P. D. E. A's

Prof. Ramkrishna More Arts, Commerce and Science College, Akurdi, Pune-411044

Affiliated to

Savitribai Phule Pune University

Choice based Credit System

Under Autonomy and NEP-2020

Implemented from Academic Year 2023-24

Rules and Regulations

- **1. National Credit Framework (NCrF):** For creditisation and integration of all higher education qualifications leading to a certificate/ diploma/ degree with multiple entry and exit options, college will refer to National Credit Framework (NCrF) which encompasses the qualification frameworks for higher education, vocational and skill education and school education, namely National Higher Education Qualification Framework (NHEQF), National Skills Qualification Framework (NSQF) and National School Education Qualification Framework (NSEQF) respectively.
- 2. Structure of Four years multidisciplinary UG Programme and Five Years Integrated Multidisciplinary Master's Degree Programmes with Multiple Entry and Exit Options at Different Levels:
 - (i) Students will have the flexibility to enter four years multidisciplinary Under Graduate Programme in odd semesters and exit a programme after the successful completion of even semesters as per their future career needs.
 - (ii) Students will get a Certificate after a One year programme (minimum 40 Credits), a Diploma after two years (minimum 80 Credits), a Bachelor's degree after three years (minimum 120 Credits), and a Bachelor's degree with Research or Honours after Four years (minimum 160 Credits).
- **3.** Qualification Type and Credit Requirements of Four Years Multidisciplinary Degree Programme with Multiple Entry and Exit Options

Levels	Qualification Title	Cro Requir	edit ements	Semester	Year
		Minimum	Maximum		
4.5	UG Certificate	40	44	2	1
5.0	UG Diploma	80	88	4	2
5.5	Three Years	120	132	6	3
	Bachelor's degree				
6.0	Bachelor's degree	160	176	8	4
	Honour's with Major				
	Bachelor's degree	160	176	8	4
	Honour's with Major				
7.0	Master's Degree	200	220	10	5
8.0	Ph. D.				

(i) Details of qualifications, minimum credit requirements, exit credit courses, year and semester are as under:

- (ii) An exit 6-credit bridge course(s) lasting two months, including at least 6-credit job specific internship/apprenticeship that will help the graduates acquire job-ready competencies required to enter the workforce will be an additional requirement for the award of the undergraduate Certificate/ Diploma/ three year Bachelor's Degree.
- (iii) On exit, the students will have the option to re-enter the programme in the college, or in a different higher education institution. Re-entry at various levels for lateral entrants in academic programmes should be based on the earned and valid credits as deposited and accumulated in the Academic Bank of Credits (ABC) through Registered Higher Education Institutions (RHEI) and proficiency test records.
- (iv) Eligibility for admission to the fourth year of four-year Honours with Research Degree Programmes as per UGC guidelines: Minimum CGPA of 7.5 or minimum 75% at three-year degree.
- (v) PG curriculum, as illustrated below, have flexibility a) One-year Post-Graduate Diploma (PGD), b) Two year Post-graduate Programme and c) 5 Years Master's

degree programmes with multiple Entry and Exit options at different levels.

- (a) **Post-Graduate Diploma (PGD):** Programme duration- One year (2 semesters) after any bachelor's degree, min. 40 credits
- (i) UGC: 1-Year (2 semesters) Post-Graduate Diploma (PGD) after 3-years Bachelor's degree: Level 6.0
- (ii) UGC: 1-Year (2 semesters) PGD after 4 years Bachelor's degree (Honors/ Research): Level 6.5
- (b) Master's Degree:
- (i) UGC: 2-Years (four semesters) Master's Degree after obtaining a 3-years Bachelor's degree, Minimum 40 credits/year, second year devoted entirely to research, $PG 2^{nd}$ year: Level 6.5

OR

- (i) 1-Year (two semesters) Master's Degree after obtaining a 4-year Bachelor's degree (Honours/Research): Minimum 40 credits: Level 6.5
- (c) Level 8 represents Ph. D. Research Degree.
- (d) A 5-year Integrated Bachelor's and Master's programme shall have a minimum of 220 credits.
- (e) Master's and doctoral programmes, while providing rigorous research-based specialization, should also provide opportunities for multidisciplinary work, in academia, government, research institutions, and industry.

4. Lateral Entry/ Re-entry at higher Levels after exit from lower levels of four years multidisciplinary UG degree programme:

- (i) The credit points earned and accumulated shall be used to determine the eligibility for taking admission to various programs at multiple levels, subject to fulfilment of the broad principles laid down under NCrF. Students who leave with a Certification, Diploma, or a Basic Bachelor's Degree will be eligible to re-enter the programme at the exit level to complete or progress to the next level through lateral entry mode. Depending upon the academic and physical facilities available, the State Universities/ Autonomous Colleges (Higher Education Institutions or HEI) may earmark specific seats/ intake for lateral entry into the second year/ third year/ fourth year of a four years multidisciplinary UG degree programme as approved by Professional Standard Setting Bodies (PSSB/Govt. of Maharashtra/ statutory council of affiliating University plus any consequential vacancies caused by exits to an ongoing programme (four-year Degree Programme and Integrated Master's or second year Master's). Lateral entry or Re-entry is open to those students if he/she has either
 - (a) successfully completed the first year/second year/third year of the particular four years multidisciplinary degree programme in any ABC registered HEI with valid credits in ABC and re-entering into the second year/third year/fourth year, respectively of the same four years degree programme of any ABC registered HEI, within stipulated/ permissible period of years as decided by Statutory Councils of that HEI

OR

- (b) Already successfully completed a multidisciplinary four-year first-degree programme and is desirous of and academically capable of pursuing another multidisciplinary four years first-degree programme in an allied subject.
- (ii) A student will be allowed to enter/re-enter only at the odd semester. Re-entry at various levels for lateral entrants in academic programmes should be based on the earned and valid credits as deposited and accumulated in Academic Bank of Credits (ABC) through Registered Higher Education Institutions (RHEI) and proficiency test records. However, in terms of the admission eligibility requirements, the student

shall belong to the same faculty/ discipline in terms of Major Subject i.e., the Major subject of his earlier Programme and the Major subject of the new Programme for which he is seeking admission must be from the same faculty/discipline. Reservation for lateral entry will be executed as per the Government of Maharashtra norms.

5. Distribution of Credits across Multidisciplinary Four Years Degree Program:

- (i) Four-year multidisciplinary degree programme with Honours/ Specialization Degree will have Internship and Core /Major Courses with a minimum of 22 credits per sem. in the Fourth Year.
- (ii) Four-year multidisciplinary degree programme with Research will have Research Projects, Seminars, Dissertations and Internships with a minimum of 22 credits per Sem. in the Fourth Year.
- (iii) Students shall select a 'Major or Core Subject/ Discipline' and a 'Minor Subject/Discipline' from the lists of various Subject Combinations and Options provided the Colleges. In general, for the four years multidisciplinary bachelor's degree programme, the distribution of credits will be as follows:
 - (a) Disciplinary/interdisciplinary Major/ Core Subject (minimum of 68 credits)-Mandatory and Elective Courses
 - (b) Disciplinary/interdisciplinary Minor Subject (maximum of 22 credits)
 - (c) Skill based/Vocational studies corresponding to the Major/ Core Subject (8 credits)
 - (d) Field projects/internship/apprenticeship/community engagement and service corresponding to the Major/ Core Subject (14-22 credits) with a maximum of six credits per Semester
 - (e) Generic/ Open Electives through Baskets of Elective Courses (12 credits),
 - (f) Ability Enhancement Courses including Languages, Literature and Environmental Studies (12 credits),
 - (g) In-built modules on the Indian Knowledge System (IKS) in Major/ Core Subject at Level 4.5 2 credits
 - (h) Value-based Education, Life Skills and Professional Ethics: Co-curricular Courses such as Sports and Culture, NSS/NCC and Fine/ Applied/Visual Arts (8 credits).

Student can earn some credits (SEC/VSC/GE/OE) in the form of online from-

- (i) The National Skills Qualifications Framework (NSQF) organizes qualifications for Vocational and Skill Courses in a series of 8 levels based on professional knowledge, professional skills, core skills and responsibilities, in the increasing order of complexity and competency.
- (ii) University Grants Commission (Credit Framework For Online Learning Courses through Study Webs of Active-Learning for Young Aspiring Minds) Regulations, 2021, permits up to 40 per cent of the total courses being offered in a particular programme in a semester through the Online Learning Courses offered through the Study Webs of Active-Learning for Young Aspiring Minds (SWAYAM) platform.

6. Examination and Assessment Process:

- (i) The basic principle of the credit framework is that credits are a function of the successful completion of a program of study/ vocational education/ training and assessment. No credit can be earned by the student unless the student is assessed for the achievement of the desired competencies and outcome of a program.
- (ii) Exit options are provided with certification, diploma and basic Bachelor's degrees to the students at the end of the second, fourth and sixth semesters of a four years multidisciplinary degree programme. Students will receive a Bachelor's degree with Honours/ Research on successfully completing of all eight semesters of the UG Program either at a stretch or with opted exits and re-entries.

For the smooth success of four-year multidisciplinary degree programme with multiple entry and exit systems, the examination mode will be based on the combination of innovative trends in formative (informal

and formal tests administered during the learning process) and summative (evaluation of student learning at the end of an instructional unit) examination modes. This is in line with the UGC Report on 'Evaluation Reforms in Higher Educational Institutions (2019)'.

(iii) Evaluation of each students in each course will be done as follows

- a. Each theory or practical course will be of 2 credits = 50 mark
- b. Internal evaluation 30% weightage (15 mark)
- c. External evaluation 70% weightage (35 marks)
- d. Students should secure 40% marks in each type of evaluation for successful completion of a course (student should secure at least 6 marks in internal and 14 marks in external evaluation).

(iv) Evaluation Pattern.

- **a. Internal evaluation** Two written test, each of 20 marks will be conducted i. e. two tests on two modules. 1st assignment after completing 6 weeks of teaching and 2nd on completion of 13th week of teaching. Question paper should be designed so that evaluation of CO, PO, PSO can be performed. 10 marks out of 15 will be assigned from these written tests. Remaining 5 marks will be assigned from other types of evaluation such as seminars, orals, poster presentation, open book challenging tests, surprise test, objective test on whole syllabus of the course (at least 40 questions of objective type must be designed), etc. for 5 marks at least two different types technique must be utilized.
- **b. External Evaluation** External evaluation will be done at the end of semester. For theory, 35 marks written examination will be conducted and time of examination will be 2-hours.

7. Declaration of Results:

(i) Declaration of result is based on the Semester Grade Point Average (SGPA) earned towards the end of each semester or the Cumulative Grade Point Average (CGPA) earned at the completion of all eight semesters of the programme and the corresponding overall alpha-sign or letter grades as given in Table 2. If some candidates exit at the completion of the first, second or third year of the four years Undergraduate Programmes, with Certificate, Diploma or Basic Degree, respectively, then the results of successful candidates at the end of the second, fourth or sixth semesters shall also be classified on the basis of the CGPA obtained in the two, four, six or eight semesters, respectively. Successful candidates at the end of the tenth semester of the integrated Master's Degree Programmes shall also be classified on the basis of the Programmes. Likewise, the successful candidates of one year or two semesters Master's Degree Programme are also classified on the basis of the CGPA of two semesters of the Master's Degree Programme.

Semester GPA/ Program CGPA Semester/Program	% of Marks	Alpha-Sign / Letter Grade Result
9.00-10.00	90-100	O (outstanding)
8.00 - <9.00	80.00 - <90.00	A+ (Excellent)
7.00 - <8.00	70.00-<80.00	A (Very Good)
6.00 - <7.00	60.00-<70.00	B+ (Good)

Table-2: Grades on degree certificate/mark sheet will be assigned to the students
as per the following table

5.50 - <6.00	55.00-<60.00	B (Above Average)
5.00 - <5.50	50.00-<55.00	C (Average)
4.00 - <5.00	40.00-<50.00	P (Pass)
Below 4.00	< 40	F (Fail)
Ab		Absent

(ii) A student obtaining Grade F shall be considered failed and will be required to reappear in the examination. For non-credit courses 'Satisfactory' or "Unsatisfactory' shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

8. Award of Major and Minor Degree:

- (i) A student pursuing four-year multidisciplinary UG programme will be awarded an appropriate Honours/ Research degree in Major/ Core Subject on completion of VIII Semester with the minimum of 176 credits if he secures in that Subject at least 50% of the total credits for that programme. He shall thus study the specific number of Mandatory Core Courses, Core Electives, Vocational and Skill Courses and Field projects/ Internships connected to Core Subjects in eight semesters so as to cover at least 50% of the total credits.
- (ii) In case of Research Degree, a student shall pursue research project and write dissertation in that Major in the VII and VIII semesters.

On the basis of above rules and regulations under NEP-2020 following course frame work is adopted by the Prof. Ramkrishna More Arts, Commerce and Science College, Akurdi, Pune-411044 for the completing of four years honours degree in Major and Minor subjects.

9. Distribution of Credits across Four Years Degree Programmes:

In general, for the four years' bachelor's degree programme, the distribution of credits will be as follows:

(a) Major (Core) Subject comprising Mandatory and Elective Courses:

- i. Minimum 50% of total credits corresponding to Three/Four year UG Degree-Mandatory Courses offered in all Four years;
- ii. 2 credit course on Major Specific IKS shall be included under Major;
- iii. Elective courses of Major will be offered in the third and/or final year.
- iv. Vocational Skill Courses, Internship/ Apprenticeship, Field Projects, Research Projects connected to Major first to fourth year.

(b) Minor Subject: 18-20 Credits

- i. The Minor subjects may be from the different disciplines of the same faculty of DSC Major (Core) or they can be from different faculty altogether.
- ii. The credits of Minor subjects shall be completed in the first three years of UG Programme.

(c) Generic/ Open Elective Courses (OE): 10-12 credits

- i. It is to be offered in I and/or II year
- ii. Faculty-wise baskets of OE shall be prepared by University/ Autonomous Colleges.
- iii. OE is to be chosen compulsorily from faculty other than that of the Major.

(d) Vocational and Skill Enhancement Courses (VSEC): 14-16 credits

- # Vocational Skill Courses (VSC): 8-10 credits, including Hands on Training corresponding to the Major and/or Minor Subject:
- i. To be offered in first to three years;
- Wherever applicable vocational courses will include skills based on
- ii. advanced laboratory practical of Major

Skill Enhancement Courses (SEC): 06 credits

i. To be offered in I and II year;

ii. To be selected from the basket of Skill Courses approved by University/ Autonomous Colleges

(e) Ability Enhancement Courses (AEC), Indian Knowledge System (IKS) and Value Education Courses (VEC): 14 Credits

• AEC: 08 credits

i. To be offered in I and II year

ii. English: 04 Credits

iii. Modern Indian Language: 04 credits

iv. To be offered from the Basket approved by the College;

The focus for both languages should be on linguistic and communication skills.

o IKS: 2 Credits

i. To be offered in I Year

ii. Courses on IKS to be selected from the basket of IKS courses approved by the Colleges

o VEC: 04 Credits

- i. To be offered in I year
- ii. Value Education Courses (VEC) Environmental Science Education (Compulsory), Understanding India, and Digital and Technological Solutions.

(f) Field Projects/ Internship/ Apprenticeship/ Community Engagement and Service corresponding to the Major (Core) Subject, Co-curricular Courses (CC) and Research Project

o Internship/Apprenticeship corresponding to the Major (Core) Subject: 8 Credits

o Field Projects/Community Engagement and Service corresponding to the Major (Core) Subject: minimum 4-6 credits

To be offered in II, and III years of UG Degree Programmes.

o Co-curricular Courses (CC) such as Health and Wellness, Yoga education sports, and fitness, Cultural Activities, NSS/NCC and Fine/ Applied/ Visual/ Performing Arts: 8 credits. To be offered in I and/or II year

o Research Projects: 12 credits

To be offered in the final year for 4-year Honours with Research UG Degree

The UGC Regulations, 2021 permit up to 40% of the total courses being offered in a particular programme in a semester through the Online Learning Courses offered through the SWAYAM platform and/or other State Level Common Platforms which can be developed in due course with the participation of different Universities/ HEIs.

Abbreviations: Generic/ Open Electives: GE/OE; Vocational Skill and Skill Enhancement Courses: VSEC; Vocational Skill Courses: VSC; Skill Enhancement Courses: SEC; Ability Enhancement Courses: AEC; Indian Knowledge System: IKS; Value Education Courses: VEC; OJT: On Job Training: Internship/ Apprenticeship; Field projects: FP; Community engagement and service: CEP; Co-curricular Courses: CC; Research Methodology-RM; Research Project: RP Note: The Credit Distribution Table given above is illustrative only. The Universities/ Autonomous Colleges may suitably modify within the broader framework of credit distribution across six verticals.

Graduate and Honors Degree Course Framework under Autonomy as per NEP-2020 If not mentioned, each proposed course (theory/practical) is of 2 credits

Sem.	Major Courses	Major Elective Curses	Minor Curses	VSC	IKS	FP/OJT/ CEP	GE/OE	SEC	AEC	VEC	сс	Total Credits
	First Year Certificate Course											

Ι	2 theory + 1 Practical	0	0	1 Theory	1 Theory	0	1 theory + 1 Practical	1 theory/ practical	1 theory	1 theory	2 Credit	22
Π	2 theory +	0	1 Theory	1	0	0	1 theory +	1 theory/	1	1	2	22
	1 Practical			Practical			I Practical	practical	theory	theory	Credit	
	Second Year Graduate Diploma											

III	3 theory +	0	1 Theory +	1 Theory	0	FP	1 theory	0	1		2	22
	1 Practical		1 Practical			(2 Credit)			theory		Credit	
IV	3 theory +	0	1 Theory +	0	0	CEP	1 Practical	1 theory/	1		2	22
	1 Practical		1 Practical			(2 Credit)		practical	theory		Credit	
	Third Year Graduate Degree											
V	3 theory +	1 Theory +	1 Theory +	1	0	FP/CEP	0	0	0	0	0	22
	2 Practical	1 Practical	1 Practical	Practical		(2 Credit)						
VI	3 theory +	1 Theory +	1 Theory +	0	0	OJT	0	0	0	0	0	22
	2 Practical	1 Practical	1 Practical			(4 Credit)						
	VII and VIII Semester honours degree with major											
VII	5 theory +	1 Theory +	RM	0	0	0		0	0	0	0	22
	2 Practical	1 Practical	4 Credits									
VIII	5 theory +	1 Theory +	0	0	0	OJT	0	0	0	0	0	22
	2 Practical	1 Practical				(4 Credit)						
			VII a	ind VIII Sei	mester ho	nours degr	ee with resea	rch				
VII	4 theory +	1 Theory +	RM	0	0	RP	0	0	0	0	0	22
	1 Practical	1 Practical	4 Credits			(4 Credit)						
VIII	4 theory +	1 Theory +	0	0	0	RP	0	0	0	0	0	22
	1 Practical	1 Practical				(8 Credit)						

Post Graduate Degree Course Framework under Autonomy as per NEP-2020 If not mentioned, each proposed course (theory/practical) is of 2 credits

Sem.	Major Courses	Major Elective Curses	Minor Curses	VSC	IKS	FP/OJT/CEP	GE/OE	SEC	AEC	VEC	сс	Total Credits
	PG-I											
VII	5 theory + 2 Practical	1 Theory + 1 Practical	RM 4 Credits	0	0	0		0	0	0	0	22
VIII	5 theory + 2 Practical	1 Theory + 1 Practical	0	0	0	OJT (4 Credit)	0	0	0	0	0	22
					PG	-II						
IX	5 theory + 2 Practical	1 Theory + 1 Practical	0	0	0	Research Project (4 credits)		0	0	0	0	22
Х	5 theory + 2 Practical	1 Theory + 1 Practical	0	0	0	OJT (4 Credit)	0	0	0	0	0	22

Definitions:

- **1. One semester** = 15 weeks
- **2.** 1-credit theory = 15 hours i.e. for 1 credit, 1 hour per week teaching is to be performed.
 - 15 hours of 1-credit are splinted as 12 hours actual teaching + 3 hours Tutorial (practice problem solving sessions, repeated discussion on difficult topics, discussion on student's difficulties, questions discussion and internal evaluation)

1-credit practical = 30 hours. Thus, 1 credit practical = 2 contact hours in laboratory

- **3.** per week. 30 hours splinted as 24 hours actual table work and 6 hours for journal competition, oral on each practical and other internal evaluation.
- 4. Each theory course of any type (major, minor, VSC, VEC, OE/GE, VEC, SEC, CC, etc.)

is of 2 credits.

- **a. Theory per semester:** Contact hours = 24 teaching + 6 tutorials (problem solving sessions, repeated discussion on difficult topics, difficult solution, questions discussion and internal evaluation)
- b. Each course will be of two modules, One module = 15 hours
- c. Each module may consist of one or more than one chapter.

5. Each practical course of any course is of 2 credits = 60 hours per semester

- a. Minimum 12 laboratory sessions will be conducted in one semester.
- b. Each laboratory sessions will be of 4 hours.

Structure of the course B. Sc. Mathematics:

		Ma	jor, Major Elective and	d VSC Courses
Semes	Course	Course	Generic Name	Title of the paper
ter	Туре	code		
Ι	Major	MTMAT-	Mathematics theory	Algebra-I
		111	paper-1	
		MTMAT-	Mathematics theory	Calculus-I
		112	paper-2	
		MTMAP-	Mathematics	Practical based on Algebra-I
		113	practical paper-1	and Calculus-I
	VSC	MTVST-	Vocational	Python Programming
	(Related	111	Mathematics theory-I	
	to Major)			
	IVC	MTIKT-	IKS theory-I	Vedic Mathematics
	IND	111		
II	Major	MTMAT-	Mathematics theory	Algebra-II
		121	paper-3	
		MTMAT-	Mathematics theory	Calculus-II
		122	paper-4	
		MTMAP-	Mathematics	Practical based on Algebra-II
		123	practical paper-2	and Calculus-II
	VSC	MTVSP-	Vocational	Practical on Python
	(Related	121	Mathematics	Programming
	to Major)		Practical-I	
III	Major	MTMAT-	Mathematics theory	Introduction to Graph Theory
		231	paper-5	
		MTMAT-	Mathematics theory	Linear Algebra
		232	paper-6	
		MTMAT-	Mathematics theory	Combinatorics
		233	paper-7	
		MTMAP-	Mathematics	Mathematics Practical Based
		234	practical paper-3	on Linear Algebra and
				Combinatorics
	VSC	MTVST-	Vocational	
	(Related	231	Mathematics theory-	Numerical Analysis
	to Major)		II	
IV	Major	MTMAT-	Mathematics theory	Operation Research
		241	paper-8	

		MTMAT-	Mathematics theory	Multivariable Calculus
		242	paper-9	
		MTMAT-	Mathematics theory	Ordinary Differential
		243	paper-10	Equations
		MTMAP-	Mathematics	Mathematics Practical Based
		244	practical paper-4	on Multivariable Calculus and
				Ordinary Differential
				Equations
	VSC	MTVST-	Vocational	Practical on Numerical
	(Related	241	Mathematics	Analysis using Python
	to Major)		practical-II	
V	Major	MTMAT-	Mathematics theory	Metric Spaces
		351	paper-11	
		MTMAT-	Mathematics theory	Real Analysis-I
		352	paper-12	
		MTMAT-	Mathematics theory	Group Theory
		353	paper-13	
		MTMAP-	Mathematics	Mathematics Practical Based
		354	practical paper-5	on Real Analysis-I and Group
				Theory
		MTMAP-	Mathematics	Computational Geometry
		355	practical paper-6	
	Major	MTMAET-	Elective Mathematics	Vector Calculus
	Elective	356A	theory paper-1-A	
		MTMAET-	Elective Mathematics	Laplace Transform
		356B	theory paper-1-B	
		MTMAEP-	Elective Mathematics	Latex-I
		357A	practical paper-1-A	
			r	
		MTMAEP-	Elective Mathematics	C Programming-I
		357B	practical paper-1-B	
	VSC	MTVST-	Vocational	Machine Learning
	(Related	351	Mathematics Theory-	
	to Major)		II	
VI	Major	MTMAT-	Mathematics theory	Complex Analysis
		361	paper-14	
		MTMAT-	Mathematics theory	Real Analysis-II
		362	paper-15	

		MTMAT-	Mathematics theory	Ring Theory
		363	paper-16	
		MTMAP-	Mathematics	Mathematics Practical Based
		364	practical paper-7	on Real Analysis-II and Ring
				Theory
		MTMAP-	Mathematics	Practical on Computational
		365	practical paper-8	Geometry
	Major	MTMAET-	Elective Mathematics	Optimization Techniques
	Elective	366A	theory paper-2-A	
		MTMAET-	Elective Mathematics	Partial Differential Equations
		366B	theory paper-2-B	
		MTMAEP-	Elective Mathematics	Latex-II
		367A	practical paper-2-A	
		MTMAEP-	Elective Mathematics	C Programming-II
		367B	practical paper-2-B	
	VSC	MTVST-	Vocational	Practical on Machine Learning
	(Related	351	Mathematics	
	to Major)		Practical-II	
VII	Major	MTMAT-	Mathematics theory	Linear Algebra
		471	paper-17	
		MTMAT-	Mathematics theory	Group Theory
		472	paper-18	
		MTMAT-	Mathematics theory	Advanced Calculus
		473	paper-19	
		MTMAT-	Mathematics theory	Ordinary Differential
		474	paper-20	Equations
		MTMAT-	Mathematics theory	Financial Mathematics-I
		475	paper-21	
		MTMAP-	Mathematics	Mathematics Practical Based
		476	practical paper-11	on Linear Algebra and Group
				Theory
		MTMAP-	Mathematics	Mathematics Practical Based
		477	practical paper-12	on Advanced Calculus and
				Financial Mathematics-I
	Major	MTMAET-	Elective Mathematics	Dynamical Systems
	Elective	478-A	theory paper-3-A	· · · ·
		MTMAEP-	Elective Mathematics	Python Programming
		478-B	theory paper-3-B	
		MTMAET-	Elective Mathematics	Practical on Dynamical
		479-A	practical paper-4-A	Systems

		MTMAEP-	Elective Mathematics	Practical on Python
		479-B	practical paper-4-B	Programming
	RM	MTRMT-		Research Methodology
		477		
VIII	Major	MTMAT-	Mathematics theory	Number Theory
		481	paper-22	Number Theory
		MTMAT-	Mathematics theory	Ring Theory
		482	paper-23	King Theory
		MTMAT-	Mathematics theory	Measure and Integration
		483	paper-24	
		MTMAT-	Mathematics theory	Partial Differential Equations
		484	paper-25	
		MTMAT-	Mathematics theory	Financial Mathematics-II
		485	paper-26	
		MTMAP-	Mathematics	Mathematics Practical Based
		486	practical paper-13	on Number Theory and Ring
				Theory
		MTMAP-	Mathematics	Mathematic Practical Based on
		487	practical paper-14	Measure and Integration and
				Partial Differential Equations
	Major	MTMAET-	Elective Mathematics	Integral Equations
	Elective	488-A	theory paper-5-A	
		MTMAET-	Elective Mathematics	Cryptography
		488-B	theory paper-5-B	
		MTMAEP-	Elective Mathematics	Practical on Financial
		489-A	practical paper-6-A	Mathematics-II
		MTMAEP-	Elective Mathematics	Practical on Cryptography
		489-B	practical paper-6-B	
	On Job	MTOJT-		
	Training	490		
		Elective		
V		MTMAET-	Elective Mathematics	Vector Calculus
		356A	theory paper-1-A	
		MTMAET-	Elective Mathematics	Laplace Transform
		356B	theory paper-1-B	
		MTMAEP-	Elective Mathematics	Latex-I
		357A	practical paper-1-A	
		MTMAEP-	Elective Mathematics	C Programming-I
		357B	practical paper-1-B	

VI	MTMAET-	Elective Mathematics	Optimization Techniques
	366A	theory paper-2-A	
	MTMAET-	Elective Mathematics	Partial Differential Equations
	366B	theory paper-2-B	
	MTMAEP-	Elective Mathematics	Latex-II
	367A	practical paper-2-A	
	MTMAEP-	Elective Mathematics	C Programming-II
	367B	practical paper-2-B	
VII	MTMAET-	Elective Mathematics	Dynamical Systems
	478-A	theory paper-3-A	
	MTMAET-	Elective Mathematics	Python Programming
	478-B	theory paper-3-B	
	MTMAEP-	Elective Mathematics	Practical on Dynamical
	479-A	practical paper-4-A	Systems
	MTMAEP-	Elective Mathematics	Practical on Python
	479-B	practical paper-4-B	Programming
VIII	MTMAET-	Elective Mathematics	Integral Equations
	488-A	theory paper-5-A	
	MTMAET-	Elective Mathematics	Cryptography
	488-B	theory paper-5-B	
	MTMAEP-	Elective Mathematics	Practical on Financial
	489-A	practical paper-6-A	Mathematics-II
	MTMAEP-	Elective Mathematics	Practical on Cryptography
	489-B	practical paper-6-B	
	Vocation	nal Skill Courses (VSC) Related to Major
Ι	MTVST-	Vocational	Python Programming
	111	Mathematics theory-I	
II	MTVSP-	Vocational	Practical on Python
	122	Mathematics	Programming
		Practical-I	
III	MTVST-	Vocational	Numerical Analysis
	233	Mathematics theory-	
		II	
IV	MTVSP-	Vocational	Practical on Numerical
	244	Mathematics	Analysis using Python
		Practical-II	

V			MTVST-	Vocation	nal	Machine Learning
			355	Mathema	atics Theory-	
				III		
VI			MTVSP-	Vocation	nal	Practical on Machine Learning
			366	Mathema	atics	
				Practical	-III	
	•			M	linor Mathema	atics
Ι						
II			MTMIT-	Minor	Mathematics	Matrix Algebra
			121	Theory-	-1	
III			MTMIT-	Minor	Mathematics	Discrete Mathematics
			232	Theory-	-2	
			MTMIP-	Minor	Mathematics	Practical on Discrete
			233	Practica	ıl-1	Mathematics using Maxima
IV			MTMIT-	Minor	Mathematics	Linear Algebra
			244	Theory-	-3	
			MTMIP-	Minor	Mathematics	Practical on Linear Algebra
			245	Practica	ıl-2	using Maxima
V			MTMIT-	Minor	Mathematics	Numerical Techniques
			356	Theory-	-4	
			MTMIP-	Minor	Mathematics	Practical on Numerical
			357	Practica	ıl-3	Techniques using Python
			MTMIP-	Minor	Mathematics	Operation Research
			368	Theory-	-5	
			MTMIP-	Minor	Mathematics	Practical on Operation
			369	Practica	ıl-4	Research using Python
			Ι	KS Relat	ted to Mathem	atics Major
Ι			MTIKT-	Indian	knowledge	Vedic Mathematics
			111	system	Mathematics	
				paper		
		S	EC for scien	ce faculty students from		n Mathematics discipline
Ι			MTSET-	Skill	Mathematics	Analytical Geometry of three
		111	Theory-	·I	Dimensions	
II	II		MTSEP-	Skill	Mathematics	Practical on Analytical
	SEC		121	Practica	ll-I	Geometry of three Dimensions
III						
IV			MTSET-	Skill	Mathematics	Applied Linear Algebra
			221	Theory-	·I	
			OE/GE			

	MTGET-	General	Elective	Ouantitative Aptitude-I
	111	Theory-1		
	MTGET-	General	Elective	Basic Mathematics - I
	112	Practical-1		
	MTGET-	General	Elective	Quantitative Aptitude-II
	121	Theory-2		
UE/UE	MTGET-	General	Elective	Basic Mathematics-II
	122	Practical -2		
	MTGET-	General	Elective	Basic Calculus
	211	Theory-3		
	MTGEP-	General	Elective	Practical on Basic Calculus
	221	Practical -3		

SEMESTER-I

NEP- 2020: First Year UG Major Mathematics

Course Code: MTMAT-111

Course Name: Algebra-I

Course Type: Theory

Credits allotted – 2

Lectures allotted - 30

Module –I

Unit 1: Sets Relations and Functions

- 1.1 Sets, Relations, Equivalence relations, Equivalence classes and partitions of a set
- 1.2 Functions, Basic terminology, Types of Functions, Invertibility and Inverse of a Function, Composition of Functions (Excluding theorems only examples).
- 1.3 One-to-one correspondence and the cardinality of a set. Countable and Uncountable sets,

Reference Book 2 - [page no. 1 -114)

Unit2: Divisibility Theory in the Integers

Well ordering principle, First Principle of Finite Induction and Examples 2.1

2.2 Divisibility, The division algorithm in \mathbb{Z} (without proof), the Euclidean algorithm,

2.3 The greatest common divisor, Euclid's Lemma, The least common multiple,

Diophantine equation ax + by = c, theorem on linear Diophantine equation 2.4 (without Proof) and examples

Reference Book 1 - [page no. 1 - 38)

Module -II

Unit 3: Primes and the theory of Congruence

- 2.1 Prime numbers, Fundamental theorem of arithmetic,
- 2.2 Congruence relation, Basic properties of congruence, Fermat theorem, Euler's phi-function and it's properties (without proof), Euler's theorem,
- 2.3 Encryption and decryption using Caesar cipher
- 2.4 RSA public-key cryptosystem

Reference Book 1 - [page no.39 -84, page no. 197-208]

Reference Books:

(10 Lectures)

(10 Lectures)

(10 Lectures)

- 1. Elementary Number Theory, David M. Burton, Tata McGraw Hill, Sixth Edition.
- 2. A Foundation Course in Mathematics, Ajit Kumar, S. Kumaresan, Bhaba Kumar Sarma, Narosa Publication

Course Outcomes:

<u>**CO-1**</u> : State the basic terminology in functions.

<u>CO-2</u>: Use it to find inverse of a Function, composition of Functions.

<u>CO-3</u>: Find equivalence classes and partitions of a set for given relation.

<u>CO-4</u> : Solve linear Diophantine equations.

<u>CO-5</u>: Apply Fermat theorem, Euler's phi-function to given examples.

<u>CO-6</u> : Explain the RSA public-key cryptosystem.

SEMESTER-I Major Paper No: II

Course Code: MTMAT-112		Course Type- Theory	
Course Na	me: Calculus-I		
Credits All	lotted:2	Lectures Allotted: 30	
Mod	<u>ule -1</u>		
Unit	1: Real Numbers	(6 Lectures)	
1.1	The Algebraic and Order Properties of R		
1.2	Absolute Value and the Real Line		
1.3	The Completeness Property of R		
1.4	Applications of the Supremum Property		
1.5	Intervals		
Refe	rence Book 1 – (Page Number- 22 to 51)		
Unit	2: Functions and Graphs	(6 Lectures)	
2.1	Domain and range of a function		
2.2	Graphs of functions		
2.3	Operations on functions		
2.4	One to one function		
2.5	Composite functions		
Refe	rence Book 2- (Page Number- 11 to 25)		
Mod	ule -II		
Unit	3: Limit and Continuity	(10 Lectures)	
3.1	Limit of Function	()	
3.2	Limit Theorems, Algebra of limits		
3.3	Continuous Functions. Algebra of Continuous	functions	
3.4	Divergence criteria		
3.5	Functions Continuous on Closed Intervals		
Refe	rence Book 3 (Page no 145 to 171) except page	no 155 and 159(theorem	
4))	lenee Book & (l'age no 1 le to 1, 1, encept page		
Unit	4: Differentiation	(8 Lectures)	
4.1 Deriv	Differentiable Functions, Caratheodary's Theor	rem, The chain rule,	
Δ 2	Mean Value Theorems		
т.2 Л З	Indeterminate forms I 'Hospital Rule		
н.J Л Л	Taylor's Theorem Taylor's series Maclaurin'	theorem Maclaurin's	
serie	S	5 moorem, waarauriii 5	

4.5 Successive Differentiation and Leibnitz TheoremReference Book 1 - (Page Number- 157 to 192)Reference Book 2- (Page Number- 172 to 173, 179 to 180)

Reference Books:

- 1. Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons Inc, Fourth Edition.
- 2. Differential Calculus by Shanti Narayan and P.K. Mittal, S.Chand Publication
- 3. Mathematical Analysis, S. C. Malik and Savita Arora, New Age International Publications, 6th Edition.

Course Outcomes:

<u>**CO-1**</u> : State the properties of real numbers.

<u>CO-2</u> : Apply properties of real numbers to prove some inequalities.

<u>CO-3</u>: Find domain and range of function and plot graph of the function.

<u>**CO-4**</u>: Use graph of function to find out the profit and loss depending on the nature of the graph.

<u>CO-5</u> : Define limit and continuity of functions.

<u>**CO-6**</u> : Apply definition to prove limit and continuity theorem.

SEMESTER-I

Major Paper No: III

Course Code: MTMAP-113Course Type: PracticalCourse Name: Mathematics Practical based on Algebra-I and Calculus-ICredits Allotted-2Lectures Allotted - 12

- 1. Practical on Equivalence relations, Equivalence classes
- 2. Practical on Principle of Finite Induction
- 3. Practical on the Euclidean algorithm and greatest common divisor
- 4. Practical on Fermat theorem, Euler's phi-function
- 5. Practical on RSA public-key cryptosystem
- 6. Practical on Inverse of a Function, Composition of Functions
- 7. Practical on Real Numbers
- 8. Practical on Function and Graphs
- 9. Practical on Limit of function.
- 10. Practical on Continuous functions.
- 11. Practical on Differentiable functions and Mean Value Theorem.
- 12. Practical on Successive Differentiation and Indeterminate forms.

Course Outcomes:

<u>**CO-1</u>**: Use basic terminology in functions to find the inverse of a Function and composition of functions.</u>

<u>CO-2</u>: Find GCD using Euclidean Algorithm, equivalence classes and partitions of a set for a given relation

- **<u>CO-3</u>**: Apply Fermat theorem, Euler's phi-function to given examples.
- **<u>CO-4</u>** : Find domain and range of function and plot graph of the function.
- **<u>CO-5</u>** : Find limit of function and check continuity of a function.

<u>CO-6</u> : Check differentiability of functions and find successive differentiation.

SEMESTER-I IKS

Course Code: MTIKT-111 C	ourse Type- Theory
Course Title: Vedic Mathematic	
Credits Allotted – 2 Lo	ectures Allotted: 30
Module -I	
Unit 1- Introduction to Vedic Mathematics	(6 Lectures)
1.1 How to predict a person's Date of Birth	, , , , , , , , , , , , , , , , , , ,
1.2 How to Predict a Person's pocket money	
1.3 How to Find the answer without knowing the equa	tion
Reference book 1-(page numbers 15 to 20)	
Unit .2-Multiplication, Squaring, Cube root and Squa	are root (9 Lectures)
2.1 Miscellaneous Simple Method	
2.2 Criss-cross system of Multiplication	
2.3 Squaring Numbers	
2.4 Cube roots of Perfect Cubes	
2.5 Square root of perfect Squares	
Reference book 1-(page numbers 21 to 64)	
Module -II	
Unit .3 - Base Methods and Application of Vedic Mat	thematics (10 Lectures)
3.1 Base Method of Multiplication	
3.2 Base Method of Division	
3.3 Base Method of Squaring	
3.4 Magic Squares	
3.5 Dates and Calendars	
3.6 Simultaneous Linear Equation	
Reference book 1-(page numbers 65 to 83 -3.1,3)	.2 & 130-138-3.3)
(page numbers 90 to 114-3.4,3	3.6)
Unit .4 - Square root and Cube	(5 Lectures)
4.1 Square Roots of Imperfect Squares	
4.2 Cubing Numbers	
Reference book 1-(page numbers 115 to 130)	
Reference Books	
1. Vedic Mathematics Made Easy Published by Dhaval	Batia
2. Vedic Mathematics by Jagadguru Swami sri Bharati	Krishna Tirthaji Maharai
3. Speed Mathematics by Bill Hanley	······································

Course Outcomes:

<u>CO-1</u>: State different methods in Mathematics in ancient India.

<u>CO-2</u>: State the method of predicting a person's Date of Birth

<u>CO-3</u>: Explain Criss-cross system of Multiplication of any two numbers

<u>CO-4</u>: Solve Magic Squares using techniques of Vedic Mathematics

<u>CO-5</u>: Apply tricks of Vedic Mathematics to find Square Roots of Imperfect Squares

<u>**CO-6**</u>: Find connections between methods in ancient Indian Mathematics to Modern Mathematics.

SEMESTER-I

Vocational Mathematics Theory-I

Course Code- MTVST-111 Course Name- Python Programming Credits Allotted-2 **Course Type-Theory**

Lectures Allotted: 30

Module -I

Unit 1 : Introduction to Python

- 1.1. Features of Python
- 1.2. Types of errors in Python, Print Function
- 1.3. Values and types: int, float and str,
- 1.4. Variables, Variable names and Keywords
- 1.5. Interactive mode and Script mode

1.6. Variables: assignment statements, printing variable values, types of variables.

- 1.7. Mathematical Operators, operands and Rules of precedence: PEMDAS
- 1.8. String operations: + : Concatenation, * : Repetition, Comment
- 1.9. Use of input function Reference book 1-(page numbers 1 to 18)

Unit 2: Conditional Statements and looping

- 2.1 Operators: Arithmetic, assignment, Logical, Relational operators
- 2.2 if, if-else, if-elif-else, Constructs
- 2.3 if- elif-else Ladder
- 2.4 while loop
- 2.5 for loop Reference book 2-(3.1 to 3.4, 3.7, 4.1, to 4.3)

Module -II

Unit 3: String, list, tuple 3.1 Strings:

- 3.1.1 Length (Len function)
- 3.1.2 String traversal: Using while statement, Using for statement
- 3.1.3 String slice

3.2 Lists:

- 3.2.1 List operations
- 3.2.2 Use of range function
- 3.2.3 Accessing list elements
- 3.2.4 List membership and for loop
- 3.2.5 List operations

[10 Lectures]

[10Lectures]

[10 Lectures]

3.2.6 Updating list: addition, removal or updating of elements of a list

3.3 Tuples:

- 3.3.1 Defining a tuple,
- 3.3.2 Index operator,
- 3.3.3 Slice operator,
- 3.3.4 Tuple assignment,
- 3.3.5 Tuple as a return value Reference book 2-(2.1, 2.2, 2.3, 2.4)

Unit 4: Iterations and Conditional statements

[10 Lectures]

- 4.1 Features of functions
- 4.2 Basic Terminology
- 4.3 Types of functions
- 4.4 Linear search
- 4.5 Recursion Reference book 2-(5.1 to 5.8)

Reference Books:

- 1. Allen Downey, Think Python, How to Think Like a Computer Scientist, Green Tea Press Needham, Massachusetts, 2015,
- 2. Python Basics by H. Bhasin

3. Robert Johansson, Introduction to Scientific Computing in Python, 2016

Course Outcome:

<u>CO-1</u>: To understand why Python is a useful scripting language for developers.

<u>**CO-2**</u>: To learn how to use lists, tuples, and dictionaries in Python programs.

<u>**CO-3**</u>: To learn and understand python looping, control statements and string manipulations.

<u>CO-4</u>: To acquire programming skills in core Python.

<u>**CO-5**</u>: The student will be able to explain basic principles of Python programming language.

<u>CO-6</u>: The student will implement object oriented concepts.

SEMESTER-I

NEP- 2020: First Year General Elective			
Course Code: MTGET - 111	Course Type: Theory		
Course Name: Quantitative Aptitude-I			
Credits allotted – 2	Lectures Allotted - 30		
Module -I			
Unit 1: Number System	[8 lectures]		
1. Introduction			
2. Divisibility			
3. Divisibility Tests			
4. Primes composite numbers			
5. Co Primes numbers			
Reference book 2- (page numbers -3 to 50)			
Unit 2: HCF and LCM	[8 lectures]		
1. Factors			
2. HCF			
2.1 Factorization Method			
2.2 Division Method			
3. LCM			
3.1Factorization method			
4. HCF and LCM of fractions			
Reference book 2- (page numbers – 51 to 68)			
Module -II			
Unit 3: Quantitative Ability	[8 lectures]		
1. Average			
2. Concept of Percentage			
3. Results on Population			
4. Results on Depreciation			
Reference book 2-(page numbers – 206 to 2	239, 308 to 373)		
Unit 4: Quantitative Approach	[6 lectures]		
1. Indices			
2. Problems on Numbers			
3. Problems on Ages			
Reference book 2 -(page numbers 278 to 29	(6, 240 to 277)		

Reference Books:

1. Quantitative Aptitude by R.S. Agarwal

Course Outcomes:

<u>CO-1</u>: State the Number System, LCM and HCF of numbers.

<u>CO-2</u>: Understand basic concept in examples of factors

<u>CO-3</u>: Learn Average and Percentage

<u>CO-4</u>: Analyze population problems

<u>CO-5</u>: Solve examples on Numbers and ages

<u>CO-6</u>: Apply the logical reasoning skills to solve problems

SEMESTER-I

NEP- 2020: First Year General Elective				
	Course Code: MTGET - 112	Course Type: Theory		
	Course Name: Basic Mathematics - I			
	Credits allotted – 2	Lectures allotted – 30		
	Module-I			
	Unit 1: Area and Volume	[8 lectures]		
1.	Area			
	1.1 Results on Triangles			
	1.2 Results on Quadrilateral			
2.	Volume			
	2.1 Cuboid			
	2.2 Cube			
	2.3 Cylinder			
	2.4 Cone			
	2.5 Sphere			
3.	Surface Area			
	Reference book 2(page numbers 688 to 813			
	Unit 2: Calendar and Clock Problems	[7 lectures]		
	1. Calendars			
	2. Clocks			
	3. Seating Arrangement			
	Reference book 2 (page numbers 819-833)			
	Module-II			
	Unit 3: Surds and Indices	[8 lectures]		
	1. Simplification			
	2. Indices			
	1.1 Introduction			
	1.2 Laws of Indices			
	1. Surds			
	2.1 Introduction			
	2.2 Laws of Surds	2 0 < 0 2 0		
	Reference book 2 (page numbers 95-179 qnd 278 t	io 296-833)		

Unit 4: Quantitative Ability

[7 lectures]

1. Square Roots

- 2. Cube Roots
- 3. Ratio
- 4. Proportion

Reference book 2 -- (page numbers 95-179 and 278 to 296)

Reference Books:

1. Quantitative Aptitude by R.S. Agarwal

Course Outcomes:

<u>CO-1</u>: Understand the concepts Area, Volume and Surface Area.

<u>CO-2</u>: Understand basic concept in examples of Surds and Indices.

<u>CO-3</u>: Solve problems on clocks

<u>CO-4</u>: Analyze calendar problems

<u>CO-5</u>: Solve examples on Square roots and cube roots

<u>CO-6</u>: Apply the logical reasoning skills to solve problems

SEMESTER-I Skill Mathematics Theory-I

Course Code- MTSET-111 Course Name- Analytical Geometry of 3D Credits Allotted-2 **Course Type- Theory**

Lectures Allotted: 30

Module -I

Unit 1: Planes

- 1. Direction cosines and direction ratios,
- 2. Equation of plane, Normal form, Transform to the normal form, Plane passing through non-collinear points, Intercept form,
- Angle between two planes. Distance of a point from a plane, Distance between parallel planes, Systems of planes, two sides of planes, Bisector planes

Reference book 1-(page numbers 19 to 28)

Unit 2: Lines in three dimension

- 1. Equations of a line in Symmetric and unsymmetrical forms, Line passing through two points, Angle between a line and a plane.
- Perpendicular distance of a point from a plane, Condition for two lines to be Coplanar, number of arbitrary constants in the equation of line. Reference book 1-(page numbers 37 to 60)

Module - II

Unit 3: Sphere

- 1. Equation of a sphere in different forms, plane section of a sphere.
- 2. Sphere through a given circle.
- 3. Intersection of a sphere and a line, equation of Tangent plane to the Sphere. <u>Reference book 1-(page numbers 85 to 93)</u>

Unit 4: Cones and Cylinders

- 1. Equation of a cone, Cone with vertex at the origin, The Right circular Cone, Equation of a right circular cone
- 2. Equation of a cylinder, right circular cylinder Reference book 1-(page numbers 110 to 121)

Reference Books:

1. Analytical Solid Geometry: Shanti Narayan; S. Chand and Company Ltd, New Delhi, 1998.

(6 lectures)

(6 lectures)

(12 Lectures)

(6 lectures)

Course Outcomes :

<u>CO-1</u>: Define the Direction cosines and direction ratios of line.

<u>CO-2</u>: State the different forms of equations of plane, symmetric and unsymmetrical forms of line.

<u>CO-3</u>: Derive Condition for two lines to be Coplanar

<u>CO-4</u>: Find the equation of sphere through a given circle.

<u>CO-5</u>: Solve examples on calendar and clock

<u>CO-6</u>: Find equations of right circular cone and right circular cylinder

SEMESTER-II Major Paper No: I

Course Code-MTMAT-121 Course Name- Algebra-II Credits Allotted-2 **Course Type-Theory**

Lectures Allotted: 30

(10 Lectures)

(8 Lectures)

Module -I

Unit 1: Complex Numbers

- 1.1.Sums and Products of complex numbers, Basic Algebraic Properties,
- 1.2.Moduli, Argument, Complex Conjugates and Exponential form of complex number
- 1.3.Product and powers in the exponential form of complex number
- 1.4.Roots of Complex Numbers using De Moivre's theorem, The nth roots of unity

Reference book 1-(page numbers 1 to 34)

Unit 2: Polynomials

- 2.1.Integral rational functions or polynomials.
- 2.2. Multiplication of polynomials.
- 2.3. Division of polynomials.
- 2.4. The remainder theorem.
- 2.5.Synthetic division.
- 2.6. Highest Common divisor of two polynomials.
- 2.7. The fundamental theorem of Algebra.
- 2.8. Relations between roots and coefficients.

Reference book 2 -(page numbers 35 to 50)

Module -II

Unit3: Matrices and System of linear equations

(10 Lectures)

- 3.1 Introduction to Systems of Linear Equations
- 3.2 Gaussian Elimination
- 3.3 Inverses; Algebraic Properties of Matrices
- 3.4 Elementary Matrices and Method for Finding A⁻¹
- 3.5 More on Linear Systems and Invertible Matrices
- 3.6 Diagonal, Triangular, and Symmetric Matrices
- 3.7 LU Decomposition

- 3.8 Determinants by Cofactor Expansion
- 3.9 Evaluating Determinants by Row Reduction
- 3.10 Properties of Determinants; Cramer's Rule

Reference book 1-(page numbers 1 to 160)

Reference Books:

1. Complex Variables and Applications, James Ward Brown and Ruel V. Churchill, Mc-Graw Hill, Seventh Edition

Unit 1: Chapter 1

- 2. Theory of Equations, J. V. Uspensky, McGraw Hill Book Company.
- 3. Elementary Linear Algebra by Howard Anton, Chris Rorres, 11th edition.

Course Outcomes:

- <u>CO-1</u>: State the argument, modulus and algebraic properties of complex numbers.
- **<u>CO-2</u>**: Use it to prove some inequalities in complex numbers.
- **<u>CO-3</u>**: Find roots of polynomials using factor theorem.
- <u>CO-4</u>: Apply method of Gaussian elimination and elementary matrices to find inverse of Matrix.
- **<u>CO-5</u>**: Evaluating Determinants by Row Reduction and cofactor expansion.
- **<u>CO-6</u>**: Explain the relations between roots and coefficients.

SEMESTER-II Major Paper No: II

Course Code- MTMAT-122 Course Name- Calculus-II Credits Allotted-2

Course Type- Theory

Lectures Allotted: 30

Module	<u>I</u>	
Unit 1:	Integration	(8 Lectures)
1.1.	Upper Sum, Lower Sum and Riemann Integration	
1.2.I	ntegral as a sum	
1.3.	Definite integral	
1.4.	Integration by substitution	
1.5.	Integration by parts	
1.6.	Integration of algebraic rational functions	
1.7.I	ntegration of trigonometric functions	
F	Reference Book 1- (Page numbers – 1, 5 to 7, 21 to 37)	
Unit 2:	Application of Integration	(4 Lectures)
2.1.	Area of plane regions	
2.2.	Length of plane curves	
2.3.	Volume	
	Reference Book 1- (Page Numbers – 153 to 161, 183 to 1	88, 196 to 207)
Module	<u>>-11</u>	
Unit 3:	Differential Equation	(10 Lectures)
3.1	Definition, Order, Degree, Solution	
3.2	Formation of Differential Equation	
3.3	Equations in which variables are separable	
3.4	Linear Equations	
3.5	Equations reducible to the Linear form	
3.6	Homogeneous Equations	
3.7	Equations reducible to Homogeneous form	
3.8	Exact Differential Equations	
3.9	Integrating Factors	
	Reference Book 1- (Page Numbers – 234 to 155)	
Unit4:	Application of First Order Differential Equation	(8 Lectures)
4.1	Growth and Decay	
4.2	Cooling and Mixing	

- 4.3 Elementary Mechanics
- 4.4 Applications to Curves
 Reference Book 2 (Page Numbers 130 to 161, 179 to 193)

Reference Books:

- 1. Integral Calculus by Shanti Narayana, First Edition, S. Chand Publication
- 2. Elementary Differential equations, William F. Trench

Course Outcomes:

<u>CO-1</u>: Define Integration of function.

- **<u>CO-2</u>**: Find integration by substitution and by parts.
- <u>CO-3</u>: Apply the definition of integral to find the length, area and volume of curve or region.
- <u>CO-4</u>: Define the Differential equation, Homogeneous equation, Exact differential equation and Integrating factor.
- <u>CO-5</u>: Identify the type of differential equation and use appropriate method to solve the differential equation
- <u>CO-6</u>: Apply differential equations to solve problems of growth and decay, cooling and mixing, etc.

SEMESTER-II

Major Paper No: III

Course Code: MTMAP-123Course Type- PracticalCourse Name- Mathematics Practical based on Algebra-II and Calculus-IICredits Allotted-2Lectures Allotted: 12

- 1. Practical Complex Numbers-I
- 2. Practical Complex Numbers-II
- 3. Practical Polynomials-I
- 4. Practical Polynomials-I
- 5. Practical Matrices and System of linear Equations-I
- 6. Practical Matrices and System of linear Equations-I
- 7. Practical on Integration-I.
- 8. Practical on Integration-II.
- 9. Practical on Application of Integration.
- 10. Practical on Differential Equation-I.
- 11. Practical on Differential Equation-II.
- 12. Practical on Application of Differential Equations.

Course Outcomes:

- <u>**CO-1:**</u> State the argument, modulus and algebraic properties of complex numbers and use it to prove some inequalities in complex numbers.
- <u>CO-2:</u> Find roots of polynomials using factor theorem and apply method of Gaussian elimination and elementary matrices to find inverse of Matrix.
- **<u>CO-3:</u>** Evaluating Determinants by Row Reduction and cofactor expansion and the relations between roots and coefficients.
- <u>CO-4:</u> Apply the definition of integral to find the length, area and volume of curve or region.
- <u>CO-5</u>: Identify the type of differential equation and use appropriate method to solve the differential equation
- <u>CO-6</u>: Apply differential equations to solve problems of growth and decay, cooling and mixing, etc.

SEMESTER-II Minor Mathematics Paper 1

Course Code- MTMIT-121 Course Name- Matrix Algebra Credits Allotted-2 **Course Type- Theory**

Lectures Allotted: 30

Module-I(6 Lectures)Unit 1: Matrices(6 Lectures)1.1. Matrix Operations1.2. The Inverse of a Matrix1.3. Characterization of Invertible Matrices
Reference book 1, chapter1(Page no 6 to 29)
Reference book 2, chapter1(Page no 4 to 10)
Chapter2(Page no 12 to 48)Unit 2: Determinants(5 Lectures)

- 2.1 Cofactor Expansion
- 2.2 Properties of Determinants
- 2.3 Cramer's RuleReference book 1, chapter-3(Page no 69 to 89)Reference book 2, chapter-3(Page no 63 to 110)

Module-II

Unit 3 : System of Linear equations and Matrices

(8 Lectures)

- 3.1 Linear Equations
- 3.2 System of Linear Equations
- 3.3 Homogeneous and Non Homogeneous System of Linear Equations
- 3.4 Row Reduction and Echelon Forms
- 3.5 The Matrix Equation AX=B

Reference book 1, chapter-2(sec 3.1,3.2 - page no 57 to 67, sec 3.4- page no 39 to 50)

Reference book 2, chapter-6(Sec 3.3- Page no 155to 173)

Unit 4: Eigen Values and Eigen Vectors

(8 Lectures)

- 4.1 Eigenvalues and Eigenvectors
- 4.2 Triangularization of a matrix
- 4.3 Jordan Canonical form
- 4.4 Diagonalization of Matrix

Reference book 1, chapter-6(page no 140 to 159)

Text Books:

- 1. First Course in Linear Algebra: P B Bhattacharya, S.K. Jain , S.R. Nagpaul (New age international Publishers)
- 2. A Text book of Matrices :Shanti Narayan, P.K. Mittal (S. Chand Publishers)

Reference Books:

- 1. N.S. Gopalkrishnan: University Algebra (Wiley Eastern Ltd)
- 2. I.N. Herstein: Topics in Algebra (Wiley Eastern Ltd)

Course Outcomes:

- **<u>CO-1</u>**: Define Matrices and properties of Matrices, elementary matrices.
- **<u>CO-2</u>**: Illustrate it by finding solution of system of linear equations.
- **<u>CO-3</u>**: Determine determinants of a matrix
- <u>**CO-4**</u> : Find inverse of a matrix using Gaussian elimination method.
- **<u>CO-5</u>** : Evaluate Eigen values and eigenvectors of a matrix
- **<u>CO-6</u>** : Apply Diagonalization to a matrix

SEMESTER-II

Vocational Mathematics Practical-II

Course Code :MTVSP-122

Course Type- Practical

Course Name: Practical on Python Programming Credits Allotted-2

Lectures Allotted: 30

Practical 1: Introduction to Python, Python Data Types-I
Practical 2: Python Data Types- II
Practical 3: Control statements in Python-I
Practical 4: Control statements in Python-II
Practical 5: Practical on Strings
Practical 6: Practical on Iterations and Conditional statements
Practical 7: Application: Matrices
Practical 8: Application: Determinants, system of Linear Equations
Practical 9: Application: System of equations
Practical 10: Practical on List
Practical 11: Practical on Tuples

Practical 12: Practical on Functions

Course Outcome:

- **<u>CO-1</u>**: To understand why Python is a useful scripting language for developers.
- **<u>CO-2</u>**: To use lists, tuples, and dictionaries in Python programs.
- **<u>CO-3</u>**: To apply python looping, control statements and string manipulations.
- **<u>CO-4</u>**: To acquire programming skills in core Python.
- **<u>CO-5</u>**: The student will be able to explain basic principles of Python programming language.
- **<u>CO-6</u>**: The student will implement object oriented concepts.

SEMESTER-II

NEP- 2020: First Year UG Major Mathematics

Course Code: MTGET - 121

Course Type: Theory

Course Name: Quantitative Aptitude - II Credits allotted - 2

Lectures allotted - 30

Module-I

Unit 1: Simple and Compound Interest	(8 lectures)
1. Revision (Ratio, Proportion and percentage	
2. Concept of Present value and Future value,	
3. Simple interest,	
4. Compound interest,	
5. Nominal and Effective rate of interest,	
6. Examples and Problems	
Reference book 1:(Page no 641 to 687)	
Unit 2: Profit and Loss	(8 lectures)
1. Cost Price	
2. Selling Price	
3. Profit or Gain	
4. Loss	
5. Profit Percentage and Profit Loss	
Reference book 1:(Page no 374 to 425)	

Module-II

Unit 3 :

Unit 4: Data Interpretation I	(8 lectures)
1. Data interpretation	
2. Bar Graphs	
3. Examples on Bar Graphs	
Reference book 1:(Page no 887 to 922)	

(8 lectures)

Unit 4: Data Interpretation II

Pie Chart

 Introduction
 Examples on Pie Chart

 Venn Diagrams

 Introduction
 Introduction
 Examples on Venn Diagrams
 Reference book 1:(Page no 923 to 952)

Recommended Books:

- 1. Quantitative Aptitude by R.S. Agarwal
- 2. Business Mathematics with Applications Dinesh Khattar & S. R. Arora S. Chand Publishing New Delhi.

Course Outcome:

- **<u>CO-1</u>** : To understand the ratio and proportion
- **<u>CO-2</u>**: To understand cconcept of Present value and Future value
- **<u>CO-3</u>** : To understand the concept of Profit and Loss
- **<u>CO-4</u>**: To find simple interest, compound interest.
- **<u>CO-5</u>** : To use concepts of data interpretation
- <u>**CO-6**</u> : To apply the techniques to solve problems in Business and Economics.

SEMESTER-II

NEP- 2020: First Year UG Major Mathematics		
Course Code: MTGET - 122	Course Type: Theory	
Course Name: Basic Mathematics – II Credits allotted – 2	Lectures allotted - 30	
Module-I		
Unit 1: Time, work and Distance	(8 lectures)	
1. Time and work		
2. Time and Distance		
3. Boats and Streams		
4. Problems on Trains		
Reference book 1:(Page no 526 to 632)		
Unit 2: Discount	(7 lectures)	
1. True Discount		
1.1 Present worth		
2.1 True Discount		
2. Bankers Discount		
2.1 Bankers Gain		
2.2 Bankers Discount		
Reference book 1:(Page no 861 to 869)		
Module-II		
Unit 3: Combinatorial Approach	(8 lectures)	
1. Odd man out and series		

- 1. Permutation
- 2. Combination
- 3. Probability

Reference book 1:(Page no 841 to 860, 877-883)

(7 lectures)

Unit 3: Partnership and chain Rule

- 1. Partnership
- 2. Chain Rule
- 3. Pipes and Cisterns
- Reference book 1:(Page no 476-525)

Recommended Books:

1. Quantitative Aptitude by R.S. Agarwal

2. Business Mathematics with Applications Dinesh Khattar & S. R. Arora S. Chand Publishing New Delhi.

NEP- 2020: First Year UG Major Mathematics Skill Mathematics Practical-I

Course Code: MTSEP-121

Course Type: Practical

Course Name: Practical on Analytical Geometry of three dimensions Credits allotted – 2 Lectures allotted - 30

Practical 1: Direction Ratios and Direction Cosines
Practical 2: Planes-I
Practical 3: Planes - II
Practical 4: Lines in three dimensions - I
Practical 5: Lines in three dimensions - II
Practical 6: Sphere - I
Practical 7: Sphere - II
Practical 8: Sphere - III
Practical 9: Cone - I
Practical 10: Cone - II
Practical 11: Cylinder - I

Practical 12: Cylinder - II

Course Outcomes :

<u>CO-1</u>: Define the Direction cosines and direction ratios of line.

<u>CO-2</u>: State the different forms of equations of plane, symmetric and unsymmetrical forms of line.

<u>CO-3</u>: Derive Condition for two lines to be Coplanar

<u>CO-4</u>: Find the equation of sphere through a given circle.

<u>CO-5</u>: Solve examples on calendar and clock

<u>CO-6</u>: Find equations of right circular cone and right circular cylinder