P. D. E. A's

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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**

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

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

   (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 – 2nd 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 CGPA obtained in the ten semesters 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.

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

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)

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;

ii. Wherever applicable vocational courses will include skills based on 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	CC	Total Credits
First Year Certificate Course												
I	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
II	2 theory + 1 Practical	0	1 Theory	1 Practical	0	0	1 theory + 1 Practical	1 theory/ practical	1 theory	1 theory	2 Credit	22
Second Year Graduate Diploma												

III	3 theory + 1 Practical	0	1 Theory + 1 Practical	1 Theory	0	FP (2 Credit)	1 theory	0	1 theory		2 Credit	22
IV	3 theory + 1 Practical	0	1 Theory + 1 Practical	0	0	CEP (2 Credit)	1 Practical	1 theory/ practical	1 theory		2 Credit	22
Third Year Graduate Degree												
V	3 theory + 2 Practical	1 Theory + 1 Practical	1 Theory + 1 Practical	1 Practical	0	FP/CEP (2 Credit)	0	0	0	0	0	22
VI	3 theory + 2 Practical	1 Theory + 1 Practical	1 Theory + 1 Practical	0	0	OJT (4 Credit)	0	0	0	0	0	22
VII and VIII Semester honours degree with major												
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
VII and VIII Semester honours degree with research												
VII	4 theory + 1 Practical	1 Theory + 1 Practical	RM 4 Credits	0	0	RP (4 Credit)	0	0	0	0	0	22
VIII	4 theory + 1 Practical	1 Theory + 1 Practical	0	0	0	RP (8 Credit)	0	0	0	0	0	22

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	CC	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
X	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:

	Major, Major Elective and VSC Courses			
Semester	**Course Type**	**Course code**	**Generic Name**	**Title of the paper**
I	Major	MTMAT-111	Mathematics theory paper-1	Algebra-I
		MTMAT-112	Mathematics theory paper-2	Calculus-I
		MTMAP-113	Mathematics practical paper-1	Practical based on Algebra-I and Calculus-I
	VSC (Related to Major)	MTVST-111	Vocational Mathematics theory-I	Python Programming
	IKS	MTIKT-111	IKS theory-I	Vedic Mathematics
II	Major	MTMAT-121	Mathematics theory paper-3	Algebra-II
		MTMAT-122	Mathematics theory paper-4	Calculus-II
		MTMAP-123	Mathematics practical paper-2	Practical based on Algebra-II and Calculus-II
	VSC (Related to Major)	MTVSP-121	Vocational Mathematics Practical-I	Practical on Python Programming
III	Major	MTMAT-231	Mathematics theory paper-5	Multivariable Calculus
		MTMAT-232	Mathematics theory paper-6	Graph Theory
		MTMAT-233	Mathematics theory paper-7	Operation Research
		MTMAP-234	Mathematics practical paper-3	Mathematics Practical Based on Multivariable Calculus and Operation Research and Graph Theory.
	VSC (Related to Major)	MTVST-231	Vocational Mathematics theory-II	Numerical Analysis

IV	Major	MTMAT-241	Mathematics theory paper-8	Combinatorics
		MTMAT-242	Mathematics theory paper-9	Linear Algebra
		MTMAT-243	Mathematics theory paper-10	Ordinary Differential Equation
		MTMAP-244	Mathematics practical paper-4	Mathematics Practical Based on Linear Algebra
V	Major	MTMAT-351	Mathematics theory paper-11	Metric Spaces
		MTMAT-352	Mathematics theory paper-12	Real Analysis-I
		MTMAT-353	Mathematics theory paper-13	Group Theory
		MTMAP-354	Mathematics practical paper-5	Mathematics Practical Based on Real Analysis-I and Group Theory
		MTMAP-355	Mathematics practical paper-6	Machine Learning-I
	Major Elective	MTMAET-351A	Elective Mathematics theory paper-1-A	Ordinary Differential Equation
		MTMAET-351B	Elective Mathematics theory paper-1-B	Laplace Transform
		MTMAEP-352A	Elective Mathematics practical paper-1-A	Practical on Ordinary Differential Equation
		MTMAEP-352B	Elective Mathematics practical paper-1-B	Practical on Laplace Transform
	VSC (Related to Major)	MTVSP-352	Vocational Mathematics Practical-II	Practical on Latex
VI	Major	MTMAT-361	Mathematics theory paper-14	Complex Analysis
		MTMAT-362	Mathematics theory paper-15	Real Analysis-II
		MTMAT-363	Mathematics theory paper-16	Ring Theory

		MTMAP-364	Mathematics practical paper-7	Mathematics Practical Based on Real Analysis-II and Ring Theory
		MTMAP-365	Mathematics practical paper-8	Machine Learning-II
	Major Elective	MTMAET-363A	Elective Mathematics theory paper-2-A	Optimization Techniques
		MTMAET-363B	Elective Mathematics theory paper-2-B	Partial Differential Equations
		MTMAEP-364A	Elective Mathematics practical paper-2-A	Practical on Optimization Techniques
		MTMAEP-364B	Elective Mathematics practical paper-2-B	Practical on Partial Differential Equations
VII	Major	MTMAT-471	Mathematics theory paper-17	Linear Algebra
		MTMAT-472	Mathematics theory paper-18	Group Theory
		MTMAT-473	Mathematics theory paper-19	Advanced Calculus
		MTMAT-474	Mathematics theory paper-20	Ordinary Differential Equations
		MTMAT-475	Mathematics theory paper-21	Financial Mathematics-I
		MTMAP-476	Mathematics practical paper-11	Mathematics Practical Based on Linear Algebra and Group Theory
		MTMAP-477	Mathematics practical paper-12	Mathematics Practical Based on Advanced Calculus and Financial Mathematics-I
	Major Elective	MTMAET-475-A	Elective Mathematics theory paper-3-A	Python Programming
		MTMAET-475-B	Elective Mathematics theory paper-3-B	Dynamical Systems
		MTMAEP-476-A	Elective Mathematics practical paper-4-A	Practical on Python Programming
		MTMAEP-476-B	Elective Mathematics practical paper-4-B	Practical on Dynamical Systems
	RM	MTRMT-471		Research Methodology

VIII	Major	MTMAT-481	Mathematics theory paper-22	Number Theory
		MTMAT-482	Mathematics theory paper-23	Ring Theory
		MTMAT-483	Mathematics theory paper-24	Measure and Integration
		MTMAT-484	Mathematics theory paper-25	Partial Differential Equations
		MTMAT-485	Mathematics theory paper-26	Integral Equations
		MTMAP-486	Mathematics practical paper-13	Mathematics Practical Based on Number Theory and Ring Theory
		MTMAP-487	Mathematics practical paper-14	Mathematics Practical Based on Measure and Integration and Partial Differential Equations
	Major Elective	MTMAET-487-A	Elective Mathematics theory paper-5-A	Financial Mathematics-II
		MTMAET-487-B	Elective Mathematics theory paper-5-B	Advanced Complex Analysis
		MTMAEP-488-A	Elective Mathematics practical paper-6-A	Practical on Financial Mathematics-II
		MTMAEP-488-B	Elective Mathematics practical paper-6-B	Practical on Advanced Complex Analysis
	On Job Training	MTOJT-481		
	Elective			
V		MTMAET-351A	Elective Mathematics theory paper-1-A	Ordinary Differential Equations
		MTMAET-351B	Elective Mathematics theory paper-1-B	Laplace Transform
		MTMAEP-352A	Elective Mathematics practical paper-1-A	Practical on Ordinary Differential Equations
		MTMAEP-352B	Elective Mathematics practical paper-1-B	Practical on Laplace Transformation
VI		MTMAET-363A	Elective Mathematics theory paper-2-A	Optimization Techniques
		MTMAET-363B	Elective Mathematics theory paper-2-B	Partial Differential Equations

		MTMAEP-364A	Elective Mathematics practical paper-2-A	Practical on Optimization Techniques
		MTMAEP-364B	Elective Mathematics practical paper-2-B	Practical on Partial Differential Equations
VII		MTMAET-475-A	Elective Mathematics theory paper-3-A	Python Programming
		MTMAET-475-B	Elective Mathematics theory paper-3-B	Dynamical Systems
		MTMAEP-476-A	Elective Mathematics practical paper-4-A	Practical on Dynamical Systems
		MTMAEP-476-B	Elective Mathematics practical paper-4-B	Practical on Python Programming
VIII		MTMAET-487-A	Elective Mathematics theory paper-5-A	Financial Mathematics-II
		MTMAET-487-B	Elective Mathematics theory paper-5-B	Advanced Complex Analysis
		MTMAEP-488-A	Elective Mathematics practical paper-6-A	Practical on Financial Mathematics-II
		MTMAEP-488-B	Elective Mathematics practical paper-6-B	Practical on Advanced Complex Analysis
	Vocational Skill Courses (VSC) Related to Major			
I		MTVST-111	Vocational Mathematics theory-I	Python Programming
II		MTVSP-121	Vocational Mathematics Practical-I	Practical on Python Programming
III		MTVST-231	Vocational Mathematics Practical-II	Numerical Analysis
IV		-------	----------	----------
V		MTVSP-352	Vocational Mathematics Practical-II	Practical on Latex
VI		-------	----------	----------
	Minor Mathematics			
I		-------	--------	---------

II		MTMIT-121	Minor Mathematics Theory-1	Linear Algebra
III		MTMIT-231	Minor Mathematics Theory-2	Discrete Mathematics
		MTMIP-232	Minor Mathematics Practical-1	Practical on Discrete Mathematics
IV		MTMIT-241	Minor Mathematics Theory-3	Calculus
		MTMIP-242	Minor Mathematics Practical-2	Practical on Calculus
V		MTMIT-356	Minor Mathematics Theory-4	Numerical Techniques
		MTMIP-357	Minor Mathematics Practical-3	Practical on Numerical Techniques using Python
VI		MTMIP-368	Minor Mathematics Theory-5	Operation Research
		MTMIP-369	Minor Mathematics Practical-4	Practical on Operation Research using Python
	IKS Related to Mathematics Major			
I		MTIKT-111	Indian knowledge system Mathematics paper	Vedic Mathematics
	SEC for science faculty students from Mathematics discipline			
I	SEC	MTSET-111	Skill Mathematics Theory-I	Analytical Geometry of three Dimensions
II		MTSEP-121	Skill Mathematics Practical-I	Practical on Analytical Geometry of three Dimensions
III		------	-----	
IV		MTSET-241	Skill Mathematics Theory-I	Computational Geometry
	OE/GE			
I	GE/OE	MTGET-111	General Elective Theory-1	Quantitative Aptitude-I
I		MTGET-112	General Elective Practical-1	Basic Mathematics - I
II		MTGET-121	General Elective Theory-2	Quantitative Aptitude-II
II		MTGET-122	General Elective Practical -2	Basic Mathematics-II

III		MTGET-231	General Elective Theory-3	Basic Algebra
IV		MTGEP-241	General Elective Practical -3	Practical on Basic Algebra

Program Outcomes:

PO1: Knowledge: The learner is encouraged to use various mathematical methods (analytical and numerical) and experimental methods as an application to the acquired concepts and principles that help in studying various branches of sciences.

PO-2: Problem Analysis: Well equipped with an understanding of the analytical methods involved, they are in a position to interpret and analyse results obtained from experiments and draw suitable conclusions against their supported data acquired.

PO-3:Designing Solutions: Having acquired knowledge of mathematical subjects, students are trained to think out of the box, design and conduct an experiment or a series of experiments that demonstrate their understanding of the mathematical methods and processes involved.

PO-4: Communication: Ability to share ideas and insights while seeking and benefitting from knowledge.

PO-5: Project management and finance: Demonstrate knowledge and understanding of the Mathematical principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-6: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern Mathematical and IT tools including prediction and modelling to Industrial activities with an understanding of the limitations.

PO-7: Self-Directed and Life-Long learning: Work independently, identify appropriate resources required for a project, and manage a project through to completion. Exhibit subject-specific transferable knowledge in Mathematics relevant to job trends and employment opportunities.

Po-8: Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO-9: Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO-10: Science and Society: Learners are encouraged to take up specific projects such as impact of salinity on fresh water wells in an adopted village, and provide effective solutions.

Program Specific Outcomes:

PSO-1: Demonstrate educational skills in areas of Analysis, Geometry, Algebra, Mechanics, Differential Equations, etc.

PSO-2: Help the students to enhance their knowledge in soft skills and Computing skills.

PSO-3: Fulfill one's learning requirements in mathematics, drawing from a range of contemporary research works and their application in diverse areas of Mathematical Sciences.

SEMESTER-I

NEP- 2020: First Year UG Major Mathematics

Course Code: MTMAT-111 **Course Type: Theory**

Course Name: Algebra-I

Credits allotted – 2 **Lectures allotted - 30**

Module –I

Unit 1: Sets Relations and Functions (10 Lectures)

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, One-one and onto function.

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

Unit2: Divisibility Theory in the Integers (10 Lectures)

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

2.2 Divisibility, The division algorithm in z, the Euclidean algorithm,

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

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

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

Module -II

Unit 3: Primes and the theory of Congruence (10 Lectures)

2.1 Prime numbers, Fundamental theorem of arithmetic,

2.2 Congruence relation, Basic properties of congruence, Fermat theorem, Euler's phi-function and its 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:

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:

CO-1 : State the basic terminology in functions.

CO-2 : Use it to find inverse of a Function.

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

CO-4 : Solve linear Diophantine equations.

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

CO-6 : Explain the RSA public-key cryptosystem.

SEMESTER-I

Major Paper No: II

Course Code: MTMAT-112 **Course Type- Theory**

Course Name: Calculus-I

Credits Allotted:2 **Lectures Allotted: 30**

Module -I

Unit 1: Real Numbers **(7 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

Reference Book 1 – (Page Number- 22 to 51)

Unit 2: Functions and Graphs **(8 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

Reference Book 2- (Page Number- 11 to 25)

Module -II

Unit 3: Limit and Continuity **(15 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

Reference Book 3 (Page no 145 to 171, except page no 155 and 159(theorem 4))

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:

CO-1 : State the properties of real numbers.

CO-2 : Apply properties of real numbers to prove some inequalities.

CO-3 : Find domain and range of function and plot graph of the function.

CO-4 : Use graph of function to find out the profit and loss depending on the nature of the graph.

CO-5 : Define limit and continuity of functions.

CO-6 : Apply definition to prove limit and continuity theorem.

SEMESTER-I

Major Paper No: III

Course Code: MTMAP-113 **Course Type: Practical**

Course Name: Mathematics Practical based on Algebra-I and Calculus-I

Credits Allotted-2 **Lectures Allotted - 60**

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:

CO-1 : Use basic terminology in functions to find the inverse of a Function and composition of functions.

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

CO-3 : Apply Fermat theorem, Euler's phi-function to given examples.

CO-4 : Find domain and range of function and plot graph of the function.

CO-5 : Find limit of function and check continuity of a function.

CO-6 : Check differentiability of functions and find successive differentiation.

SEMESTER-I

Skill Mathematics Practical-I

Course Code- MTSEP-111 **Course Type-Practical**

Course Name: Practical on Python Programming

Credits Allotted-2 **Lectures Allotted: 60**

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:

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

CO-2 : To use lists, tuples, and dictionaries in Python programs.

CO-3 : To apply python looping, control statements and string manipulations.

CO-4 : To acquire programming skills in core Python.

CO-5 : The student will be able to explain basic principles of Python programming language.

CO-6 : 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 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 296, 240 to 277)

Reference Books:

1. Quantitative Aptitude by R.S. Agarwal

Course Outcomes:

CO-1 : State the Number System, LCM and HCF of numbers.

CO-2 : Understand basic concept in examples of factors

CO-3 : Learn Average and Percentage

CO-4 : Analyze population problems

CO-5 : Solve examples on Numbers and ages

CO-6 : Apply the logical reasoning skills to solve problems

SEMESTER-II

Major Paper No: I

Course Code-MTMAT-121 **Course Type-Theory**

Course Name- Algebra-II

Credits Allotted-2 **Lectures Allotted: 30**

Module -I

Unit 1: Complex Numbers (10 Lectures)

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 n^{th} roots of unity

Reference book 1-(page numbers 1 to 34)

Unit 2: Polynomials (8 Lectures)

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

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:

CO-1 : State the argument, modulus and algebraic properties of complex numbers.

CO-2 : Use it to prove some inequalities in complex numbers.

CO-3 : Find roots of polynomials using factor theorem.

CO-4 : Apply method of Gaussian elimination and elementary matrices to find inverse of Matrix.

CO-5 : Evaluating Determinants by Row Reduction .

CO-6 : Explain the relations between roots and coefficients.

SEMESTER-II
Major Paper No: II

Course Code- MTMAT-122 **Course Type- Theory**
Course Name- Calculus-II
Credits Allotted-2 **Lectures Allotted: 30**

Module-I

Unit 1: Differentiation (8 Lectures)

1.1 Differentiable Functions, Caratheodary's Theorem, The chain rule, Derivative of Inverse function

1.2 Mean Value Theorems

1.3 Indeterminate forms, L'Hospital Rule

1.4 Taylor's Theorem, Taylor's series, Maclaurin's theorem, Maclaurin's series

1.5 Successive Differentiation and Leibnitz Theorem

Reference Book 2 - (Page Number- 157 to 192)

Reference Book 3- (Page Number- 172 to 173, 179 to 180)

Unit 2: Integration (8 Lectures)

2.1 Definite integral

2.2 Integration by substitution

2.3 Integration by parts

2.4 Integration of algebraic rational functions

2.5 Integration of trigonometric functions

Reference Book 1- (Page numbers – 1, 5 to 7, 21 to 37)

Module-II

Unit 3: Differential Equation (14 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)

Reference Books:

1. **Integral Calculus by Shanti Narayana, First Edition, S. Chand Publication**
2. **Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons Inc, Fourth Edition.**
3. **Differential Calculus by Shanti Narayan and P.K. Mittal, S. Chand Publication**

Course Outcomes:

CO-1 : Define Differentiation and Integration of function and Define the Differential equation, Homogeneous equation, Exact differential equation and Integrating factor.

CO-2 : State and prove Mean Value Theorems.

CO-3 : State Taylor's and Maclaurin's Theorem and Series and find series of different functions.

CO-4 : Find the integration of Algebraic Rational functions and Trigonometric functions.

CO-5 : Identify the type of differential equation and use appropriate method to solve the differential equation

SEMESTER-II

Major Paper No: III

Course Code: MTMAP-123 **Course Type- Practical**

Course Name- Mathematics Practical based on Algebra-II and Calculus-II

Credits Allotted-2 **Lectures 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:

CO-1: State the argument, modulus and algebraic properties of complex numbers and use it to prove some inequalities in complex numbers.

CO-2: Find roots of polynomials using factor theorem and apply method of Gaussian elimination and elementary matrices to find inverse of Matrix.

CO-3: Evaluating Determinants by Row Reduction and cofactor expansion and the relations between roots and coefficients.

CO-4: Apply the definition of integral to find the length, area and volume of curve or region.

CO-5 : Identify the type of differential equation and use appropriate method to solve the differential equation

CO-6 : Apply differential equations to solve problems of growth and decay, cooling and mixing, etc.

SEMESTER-II

Skill Mathematics Theory-I

Course Code- MTSET-121 **Course Type- Theory**

Course Name- Analytical Geometry of 3D

Credits Allotted-2 **Lectures Allotted: 30**

Module -I

Unit 1: Planes (12 Lectures)

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,
3. 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 (6 lectures)

1. Equations of a line in Symmetric and unsymmetrical forms, Line passing through two points, Angle between a line and a plane.
2. 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 (6 lectures)

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.

Reference book 1-(page numbers 85 to 93)

Unit 4: Cones and Cylinders (6 lectures)

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.**

Course Outcomes :

CO-1 : Define the Direction cosines and direction ratios of line.

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

CO-3 : Derive Condition for two lines to be Coplanar

CO-4 : Find the equation of sphere through a given circle.

CO-5 : Solve examples on calendar and clock

CO-6 : Find equations of right circular cone and right circular cylinder

SEMESTER-II

Vocational Mathematics Practical-II

Course Code :MTVSP-121 **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:

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

CO-2 : To use lists, tuples, and dictionaries in Python programs.

CO-3 : To apply python looping, control statements and string manipulations.

CO-4 : To acquire programming skills in core Python.

CO-5 : The student will be able to explain basic principles of Python programming language.

CO-6 : 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)

Unit 4: Data Interpretation II **(8 lectures)**

1. Pie Chart
   1.1 Introduction
   2.1 Examples on Pie Chart
2. Venn Diagrams
   1.1 Introduction
   2.1 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:

CO-1 : To understand the ratio and proportion
CO-2 : To understand cconcept of Present value and Future value
CO-3 : To understand the concept of Profit and Loss
CO-4 : To find simple interest, compound interest.
CO-5 : To use concepts of data interpretation
CO-6 : 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)

Unit 3: Partnership and chain Rule **(7 lectures)**

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 :

CO-1 : Define the Direction cosines and direction ratios of line.

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

CO-3 : Derive Condition for two lines to be Coplanar

CO-4 : Find the equation of sphere through a given circle.

CO-5 : Solve examples on calendar and clock

CO-6 : Find equations of right circular cone and right circular cylinder

Repeated

SEMESTER-I

Skill Mathematics Theory-I

Course Code- MTSET-111 **Course Type-Theory**

Course Name- Python Programming

Credits Allotted-2 **Lectures Allotted: 30**

Module -I

Unit 1 : Introduction to Python [10 Lectures]

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 [10Lectures]

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 [10 Lectures]

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

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:

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

SEMESTER-I

IKS

Course Code: MTIKT-111 **Course Type- Theory**

Course Title: Vedic Mathematic

Credits Allotted – 2 **Lectures 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 equation
Reference book 1-(page numbers 15 to 20)

Unit .2-Multiplication, Squaring, Cube root and Square 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 Mathematics (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 114-3.4,3.6)

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 Maharaj
3. Speed Mathematics by Bill Hanley

Course Outcomes:

CO-1 : State different methods in Mathematics in ancient India.
CO-2 : State the method of predicting a person's Date of Birth
CO-3 : Explain Criss-cross system of Multiplication of any two numbers
CO-4 : Solve Magic Squares using techniques of Vedic Mathematics
CO-5 : Apply tricks of Vedic Mathematics to find Square Roots of Imperfect Squares
CO-6 : Find connections between methods in ancient Indian Mathematics to Modern Mathematics.

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

Reference book 2 --(page numbers 95-179 qnd 278 to 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:

CO-1 : Understand the concepts Area, Volume and Surface Area.

CO-2 : Understand basic concept in examples of Surds and Indices.
CO-3 : Solve problems on clocks
CO-4 : Analyze calendar problems
CO-5 : Solve examples on Square roots and cube roots
CO-6 : Apply the logical reasoning skills to solve problems

SEMESTER-II

Minor Mathematics Paper 1

Course Code- MTMIT-121 **Course Type- Theory**
Course Name- Linear Algebra
Credits Allotted-2 **Lectures Allotted: 30**

Module-I

Unit 1: Matrices (4 Lectures)

1.1. Matrix Operations
1.2. The Inverse of a Matrix
1.3. 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: System of Linear equations and Matrices (8 Lectures)

2.1 Linear Equations
2.2 System of Linear Equations
2.3 Homogeneous and Non - Homogeneous System of Linear Equations
2.4 Row Reduction and Echelon Forms
2.5 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)

Module-II

Unit 3: Vector Spaces (10 Lectures)

3.1 Definitions and Examples
3.2 Subspaces; Examples on Subspace
3.3 Linearly dependent and Independent sets of vectors

3.4 Basis and Dimension

3.5 Row Space and Column Spaces of a Matrix

Reference book 1, chapter no 4 (sec 4.1,4.2,4.3 page no 95 to 111)
Reference book 2, chapter no 5 ,(sec 5.2,5.3,5.4,5.7 page no 138 to 153)

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:

Course Outcomes:

CO-1 : Define Matrices and properties of Matrices, elementary matrices.

CO-2 : Illustrate it by finding solution of system of linear equations.

CO-3 : Determine determinants of a matrix

CO-4 : Find inverse of a matrix using Gaussian elimination method.

CO-5 : Evaluate Eigen values and eigenvectors of a matrix

CO-6 : Apply Diagonalization to a matrix