦੀ ਉਚਾਰਨਪ੍ਰਣਾਲੀਤੋਂਵਾਕਫ਼ ਹੋਣਗੇ।**

Master of Science (Mathematics)(FYIP)
Semester–I
Session- 2026-27
Course Title: Punjabi Compulsory
Course Code: FMAL-1421

ਸਮਾਂ : 3 ਘੰਟੇ

Maximum Marks: 50
Theory : 35
CA :15

L-T-P 2-0-0

ਅੰਕ ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਸੈਕਸ਼ਨ ਹੋਣਗੇ।ਸੈਕਸ਼ਨ੍ਂਣਤੱਕ ਦੇ ਪ੍ਰਸ਼ਨ ਯੂਨਿਟਜ਼ੂਜ਼ੜ ਵਿਚੋਂ ਪੁੱਛੇ ਜਾਣਗੇ। ਹਰ ਸੈਕਸ਼ਨ ਵਿਚ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।

2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਸੈਕਸ਼ਨ ਵਿਚੋਂ ਇਕ ਪ੍ਰਸ਼ਨ ਕਰਨਾ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਸੈਕਸ਼ਨ ਵਿਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।

3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ 7 ਅੰਕ ਹਨ।

4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ ਪ੍ਰਸ਼ਨਾਂਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

ਪਾਠਕ੍ਰਮ ਅਤੇ ਪਾਠ ਪੁਸਤਕਾਂ

ਯੂਨਿਟ-I

ਸਾਹਿਤ ਦੇ ਰੰਗ (ਸੰਪਾ.ਡਾਮਹਿਲਸਿੰਘ),ਭਾਗਪਹਿਲਾ(ਕਵਿਤਾ),

ਰਵੀ ਸਾਹਿਤਪ੍ਰਕਾਸ਼ਨ,ਅੰਮ੍ਰਿਤਸਰ।

(ਪ੍ਰਸੰਗ ਸਹਿਤ ਵਿਆਖਿਆ,ਸਾਰ)

(ਡਾ.ਹਰਿਭਜਨਸਿੰਘ,ਪਾਸ਼,ਸੁਰਜੀਤਪਾਤਰ ਕਵੀ ਪਾਠਕ੍ਰਮਦਾਹਿੱਸਾਨਹੀਂਹਨ)8ਅੰਕ

ਯੂਨਿਟ-II

ਸਾਹਿਤ ਦੇ ਰੰਗ (ਸੰਪਾ.ਡਾਮਹਿਲਸਿੰਘ),ਭਾਗਪਹਿਲਾ(ਕਹਾਣੀ),

ਰਵੀ ਸਾਹਿਤਪ੍ਰਕਾਸ਼ਨ,ਅੰਮ੍ਰਿਤਸਰ।

(ਸਾਰ,ਵਿਸ਼ਾਵਸਤੂ)

(ਕੋਈਇਕ ਸਵਾਰ,ਘੋਟਣਾ, ਆਪਣਾਆਪਣਾਹਿੱਸਾਕਹਾਣੀਆਂਪਾਠਕ੍ਰਮਦਾਹਿੱਸਾਨਹੀਂਹਨ)8 ਅੰਕ

ਯੂਨਿਟ-III

ਪੈਰ੍ਹਾਰਚਨਾ

ਪੈਰ੍ਹਾਪੜ੍ਹ ਕੇ ਪਸ਼੍ਨਾਂ ਦੇ ਉਤਰ।8 ਅੰਕ

ਯੂਨਿਟ-IV

(ੳ) ਪੰਜਾਬੀ ਧੁਨੀਵਿਉਂਤ :ਪਰਿਭਾਸ਼ਾ ਤੇਉਚਾਰਨਅੰਗ

(ਅ) ਸਵਰ, ਵਿਅੰਜਨ8 ਅੰਕ

Master of Science (Mathematics)(FYIP)
Semester–I
Session- 2026-27
Course Title: Punjab History and Culture (From Earliest Times to C 320)
Course Code: FMAL-1431

COURSE OUTCOMES

After completing Semester I and course on Punjab History and Culture students of History will be able to identify and have a complete grasp on the sources & writings of Ancient Indian History of Punjab.

CO1: Identify and understand the sources and physical features of Punjab

CO 2: To study the earliest civilisation (Indus Valley Civilization) and original home of Aryans

CO 3: To examine the Social, Religious and Economic life during Early and Later Vedic Age

CO 4: To comprehend the Buddhist, Jain and Hindu faith and their relevance in the modern times

Master of Science (Mathematics)(FYIP)
Semester–I
Session- 2026-27
Course Title: Punjab History and Culture (From Earliest Times to C 320)
Course Code: FMAL-1431

Examination Time: 3 Hours | Max. Marks: 50
Credits L-T-P: 2-0-0 | Theory: 35
Contact Hours: 2 Hrs/Week | CA: 15

Instructions for the Paper Setter:

1. Question paper shall consist of four Units
2. Examiner shall set 8 questions in all by selecting Two Questions of equal marks from each Unit.
3. Candidates shall attempt 5 questions in 500 words, by at least selecting One Question from each Unit and the 5th question may be attempted from any of the four Units.
4. Each question will carry 7 marks

Unit I

1. Physical features of the Punjab
2. Sources of the ancient history of Punjab

Unit II

3. Harappan Civilization: social, economic and religious life of the Indus Valley People.
4. The Indo-Aryans: Original home

Unit III

5. Social, Religious and Economic life during Early Vedic Age.
6. Social, Religious and Economic life during Later Vedic Age.

Unit IV

7. Teachings of Buddhism
8. Teachings of Jainism

Suggested Readings

- B.N. Sharma, Life in Northern India, Delhi. 1966.
- Budha Parkash, Glimpses of Ancient Punjab, Patiala, 1983.
- Chopra, P.N., Puri, B.N., & Das,M.N.(1974). A Social, Cultural & Economic History of India, Vol. I, New Delhi: Macmillan India.
- L. M Joshi (ed.), History and Culture of the Punjab, Art-I, Patiala, 1989 (3rd edition)
- L.M. Joshi and Fauja Singh (ed.), History of Punjab, Vol.I, Patiala 1977.

Master of Science (Mathematics)(FYIP)
Semester–I
Session- 2026-27
Course Title: Communicative English-I
Course Code: FMAL-1102
Course Outcomes

The students will be:

CO 1: able to enhance their vocabulary through vocabulary building exercises

CO2: able to improve their writing skills by writing letters and reports

CO3: able to enhance their reading and analyzing power of texts through guided reading by the study of "Making Connections" by Kenneth J. Pakenham

CO4: acquainted to the techniques of effective essay writing

Master of Science (Mathematics)(FYIP)
Semester–I
Session- 2026-27
Course Title: Communicative English-I
Course Code: FMAL-1102

Examination Time: 3 Hours

Max. Marks: 50
Theory: 35
CA:15

L T P
2 0 0

Instructions for Paper Setters:

Eight questions of equal marks (07 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four).Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

"Word List", "Correct Usage of Commonly used words and Phrases" from the chapter "Vocabulary" given in The Written Word by Vandana R. Singh

Unit II

Letter- writing as prescribed in The Written Word by Vandana R. Singh
Report writing as prescribed in The Written Word by Vandana R. Singh

Unit III

Unit-I from Making Connections: A Strategic Approach to Academic Reading by Kenneth J. Pakenham, Second Edition

Unit IV

Unit-II from Making Connections: A Strategic Approach to Academic Reading by Kenneth J. Pakenham, Second Edition

Text Books:

The Written Word by Vandana R. Singh, Oxford University Press, New Delhi.
Making Connections: A Strategic Approach to Academic Reading by Kenneth J.Pakenham, Second Edition

Master of Science (Mathematics)(FYIP)
Semester–I
Session- 2026-27
Course Title: Calculus
Course Code: FMAL-1333

Course Outcomes

After passing this course, the students will be able to:

CO 1: Understand real number system, limit of a function, basic properties of limit, continuity, and classification of discontinuities & to apply it in real world problem.

CO 2: To Classify the difference between increasing and decreasing functions and understand the concept of Differentiability of functions and maxima & minima.

CO 3: Demonstrate Asymptotes, points of inflexion, multiple points on a curve & also to differentiate between concavity and convexity.

CO 4: To understand the concepts of Riemann sum, definite integrals and their properties, the fundamental theorem of calculus, applications to length of arc and area bounded between curves, Reduction Formulae & to apply in a wide variety of disciplines like Bio, Eco, Physics & Engineering.

Master of Science (Mathematics)(FYIP)
Semester–I
Session-2026-27
Course Title: Calculus
Course Code: FMAL-1333

Examination Time: 3 Hours | Max. Marks: 100
Theory: 70
L T P | CA:30
4 1 0

Instructions for Paper Setters:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four).Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Review of limit and continuity of a function of real variable, indeterminate forms, higher order derivatives, Leibnitz theorem and applications to problems of the type

$$e^{ax}\sin(bx+c)\,,\, e^{ax}\cos(bx+c)\,,\,(a+bx)^n\sin x,\,(a+bx)^n\cos x.$$

Unit II

Differentiability of functions of real variable, increasing and decreasing functions, maxima and minima, Taylor's and Maclaurin's theorem with various forms of remainders.

Unit III

Concave upward, Concave downward, Point of inflexion, Asymptotes, Horizontal and Vertical Asymptotes, asymptotes of the algebraic curves represented by homogeneous equation in two variables.

Unit IV

Anti derivative of function of real variable, Riemann sums, definite integrals and their properties, the fundamental theorem of calculus, applications to length of arc and area bounded between Cartesian curves, Reduction Formulae, illustration of Reduction Formulae of type $\int \mathrm{Sin}^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \mathrm{Sec}^n x\,dx$, $\int \mathrm{Sin}^n x \mathrm{Sin}^m x\,dx$

Text Book:
Thomas, G.B., and Finney, L.R., Calculus and Analytic Geometry, 9th Edition, Addison Wesley, 1998, (Scope as in Ch.1-7, 9, 11).

Reference Books:

1. Apostol, T.M., Calculus, An Indian Adaptation, Wiley, 2022.
2. Anton, H., Bivens, I., and Davis, S., Calculus, 12th Ed. John Wiley and Sons (Asia)P. Ltd, Singa- pore, 2002. (Scope as in ch.0-3, 6, 10,12)
3. R. Courant and F. John. Introduction to Calculus and Analysis (Vol. 1), Springer, 1999. (Scope as in Ch.4)

Master of Science (Mathematics) (FYIP)
Semester–I
Session-2026-27
Course Title: Theory of Equations
Course Code: FMAL- 1334
Course Outcomes

After passing this course, the students will be able to:

CO 1: Understand the concept of Greatest Common Divisor, Unique Factorization of Polynomial over a field F

CO 2: To find the relations between the roots and coefficients of general equation in one variable, distinguish between solution of cubic equations and Bi-quadratic equations.

CO 3: Classify Symmetric functions, Solutions of reciprocal and binomial equations, and Algebraic solutions of the cubic and biquadratic Equations using Cardan's Method, Descarte's Method, Ferrari Method.

CO 4: Obtain homogeneous products, limits of the roots of equations and Separation of the roots of equations.

Master of Science (Mathematics) (FYIP)
Semester: I
Session: 2026-27
Course Title: Theory of Equations
Course Code: FMAL- 1334

Examination Time: 3 Hours | Max. Marks: 100
Theory: 70
CA: 30

L T P
4 1 0

Instructions for Paper Setters:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

General properties of polynomials, Graphical representation of a polynomial, maximum and minimum values of a polynomials, Euclid's Algorithm, Greatest Common Divisor, Unique Factorization of Polynomial over a field F of numbers (Statement Only), Fundamental Theorem of Algebra (Statement only), Roots and their Multiplicity.

Unit II

General properties of equations, Relationship between the roots and the coefficients, Fundamental theorem of symmetric polynomials (without proof), Evaluation of symmetric functions of roots, Rational roots of polynomials with integral coefficients, Descarte's rule of signs positive and negative rule.

Unit III

Symmetric functions, Applications of symmetric function of the roots, Transformation of equations, Solutions of reciprocal and binomial equations, Algebraic solutions of the cubic and biquadratic Equations using Cardan's Method, Descarte's Method, Ferrari Method.

Unit IV

Symmetric functions of the roots, Newton's theorem on the sums of powers of roots, homogeneous products, limits of the roots of equations, Separation of the roots of equations

Text Books:

1. Burnside, W.S. and Panton, A.W., The Theory of Equations, Dublin University Press, 1954.
2. MacDuffee, C.C., Theory of Equations, John Wiley & Sons Inc., 1954.

Reference Book:

Kishan, H., Theory of Equations, Atlantic Publications, 2022.

Master of Science (Mathematics)(FYIP)
Semester–I
Session-2026-27
Course Title: Programming Language - I
Course Code: FMAM- 1135
Course Outcomes

After passing course the student will be able to:

CO1: Articulate various kind of software and hardware used in computers.

CO2: Work with different set of operations in C programming.

CO3: Apply various control statements of C Programming Language for designing solutions to different real world problems.

CO4: Implement single and multidimensional arrays for representing complex data collections.

Master of Science (Mathematics)(FYIP)
Semester–I
Session-2026-27
Course Title: Programming Language - I
Course Code: FMAM- 1135

Examination Time: (3+3) Hours

Max. Marks: 100
Practical-30
Theory: 40
CA: 30

L T P
3 0 1

Instructions for the Paper Setters: Eight questions of equal marks (8 Marks each) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Unit I

Introduction to Computer Programming, Program Development life cycle, algorithms, flow chart, decision table & pseudo code.

Unit II

Introduction to C language, data types, Operators and Expression, Input/output Functions, Structured programming elements, Control statements: Branching, Jumping, Looping Arrays.

Unit III

Pointers, Functions: Inbuilt Functions, User defined Functions, Recursion, Storage Classes in C, dynamic memory management.

Unit IV

Strings, Structure and union, Reference variables, basics of searching and sorting techniques, file handling in C

References / Textbooks:

1. E. Balagurusamy, Programming in ANSI C, Tata McGraw-Hill (2002), 5th edition.
2. Stephen G. Kochan, Programming in C, Pearson Education (2015), 4th edition.
3. R.S. Salari, Application Programming in C, Khanna Book Publishing (2012), 4thedition.
4. Anshuman Sharma, Learn programming in C, Lakhanpal Publishers (2016), 7thedition.

Practicals

Development of Computer Programs using C language for:

- Separation of odd and even numbers
- Summation of N Natural numbers
- Generating Fibonacci series
- Roots of quadratic and Cubic equations
- Evaluating various mathematical functions: exp(x), log(x), sin(x), cos(x) etc using Taylor series expansion
- Arranging numbers in ascending and descending orders
- Finding maximum/minimum of numbers, for matrix operations, determinants, and inverse of 3x3 matrix, elementary numerical methods and statistical methods.

Master of Science (Mathematics)(FYIP)
Semester–I
Session-2026-27
Course Title: Calculus Laboratory
Course Code: FMAP-1336
Course Outcomes

CO1: To Plot and analyze elementary function graphs and understand the effects of parameters a and b.

CO2: To Sketch and interpret polynomial functions of degree 4 and 5.

CO3:To Generate surfaces of revolution and sketch standard 3D quadric surfaces using Cartesian coordinates.

CO4: To Perform matrix operations and compute eigenvalues and eigenvectors.

Master of Science (Mathematics)(FYIP)

Semester–I

Session-2026-27

Course Title: Calculus Laboratory

Course Code: FMAP-1336

Examination Time: 3 Hours

Max. Marks: 50

Practical: 35

CA:15

L T P

0 0 2

Practical (Using any Software)

1. Plotting the graphs of elementary functions: $e^{ax+b}\sin(bx+c)$, $\log(ax+b)$, 1/(ax+b), $\sin(ax+b)$, $\cos(ax+b)$, $|ax+b|$ and to illustrate the effect of a and b on the graph.
2. Plotting the graphs of the polynomial of degree 4 and 5
3. Obtaining surfaces of revolution of curves and their area.
4. Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic paraboloid, hyperbolic paraboloid using Cartesian coordinates.
5. Matrix operations (addition, multiplication, inverse, transpose), eigenvalues and eigenvectors.

Text Book:

Thomas, G.B. and Finney, R.L., Calculus and Analytic Geometry, 9th Edition, Addison Wesley, 1998. (Scope as in Ch.1-7,9,11)

Reference Books:

1. Anton, H., Bivens, I., and Davis, S., Calculus, 12th Ed. John Wiley and Sons (Asia) P. Ltd, Singapore, 2002. (Scope as in Ch.0-3,6,10,12)
2. Courant, R.and John, F., Introduction to Calculus and Analysis (Vol I), Springer,1999.(Scopes in Ch.4)

Master of Science (Mathematics)(FYIP)

Semester–I

Session-2026-27

Course Title: Statistical Analysis Using Spreadsheet

Course Code: FMAL -1330

Course Outcomes

After passing this course, the students will be able to:

CO:1 Understand the basic concepts and functions of Statistics, collect and present data using tabulation and charts (including Excel/SPSS), and compute measures of central tendency such as mean, median, mode, weighted mean, geometric mean, and harmonic mean.

CO:2 Analyze variability in data by calculating and interpreting measures of dispersion including range, quartile deviation, mean deviation, standard deviation, and coefficient of variation.

CO:3 Evaluate the shape of data distribution by computing and interpreting Karl Pearson's and Bowley's coefficients of skewness and understanding the concept of kurtosis.

CO:4 Examine relationships between variables by identifying types of correlation and applying Karl Pearson's coefficient of correlation and rank correlation methods.

Master of Science (Mathematics)(FYIP)

Semester–I

Session-2026-27

Course Title: Statistical Analysis Using Spreadsheet

Course Code: FMAL -1330

Examination Time: 3 Hours

Max. Marks: 50

Theory: 35

CA: 15

L T P

2 0 0

Instructions for Paper Setters:

Eight questions of equal marks (7 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Introduction to statistics, functions of statistics, collection of data, presentation of data, tabulation of data, charting of data, introduction to excel/spss, graphs in excel, measures of central tendency-, mean, median - meaning and computation, mode-meaning and computation, weighted average mean, geometric mean and harmonic mean.

Unit II

Measures of dispersion, types of dispersion- range, quartile deviation, mean deviation, standard deviation, co-efficient of variation.

Unit III

Skewness- Karl Pearson co-efficient of skewness, Bowley's co-efficient of skewness and Kurtosis.

Unit IV

Correlation, Types of correlation, positive, negative, linear. methods of correlations - Karl Pearson's Co-efficient of correlation, rank correlation coefficient.

Reference Books:-

1. S.C. Gupta. Fundamentals of Mathematical Statistics, S. Chand Publication, 2000.
2. K. Berk, & P. Carey. Data Analysis with Microsoft Excel, Duxbury Press, 2000.

Master of Science (Mathematics)(FYIP)

Semester–I

Session-2026-27

Course Title: Statistical Analysis Using Laboratory

Course Code: FMAP -1330

Course Outcomes:

After passing this course, the students will be able to:

CO:1 Apply spreadsheet functions such as SUM, COUNT, COUNTIF, MAX, MIN, and SORT to perform data organization, calculation, and analysis effectively.

CO:2 Prepare and analyze academic results by calculating total marks, percentages, grades, SGPA, and credits using Spreadsheet formulae and functions.

CO:3 Construct and interpret graphical representations including histograms, bar charts, pie charts, and two-dimensional graphs for better data visualization.

CO:4 Compute and interpret statistical measures such as central tendency, dispersion, skewness, kurtosis, correlation, and regression using Spreadsheet tools.

Master of Science (Mathematics) (FYIP)

Semester–I

Session-2026-27

Course Title: Statistical Analysis Using Laboratory

Course Code: FMAP -1330

Examination Time: 3 Hours

Max. Marks: 100

Practical: 70

C A: 30

L T P

0 0 4

List of Practicals

1. Introduction of basics of excel and functions such as ‘sum’, ‘count’, ‘countif’, ‘max’, ‘min’,‘sort’ etc.
2. Create frequency distribution table; plot histogram, bar chart, pie chart, etc.
3. Plotting two dimensional graphs.
4. To find measures of central tendency for a given data.
5. To find measures of dispersion for a given data.
6. To find measures of skewness and kurtosis for a given data.
7. To find Karl Pearson Coefficient of correlation and rank correlation coefficient for a givendata.
8. To find regression coefficient for bivariate data and plotting regression lines.

Reference Books:-

1. S. C. Gupta, Fundamentals of Mathematical Statistics, Himalaya Publication.
2. K. Berk, Partrick Carey, Data Analysis with Microsoft Excel.

SEMESTER-II

Master of Science (Mathematics)(FYIP)
Semester–II
Session- 2026-27
Course Title: Basic Punjabi
Course Code: FMAL-2031
Course Outcomes

CO1: **ਸ਼ਬਦ ਸ਼੍ਰੇਣੀਆਂ : ਪਛਾਣ ਅਤੇ ਵਰਤੋਂ (ਨਾਂਵ, ਪੜਨਾਂਵ, ਕਿਰਿਆ, ਵਿਸ਼ੇਸ਼ਣ, ਕਿਰਿਆ ਵਿਸ਼ੇਸ਼ਣ, ਸਬੰਧਕ, ਯੋਜਕ ਅਤੇ ਵਿਸਮਿਕ)ਨੂੰ ਪੜ੍ਹਾਉਣ ਦਾ ਮਨੋਰਥ ਵਿਦਿਆਰਥੀਆਂ ਅੰਦਰ ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦੀ ਅਮੀਰੀ ਦਾ ਅਤੇ ਬਾਰੀਕੀਆਂ ਨੂੰ ਸਮਝਣ ਲਈ ਵੱਖਰੇ ੍ਵੱਖਰੇ ਸਿਧਾਂਤਾਂ ਦਾ ਵਿਕਾਸ ਕਰਨਾ ਹੈ।**

CO2: **ਵਿਦਿਆਰਥੀ ਪੰਜਾਬੀ ਵਾਕ ਬਣਤਰ (ਸਾਧਾਰਨ ਵਾਕ, ਸੰਯੁਕਤ ਵਾਕ, ਮਿਸ਼ਰਤ ਵਾਕ, ਬਿਆਨੀਆ ਵਾਕ, ਪ੍ਰਸ਼ਨ ਵਾਚਕ ਵਾਕ ਅਤੇ ਹੁਕਮੀ ਵਾਕ) ਦੀ ਪਰਿਭਾਸ਼ਾ ਅਤੇ ਇਸ ਦੀ ਬਣਤਰ ਤੋਂ ਜਾਣੂ ਹੋਣਗੇ ਅਤੇ ਉਨ੍ਹਾਂ ਦੀ ਭਾਸ਼ਾ ਤੇ ਪਕੜ ਮਜਬੂਤ ਹੋਵੇਗੀ।**

CO3: **ਪੈਰ੍ਹਾ ਰਚਨਾ ਅਤੇ ਸੰਖੇਪ ਰਚਨਾ ਦਾ ਮਨੋਰਥ ਵਿਦਿਆਰਥੀਆਂ ਦੀ ਬੁੱਧੀ ਨੂੰ ਤੀਖਣ ਕਰਦਿਆਂ ਉਨਾਂ ਦੀ ਲਿਖਣ ਪ੍ਰਤਿਭਾ ਨੂੰ ਉਜਾਗਰ ਕਰਨਾ ਹੈ।**

CO4: **ਘਰੇਲੂ ਅਤੇ ਦਫ਼ਤਰੀ ਚਿੱਠੀ ਪੱਤਰ ਲਿਖਣ ਦਾ ਮਨੋਰਥ ਵਿਦਿਆਰਥੀਆਂ ਨੂੰ ਇਸ ਕਲਾ ਵਿਚ ਨਿਪੁੰਨ ਕਰਨਾ ਹੈ ਜ਼ਅਖਾਣ ਅਤੇ ਮੁਹਾਵਰੇ ਦੀ ਵਰਤੋਂ ਨਾਲ ਗੱਲਬਾਤ ਵਿਚ ਪਰਪੱਕਤਾ ਆਉਂਦੀ ਹੈ।ਇਹ ਵਿਦਿਆਰਥੀਆਂ ਦੀ ਗੱਲਬਾਤ ਵਿਚ ਨਿਖਾਰ ਲਿਆਉਣ ਦਾ ਕੰਮ ਕਰਨਗੇ।**

Master of Science (Mathematics)(FYIP)
Semester–II
Session- 2026-27
Course Title: Basic Punjabi
Course Code: FMAL-2031

ਸਮਾਂ : 3 ਘੰਟੇ

Maximum Marks : 50

Theory : 35

CA : 15

ਅੰਕ ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਸੈਕਸ਼ਨ ਹੋਣਗੇ।ਸੈਕਸ਼ਨ ਇੱਕ ਤੱਕ ਦੇ ਪ੍ਰਸ਼ਨ ਯੂਨਿਟ ਜ਼ਜ਼ਜ਼ ਵਿਚੋਂ ਪੁੱਛੇ ਜਾਣਗੇ। ਹਰ ਸੈਕਸ਼ਨ ਵਿਚ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।

2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਸੈਕਸ਼ਨ ਵਿਚੋਂ ਇਕ ਪ੍ਰਸ਼ਨ ਕਰਨਾ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਸੈਕਸ਼ਨ ਵਿਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।

3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ 7 ਅੰਕ ਹਨ।

4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ ਪ੍ਰਸ਼ਨਾਂ

ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

ਪਾਠਕ੍ਰਮ

ਯੂਨਿਟ-I

ਸ਼ਬਦ ਸ਼੍ਰੇਣੀਆਂ : ਪਛਾਣ ਅਤੇ ਵਰਤੋਂ (ਨਾਂਵ, ਪੜਨਾਂਵ, ਕਿਰਿਆ, ਵਿਸ਼ੇਸ਼ਣ, ਕਿਰਿਆਵਿਸ਼ੇਸ਼ਣ, ਸਬੰਧਕ,

ਯੋਜਕ ਅਤੇ ਵਿਸਮਿਕ)

ਯੂਨਿਟ-II

ਪੰਜਾਬੀਵਾਕਬਣਤਰ : ਮੁੱਢਲੀਜਾਣਪਛਾਣ

(ੳ) ਸਾਧਾਰਨਵਾਕ, ਸੰਯੁਕਤਵਾਕ ਅਤੇ ਮਿਸ਼ਰਤਵਾਕ (ਪਛਾਣ ਅਤੇ ਵਰਤੋਂ)

(ਅ) ਬਿਆਨੀਆਵਾਕ, ਪ੍ਰਸ਼ਨਵਾਚਕਵਾਕ ਅਤੇ ਹੁਕਮੀਵਾਕ (ਪਛਾਣ ਅਤੇ ਵਰਤੋਂ)

ਯੂਨਿਟ-III

ਪੈਰ੍ਹਾਰਚਨਾ

ਸੰਖੇਪ ਰਚਨਾ

ਯੂਨਿਟ-IV

ਚਿੱਠੀਪੱਤਰ (ਘਰੇਲੂ ਅਤੇ ਦਫ਼ਤਰੀ)

ਅਖਾਣ ਅਤੇ ਮੁਹਾਵਰੇ (ਲਿਸਟ ਨਾਲ ਨੱਥੀ ਹੈ)

Master of Science (Mathematics)(FYIP)
Semester–II
Session- 2026-27
Course Title: Punjabi Compulsory
Course Code: FMAL-2421

COURSE OUTCOMES

CO1:ਆਧੁਨਿਕ ਇਕਾਂਗੀਪੁਸਤਕ ਨੂੰ ਪੜ੍ਹਾਉਣ ਦਾਮਨੋਰਥਵਿਦਿਆਰਥੀਆਂਅੰਦਰਇਕਾਂਗੀਪ੍ਰਤੀਦਿਲਚਸਪੀ, ਸੂਝ ਨੂੰ ਪੈਦਾਕਰਨਾ ਹੈ।

CO2: ਆਧੁਨਿਕ ਇਕਾਂਗੀ ਪੁਸਤਕ ਨੂੰ ਪੜ੍ਹਾਉਣ ਦਾ ਮਨੋਰਥ ਵਿਦਿਆਰਥੀਆਂ ਅੰਦਰ ਇਕਾਂਗੀ ਪ੍ਰਤੀ ਦਿਲਚਸਪੀ, ਸੂਝ ਨੂੰ ਪੈਦਾ ਕਰਨਾ ਹੈ।

CO3:ਮੁਹਾਵਰੇ ਅਖਾਣਦੀ ਵਰਤੋਂ ਨਾਲ ਗੱਲਬਾਤ ਵਿਚ ਪਰਪੱਕਤਾ ਆਉਂਦੀ ਹੈ।ਇਹ ਵਿਦਿਆਰਥੀਆਂ ਦੀ ਗੱਲਬਾਤ ਵਿਚ ਨਿਖਾਰ ਲਿਆਉਣ ਦਾ ਕੰਮ ਕਰਨਗੇ।

CO4:ਸ਼ਬਦ ਸ਼੍ਰੇਣੀਆਂਨੂੰ ਪੜ੍ਹਾਉਣ ਦਾਮਨੋਰਥਵਿਦਿਆਰਥੀਆਂਅੰਦਰਪੰਜਾਬੀਭਾਸ਼ਾ ਦੀ ਅਮੀਰੀਦਾ ਅਤੇ ਬਾਰੀਕੀਆਂਨੂੰ ਸਮਝਣਲਈਵੱਖਰੇ ਵੱਖਰੇ ਸਿਧਾਂਤਾਂਦਾਵਿਕਾਸ ਕਰਨਾ ਹੈ।

Master of Science (Mathematics)(FYIP)
Semester–II
Session- 2026-27
Course Title: Punjabi Compulsory
Course Code: FMAL-2421

ਸਮਾਂ : 3 ਘੰਟੇ Maximum Marks: 50
L-T-P Theory : 35
2-0-0 CA :15

ਅੰਕ ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. **ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਸੈਕਸ਼ਨ ਹੋਣਗੇ।ਸੈਕਸ਼ਨ੍ਂਣਤੱਕ ਦੇ ਪ੍ਰਸ਼ਨ ਯੂਨਿਟਜ਼ੜ ਵਿਚੋਂ ਪੁੱਛੇ ਜਾਣਗੇ। ਹਰ ਸੈਕਸ਼ਨ ਵਿਚ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।**

2. **ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਸੈਕਸ਼ਨ ਵਿਚੋਂ ਇਕ ਪ੍ਰਸ਼ਨ ਕਰਨਾ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਸੈਕਸ਼ਨ ਵਿਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।**

3. **ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ 7 ਅੰਕ ਹਨ।**

4. **ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ ਪ੍ਰਸ਼ਨਾਂਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।**

ਪਾਠਕ੍ਰਮ ਅਤੇ ਪਾਠ ਪੁਸਤਕਾਂ

ਯੂਨਿਟ-I

ਆਧੁਨਿਕ ਇਕਾਂਗੀ, ਸੰਪਾਦਕ ਰੌਸ਼ਨ ਲਾਲ ਅਹੂਜਾ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ

ਸੁਹਾਗ, ਜ਼ਫ਼ਰਨਾਮਾ, ਇੱਕ ਐਤਵਾਰ ਇਕਾਂਗੀਆਂ ਪੜ੍ਹਾਈਆਂ ਜਾਣਗੀਆਂ।

(ਸਾਰ,ਵਿਸ਼ਾਵਸਤੂ)

8 ਅੰਕ

ਯੂਨਿਟ-II

ਆਧੁਨਿਕ ਇਕਾਂਗੀ, ਸੰਪਾਦਕ ਰੌਸ਼ਨ ਲਾਲ ਅਹੂਜਾ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ
ਬੰਬ ਕੇਸ, ਜੁੱਤੀਆਂ ਦਾ ਜ਼ੋੜਾ, ਕੱਚ ਦਾ ਗਜਰਾ ਇਕਾਂਗੀਆਂ ਪੜ੍ਹਾਈਆਂ ਜਾਣਗੀਆਂ।
(ਸਾਰ,ਵਿਸ਼ਾ ਵਸਤੂ)

8 ਅੰਕ

ਯੂਨਿਟ-III

(ੳ) ਮੁਹਾਵਰੇ ਅਖਾਣ
(ਅ) ਘਰੇਲੂ ਚਿੱਠੀ ਪੱਤਰ8ਅੰਕ

ਯੂਨਿਟ-IV

(ੳ) ਸ਼ਬਦਸ਼੍ਰੇਣੀਆਂ : ਨਾਂਵ,ਪੜਨਾਂਵ,ਕਿਰਿਆ,ਵਿਸ਼ੇਸ਼ਣ
(ਅ) ਸ਼ਬਦਸ਼੍ਰੇਣੀਆਂ: ਕਿਰਿਆਵਿਸ਼ੇਸ਼ਣ,ਸੰਬੰਧਕ,ਯੋਜਕ,ਵਿਸਮਿਕ8 ਅੰਕ

Master of Science (Mathematics)(FYIP)
Semester–II
Session- 2026-27
Course Title: Punjab History and Culture (C. 320 to 1000 A.D)
Course Code: FMAL-2431

COURSE OUTCOMES

After completing Semester II and course on Ancient History of Punjab students will be able to understand:

CO 1: The reasons and impact of Alexander's invasions and to comprehend various factors leading to rise and fall of empires and emergence of new dynasties and their administration specifically of Maurya rule in general and Ashok in particular

CO 2: art and architecture of Gupta period and the Indo-Greek style of architecture under Gandhara School

CO 3: To have an insight into the socio-cultural history under Harshvardhan and punjab under the stated period

CO 4: To enable students to have thorough insight into the various forms/styles of Architecture and synthesis of Indo - Greek Art and Architecture in Punjab

Master of Science (Mathematics) (FYIP)
Semester–II
Session- 2026-27
Course Title: Punjab History and Culture (C. 320 to 1000 A.D)
Course Code: FMAL-2431

Examination Time: 3 Hours | Max. Marks: 50
Credits L-T-P: 2-0-0 | Theory: 35
Contact Hours: 2 Hrs/Week | CA: 15

Instructions for the Paper Setter:

1. Question paper shall consist of four Units
2. Examiner shall set 8 questions in all by selecting Two Questions of equal marks from each Unit.
3. Candidates shall attempt 5 questions in 500 words, by at least selecting One Question from each Unit and the 5th question may be attempted from any of the four Units.
4. Each question will carry 7 marks

Unit I

1. Alexander's Invasion's and Impact
2. Administration of Chandragupta Maurya with special reference to reforms introduced by Ashok

Unit II

3. The Kushans: Gandhar School of Art
4. Gupta Empire: Golden Period-Social and cultural life, Art and Architecture)

Unit III

5. The Punjab under Harshvardhana-Society and Religion During the time of Harshvardhana
6. Socio-cultural History of Punjab from 7th to 1000 A.D.

Unit IV

7. Development of Languages and Education with Special reference to Taxila
8. Development to Art and Architecture

Suggested Readings

- B.N. Sharma: *Life in Northern India*, Delhi. 1966
- Budha Parkash, *Glimpses of Ancient Punjab*, Patiala, 1983.
- L. M Joshi (ed), *History and Culture of the Punjab*, Art-I, Punjabi University, Patiala, 1989 (3rd edition)
- L.M. Joshi and Fauja Singh (ed.), *History of Punjab*, Vol.I, Punjabi University, Patiala, 1977.

Master of Science (Mathematics)(FYIP)
Semester–II
Session- 2026-27
Course Title: Communicative English-II
Course Code: FMAL-2102

Course Outcomes

At the end of this course, students will be able to:

CO1: distinguish the main points from the supporting details and the irrelevant information from the relevant one through Note-Taking

CO2: learn the skills and strategies of effective writing by paragraph writing

CO3: enhance their reading and analyzing power of texts through guided reading through the study of "Making Connections" by Kenneth J. Pakenham

CO4: be acquainted to the techniques of effective essay writing

Master of Science (Mathematics)(FYIP)
Semester–II
Session- 2026-27
Course Title: Communicative English-II
Course Code: FMAL-2102

Examination Time: 3 Hours | Max. Marks: 50
Theory: 35
L T P | CA:15
2 0 0

Instructions for Paper Setters:

Eight questions of equal marks (07 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four).Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Practical question on Note Making, Summarizing and Abstracting as given in The Written Word by Vandana R. Singh

Unit II

Practical question on Paragraph writing as prescribed in The Written Word by Vandana R. Singh

Unit III

Theoretical questions based on ABC of Good Notes as prescribed in The Written Word by Vandana R. Singh, Unit-III from Making Connections: A Strategic Approach to Academic Reading by Kenneth J. Pakenham, Second Edition

Unit IV

Practical question on Essay writing from The Written Word by Vandana R. Singh, Unit - IV from Making Connections: A Strategic Approach to Academic Reading by Kenneth J. Pakenham, Second Edition.

Text books:

- The Written Word by Vandana R. Singh, Oxford University Press, New Delhi
- Making Connections: A Strategic Approach to Academic Reading by Kenneth J. Pakenham, second edition.

Master of Science (Mathematics)(FYIP)
Semester–II
Session-2026-27
Course Title: Sequences and Series
Course Code: FMAL-2333

Course Outcomes

After passing this course, the students will be able to:

CO 1: Demonstrate an understanding of sequences and series and their convergence, Cauchy criterion, sub sequence and algebra of limit of sequences.

CO 2: Know and describe the behaviour of Infinite series using various tests like comparison test, Cauchy Integral test. Ratio test, Raabe's test.

CO 3: Distinguish between the absolute convergence and conditional convergence.

CO 4: Manage to solve the problem related to Fourier series expansion, Fourier series for even and odd functions and half range series.

Master of Science (Mathematics)(FYIP)
Semester–II
Session-2026-27
Course Title: Sequences and Series
Course Code: FMAL-2333

Examination Time: 3 Hours

Max. Marks: 100
Theory: 70
CA: 30

L T P
4 1 0

Instructions for Paper Setters:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Sequence, sub sequence, bounded sequences, monotone sequences, convergence, Cauchy criterion, algebra of limit of sequences (proofs with ε-N rigor), Sandwich Theorem.

Unit II

Infinite series, Sequences of partial sums, convergence and divergence of series, series of non-negative terms, comparison test, Limit Comparison test, Cauchy's nth root test, Cauchy's Condensation test, Cauchy's Integral test. Ratio test, Raabe's test (all tests with proofs).

Unit III

Logarithmic test and Gauss test, Alternating series, Leibnitz Test, absolute and conditional convergence, Convergence of Power Series, Taylor Series.

Unit IV

Periodic functions, trigonometric series, Fourier series expansion, Fourier series for even and odd functions, half range series.

Text Book:

George B. Thomas and Ross L. Finney, Calculus and Analytic Geometry, Pearson publication, 9th Edition, 1998.

Reference Books:

1. S. C. Malik and S. Arora, Mathematical Analysis, New Age International Publishers, New Delhi, 2nd Edition, 2005.

2. Sudhir R. Ghorpade and B.V. Limaye, A course in calculus and real analysis, Springer, 2006.

Master of Science (Mathematics)(FYIP)
Semester–II
Session-2026-27
Course Title: Algebra
Course Code: FMAL-2334

Course Outcomes

After passing this course, the students will be able to:

CO 1: Understand the concept of Groups, Rings, Fields and Vector space with examples.

CO2: Understand the concepts of Linearly independent and dependent vectors, linear span, subspace generated by a subset, basis and dimension.

CO3: Understand matrix representation of a linear transformation and to determine Linear transformations, null space and range space of a linear transformation

CO 4: Obtain Eigen values, Eigen vectors and to solve the System of linear equations over a field.

Master of Science (Mathematics)(FYIP)
Semester–II
Session-2026-27
Course Title: Algebra
Course Code: FMAL-2334

Examination Time: 3 Hours

Max. Marks: 100
Theory: 70
CA: 30

L T P
4 1 0

Instructions for Paper Setters:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Definition of Group, Ring and Fields with examples. Definition of a vector space, subspaces with examples. Direct sum of subspaces

Unit-II

Linearly independent and dependent vectors, linear span, subspace generated by a subset, basis and dimension.

Unit-III

Linear transformations, null space and range space of a linear transformation, rank and nullity of a linear transformation, matrix representation of a linear transformation.

Unit-IV

Elementary matrix operations and Elementary matrices, Row rank and Column rank of a matrix and their equality, System of linear equations over a field, Characteristic polynomial of a matrix, Cayley-Hamilton Theorem, Eigen values and Eigen vectors.

Text Book:

S. Axler, Linear Algebra Done Right, Springer, Second edition, 1997.

Reference Books:

1. S. H. Friedberg, A.J. Insel and L.E. Spence., Linear Algebra, PHI Learning Pvt. Ltd, New Jersey, 1979

2. V. Sahai and V. Bist., Linear Algebra, Narosa Publishing House Pvt. Ltd, Delhi, 2013

3. Andreescu, T. and Andrica, D. ,Complex Numbers from A to Z, Birkhauser,2006.

Master of Science (Mathematics)(FYIP)
Semester–II
Session-2026-27
Course Title: Object Oriented Programming C++
Course Code: FMAM-2135

After the completion of this course, the student will be able to:

CO1: Comprehend the concepts of Object-Oriented Programming Paradigm.

CO2: Identify the use of access specifiers and different types of constructors in class.

CO3: Apply function and operator overloading.

CO4: Comprehend different types of inheritance and polymorphism.

Master of Science (Mathematics)(FYIP)
Semester–II
Session-2026-27
Course Title: Object Oriented Programming C++
Course Code: FMAM-2135

Examination Time: 3 Hours

Max. Marks: 100
Practical-30
Theory: 40
CA: 30

L T P
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Instructions for the Paper Setters:

Eight questions of equal marks (8 Marks each) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Unit I

GettingStarted:Introduction.AbriefhistoryofC++,Variable,Constant,Expression,Statements,Comments and keywordsofC++.

Operator: Arithmetic, Relational, Logical, Assignment, Increment/Decrement, Conditional, Precedence ofOperators.Datatype, Typeconversion,libraryfunction.

Input/OutputStatements:Inputtingusingcinandoutputtingusingcoutstatements,Preprocessordirectives.

Basic Program construction: A complete C++ program: invoking Turbo C++, naming your program, usingthe editor, saving your program, compiling and linking, running the program Errors: Compiler, linker andruntime.

Other IDE features: Compiling and linking, shortcut exiting from IDE, examining files, opening an existingfile, DOSshell.

Unit II

Programming Paradigms: Introduction to the object oriented approach towards programming by discussing Traditional, Structured Programming methodology.

Objects & Classes: Object Definition, Instance, Encapsulation, Data Hiding, Abstraction, Inheritance, Messages, Method, Polymorphism, Classes.

Object Oriented Programming using C++: Characteristics of OOP, Overview of C++, Objects and Classes, Member functions and data, private & public, constructor & destructor, Constructor Overloading, Types of Constructors.

Unit III

Operator Overloading: Overloading unary operators, Overloading binary operators, Data conversion, Pit-fallsoperator overloadingandconversion.

Function Overloading: Function Overloading, Default Arguments, Ambiguity in Function Overloading.

Unit IV

Inheritance: Concept of inheritance, Base & derived classes, Access Specifiers, Class Hierarchies, Types of Inheritance with examples.

Polymorphism: Virtual functions, friend functions, static function, this pointer, polymorphism, Types of Polymorphism with examples, Templates

References / Textbooks:

1. Herbertt Schildt, C++: The Complete Reference, Tata McGraw-Hill Education India, 4th Edition.
2. Bjarne Stroustrup, The C++ Programming Language, Addison – Wesley Professional (2013), 4th Edition
3. G.S. Baluja, C++ Program Design (w/CD), Khanna Book Publishing Company (2015), 2nd edition.
4. Stanley Lippman, Josee Lajoie, Barbara Moo, C++ Primer, Addison-Wesley Professional (2012), 5th edition.
5. Richard Johnsonbaugh and Martin Kalin, Object Oriented Programming in C++, Pearson Education (1999), 2nd Edition

Master of Science (Mathematics) (FYIP)
Semester–II
Session-2026-27

Course Title: Algebra Laboratory

Course Code: FMAP-2336

Course Outcomes

After passing this course, the students will be able to:

CO 1: To develop practical skills in applying computational tools for performing various matrix operations, including addition, multiplication, inversion, transposition, and determinant calculation.

CO 2: To enhance problem-solving abilities in linear algebra by determining matrix rank, reducing matrices to row echelon form, and solving systems of linear equations using numerical methods.

CO 3: To enable students to analyze and interpret matrix properties through the computation of eigenvalues, eigenvectors, and other numerical techniques using built-in software functions.

CO 4: To bridge theoretical concepts of linear algebra with practical implementation using computational packages, fostering efficiency, accuracy, and deeper understanding of engineering mathematics applications.

Master of Science (Mathematics) (FYIP)
Semester–II
Session-2026-27

Course Title: Algebra Laboratory

Course Code: FMAP-2336

Examination Time: 3 Hours

Max. Marks: 50
Practical: 35
CA: 15

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List of Practicals (using any package)

1. Introduction to the computer package in the practicals.
2. Matrix operations: addition, multiplication, inverse. transpose, determinant of matrix.
3. Find Rank of matrix: Row Rank, Column Rank.
4. Find row reduced echelon form
5. Create the coefficient matrix A and vector b. Solve for x using the inverse, using the built-in function.
6. Solving a linear system, using Gauss elimination numerically.
7. Finding eigenvalues and eigenvectors, numerically.

Reference Books:-

1. S.S. Sastry, Engineering Mathematics - Volume I (4th Edition), PHI, 2008.
2. S.S. Sastry, Engineering Mathematics - Volume II (4th Edition), PHI, 2008.

Master of Science (Mathematics) (FYIP)
Semester–II
Session-2026-27
Course Title: Numerics Using SCILAB
Course Code: FMAM-2330

Course outcomes:

After passing this course, the students will be able to:

CO1: Apply basic Scilab commands, arithmetic operations, mathematical functions, and array operations to perform numerical computations.

CO2: Use Scilab programming constructs, matrices, user-defined functions, and numerical techniques to solve mathematical problems.

CO3: Create and analyze 2D and 3D graphical representations of functions, curves, and surfaces using Scilab.

CO4: Utilize Scilab for modeling, simulation, and analysis of real-world problems and dynamical systems.

Master of Science (Mathematics) (FYIP)
Semester–II
Session-2026-27
Course Title: Numerics Using SCILAB
Course Code: FMAM-2330

Examination Time: 3 Hours

Max. Marks: 100
Practical-30
Theory: 40
CA: 30

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Instructions for Paper Setters:

Eight questions of equal marks (8 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Scilab console and Editor windows, arithmetical operations (+, -, *, /, ^), the commands such as ;, format(16), //.//, clear, clc, sqrt, %e, %pi, %i, disp, factorial, exp, log, log10, sin, cos, sec, csc, tan, cotg, asin, acos, asec, acsc, atan, acot, sinh, cosh, etc., array operations (.+, .-, .*, ./, .^).

Unit II

Scilab files (.sce, .scf), matrices and matrix operations, relational operators (==, <>,,<=,>=,%T,%F, &, | , ~) , strings“ ”, for loop, if and elseif commands, user defined functions, feval, executing a .sce file, eigen values & eigen vectors, solving linear equations using SCILAB.

Unit III

Graphics using Scilab (2D and 3D graphics), plotting graphs of elementary functions, plotting parametric curves (param3d) and surfaces (surf), handling graphics.

Unit IV

Usage of SCILAB in Solving Problems such as: Motion of Pendulum, Calculation of EMI for home loan, Modeling & Simulation of Car, Errors and approximation, Two dimensional dynamical systems, phase portrait, equilibrium points & their classification (using SCILAB).

Text Book:

1. Campbell, S.L., Chanceller, J.P., Nikoukhah, R. Modeling and Simulation in Scilab/Scios, Springer, 2006.

2. Jain, C., Advanced Programming in SCILAB, Alpha Science International, Oxford, UK, 2020.

Note: Practical: The practical examination will include applications and concepts drawn from the prescribed theory syllabus only.

SEMESTER-III

Master of Science (Mathematics) (FYIP)
Semester–III
Session-2026-27
Course Title: Theory of Real Functions
Course Code: FMAL-3331
Course Outcomes

After passing this course, the students will be able to:

CO 1: Understand real number system, limit of a function, basic properties of limit, continuity, and classification of discontinuities & to apply it in real world problem.

CO 2: To understand the concept of Differentiability of functions and Uniform Continuity.

CO 3: Demonstrate Relative extrema, Mean Value Theorem and its Applications to inequalities.

CO 4: To understand the concepts of Taylor's theorem & to apply in a wide variety of disciplines like Bio, Eco, Physics & Engineering.

Master of Science (Mathematics) (FYIP)
Semester–III
Session-2026-27
Course Title: Theory of Real Functions
Course Code: FMAL-3331

Examination Time: 3 Hours

Max. Marks: 100
Theory: 70
CA:30

L T P
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Instructions for Paper Setters:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Limit of a function ($-\delta$ approach), Algebra of limit, One sided limits, Infinite limits and limits at infinity, Continuous functions, discontinuity criterion, Composition of continuous functions.

Unit II

Continuous functions on an interval, Bolzano's Intermediate Value Theorem, Uniform Continuity, Differentiability of a function at a point and in an interval, Algebra of differentiablefunctions, Chain Rule.

Unit III

Concavity and convexity, points of inflexion, Rolle's theorem, Mean Value Theorem and its Applications to inequalities, Cauchy Mean Value Theorem, L' Hospi- tal's Rule.

Unit IV

Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, Application of Taylor's theorem, Taylor's series and Maclaurin's series expansions of ex- ponential and trigonometric functions.

Text Book:

Bartle, R. G. and Sherbert, D. R., Introduction to Real Analysis, 3rd Ed., John Wiley and Sons(Asia) Pvt. Ltd., Singapore, 2002.

Reference Books:

1.Rudin, W., Principles of Mathematical Analysis, 3rd edition. McGraw Hill, 1976.

2. Apostol, T. M., Mathematical Analysis, 2nd Edition, Narosa Publishing House, Reprint 2002.

3. Ghorpade, S. R. and Limaye, B. V., A Course in Calculus and Real Analysis, Springer, 2006.

4. A. Mattuck, Introduction to Analysis, Prentice Hall, 1999.

5. Ross, K.A., Elementary Analysis: The theory of Calculus, Springer 2004.

Master of Science (Mathematics)(FYIP)
Semester–III
Session-2026-27
Course Title: Applied Differential Equations
Course Code: FMAL-3332

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

CO1: Identify differential equation, its order and degree, exact differential equations and special rules to find integrating factors.

CO2: Apply the Decay model to solve real life problem and analyze the dynamics of pollutant accumulation in a lake using differential equations.

CO 3: Demonstrate the concept of Linear homogeneous and non-homogeneous equations with constant coefficients, The Cauchy Euler Equations, Method of variation of parameters.

CO 4: Analyze the System of ordinary differential equations, Power Series, convergence of power series and Radius of convergence.

Master of Science (Mathematics)(FYIP)
Semester–III
Session-2026-27
Course Title: Applied Differential Equations
Course Code: FMAL-3332

Examination Time: 3 Hours | Max. Marks: 100
Theory: 70
L T P | CA:30
4 0 0

Instructions for Paper Setters:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four).Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Classification of Differential Equations, their origin and application, solutions, initial value problems, boundary value Problem and existence of Solutions. Exact differential equations and integrating factors, sep- arable equations and equations reducible to this form, linear equation and Bernoulli equations, special inte- grating factors and transformations.

Unit II

Orthogonal and oblique trajectories. Introduction to compartmental model, exponential decay model, lake pollution model (case study of Lake Burley Griffin), exponential growth of population, limited growth of population, drug assimilation into the blood (case of a single cold pill)

Unit III

General solution of homogeneous equation of second order, principle of superposition for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations with constant coefficients, The Cauchy Euler Equations, Method of variation of parameters.

Unit IV

Power Series solution about an ordinary point, solutions about singular points, the method of Frobenius, Bessel equation and Bessel function and their recurrence relations.

Text Book:

S. L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.

Reference Books:

1. Barnes, B., and Fulford, G. R., Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab, 2nd Ed., Taylor and Francis group, London and New York, 2009.
2. Edwards, C.H. and Penny, D.E., Differential Equations and Boundary Value problems Computing and Modeling, Pearson Education India,2005.
3. Abell, M.L., Braselton, J. P., Differential Equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press, 2004.
4. Boyce, W.E., and Diprima, R.C., Elementary differential equations and boundary value problems, John Wiley & Sons, 8th edition, 2005.

Master of Science (Mathematics) (FYIP)
Semester-III
Session: 2026-27
Course Title: Logic and Reasoning
Course Code: FMAL-3333

Course Outcomes:
After passing this course, the students will able to:

CO1.Understand and apply concepts of verbal reasoning including classification, analogy, and series.

CO2. Develop skills to solve puzzles and apply mathematical logic in reasoning problems.

CO3. Analyze and interpret non-verbal reasoning problems through visualization and logic pattern identification.

CO4. Develop problem solving skills in visual-spatial reasoning through figure manipulation and recognition.

Master of Science Mathematics (FYIP)
Semester-III
Session: 2026-27
Course Title: Logic and Reasoning
Course Code: FMAL-3333

Examination Time: 3 Hours | Maximum Marks: 100
L T P | Theory: 70
4 0 0 | CA: 30

Instruction for the Paper Setters:

Eighth questions of equal marks (14 marks each) are to be set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding fours). Candidates are required to attempt five questions, selecting at least one questions from each section. The fifth question may be attempted from any sections.

Unit – I

Verbal Reasoning: Series Completion, Number and Alphabet analogy, Missing number in a sequence or a series, Classification, Coding and Decoding, Blood Relationship.

Unit-II

Puzzle test, Direction Sense test, Logical Venn Diagram, Mathematical operations, Arithmetical Reasoning, Inserting the missing character, Logic

Unit-III

Non-Verbal Reasoning: Series, Analogy, Classification, Analytical reasoning, Mirror Images, Water Images, Spotting out of the embedded figures. Vocabulary: Antonym, synonym, phrases

Unit-IV

Non-Verbal Reasoning: Completion of Incomplete pattern, Figure Matrix, Paper Folding, Rule Detection, Grouping of identical Figures, Cubes and dice, Construction of squares and triangles.

Text-Book:

R.S Aggarwal, A Modern approach to Verbal and Non-Verbal Reasoning, S. Chand and Co. Pvt. Ltd, New Delhi, Eighth Edition, 2018

Reference Books:

1. M.K Pandey, Analytical reasoning, BSC Publishing Co. Pvt. Ltd., 2024 Edition.
2. Mishra & Kumar, Multidimensional Reasoning, Arihant Publication, Latest Edition 2024.
3. Course in Mental Abilities and Quantitative Aptitude for Competitive Examinations by Edgar Thorpe, Tata McGraw Hill Pub. Co. Ltd. New Delhi.

Master of Science (Mathematics) (FYIP)
Semester–III
Session-2026-27
Course Title: Basics of Python Programming
Course Code: FMAM-3334

Course Outcomes:

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

CO1: Comprehend basics of Python programming like operators, data types, etc.

CO2: Apply various control statements of Python Programming Language for designing solutions to different real world problems.

CO3: Implement various built-in and user defined function, packages and modules to solve mathematical problems.

CO4: Apply different matrix operations and perform file manipulations.

Master of Science (Mathematics) (FYIP)
Semester–III
Session-2026-27
Course Title: Basics of Python Programming
Course Code: FMAM-3334

Examination Time: (3+3) Hours

Max. Marks: 100
Practical-30
Theory: 40
CA: 30

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Instructions for Paper Setters:

Eight questions of equal marks (8 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Introduction to python: Features of Python, How to Run Python, Identifiers, Reserved Keyboards, Variables, Comments in Python, Indentation in Python, Multi-Line Statements, Multiple Statement Group (Suite), Quotes in Python, Input, Output and Import Functions, Operators, Data Types and Operations: Numbers, String, Lists, Tuple, Set, Dictionary, Mutable and Immutable Objects, Data Type Conversions

Unit II

Flow Control: Decision Making, Loops, Nested Loops, Control Statements, Types of Loops. Functions: Function Defining in Python, Function Calling, Function Arguments, Anonymous (Lambda) Functions, Recursive Functions, Function with more than one return value.

Math Module: Constants, Arithmetic functions, Power functions, Logarithmic functions

Unit III

Modules and Packages: Built-in modules, Creating Modules, Import Statement, Locating Modules, Namespaces and scope, The dir() function, The reload() function, Packages in Python, Date and Time Module. Math Module: Trigonometric and Angular functions.

Unit IV

File Handling: Opening a File, Closing a File, Writing to a File, Reading from a File, File Methods, Renaming a File, Deleting a File, Directories in Python. Math Module: Matrix operations (Multiplication. Addition, matrix multiplication, inverse, determinant, adjoint, Eigenvalues).

References Books:

1. Jeeva Jose, P. Solan Lal, Introduction to Computing and Problem Solving with Python, Publisher of Science, Technology and Engineering Books, 2022
2. John V. Guttag, Introduction to Computation and Programming Using Python, PHI Learning Pvt. Limited Second Edition, 2016.

Note: Practical: The practical examination will include applications and concepts drawn from the prescribed theory syllabus only.

Master of Science (Mathematics) (FYIP)
Semester–III
Session-2026-27
Course Title: Applied Differential Equations Laboratory
Course Code: FMAP-3335

Course Outcome:

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

CO1:Apply analytical and graphical techniques to solve and visualize first and second-order differential equations, including plotting solutions for single and family of equations.

CO2:Implement numerical methods, specifically the Runge-Kutta method, to solve systems of ordinary differential equations.

CO3:Model and solve real-life exponential growth and decay problems, interpreting the behavior of dynamic systems over time.

CO4:Analyze and simulate real-world models such as lake pollution and population growth (with and without harvesting) using differential equations with constant or variable parameters.

Master of Science (Mathematics) (FYIP)
Semester–III
Session-2026-27
Course Title: Applied Differential Equations Laboratory
Course Code: FMAP-3335

Examination Time: 3 Hours | Max. Marks: 50
Practical: 35
CA:15

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List of Practicals (using any software)

1. Plotting solution of first order differential equation.
2. Plotting of solution of family of second order differential equation.
3. Solution of system of ordinary differential equations, numerically using Runge-Kuttamethod.
4. Growth & Decay model (exponential case only).
5. Lake pollution model (with constant/seasonal flow and pollution concentration).
6. Limited growth of population (with and without harvesting).

Reference Books:

1. Barnes, B., and Fulford, G. R., Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab, 2nd Ed., Taylor and Francis group, London and New York, 2009.
2. Edwards, C.H. and Penny, D.E., Differential Equations and Boundary Value problems Computing and Modeling, Pearson Education India,2005.
3. Abell, M.L., Braselton, J. P., Differential Equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press, 2004.
4. Boyce, W.E., and Diprima, R.C., Elementary differential equations and boundary value problems, John Wiley & Sons, 8th edition, 2005.
5. Ross, S. L., Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.

Master of Science (Mathematics) (FYIP)
Semester–III
Session-2026-27
Course Title: Graph Theory
Course Code: FMAL-3330

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

CO1: Achieve command of the fundamental definitions and concepts of graph theory.

CO2: Develop a graph theoretical model for real life situations.

CO3: Understand the structures, applications, and algorithms related to tree data structures.

CO4: Evaluate or synthesize any real world applications using graph theory based on directed or unidirected graphs in networks.

Master of Science (Mathematics) (FYIP)
Semester–III
Session-2026-27
Course Title: Graph Theory
Course Code: FMAL-3330

Examination Time: 3 Hours | Max. Marks: 100
Theory: 70
CA:30

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Instructions for Paper Setters:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Graph and its terminology: vertex, edge, types of vertex and edges, incidence matrix and diagram of a graph, order and size of graph, null graph, isomorphic graph, homeomorphic graph, finite and infinite graph, subgraphs and its types, Complement of a graph, Dual graphs, complete graph, regular graph, bipartite, weighted graph, planar graph

Unit II

Walk, path and its length, Cycle and its length, connected and disconnected graph, Shortest path in weighted graph, Eulerian paths and circuits, Hamiltonian paths and circuits

Unit III

Tree, distance and centers in a tree, rooted tree, binary tree, spanning tree, minimum spanning tree in a weighted graph, Kruskal's algorithm, Prim's algorithm

Unit IV

Graph coloring, vertex coloring, chromatic polynomial, chromatic number, algebraic operations in graph, Directed graph, out degree and in degree of a vertex, matrix and diagrammatic representation of directed graph

Text Book:

Gupta, S.B. and Gandhi, C.P. , Discrete Structures, 4th edition, University Science Press, New Delhi. India.

Master of Science (Mathematics) (FYIP)
Semester–III
Session-2026-27
Course Title: Environmental Studies
Course Code: VACE-3221

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1. Understand the concept and need of environmental education and role of an individual in conservation of natural resources.

CO2. Learn about role of major Eco system and their conservation and Develop desirable attitude, value and respect for protection of Biodiversity.

CO3. Learn about the control measure of pollution and solid waste management and climate change and global warming.

CO4. Knowledge regarding welfare programmes and Human rights and understand the role of different agencies in the protection of environment

Master of Science (Mathematics) (FYIP)
Semester–III
Session-2026-27
Course Title: Environmental Studies
Course Code: VACE-3221

Time: 3 Hrs. **Max. Marks: 50**
Credit: 2-0-0 **Theory: 35**
CA: 15

Instructions for the Paper Setter:
Eight questions of equal marks (7 marks) are to be set, two in each out of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Unit I

1. **The multidisciplinary nature of environmental studies**
   - Definition, scope and importance, Need for public awareness

2. **Natural resources and associated problems.**

   (a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction,mining, dams and their effects on forests and tribal people.

   (b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflictsover water, dams-benefits and problems.

   (c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineralresources, case studies.

   (d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

   (e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use ofalternate energy sources, case studies.

   (f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion anddesertification.

   - Role of an individual in conservation of natural resources.
   - Equitable use of resources for sustainable lifestyles.

Unit II

3. Ecosystems

- Concept of an ecosystem
- Structure and function of an ecosystem
- Producers, consumers and decomposers
- Energy flow in the ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries)

4. Biodiversity and its conservation

- Introduction – Definition: genetic, species and ecosystem diversity
- Biogeographical classification of India
- Value of biodiversity: consumptive use, productive use, social, ethical aesthetic and optionvalues
- Biodiversity at global, national and local levels
- India as a mega-diversity nation
- Hot-spots of biodiversity
- Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts
- Endangered and endemic species of India
- Conservation of biodiversity: *In-situ* and *Ex-situ* conservation of biodiversity

Unit III

5. Environmental Pollution

- Definition, causes, effects and control measures of Air pollution, Water pollution, Soil pollution , Marine pollution, Noise pollution, Thermal pollution, Nuclear pollution
- Solid waste management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution
- Pollution case studies
- Disaster management: floods, earthquake, cyclone and landslides

6. Social Issues and the Environment

- From unsustainable to sustainable development
- Urban problems and related to energy
- Water conservation, rain water harvesting, watershed management

- Resettlement and rehabilitation of people; its problems and concerns. Case studies.
- Environmental ethics: Issues and possible solutions
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents andholocaust. Case studies.
- Wasteland reclamation
- Consumerism and waste products
- Public awareness

Unit IV

7. Human Population and the Environment

- Population growth, variation among nations
- Population explosion – Family Welfare Programmes
- Environment and human health
- Human Rights
- Value Education
- HIV / AIDS
- Women and Child Welfare
- Role of Artificial Intelligence in Environment and Human Health

8. Introduction to Environmental Laws, Environmental Audit and Impact Assessment

- Constitutional provisions- Article 48A
- Article 51A(g) and other derived environmental rights
- Environmental Protection Act, 1986
- Air (Prevention and Control of Pollution) Act, 1981
- Water (Prevention and control of Pollution) Act, 1974
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation
- Environmental risk assessment Pollution control and management
- Waste Management- Concept of 3R (Reduce, Recycle and Reuse)
- Ecolabeling /Ecomark scheme

References:

1. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.

2. Down to Earth, Centre for Science and Environment, New Delhi.
3. Heywood, V.H. & Waston, R.T. 1995. Global Biodiversity Assessment, Cambridge House, Delhi.
4. Joseph, K. & Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
5. Kaushik, A. & Kaushik, C.P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
6. Rajagopalan, R. 2011. Environmental Studies from Crisis to Cure. Oxford University Press, New Delhi.
7. Sharma, J. P., Sharma. N.K. & Yadav, N.S. 2005. Comprehensive Environmental Studies, Laxmi Publications, New Delhi.
8. Sharma, P. D. 2009. Ecology and Environment, Rastogi Publications, Meerut.
9. State of India's Environment 2018 by Centre for Sciences and Environment, New Delhi
10. Subramanian, V. 2002. A Text Book in Environmental Sciences, Narosa Publishing House, New Delhi.

SEMESTER-IV

Master of Science (Mathematics) (FYIP)
Semester–IV
Session-2026-27
Course Title: Number Theory
Course Code: FMAL-4331

Course Outcomes

Successful completion of this course will enable the students to:

CO 1: Understand congruences and solve system of linear congruences.

CO 2: Understand concepts and applications of Number theoretic functions.

CO 3: Understand the existence of primitive roots for all integers

CO 4: Identify representation for an integer as sum of squares

Master of Science (Mathematics) (FYIP)
Semester–IV
Session-2026-27
Course Title: Number Theory
Course Code: FMAL-4331

Examination Time: 3 Hours | Max. Marks: 100
Theory: 70
CA:30

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Instructions for Paper Setters:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Basic properties of congruences, linear congruences and its properties, simultaneous linear congruences, Chinese Remainder Theorem , Fermat's Little theorem, Wilson's theorem and its applications.

Unit II

Number theoretic functions, number of divisors and sum of divisors of a natural number, multiplicative functions, the Mobius function, the Mobius Inversion formula, Euler's phi-function and its properties, Euler's theorem.

Unit III

Order of an integer modulo n, primitive roots for primes, Composite numbers having primitive roots, Theory of Indicies and its properties, Table of Indices, Quadratic residues modulo primes, Euler's criterion.

Unit IV

The Legendre symbol and its properties, Gauss Lemma, Quadratic reciprocity law, Jacobi Symbol, and its properties, Pythagorean triplet, the Diophantine equations: $x^2 + y^2 = z^2, x^4 + y^4 = z^2, x^4 + y^4 = z^4$.

Text Books:

1. Burton, D.M., Elementary NumberTheory, 6th Ed.,TataMcGraw-Hill, Indianreprint,2007.
2. Niven, I., Zuckerman, H.S. and Montgomery, H.L., An introduction to the theory of numbers, 5th edition, oxford university press, oxford, 1991.

Master of Science (Mathematics) (FYIP)
Semester–IV
Session-2026-27
Course Title: Numerical Analysis
Course Code: FMAL-4332

After passing this course, the students will be able to:

CO 1. Know how to find the roots of transcendental and polynomial equations.

CO 2. Perform computation for solving a system of equations.

CO 3. Learn how to interpolate the given set of values.

CO 4. Learn numerical solution of differential equations & compute numerical integration and differentiation, numerical solution of ordinary differential equations.

Master of Science (Mathematics) (FYIP)
Semester–IV
Session-2026-27
Course Title: Numerical Analysis
Course Code: FMAL-4332

Examination Time: 3 Hours | Max. Marks: 100
Theory: 70
CA:30

L T P
4 0 0

Instructions for Paper Setters:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Errors: Relative, absolute, round off, truncation, Transcendental and polynomial Equations: Bisection Method, R e g u l a - F a l s i M e t h o d , Secant Method, Newton's Method, Rate of convergence of these methods, Newton's method for multiple roots.

Unit II

System of linear algebraic equations: Gaussian Elimination, Gauss Jordan, LU decomposition method , Jacobi method, Gauss-Seidel Method.

Unit III

Interpolation: Finite Difference Operators, Newton Forward and backward difference interpolation, La-grange's Method, Newton's Divided Difference Formula.

Unit IV

Numerical Integration: Trapezoidal Rule, Simpson's 1/3 rd Rule, Simpson's 3/8 th Rule, Ordinary differential Equations: Picard's Method, Taylor's series method, Euler's Method, modified Euler's method, Runge-Kutta Methods of all orders.

Text Book:

Jain, M.K., Iyengar, SRK and Jain, R. K., Numerical methods for Scientific and Engineering Computation, New age International, 2007.

Reference Books:

1. Sastry, S. S., Introductory Methods of Numerical Analysis, Prentice Hall of India, 2012.
2. Bradie, B., A friendly introduction to Numerical Analysis, Pearson Education, 2007.

Master of Science (Mathematics) (FYIP)
Semester-IV
Session: 2026-27
Course Title: Quantitative Aptitude for Banking
Course Code: FMAL-4333

Course Outcomes:
After passing this course , the students will able to :

CO1 : Understand and solve the problems based on number system, algebraic expression and arithmetic operations with speed and accuracy

CO2: Apply arithmetic principles to practical business and daily life problems involving percentages, ratios and equation.

CO3: Analyze and compute time-based problems and financial calculations involving interest and mixture concepts.

CO4: Solve logical and data interpretation problems and develop skills in handling quantitative reasoning questions.

Master of Science Mathematics (FYIP)
Semester-IV
Session: 2026-27
Course Title: Quantitative Aptitude for Banking
Course Code: FMAL-4333

Examination Time: 3 Hours | Maximum Marks: 100
L T P | Theory: 70
4 0 0 | CA: 30

Instruction for the Paper Setters:
Eighth questions of equal marks (14 marks each) are to be set, two in each of the four sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding fours). Candidates are required to attempt five questions, selecting at least one questions from each sections. The fifth question may be attempted from any sections.

Unit – I

Number system, H.C.F and L.C.M of Numbers , Decimal fractions, Simplification, squares and Cube roots , Average , Problem on numbers, Problem on ages, Surds and Indices, Logarithms

Unit-II

Percentage, Profit and loss , Ratio and proportion, Partnership , Chain Rule, Pipes and Cisterns Quadratic Equation, , Height and Distance

Unit-III

Time and work, Time and Distances, Boats and Streams, Problem on Trains, Alligation or Mixtures, Simple interest , Compound Interest , Stock and Share

Unit-IV

Calendar Problem, Clock problem, True Discount, Banker's Discount, Data interpretation.

Text Book:
R.S Aggarwal, Quantitative Aptitude for Competitive Examination, S.Chand Co. Pvt. Ltd, New Delhi, Eighth Edition, 2017

Reference Books:

1. Arun Sharma , How to prepare for Quantitative aptitude for CAT McGraw Hill Education, 10th edition (2023).
2. Sarvesh K. Verma, Quantitative Aptitude Quantum CAT , Arihant Publications,latest edition 2024.
3. Course in Mental Abilities and Quantitative Aptitude for Competitive Examinations by Edgar Thorpe, Tata McGraw Hill Pub. Co. Ltd. New Delhi.

Master of Science (Mathematics) (FYIP)
Semester–IV
Session-2026-27
Course Title: Statistical Computing Using R Programming
Course Code: FMAM-4134

Course Outcomes:

After passing this course the student will be able to:

CO1: Comprehend basics of Statistical Computing and managing data structures like vector, matrix, etc.

CO2: Create, operate and manage lists and data frames.

CO3: Apply control and I/O statements for generating outputs.

CO4: Simulate various descriptive and analytical algorithms using R language along with their visualization.

Master of Science (Mathematics) (FYIP)
Semester–IV
Session-2026-27
Course Title: Statistical Computing Using R Programming
Course Code: FMAM-4134

Examination Time (3+3) Hours

Max. Marks: 100
Theory: 40
Practical: 30
CA:30

L T P
3 0 1

Instructions for Paper Setters:

Eight questions of equal marks (8 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Data Statistics: Sampling, Cumulative statistics, Statistics for Data frames, matrix objects and lists.

Introduction to R, Help functions in R, Vectors, Common Vector Operations, Using all and any function, subletting of vector. Creating matrices, Matrix operations, Applying Functions to Matrix Rows and Columns, Adding and deleting rows and columns, lists, Creating lists, general list operations, Accessing list components and values, applying functions to lists, recursive lists

Unit II

Creating Data Frames – Matrix-like operations in frames , Merging Data Frames, Applying functions to Data frames, Factors and Tables , factors and levels , Common functions used with factors , string operations

Unit III

Input/ Ouput: scan() , readline() Function, Printing to the Screen Reading and writing CSV and text file. Control statements: Loops, Looping Over Nonvector, Sets, if-else , writing user defined function, scope of the variable, R script file

Unit IV

Graphics in R: Graph Syntax ((title, xlabel, ylabel, pch, lty, col.), Simple graphics (Bar, Multiple Bar, Histogram, Pie, Box-Plot, Scatter plot, qqplot), Low-level and High-Level plot functions, par() command to generate multiple plots.

Note: Practical: Based on simple mathematical problems and based on syllabus of Statistical Methods for descriptive Statistics.

References Books:

1. Andrie de Vries and Joris Meys, R Programming for Dummies, Wiley (2016), 2nd Edition.
2. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education (2017), 1st Edition.
3. Sandip Rakhsit, Statistics with R Programming, McGraw Hill Education (2018), 1st Edition.
4. Garrett Grolemund, Hands on Programming with R, O'Reilly (2014), 1st Edition
5. Mark Gardener, Beginning R: The Statistical Programming Language, Wiley (2013)
6. Tilman M. Davies, The Book of R: A first Course in Programming and Statistics, No Strach Press (2016), 1st Edition

Master of Science (Mathematics)(FYIP)
Semester–IV
Session-2026-27
Course Title: Numerical Analysis Laboratory
Course Code: FMAP-4335
Course Outcomes:

CO1: Apply basic programming constructs to perform mathematical computations, such as calculating harmonic sums and finding absolute values.

CO2:Solve nonlinear equations using numerical techniques like the Bisection Method, Newton-Raphson Method, Secant Method, and Regula Falsi Method.

CO3:Analyze and solve systems of linear equations using direct and iterative methods, including LU Decomposition, Jacobi, and Gauss-Seidel Methods.

CO4:Use interpolation and numerical integration/differentiation techniques to approximate solutions, including Lagrange/Newton interpolation, Simpson's rules, Euler's method, and Runge-Kutta methods.

Master of Science (Mathematics)(FYIP)
Semester–IV
Session-2026-27
Course Title: Numerical Analysis Laboratory
Course Code: FMAP-4335

Examination Time: 3 Hours | Max. Marks: 50
Practical: 35
CA:15

L T P
0 0 2

Practical (Using any Software)

List of Practical's (using any software)

1. Calculate the sum1/1+1/2+1/3+1/4+ ---------- +1/N.
2. To find the absolute value of an integer.
3. Bisection Method.
4. Newton Raphson Method.
5. Secant Method.
6. Regula Falsi Method.
7. LU decomposition Method.
8. Jacobi Method.
9. Gauss Seidel Method.
10. Lagrange Interpolation or Newton Interpolation.
11. Simpson's rules.
12. Euler's Method
13. Runge-Kutta Method

Text Book:

Jain, M.K., Iyengar, S. R. K., and Jain, R.K., Numerical Methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher,India,2007.

Reference Books:

1. Jain, C., Advanced Programming in SCILAB, Alpha Science International, Oxford, UK, 2020.
2. Campbell, S.L., Chanceller, J.P., Nikoukhah, R. Modeling and Simulation in Scilab/Scios,Springer, 2006.
3. Bradie, B., A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
4. Gerald, C. F. and Wheatley, P. O., Applied Numerical Analysis, Pearson Education, India, 2008.
5. Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI LearningPrivate Limited, 2013.

Master of Science (Mathematics) (FYIP)
Semester–IV
Session-2026-27
Course Title: Statistical Methods
Course Code: FMAM-4330

Course Outcomes

CO1: Explain the scope, applications, and limitations of statistics, and distinguish between population and sample. To Compute and interpret measures of central tendency, dispersion, skewness, and kurtosis, including the use of box-and-whisker plots.

CO2: Analyze relationships between two attributes using 2×2 tables to assess consistency, independence, and association and Apply the principles of least squares to perform simple linear regression and fit polynomial and exponential curves; interpret residual plots.

CO3: Convert fixed base index numbers to chain base and vice versa, and evaluate errors in index numbers using appropriate tests. To Construct various types of index numbers (Laspeyre's, Paasche's, Edgeworth-Marshall, Fisher's Ideal) and understand the concepts of weighted and unweighted index numbers.

CO4**:** Decompose time series data into components and determine trends using graphical, mathematical, and moving average methods. Measure seasonal variations using ratio-to-moving-average and ratio-to-trend methods.

Master of Science (Mathematics) (FYIP)
Semester–IV
Session-2026-27
Course Title: Statistical Methods
Course Code: FMAM-4330

Examination Time: (3+3) Hours

Max. Marks: 100
Practical-30
Theory: 40
CA: 30

L T P
3 0 1

Instructions for Paper Setters:

Eight questions of equal marks (8 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Descriptive Statistics: Definition and scope of Statistics, limitations of statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio. Collection and tabulation of data. Diagrammatic representation of frequency distribution: histogram, frequency polygon, frequency curve, ogives, stem and leaf plot, pie chart. Measures of central tendency, dispersion, box and whisker plot, skewness and kurtosis.

Unit II

Data on two attributes, consistency, independence, and association of attributes in 2x2 tables. Linear regression: Simple linear regression, principle of least squares and fitting of polynomials and exponential curves, residual plots. Correlation: scatter diagram, Karl Pearson's and rank correlation, Partial and multiple correlation (3 variables only)

Unit III

Index Numbers: Definition, construction of index numbers and problems, weighed and unweighted index numbers including Laspeyre's, Paasche's, Edgeworth- Marshall and Fisher's Ideal Index numbers. . Chain index numbers, conversion of fixed based to chain based index numbers and vice-versa. Errors in Index numbers and tests to measure errors in index numbers. Cost of living index numbers. Uses and limitations of index numbers.

Unit IV

Time Series: Introduction and components of time series. Trend determination: by graphical methods, mathematical curve fitting and by moving average methods. Measurement of seasonal variations: ratio to moving average method, ratio to trend method. Auto regression series: first and second order auto-regression. Introduction to auto correlation and Correlogram.

Note: Practical: Based on syllabus of Statistical Methods for descriptive Statistics, Linear Regression, Index number and time series.

Text Books:

1. Goon A.M., Gupta M.K. and Dasgupta B., Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata, 2002.

2. Gupta, S. C. and Kapoor, V.K., Fundamentals of Mathematical Statistics, 4th Edition (Reprint), Sultan Chand & Sons, 2008.

Reference Book:

Gupta, S. C. and Kapoor, V.K., Fundamentals of Applied Statistics, Sultan Chand & Sons, 2008.

SEMESTER-V

Master of Science (Mathematics) (FYIP)
Semester–V
Session-2026-27
Course Title: Group Theory-I
Course Code: FMAL-5331
Course Outcomes

After passing this course, the students will be able to:

CO1: Students will be able to explain the concept of groups through symmetries, identify and verify subgroups using subgroup tests, and analyze structural properties such as centralizer, normalizer, center, and products of subgroups.

CO2: Students will be able to describe cyclic groups and their properties, classify their subgroups, and analyze permutations using cycle notation, including identifying even and odd permutations and understanding alternating groups.

CO3: Students will be able to apply coset decomposition and Lagrange's theorem to finite groups, determine normal subgroups and construct factor groups, and use results like Fermat's Little Theorem and Cauchy's theorem in problem solving.

CO4: Students will be able to analyze and apply group homomorphisms and isomorphisms, understand Cayley's theorem, and use isomorphism theorems and automorphisms to study group structures.

Master of Science (Mathematics) (FYIP)
Semester–V
Session-2026-27
Course Title: Group Theory-I
Course Code: FMAL-5331

Examination Time: 3 Hours | Max. Marks: 100

L	T	P	Theory: 70
4	1	0	CA:30

Instructions for Paper Setters:
Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), Elementary properties of groups. Subgroups and examples of subgroups, Subgroup tests, centralizer, normalizer, Center of a group, product of two subgroups.

Unit II

Cyclic groups, Properties of cyclic groups, classifications of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group.

Unit III

Cosets, Properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem, External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem finite groups.

Unit IV

Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms acting on elements and groups, Isomorphism theorems, Automorphism.

Text Book:
Gallian, A.J., Contemporary Abstract Algebra, 8th Ed., Cengage Learning, 2012.

Reference Books:
1. Fraleigh, J.B., A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. Artin, M., Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Sahai, V. and Bist, V: Algebra, 4th edition, 2018

Master of Science (Mathematics) (FYIP)
Semester–V
Session-2026-27
Course Title: PDE's and System of ODE's
Course Code: FMAL-5332
Course Outcomes

After passing this course, the students will be able to:

CO1: Students will be able to analyze curves and surfaces in three dimensions and solve first-order simultaneous differential equations and Pfaffian differential equations in three variables.

CO2: Students will be able to formulate and solve first-order partial differential equations using various methods.

CO3: Students will be able to apply advanced techniques such as method of characteristics, Charpit's method, and Jacobi's method to solve nonlinear first-order PDEs and classify second-order PDEs

CO4: Students will be able to solve systems of linear differential equations using operator methods and analyze homogeneous linear systems with constant coefficients.

Master of Science (Mathematics) (FYIP)
Semester–V
Session-2026-27
Course Title: PDE's and System of ODE's
Course Code: FMAL-5332

Examination Time: 3 Hours | Max. Marks: 100
L T P | Theory: 70
4 1 0 | CA:30

Instructions for Paper Setters:
Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

ODEs in 3 Variables:- Surfaces and curves in three dimensions, Simultaneous differential equations of first order and the first degree in three variables, Methods of solutions of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$. Orthogonal trajectories of a system of curves on a surface. Pfaffian differential forms and equations, Solution of Pfaffian differential equations in three variables.

Unit II

PDEs of the 1st order-Partial differential equations, Origins of first order partial differential equations, Cauchy's problem for first order equations, linear equation of first order, Integral surface passing through a given curve, Surfaces orthogonal to a given system of surfaces, Linea PDEs with constant coefficients.

Unit III

Non-linear partial differential equation of the first order, Cauchy method of characteristics, Compatible system of first order equations, Charpit's method, Special types of first order equations, Solutions satisfying given conditions, Jacobi's method, classification of 2nd order PDEs.

Unit IV

Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions.

Text Books:
1. Sneddon, I.N., Elements of Partial differential equations, Dover Publications, Inc. Newyork, 2006.
2. Ross, S.L., Differential equations, 3rd Ed., John Wiley and Sons, India, 2004.

Reference Books:
1. TynMyint, U., and Debnath, L., Linear Partial Differential Equations for Scientists and Engineers, 4th edition, Springer, Indian reprint, 2006.
2. Abell, L.M., Braselton, J.P., Differential equations with MATHEMATICA, 3rd Ed., Elsevier Aca demic Press, 2004.
3. Boyce, W.E., and Diprima, R.C., Elementary Differential Equations and boundary value problems, John Wiley and Sons Inc., New York.

Master of Science (Mathematics) (FYIP)
Semester–V
Session-2026-27
Course Title: Machine Learning
Course Code: FMAL-5133

Course Outcomes:

After passing course the student will be able to:

CO1: Apply the complete Machine Learning workflow to real-world datasets by performing data collection, pre-processing, feature engineering, model training, model refinement, hyper parameter tuning, and deployment preparation.

CO2: Analyse regression models by evaluating SSE, identifying overfitting and under fitting, and applying polynomial regression, learning curves, and regularization techniques to improve model performance.

CO3: Understand the concepts of Unsupervised Learning and implement various Clustering Algorithms for data analysis and pattern discovery.

CO4: Comprehends the working of the Q-learning algorithm and apply it to learn optimal policies in unknown environments.

Master of Science (Mathematics) (FYIP)
Semester–V
Session-2026-27
Course Title: Machine Learning
Course Code: FMAL-5133

Examination Time: 3 Hours | Max. Marks: 100
L T P | Theory: 70
4 0 0 | CA:30

Instructions for Paper Setters:
Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Introduction: The Machine learning landscape: What is Machine Learning (ML), Why Machine Learning, Type of ML Systems, Main challenges of machine learning, Confusion Matrix, testing and validating. Applications of Machine Learning Applying Machine Learning to a project- Step through the machine learning workflow using an example. Working with real data, get data and prepare for machine learningby pre- processing data, deriving features, and training and refining models, fine tune the model, ready the solution for production. Probability and classification, Bayes optimal decisions, Naive Bayes and Gaussian class- conditional distribution.

Unit II

Linear regression; SSE; gradient descent; normal equations; features, Overfitting and underfitting. Classification problems; decision boundaries; nearest neighbour methods Supervised Learning: Linear classifiers, Bayes' Rule and Naive Bayes Model, Training a binary classifier, performance measures, multiclass classification, error analysis, multilabel classification, multioutput classification. Training Models: gradient descent, Polynomial regression, learning curves, regularized linear models, Logistic regression, Linear SVM classification, Non-linear SVM classification, SVM regression.

Unit III

Decision tree, Ensemble methods: Bagging, random forests, boosting, practical examples; the curse of dimensionality, dimensionality reduction, principal components analysis Unsupervised learning: clustering and clustering algorithms; Using clustering for image segmentation, for pre-processing, semi-supervised learning, DBSCAN; Gaussian Mixtures– anomaly detection, selecting number of clusters, Bayesian Gaussian mixture models, novelty detections algorithms.

Unit IV

Reinforcement learning and adaptive models, the model-based reinforcement learning paradigm, Explore Q-learning and SARSA.

Reference Books:
1. Alpaydin, E., Introduction to Machine Learning, Second Edition.
2. Geron,A., Hands on Machine Learning with Scikit Learn, Keras& Tensor Flow, O'Reilly
3. Marsland, S., Machine Learning: An Algorithmic Perspective
4. Bishop, C.M., Pattern Recognition and Machine Learning
5. Mitchell, T., Machine Learning 6. Raschka, S., Python Machine Learning, PACKT Publishing

Master of Science (Mathematics) (FYIP)
Semester–V
Session-2026-27
Course Title: Sawai Jai Singh and his Astronomy
Course Code: FMAM-5334
Course Outcomes

After passing this course, the students will be able to:

CO1: Explain the historical contributions of Sawai Jai Singh, the development of Indian observatories, and the classification of masonry astronomical instruments based on their precision.

CO2: Analyze the design, construction, working principles, and precision of Samrāt Yantra and Ṣaṣṭhāṁśa Yantra for astronomical observations and time measurement.

CO3: Describe the structure, operation, and astronomical applications of Dakṣiṇottara Bhitti Yantra, Nāḍīvalaya Yantra, Digaṁśa Yantra, Krāntivṛtta Yantra, Dhruvadarśaka Paṭṭikā, and Chakra Yantra.

CO4: Evaluate the coordinate systems, design, construction, and observational significance of Kapāla Yantras, Jaya Prakāśa Yantra, and Rāma Yantra.

Master of Science (Mathematics) (FYIP)
Semester–V
Session-2026-27
Course Title: Sawai Jai Singh and his Astronomy
Course Code: FMAM-5334

Examination Time: (3+3) Hours | Max. Marks: 100
Theory: 40
L T P | Practical: 30
3 0 1 | CA: 30

Instructions for Paper Setters:
Eight questions of equal marks (8 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Sawai Jai Singh and his Times: The rulers of Amber, Education, Jai Singh The Ruler, Time measuring instruments, co-ordinate measuring devices, observatories in India.

Masonry Instruments-I: Sawai Jai Singh's low precision masonry instruments, Swai Jai Singh's medium precision masonry instruments, Sawai Jai Singh's high precision masonry instruments, instrument added after Sawai Jai Singh.

Unit II

SAMRĀṬ YANTRA: Design, Construction and Precision. The Gnomon and the polar axis, The quadrant plane and the equatorial plane, declination of the sun. ṢAṢṬHĀṀŠA YANTRA: History, deviation from median plane, the pin hole, diffraction broadening, precision of the Jaipur and Delhi Ṣaṣṭhāṁšas.

Unit III

DAKṢINOTTARA BHITTI YANTRA, NĀḌĪVALAYA YANTRA, DIGAṀŠA YANTRA, KRĀNTIVṚTTA YANTRA, DHRUVADARŠAKA PAṬṬIKĀ, CHAKRA YANTRA: Design, Construction and Precision.

Unit-IV

Masonry Instruments-II: KAPĀLA YANTRAS and JAYA PRAKĀŠA YANTRA: Coordinate systems, principle, ascendants and signs on the meridian, the complementary halves of jaya prakāša yantra. RĀMA YANTRA: History, Design, Construction and Precision

Text Book:
Sawai Jai Singh And His Astronomy: Virendra Nath Sharma, Motilal Banarsidass Publishers.

Reference Books:
1. The Astronomical Observatories of Jai Singh by G.R. KAYE, Gyan Publishing House, 2021.
2. Sawai Jai Singh and His Observatories by V.N. Sharma by Publication Scheme.
3. The Astronomical Endeavours of Sawai Jai Singh,by Rachana Sankhalker, Astronomical Society of India (ASI), Karnataka
4. Understanding JANTAR MANTAR Observatories of Jai Singh, Ankur Hobby Centre Ahmedabad.

Note: Practical: The practical syllabus comprises hands-on activities related to the models of astronomical instruments of the Jantar Mantar included in the theory syllabus.

Master of Science (Mathematics) (FYIP)
Semester–V
Session-2026-27
Course Title: PDE's and System of ODE's Laboratory
Course Code: FMAP-5335
Course Outcomes

After passing this course, the students will be able to:

CO1**:** Students will be able to solve first-order partial differential equations, including the Cauchy problem, and determine and plot their characteristic curves.

CO2**:** Students will be able to visualize integral surfaces of first-order partial differential equations corresponding to prescribed initial conditions.

CO3**:** Students will be able to analyze and solve **Pfaffian differential equations in three variables**, including testing integrability conditions and determining potential functions.

CO4**:** Students will be able to solve systems of ordinary differential equations and interpret their solutions in applied mathematical problems.

Master of Science (Mathematics) (FYIP)
Semester–V
Session-2026-27
Course Title: PDE's and System of ODE's Laboratory
Course Code: FMAP-5335

Examination Time: 3 Hours | Max. Marks: 50
Practical: 35
CA:15

L T P
0 0 2

Practical (Using any Software)

(i) Solution of Cauchy problem for first order PDE.
(ii) Finding and plotting the characteristics for the first order PDE.
(iii) Plot the integral surfaces of a given first order PDE with initial data.
(iv) Solution of Nonlinear First Order PDE using Charpit's Method.
(v) Solution of Pfaffian Differential Equations in Three Variables.
(vi) Solving system of ODEs.

Text Books:

1. Sneddon, I.N., Elements of Partial differential equations, Dover Publications, Inc. Newyork, 2006.
2. Ross, S.L., Differential equations, 3rd Ed., John Wiley and Sons, India, 2004.
3. Jain, C., Advanced Programming in SCILAB, Alpha Science International, Oxford, UK, 2020

Reference Books:

1. TynMyint, U., and Debnath, L., Linear Partial Differential Equations for Scientists and Engi neers, 4th edition, Springer, Indian reprint, 2006.
2. Boyce, W.E., and Diprima, R.C., Elementary Differential Equations and boundary value problems, John Wiley and Sons Inc., New York.
3. Campbell, S.L., Chanceller, J.P., Nikoukhah, R. Modeling and Simulation in Scilab/Scios, Springer, 2006.

Master of Science (Mathematics) (FYIP)
Semester–V
Session-2026-27
Course Title: Internship
Course Code: FMAI-5336

Students shall undertake Community Engagement and Service/ field based learning through an internship of four weeks during the fifth semester after completion of classes or during the summer vacation at the end of the fourth semester.

The internship shall be carried out in one of the areas related to the courses of study. Students participating in NCC or NSS activities may submit a certificate of participation for a minimum duration of four weeks in lieu of the internship.

Every student shall submit an internship report in the prescribed format along with the original internship completion certificate and permission letter issued by the college to carry out the internship/ community outreach.

The viva voce examination shall be conducted on the basis of the final internship report submitted and the presentation by the student.

Master of Science (Mathematics)(FYIP)
Semester–V
Session-2026-27
Course Title: Technical Writing and Latex
Course Code: FMAM- 5330
Course Outcomes

After passing this course, the students will be able to:

CO1: Students will be able to install and use Latex to create basic documents, including writing mathematical symbols, managing spacing, and formatting text structure.

CO2: Students will be able to design structured documents using title pages, sections, headers/footers, and generate tables of contents with proper labeling and referencing.

CO3: Students will be able to format documents using font styles, colors, lists, and insert tables and figures effectively in Latex.

CO4: Students will be able to typeset mathematical equations and symbols and manage bibliographies and citations in Latex documents.

Master of Science (Mathematics)(FYIP)
Semester–V
Session-2026-27
Course Title: Technical Writing and Latex
Course Code: FMAM- 5330

Examination Time: (3+3) Hours

Max. Marks: 100
Practical: 30
Theory: 40
CA: 30

L T P
3 0 1

Instructions for the Paper Setters: Eight questions of equal marks (8 Marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Unit I

Installation of the software Latex, Introduction to Latex, mathematical symbols, commands for writing mathematical symbols, spacing, Line breaking and page breaking, practical work on these topics.

Unit II

Title pages, Header and Footer, Text formatting, Essentials, troubleshooting, creating a title, sections, labelling, table of contents, practical work on these topics.

Unit III

Font effects, coloured text, font sizes, lists, comments and spacing, special characters, Practical for inserting tables and figures, practical work on these topics.

Unit IV

Inserting equations, mathematical symbols, inserting a bibliography, citing references, practical work on these topics.

Text Book:

Kopka, H., Daly, P.W., Guide to Latex, Addison-Wesley Professional, 4th Edition, 2003.

List of Practicals using Latex

1. Introduction to Latex, preparing and running a .tex file.

2. Inserting tables and figures.

3. Inserting line breaks, Foote notes.

4. Font Effects, Font sizes.

5. Write A Paragraph Containing Different colored text.

6. Use of special symbols like %, &,#,€,$ etc.

7. Mathematical symbols.

8. Write a mathematical text containing equations with equation numbers and unnumbered equations, and system of equations, arrays, matrices.

9. Preparing a bibliography using BibTeX

SEMESTER-VI

Master of Science (Mathematics) (FYIP)
Semester–VI
Session: 2026-27
Course Title: Group Theory-II
Course Code: FMAL-6331
Course Outcomes

After passing this course, the students will be able to:

CO1: Students will be able to analyze group actions, compute orbits and stabilizers, and apply results such as the Orbit-Stabilizer Theorem and Jordan–Holder Theorem to study group structure.

CO2: Students will be able to apply class equations, Sylow's theorems, and conjugacy concepts to investigate properties of finite groups, including simplicity and solvability.

CO3: Students will be able to study automorphisms, characteristic and commutator subgroups, and use derived series to determine structural properties like solvability of groups.

CO4: Students will be able to analyze and decompose groups using direct products and semidirect products, and apply the Fundamental Theorem of Finite Abelian Groups.

Master of Science (Mathematics) (FYIP)
Semester–VI
Session: 2026-27
Course Title: Group Theory-II
Course Code: FMAL-6331

Examination Time: 3 Hours | Max. Marks: 100
L T P | Theory: 70
4 1 0 | CA: 30

Instructions for the Paper Setters:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Group actions, stabilizers and kernels, orbit stabilizer theorem, permutation representation associat ed with a given group action, Applications of group actions: Generalized Cayley's theorem, Index theo rem, Simple Groups, Jordan Holder Theorem.

Unit II

Groups acting on themselves by conjugation, class equation and consequences, conjugacy in Sn, p groups, Sylow's theorems and consequences, Cauchy's theorem, Simplicity of An for $n \geq 5$, non-simplicity tests, Solvable Groups.

Unit III

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, Automorphisms of Sn($n \geq 3$) , applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties, derived series & solvability of groups.

Unit IV

Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental Theorem of finite abelian groups, Semidirect product and recognition theorems.

Text Books:

1. Dummit, D.S. and Foote, R.M., Abstract-Algebra, 3rd Edition, Wiley India, 2004.
2. Gallian, J.A., Contemporary Abstract Algebra, 8th Edition, Cengage Learning, 2012.

Reference Books:

1. Fraleigh, J.B., A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. Artin, M., Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Rotman, J.J., An Introduction to the Theory of Groups, 4th Ed., Springer Verlag, 1995.
4. Herstein, I.N., Topics in Algebra, Wiley Eastern Limited, India, 1975

Master of Science (Mathematics) (FYIP)
Semester–VI
Session: 2026-27
Course Title: Riemann Integration and Series of Function
Course Code: FMAL-6332
Course Outcomes

After passing this course, the students will be able to:

CO1: Students will be able to define and evaluate Riemann integrals using partitions and Riemann sums, and verify integrability using Riemann conditions and properties.

CO2: Students will be able to apply the Fundamental Theorems of Integral Calculus to solve problems and utilize the first and second mean value theorems of integral calculus in practical applications.

CO3: Students will be able to analyze power series, double series and test the convergence of double series using appropriate methods.

CO4: Students will be able to apply the concept of Fourier Series to represent periodic functions and compute their series expansions for problem-solving.

Master of Science (Mathematics) (FYIP)
Semester–VI
Session: 2026-27
Course Title: Riemann Integration and Series of Function
Course Code: FMAL-6332

Examination Time: 3 Hours | Max. Marks: 100
L T P | Theory: 70
4 1 0 | CA: 30

Instructions for the Paper Setters:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Definition and Existence of the Riemann Integral, Partitions and Riemann (or Darboux) sums, Some properties of Darboux Sums, Upper and lower Riemann integrals, Refinement of partitions, Darboux's Theorem, Necessary and sufficient conditions for integrability.

Unit II

Particular classes of Integrable functions, Properties of integrable functions, Integrability of the sum, difference, product, quotient and modulus, The Fundamental theorem of integral calculus, First and Second mean value theorems of integral calculus.

Unit III

Power Series, Radius of Convergence and Interval of Convergence, Cauchy Hadmard theorem, Abel's theorem, Double Sequence, Double Series, Convergence of double series.

Unit IV

Periodic functions, trigonometric series, Fourier series expansion, Fourier series for even and odd functions, half range series.

Text Books:

1. Ross, K.A., Elementary analysis, The Theory of calculus, Undergraduate Texts.
2. Malik, S.C., and Arora, S., Mathematical Analysis.

Reference Books:

1. Rudin, W., Principles of mathematical Analysis.
2. Narayan, S., A course of Mathematical Analysis.

Master of Science (Mathematics) (FYIP)
Semester–VI
Session: 2026-27
Course Title: Multivariate Calculus
Course Code: FMAL-6333
Course Outcomes

After passing this course, the students will be able to:

CO1: Students will be able to analyze functions of several variables, evaluate limits and continuity, and apply partial differentiation and Taylor's theorem to study differentiability and homogeneous functions.

CO2: Students will be able to compute double and triple integrals over various regions, apply change of variables, and use these integrals to determine area, volume, surface area, and center of mass.

CO3: Students will be able to analyze vector fields by computing gradient, divergence, and curl, and apply line and volume integrals to solve problems involving work, mass, and circulation.

CO4: Students will be able to apply major integral theorems such as Green's theorem, Stokes' theorem, and the Divergence theorem to evaluate integrals and solve physical problems.

Master of Science (Mathematics) (FYIP)
Semester–VI
Session: 2026-27
Course Title: Multivariate Calculus
Course Code: FMAL-6333

Examination Time: 3 Hours | Max. Marks: 100
L T P | Theory: 70
4 1 0 | CA: 30

Instructions for the Paper Setters:

Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Functions of several variables, limit and continuity of functions of two variables Partial differentiation, Differentiability of real valued functions of two variables, Total differentiability, sufficient condition for differentiability, Schwarz's Theorem, Young's Theorem, Euler's Theorem on homogeneous functions of two variables, Euler's Theorem on homogeneous functions of three variables, Taylor's theorem for functions of two variables.

Unit II

Double integration over rectangular and non-rectangular region, Change of variables in double integrals, Triple integrals, Triple integral over a parallelepiped and solid regions, Change of variables in triple integrals, Area by use of double integrals, Volume by use of triple integration, Surface Area by use of double integrals, Centre of Gravity (or Centre of Mass) in R2, Centre of Mass in R^3

Unit III

Definition of vector field, divergence and curl, directional derivatives, Divergence of a vector point function, Solenoidal Vector, Irrotational Vector, Physical interpretation of Curl of a vector point function, Laplacian operator, Integration of Vectors, the gradient, Tangential Line integrals, Applications of line integrals: Mass and Work, conservative vector fields, Circulation, Volume Integral .

Unit IV

The Divergence theorem, Green's theorem in a plane, Stoke's theorem and problems based on these theorems.

Text Books:-

1. G.B. Thomas and R.L. Finney. Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley, and K. J. Smith. Calculus, 3rd Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
3. E. Marsden, A.J. Tromba, and A. Weinstein. Basic Multivariable Calculus, Springer (SIE), Indian reprint, 2005.
4. J. Stewart. Multivariable Calculus Concepts and Contexts, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001

Reference Books:-

1. S.R. Ghorpade & B.V. Limaye. A Course in Multivariable Calculus and Analysis, Springer, 2020.

2. M. Fitzpatrick. Advanced Calculus, American Mathematical Society, 2006.
3. T.M. Apostol. Calculus-II: An Indian Adaptation, Wiley India, 2023

Master of Science (Mathematics) (FYIP)
Semester–VI
Session: 2026-27
Course Title: Data and File Structures
Course Code: FMAL-6134

Course Outcomes:

After passing course the student will be able to:

CO1: Comprehends fundamental data structures such as arrays, records, and linked lists, perform basic operations on them, analyse algorithm complexity using Big O notation, and evaluate time–space trade-offs for efficient problem-solving.

CO2: Implement stacks, queues, and trees using arrays and linked lists, and utilize them to solve computational problems such as expression evaluation, sorting, parenthesis checking, operating system simulations, and efficient data organization using Binary Search Trees, AVL Trees, Threaded Binary Trees, B-Trees, and B+ Trees.

CO3: Apply greedy algorithms, heap data structures, and graph algorithms to solve optimization, sorting, priority queue, minimum spanning tree, shortest path, graph traversal, connectivity, and cycle detection problems efficiently.

CO4: Apply appropriate searching, sorting, hashing, and file organization techniques to design and analyze efficient data storage and retrieval solutions, and evaluate their performance using suitable algorithms and file management methods.

Master of Science (Mathematics) (FYIP)
Semester–VI
Session: 2026-27
Course Title: Data and File Structures
Course Code: FMAL-6134

Examination Time: 3 Hours | Max. Marks: 100
L T P | Theory: 70
4 0 0 | CA: 30

Instructions for the Paper Setters: Eight questions of equal marks (14 Marks each) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Unit I

Preliminaries: Various data structures, common operations on data structures, algorithm complexity, big O notation, time–space trade off between algorithms. Arrays: Arrays defined, representing arrays in memory, various operations on linear arrays, Multi dimensional arrays, Records. Linked Lists: Types of linked lists, representing linked lists in memory, advantage of using linked lists over arrays, various operation on linked lists

Unit II

Stacks: Description of stack structure, implementation of stack using arrays and linked lists. Applications of stacks– converting arithmetic expression from infix notation to polish and their subsequent evaluation, quicksort technique to sort an array, parenthesis checker. Queues: Description of queue structure, implementation of queue using arrays and linked lists, description of priorities queues. Applications of queues– Operating system simulations Trees: Description of tree structure and its terminology, binary search tree, implementing binary search tree using linked lists, various operations on binary search trees, AVL Trees, Threaded Binary Trees, B Trees, B+ trees.

Unit III

Greedy Method: Knapsack Problem, Prim's and Kuruskal's Algorithm to find MSTs. Heaps: Description of heap structure, implementing heaps using arrays, various operations on heaps, Applications of heaps– heapsort technique to sort an array, implementation of priority queues. Graphs: Description of graph structure, implementing graphs in memory using adjacency matrix or adjacency lists, various graphs traversing algorithms, finding shortest path between two nodes, Dijkastra’s shortest path algorithm., finding biconnected component, strongly connected component and finding cycles in the graphs.

Unit IV

Searching and Sorting: Sorting Types, External and Internal sort Linear Search, Binary search, Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Shell Sort, Quick sort, Radix Sort. Hash Tables: Direct address tables, hash tables, collision resolution by chaining, hash functions, open addressing– linear probing, quadratic probing, double hashing. Files: Operations on files, Types of files, File Organizations: Sequential files, Indexed Sequential file, Directed files and multi–key files, File performance criteria and terms.

Reference Books:

1. Lipschutz, S., Theory and Problems of Data Structures, Schaum Outline Series, McGraw–Hill Book Company. Third Edition

2. Esakov, J., Data Structures– An Advanced Approach Using C, Tom Weiss, Prentice– Hall International, Inc. 2007
3.Trembley and Sorenson: An Introduction to Data Structures with Application, Tata–McGraw Hill Company, Delhi. 2003
4.Tanenbaum: Data Structures and C. Second Edition

Master of Science (Mathematics) (FYIP)
Semester–VI
Session: 2026-27
Course Title: Multivariate Calculus Laboratory
Course Code: FMAP-6335
Course Outcomes
After passing this course, the students will be able to:

CO1: Students will be able to determine and visualize maxima and minima of functions of two variables and plot surfaces $z=f(x,y)$.

CO2: Students will be able to approximate areas and volumes using double integrals.

CO3: Students will be able to approximate triple integrals for evaluating volumes and related quantities.

CO4: Students will be able to represent and analyze vector fields in a plane graphically.

Master of Science (Mathematics) (FYIP)
Semester–VI
Session: 2026-27
Course Title: Multivariate Calculus Laboratory
Course Code: FMAP-6335

Examination Time: 3 Hours | Max. Marks: 50
Practical: 35
CA:15

L T P
0 0 2

List of Practicals (using any package)

1. Finding and visualizing extremes of function of two variables.

2. Approximating area and volume using double integration.

3. Plotting graph of the surface z=f (x, y).

4. Approximating triple Integrals.

5. Draw vector fields in plane.

Text Books:-

1. G.B. Thomas and R.L. Finney. Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley, and K. J. Smith. Calculus, 3rd Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
3. E. Marsden, A.J. Tromba, and A. Weinstein. Basic Multivariable Calculus, Springer (SIE), Indian reprint, 2005.
4. J. Stewart. Multivariable Calculus, Concepts and Contexts, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001.

SEMESTER-VII

Master of Science (Mathematics) (FYIP)
Semester–VII
Session-2026-27
Course Title: Algebra-I
Course Code: FMAL-7331
Course Outcomes

Upon completion of this course, students should be able to:

CO 1: Understand the importance of the algebraic properties with regard to working with various number systems, explain the significance of the notion of a normal subgroup, quotient group, and cyclic group.

CO 2: Know and recognize the concepts of homomorphism, isomorphism and automorphism and understand permutation group.

CO 3: Describe the structure of finite abelian group using Sylow's theorems.

CO 4: State the definitions Direct Products: External and Internal, its applications; Semi direct Products, Recognition Theorems on semi direct products.

Master of Science (Mathematics) (FYIP)
Semester–VII
Session-2026-27
Course Title: Algebra-I
Course Code: FMAL-7331

Examination Time: 3 Hours | Max. Marks: 100

L	T	P		Theory: 80
4	1	0		CA:20

Instructions for Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Groups: Definition & examples, Subgroups, Normal subgroups and Quotient Groups, Lagrange's Theorem, Generating sets, Cyclic Groups.

Unit II

The Commutator subgroups, Homomorphism, Isomorphism Theorems, Automorphisms, inner Automorphisms, Permutation groups, the alternating groups, Simplicity of A_n, $n \geq 5$, Cayley's theorem.

Unit III

Structure of finite Abelian groups. Conjugate elements, class equation with applications, Cauchy's Theorem, Sylow's Theorems and their simple applications, Composition Series, and Jordan Holder Theorem, Solvable Groups.

Unit IV

Direct Products: External and Internal. Fundamental theorem of finite Abelian groups and its applications; Semi direct Products, Recognition Theorems on semi direct products.

Text Book:
Fraleigh, J.B, An Introduction to Abstract Algebra, Pearson Education Publication Ltd., 2008.

Reference Books:
1 Herstein,I.N.,TopicsinAlgebra,WilleyEastern PublicationLtd.,1975.
2. Singh,S.and Zameeruddin,Q.,ModernAlgebra,Vikas PublicationPvt.Ltd.,2006.
3. Artin,M.,Algebra,Pearson India,2015.

Master of Science (Mathematics) (FYIP)
Semester–VII
Session-2026-27
Course Title: Mathematical Programming-I
Course Code: FMAL-7332
Course Outcomes

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

CO 1: Formulate and solve linear programming problems using the simplex method and artificial variable techniques.

CO 2: Analyze and solve dual problems, transportation problems, and apply the MODI method for optimal solutions.

CO 3: Model and solve assignment and traveling salesman problems; apply game theory to two-person zero-sum games.

CO 4: Apply integer and dynamic programming techniques to solve optimization problems, including branch-and-bound and Gomory methods.

Master of Science (Mathematics) (FYIP)
Semester–VII
Session-2026-27
Course Title: Mathematical Programming-I
Course Code: FMAL-7332

Examination Time: 3 Hours | Max. Marks: 100

L	T	P		Theory: 80
4	1	0		CA:20

Instructions for Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. The question paper must contain 30% of the article/theory from the syllabus.

Unit I

The linear programming problem, properties of a solution to the linear programming problem, generating extreme point solution, simplex computational procedure, development of minimum feasible solution, the artificial basis techniques, a first feasible solution using slack variables, two phase and Big-M method with artificial variables.

Unit II

General Primal-Dual pair, formulating a dual problem, primal-dual pair in matrix form, Duality theorems, complementary slackness theorem, duality and simplex method, economic interpretation of duality, dual simplex method. General transportation problem, transportation table, duality in transportation problem, loops in transportation tables, LP formulation, solution of transportation problem, test for optimality, degeneracy, transportation algorithm (MODI method), time minimization transportation problem.

Unit III

Mathematical formulation of assignment problem, assignment method, typical assignment problem, the traveling salesman problem. Game Theory: Two-person zero-sum games, maximin-minimax principle, games without saddle points (Mixed strategies), graphical solution of 2 * n and m * 2 games, dominance property, arithmetic method of n * n games, general solution of m * n rectangular games.

Unit IV

Integer Programming: Gomory's all I.P.P. method, constructions of Gomory's constraints, Fractional cut method-all integer and mixed integer, Branch-and-Bound method, applications of integer programming. Dynamic Programming: The recursive equation approach, characteristics of dynamic programming, dynamic programming algorithm, solution of-Discrete D.P.P., some applications, solution of L.P.P. by Dynamic Programming.

Reference Books:
1. Gass, S. L. Linear Programming (Methods & Applications), John Wiley & Sons, 2014
2. Hadley, G. Linear Programming, addison Publisher, 1963.
3. Kambo, N.S. Mathematical Programming Technique Affiliated East West Press Pvt. Ltd. 2008.

4. Swaroop, K., Gupta, P. K., Manmohan. Operations Research, S. Chand & Sons.
5. Panneerselvam, R. Operations Research, PHI Publications, 2016

Master of Science (Mathematics) (FYIP)
Semester–VII
Session-2026-27
Course Title: Real Analysis
Course Code: FMAL-7333
Course outcomes

After the completion of this course, students should be able to

CO 1: Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts of interior points, interior and closure, open set, closed set, derived set, closure of a set and compact set.

CO 2: Give argument related to Separated sets, connected sets, components, Convergence and completeness in metric spaces.

CO 3: Understand and derive proofs of mathematical theorems related to limit and continuity, continuity and compactness, continuity and connectedness and uniform continuity.

CO 4: Differentiate between sequence and series of functions and able to solve problems related to uniform convergence and differentiation and use the polynomials to approximate a function.

Master of Science (Mathematics) (FYIP)
Semester–VII
Session-2026-27
Course Title: Real Analysis
Course Code: FMAL-7333

Examination Time: 3 Hours | Max. Marks: 100

L	T	P	Theory: 80
4	1	0	CA:20

Instructions for Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Set Theory: Finite, countable and uncountable sets. Metric spaces; open balls, closed balls, open and closed sets, Neighborhood, limit points, interior points, interior and closure, k- cells, compactness of k-cells, Compact subsets of Euclidean space Rk,Perfect sets, The Cantor set.

Unit II

Separated sets, connected sets in a metric space, Connected subsets of real line, Components, Sequences in Metric Spaces: Convergent sequences (in Metric Spaces), subsequences, Cauchy sequences, Complete metric spaces, Cantor's Intersection Theorem.

Unit III

Baire's theorem, Banach contraction principle, Continuity: Limits of functions (in metric spaces) Continuous functions, Continuity and Compactness, Continuity and Connectedness, Discontinuities, Monotonic functions, Uniform Continuity.

Unit IV

Sequences and Series of functions: Discussion of main problem, Uniform Convergence, Uniform Convergence and Integration, Uniform Convergence and Differentiation, Equicontinuous families of functions, Arzela's Theorem, Weierstrass Approximation theorem.

Text Book:

Rudin, W., Principles of Mathematical Analysis (3rdEdition), Mc Graw-Hill Ltd Ch.2,Ch.3, (3.1-3.12), Ch.4, Ch.6, (6.1-6.22), 2017.

Reference Books:

1. Simmons, G.F., Introduction to Topology and Modern Analysis, McGraw-Hill Ltd (App.1), pp 337-338, Ch.2 (9-13), 1963.
2. Narayan, S.,A course of Mathematical Analysis,S.ChandPublicationsLtd,2005.
3. Apostol, T.M., Mathematical Analysis 2nd Edition7.18(Th.7.30&7.31), Narosa Publication, 2002.
4. Malik, S.C. and Arora, S., Mathematical Analysis, New Age International Publisher, 2017.

Master of Science (Mathematics) (FYIP)
Semester–VII
Session-2026-27
Course Title: Machine Learning
Course Code: FMAL-7134
Course Outcomes:

After passing course the student will be able to:

CO1: Apply the complete Machine Learning workflow to real-world datasets by performing data collection, pre-processing, feature engineering, model training, model refinement, hyper parameter tuning, and deployment preparation.

CO2: Analyse regression models by evaluating SSE, identifying overfitting and under fitting, and applying polynomial regression, learning curves, and regularization techniques to improve model performance.

CO3: Understand the concepts of Unsupervised Learning and implement various Clustering Algorithms for data analysis and pattern discovery.

CO4: Comprehends the working of the Q-learning algorithm and apply it to learn optimal policies in unknown environments.

Master of Science (Mathematics) (FYIP)
Semester–VII
Session-2026-27
Course Title: Machine Learning
Course Code: FMAL-7134

Examination Time: 3 Hours | Max. Marks: 100
L T P | Theory: 80
4 0 0 | CA:20

Instructions for Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Introduction: The Machine learning landscape: What is Machine Learning (ML), Why Machine Learning, Type of ML Systems, Main challenges of machine learning, Confusion Matrix, testing and validating. Applications of Machine Learning Applying Machine Learning to a project- Step through the machine learning workflow using an example. Working with real data, get data and prepare for machine learningby pre- processing data, deriving features, and training and refining models, fine tune the model, ready the solution for production. Probability and classification, Bayes optimal decisions, Naive Bayes and Gaussian class- conditional distribution.

Unit II

Linear regression; SSE; gradient descent; normal equations; features, Overfitting and underfitting. Classification problems; decision boundaries; nearest neighbour methods Supervised Learning: Linear classifiers, Bayes' Rule and Naive Bayes Model, Training a binary classifier, performance measures, multiclass classification, error analysis, multilabel classification, multioutput classification. Training Models: gradient descent, Polynomial regression, learning curves, regularized linear models, Logistic regression, Linear SVM classification, Non-linear SVM classification, SVM regression.

Unit III

Decision tree, Ensemble methods: Bagging, random forests, boosting, practical examples; the curse of dimensionality, dimensionality reduction, principal components analysis Unsupervised learning: clustering and clustering algorithms; Using clustering for image segmentation, for pre-processing, semi-supervised learning, DBSCAN; Gaussian Mixtures– anomaly detection, selecting number of clusters, Bayesian Gaussian mixture models, novelty detections algorithms.

Unit IV

Reinforcement learning and adaptive models, the model-based reinforcement learning paradigm, Explore Q-learning and SARSA.

Reference Books:
1. Alpaydin, E., Introduction to Machine Learning, Second Edition.
2. Geron,A., Hands on Machine Learning with Scikit Learn, Keras& Tensor Flow, O'Reilly

3. Marsland, S., Machine Learning: An Algorithmic Perspective
4. Bishop, C.M., Pattern Recognition and Machine Learning
5. Mitchell, T., Machine Learning 6. Raschka, S., Python Machine Learning, PACKT Publishing

Master of Science (Mathematics) (FYIP)
Semester–VII
Session-2026-27
Course Title: Technical Writing and Latex
Course Code: FMAM-7335
Course Outcomes

Upon completion of this course, students should be able to:

CO1: Students will be able to install and use Latex to create basic documents, including writing mathematical symbols, managing spacing, and formatting text structure.

CO2: Students will be able to design structured documents using title pages, sections, headers/footers, and generate tables of contents with proper labeling and referencing.

CO3: Students will be able to format documents using font styles, colors, lists, and insert tables and figures effectively in Latex.

CO4: Students will be able to typeset mathematical equations and symbols and manage bibliographies and citations in Latex documents.

Master of Science (Mathematics) (FYIP)
Semester–VII
Session-2026-27
Course Title: Technical Writing and Latex
Course Code: FMAM-7335

Examination Time: (3+3) Hours Max. Marks: 100
Practical-30
Theory: 50
CA: 20

L T P
3 0 1

Instructions for the Paper Setters: Eight questions of equal marks (10 Marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Unit I

Installation of the software Latex, Introduction to Latex, mathematical symbols, commands for writing mathematical symbols, spacing, Line breaking and page breaking, practical work on these topics.

Unit II

Title pages, Header and Footer, Text formatting, Essentials, troubleshooting, creating a title, sections, labelling, table of contents, practical work on these topics.

Unit III

Font effects, coloured text, font sizes, lists, comments and spacing, special characters, Practical for inserting tables and figures, practical work on these topics.

Unit IV

Inserting equations, mathematical symbols, inserting a bibliography, citing references, practical work on these topics.

Text Book:
Kopka, H., Daly, P.W., Guide to Latex, Addison-Wesley Professional, 4th Edition, 2003.

List of Practicals using Latex

1. Introduction to Latex, preparing and running a .tex file.

2. Inserting tables and figures.

3. Inserting line breaks, Foote notes.

4. Font Effects, Font sizes.

5. Write A Paragraph Containing Different colored text.

6. Use of special symbols like %, &,#,€,$ etc.

7. Mathematical symbols.

8. Write a mathematical text containing equations with equation numbers and unnumbered equations, and system of equations, arrays, matrices.

9. Preparing a bibliography using BibTeX

Master of Science (Mathematics) (FYIP)
Semester–VII
Session-2026-27
Course Title: Universal Human Values-II: Understanding Harmony
Course Code: FMAL-7376

Course Outcomes

By the end of the course, students will be able to:

CO1: Develop self-awareness and philosophical reflection on their thoughts, desires, emotions, and conduct, while understanding their relationship with family, society, and nature.

CO2: Cultivate ethical responsibility and value-based judgement to address personal and social challenges through humane, sustainable, and harmonious solutions.

CO3: Strengthen critical and reflective thinking by examining beliefs, choices, human relationships, and social practices in the light of universal human values.

CO4: Apply the understanding of human values in real-life situations, fostering harmonious relationships, responsible living, and a deeper commitment towards the well-being of self, society, and nature.

Master of Science (Mathematics) (FYIP)
Semester–VII
Session-2026-27
Course Title: Universal Human Values-II: Understanding Harmony
Course Code: FMAL-7376

Examination Time: 3 Hours | Max. Marks: 100
L T P | Theory: 70
3 0 0 | CA: 30

Instructions for Paper Setters:
Eight questions of equal marks (14 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Development of Holistic Perspective through Universal Human Values a) Recapitulation from universal human values and its implications for holistic development. Self Exploration- Meaning, Content, Process (Natural Acceptance and Experiential validation). b) Human Aspirations- Concept, Requirements (Right understanding, relationship- and physical facility) and methods for fulfilment of aspirations, Critical appraisal of human aspirations to achieve happiness and prosperity.

Unit II

Harmony in Human Beings and Human-Human Relationship a) Human being as a co-existence of self and body: Characteristics of self, needs of self and body, Body as an instrument of self, Harmony of self with body: Sanyam and Health, Programs to ensure Sanyam & Health. b) Human-Human Relationship: Universal Values in Human-Human relationship, Programmes for ful filment of values, Trust & Intention, Respect & Differentiation, Harmony in society: Undivided So ciety, Universal order, family to world family for Achieving comprehensive human goals (Resolu tion, Prosperity, fearlessness & Co-existence).

Unit III

Harmony in Nature and Existence a) Understanding harmony in the Nature, Holistic perception of harmony at all levels of existence. Film on home to be used for balance / imbalance in nature. b) Importance of Yoga in daily life; Ashtang Yoga (Eight stages of Yoga) and benefits of Asanas,
Pra nayama and Concentration.

Unit IV

Harmony on Professional Ethics a) Natural acceptance of human values, Humanistic Education, Humanistic Constitution, Humanistic Universal order and Ethical Human Conduct. b) Competence in professional ethics: Ability to utilize the professional competence for augmenting universal human order, identify the scope and characteristics of people friendly and eco-friendly production systems, identify and develop appropriate technologies and management patterns for above production systems.

Reference Books:

1. Andrews, C. (2006). Slow is Beautiful: New Vision of Community, Leisure and Joie De Vivre. New Society Publishers Paperback in English.
2. Azad, M.A.K. (1988). India Wins Freedom. Madras: Orient Longman Limited.
3. Dharampal. (2003). Rediscovering India. New Delhi: Society for Integrated Development of Hima layas.

4. Gandhi, M.K. (1921). Hind Swaraj or Indian Home Rule. Madras: Navajivan Publishing House.
5. Gandhi, & Desai, M. H. (1993). An autobiography: the story of my experiments with truth. American ed. Boston, Beacon Press.
6. Kumarappa, J.C. (1984). Economy of Permanence. Sarva-Seva-Sangh-Prakashan: Rajghat, Varanasi.
7. Leonard, A. (2007). The story of stuff. Widescreen format. [Berkeley, Calif.], Free Range Studios.
8. Nagraj, A. (1999). Jeevan Vidya: EkParichaya, Jeevan Vidya Prakashan, Amarkantak. Ajab Distrib uter.
9. Rolland, R. (1930). Mahatma Gandhi. London: George Allen & Unwin Ltd. Museum Street.
10. Rolland, R. (1961).The Life of Vivekananda and the Universal Gospel. Utter Pradesh: Swami Vireswarananda.

SEMESTER-VIII

Master of Science (Mathematics) (FYIP)
Semester–VIII
Session-2026-27
Course Title: Algebra-II
Course Code: FMAL-8331
Course Outcomes

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

CO 1: State the definitions of ring, subring, ideal, ring homomorphism.

CO 2: State definitions of important classes of rings associated with factorization: Unique Factorization Domain, Principal Ideal Domain, and Euclidean Domains. Show that a given ring falls into one of these classes (or not). Relate these classes of rings to each other.

CO 3: Explain the notion of an extension of a field. State the definitions and examples of algebraic extension, finite extension, simple extension, separable extensions, splitting field and Galois extension. Identify in specific examples whether an extension satisfies one of these properties.

CO 4: Describe Galois field. Relate the concept of solvability by radicals to Galois groups and State the definition of constructible point, line and number. Relate constructability to field extension degrees.

Master of Science (Mathematics) (FYIP)
Semester–VIII
Session-2026-27
Course Title: Algebra-II
Course Code: FMAL-8331

Examination Time: 3 Hours | Max. Marks: 100

L	T	P	Theory: 80
4	1	0	CA:20

Instructions for Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Rings, Subrings, Ideals, Factor Rings, Homomorphism, Integral Domains. Maximal and prime ideals.

Unit II

The field of Quotients of an integral domain. Principal Ideal domains, Euclidean Rings. The ring of Gaussian Integers, Unique Factorization domains, Polynomial Rings, Gauss's theorem and irreducibility of a polynomial.

Unit III

Extension Fields: Finite and Infinite, Simple and Algebraic Extensions, Splitting fields: Existence and uniqueness theorem.

Unit IV

Separable and inseparable extensions, perfect fields, finite fields, Existence of GF(p^n), construction with straight edge ruler and compass.

Text Books:
1. Herstein, I.N. Topics in Algebra, Willey Eastern1975.
2. Fraleigh, J.B. An Introduction to Abstract Algebra, Pearson Education Publication Ltd., 2008.

Reference Books:
1. Singh, S. and Zameeruddin, Q. Modern Algebra, Vikas Publication Pvt. Ltd., 2006.
2. Bhattacharya, P.B., Jain, S.K., and Nagpal, S. R. Basic Abstract Algebra, Ch-14 (Sec.1-5), 1994.

Master of Science (Mathematics) (FYIP)
Semester–VIII
Session-2026-27
Course Title: Mathematical Programming-II
Course Code: FMAL-8332
Course Outcomes

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

CO 1: Understand and analyze basic queueing models, including M/M/1 and generalized birth-death processes.

CO 2: Apply multi-server queueing models and solve deterministic inventory control problems including EOQ and price break models.

CO 3: Formulate and solve replacement problems for deteriorating and failed equipment, including manpower planning.

CO 4: Develop and implement simulation models using Monte Carlo methods for systems like inventory, queues, and job sequencing

Master of Science (Mathematics) (FYIP)
Semester–VIII
Session-2026-27
Course Title: Mathematical Programming-II
Course Code: FMAL-8332

Examination Time: 3 Hours | Max. Marks: 100
L T P | Theory: 80
4 1 0 | CA:20

Instructions for Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Queueing Theory: Introduction, Queueing System, elements of queueing system, distributions of arrivals, inter arrivals, departure and service times. Classification of queueing models, single service queueing model with infinite capacity (M/M/1): (∞ /FIFO), Queueing Models: (M/M/1): (M/M/1): (N/FIFO), Generalized Model: Birth-Death Process.

Unit II

(M/M/C): (∞/FIFO), (M/M/C) (N/FIFO), (M/M/R) (KIGD), Power supply model., Inventory Control: The inventory decisions, costs associated with inventories, factors affecting Inventory control, economic order quantity (EOQ), Deterministic inventory problems with no shortage and with shortages, EOQ problems with price breaks, Multi item deterministic problems

Unit III

Replacement Problems: Replacement of equipment/Asset that deteriorates gradually, replacement of equipment that fails suddenly, recruitment and promotion problem, equipment renewal problem.

Unit IV

Need of simulation, methodology of simulation. Simulation models, event- type simulation, generation of random numbers, Monte-Carlo simulation, simulation of inventory problems, queueing systems, maintenance problem, job sequencing.

Text Book:
Kambo, N.S. Mathematical Programming Technique Affiliated East West Press Pvt. Ltd. 2008.

Reference Books:
1. Hadley, G. Linear Programming, addison Publisher, 1963.
2. Panneerselvam, R. Operations Research, PHI Publications, 2016

Master of Science (Mathematics) (FYIP)
Semester–VIII
Session-2026-27
Course Title: History of Mathematics in India
Course Code: FMAM-8333
Course Outcomes

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

CO1: Demonstrate understanding of the geometric, mensurational, and trigonometric contributions of ancient Indian mathematicians, particularly those found in the Shulbasutras and later classical texts.

CO2: Examine arithmetic, combinatorial, and recreational mathematical techniques in Indian mathematics, including number properties, series identities, Virahanka sequence, Kaprekar numbers, and magic squares.

CO3: Analyze classical Indian algebraic methods for linear, quadratic, higher degree, and indeterminate equations, with special emphasis on Kuttaka and Chakravala methods.

CO4: Appreciate the Kerala School's contributions to infinite series, trigonometric expansions, and early ideas of differential and integral calculus.

Master of Science (Mathematics) (FYIP)
Semester–VIII
Session-2026-27
Course Title: History of Mathematics in India
Course Code: FMAM-8333

Examination Time: 3 Hrs

LTP	Max. Marks: 100
4 1 0	Theory: 80
	CA: 20

Instructions for the paper setters/examiners:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Geometry in Shulbasutras [Ref. 2, Chapter-II]: Theorem of the square of the diagonal (Baudhayan, and Katyayan), Construction of geometrical figures in Shulbasutras (Squares, rectangles, trapezia, isosceles triangle equal in area to the given square and vice versa, rhombus of given area), Area preserving transformations of figures (Squaring the circle and circling the square, Rectangle to square and converse, rectangle or square into trapezium, trapezium into equivalent rectangle, rhombus into rectangle), Construction by the combination and subtraction of areas. The radius of Khavrita; hypotenuse of the right-angled triangle formed by Gnomon of shadow, Geometric proof of the sum of first n odd numbers. Brhamgupt's formula of a cyclic quadrilateral with Heron's formula as the special case. Proof of the relation between the Area and the Circumference of the circle by Neelkanth Somya ji, by the summation of Infinitesimals. Area and volume (Tetrahedron, Frustum, Cone, Pyramid, Sphere) problems by Araybhatt-I, Brahmagupt, and Bhaskar-II. The surface area and the volume of the sphere with early integration attempt in Yukti Bhasa. [Ref. 1, Ref. 2, Chapter V, VIII.] Origin of the term sine and cosine from Jya and Kotijya. Methods of constructing sine (Jya) by forming triangles and quadrilaterals in the quadrant of a circle. Yukti Bhasha proof of trigonometric identities. [Ref. 1, Ref. 2 Chapter V.]

Unit II

Mathematical Analysis of the methods developed by Bharti Krishna Tirtha: Divisibilty, squares and square roots, cubes and cube roots, and their theoretical proofs [Ref. 3, Chapter II]. Comparison of the methods developed for same by Aryabhatta, Sridhara, and Bhaskara-II. Varsankalita of Narayan Pandit (Sum of sums of natural numbers, sum of sums of terms in A.P., and extensions of Virahaṅka sequence, the so-called Fibonacci sequence, Representation of any number as a sum of Virahaṅka numbers, Super Golden ratio). Some identities related to the sum of series given by Sridhar, Mahavir, Thakkar Pheru, and Narayan Pandit with reference to Patiganit, Ganitasarasangraha, Ganitasarakaumudi, and Ganit Kaumudi. Kaprekar constant and convergence to Kaprekar constant, Kaprekar's swayambhu number, and their properties, Kaprekar's Harshad and Demlo numbers, Extension of Kaprekar's numbers to polynomials and other bases. Bhadraganit: Construction of magic squares, Pandiagonal magic squares, Sarvatobhadra of Varahamihira, Alpashruti, and Turgagati methods of Narayana Pandita. Classifications for magic squares with reference to Ganitasarasakaumudi of Thakkar Pheru (Even, odd, and evenly odd magic squares), and their construction.

Unit III

Linear equations in one variable, rules of false position, Bhaskar's method of operations with optional numbers. Aryabhatt's & Brahmgupt's method of division of differences. Linear equations with several unknowns (rules of Brahmagupt, Mahavir, and Bhaskar). [Ref. 1. Vol-II, Chapter. 7] Quadratic equations (rules of Aryabhtt-I, Brahmagupt, Aryabhatt-II, Sridhar, Mahavir, Sripati, and Bhaskar-II). Solutions of equations of higher degrees and simultaneous quadratic equations by Bhaskar and Mahavir. One linear equation with more than two unknowns, Simultaneous Indeterminate equations of the first degree. Pulverisation (Kuttak) method. Solution of Brahmgupt-Bhaskar equation (The so-called Pell's equation) of the type Nx2± c=y2. Bhavana lemmas of Brahmagupt. Chakraval method of Bhaskar-II, Continued Fractions. [Ref. 3, Chapter-III], Single Indeterminate equations of higher degrees.

Unit IV

Madhav's infinite series for inverse tangent and $\pi/4$ (The so called Gregory-Leibnitz series). Madhav's infinite series for sine and cosine. Proof by Neelkanth Somyaji in Yukti-Bhasha and early attempts of integral Calculus with reference to the Kerala School of Mathematics. Rapidly converging series, Madhav's formulae for remainder terms.

Text Books:

1. Datta, B., & Singh, A. N. History of Hindu Mathematics: A Source Book, Vol-I, II, Gyan Prakashan, 2021. (First Published 1938, Lahore).
2. A. Saraswati, T. A. Geometry in Ancient and Medieval India: Motilal Banarsidass Publishers Private Limited, 2017. (First Edition 1979).
3. Bhanu Murthy, T. S. A modern Introduction to Ancient Indian Mathematics, New Age International Publishers, 2009 (First Edition 1992).
4. Parameshwaran, S. The Golden Age of Indian Mathematics, Swadeshi Science Movement, Kerala, 1998.
5. SaKHYa. Ganitasarakaumudi The Moonlight of the Essence of Mathematics by Thakkura Pheru, MANOHOR. 2009.

Reference Books:

1. Hayashi, T. Indian Mathematics.
2. Plofker, K. Mathematics in India.
3. Joseph, G. G. The Crest of the Peacock: Non-European Roots of Mathematics.
4. Sarma, K. V. &Ramasubramanian, K. Ganita-Yukti-Bhasha of Jyesthadeva.
5. Introduction to Indian Knowledge system, Concepts and Applications.**
6. Kamble, B. The Imperishable seed, Garuda Prakashan Pvt. Ltd., 2022.
7. Clark, W. E. The Aryabhatiya of Aryabhata, An ancient Indian work on Mathematics and Astronomy, D. K. Printworld, 2018 (First Published 1930)

Master of Science (Mathematics) (FYIP)
Semester–VIII
Session-2026-27
Course Title: Data and File Structures
Course Code: FMAL-8134
Course Outcomes:

After passing course the student will be able to:

CO1: Comprehends fundamental data structures such as arrays, records, and linked lists, perform basic operations on them, analyse algorithm complexity using Big O notation, and evaluate time–space trade-offs for efficient problem-solving.

CO2: Implement stacks, queues, and trees using arrays and linked lists, and utilize them to solve computational problems such as expression evaluation, sorting, parenthesis checking, operating system simulations, and efficient data organization using Binary Search Trees, AVL Trees, Threaded Binary Trees, B-Trees, and B+ Trees.

CO3: Apply greedy algorithms, heap data structures, and graph algorithms to solve optimization, sorting, priority queue, minimum spanning tree, shortest path, graph traversal, connectivity, and cycle detection problems efficiently.

CO4: Apply appropriate searching, sorting, hashing, and file organization techniques to design and analyze efficient data storage and retrieval solutions, and evaluate their performance using suitable algorithms and file management methods.

Master of Science (Mathematics) (FYIP)
Semester–VIII
Session-2026-27
Course Title: Data and File Structures
Course Code: FMAL-8134

Examination Time: 3 Hours | Max. Marks: 100
L T P | Theory: 80
4 0 0 | CA:20

Instructions for the Paper Setters: Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Unit I

Preliminaries: Various data structures, common operations on data structures, algorithm complexity, big O notation, time–space trade off between algorithms. Arrays: Arrays defined, representing arrays in memory, various operations on linear arrays, Multi dimensional arrays, Records. Linked Lists: Types of linked lists, representing linked lists in memory, advantage of using linked lists over arrays, various operation on linked lists

Unit II

Stacks: Description of stack structure, implementation of stack using arrays and linked lists. Applications of stacks– converting arithmetic expression from infix notation to polish and their subsequent evaluation, quicksort technique to sort an array, parenthesis checker. Queues: Description of queue structure, implementation of queue using arrays and linked lists, description of priorities queues. Applications of queues– Operating system simulations Trees: Description of tree structure and its terminology, binary search tree, implementing binary search tree using linked lists, various operations on binary search trees, AVL Trees, Threaded Binary Trees, B Trees, B+ trees.

Unit III

Greedy Method: Knapsack Problem, Prim's and Kuruskal's Algorithm to find MSTs. Heaps: Description of heap structure, implementing heaps using arrays, various operations on heaps, Applications of heaps– heapsort technique to sort an array, implementation of priority queues. Graphs: Description of graph structure, implementing graphs in memory using adjacency matrix or adjacency lists, various graphs traversing algorithms, finding shortest path between two nodes, Dijkastra’s shortest path algorithm., finding biconnected component, strongly connected component and finding cycles in the graphs.

Unit IV

Searching and Sorting: Sorting Types, External and Internal sort Linear Search, Binary search, Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Shell Sort, Quick sort, Radix Sort. Hash Tables: Direct address tables, hash tables, collision resolution by chaining, hash functions, open addressing– linear probing, quadratic probing, double hashing. Files: Operations on files, Types of files, File Organizations: Sequential files, Indexed Sequential file, Directed files and multi–key files, File performance criteria and terms.

Reference Books:

1. Lipschutz, S., Theory and Problems of Data Structures, Schaum Outline Series, McGraw–Hill Book Company. Third Edition

2. Esakov, J., Data Structures– An Advanced Approach Using C, Tom Weiss, Prentice– Hall International, Inc. 2007
3.Trembley and Sorenson: An Introduction to Data Structures with Application, Tata–McGraw Hill Company, Delhi. 2003
4.Tanenbaum: Data Structures and C. Second Edition

Master of Science (Mathematics) (FYIP)
Semester–VIII
Session-2026-27
Course Title: Project
Course Code: FMAD-8335
Course Outcomes

After passing this course, the students will be able to:

CO 1: To understand the basic framework of research process.

CO 2: To understand the primary characteristics of research and to identify various sources of information for literature review and data collection.

CO 3: To learn how to design a project and will be accustomed to work independently and confidently.

CO 4: To understand the formulation of Mathematical Problem based on real time applications

Master of Science (Mathematics) (FYIP)
Semester–VIII
Session-2026-27
Course Title: Project
Course Code: FMAD-8335

The students will do project work primarily focusing on educational research for the resurgence of quality education as a whole through research practices.

To monitor the progression of the students, CP-I, MST, CP-II will be conducted accordingly. In end semester examination, students will be evaluated on the basis of viva-voce and project report as per examination policy of Kanya Maha Vidyalaya.