ST JOSEPH'S COLLEGE

Devagiri, Kozhikode,
Kerala, India

FYUGP Regulations 2024

B.Sc. ECONOMICS AND MATHEMATICS HONOURS

(MAJOR, ELECTIVE AND GENERAL FOUNDATION COURSES)

SYLLABUS
(w.e.f. 2024 admission)

MODEL QUESTION PAPERS

FYUGP REGULATIONS

B.Sc. ECONOMICS AND MATHEMATICS HONOURS

PROGRAMME OUTCOMES (PO):

At the end of the graduate programme at St Joseph's College Devagiri(Autonomous) affiliated to the University of Calicut, a student would:

PO1	Knowledge Acquisition: Demonstrate a profound understanding of knowledge trends and their impact on the chosen discipline of study.
PO2	Communication, Collaboration, Inclusiveness, and Leadership: Become a team player who drives positive change through effective communication, Collaborative acumen, transformative leadership, and a dedication to inclusivity.
PO3	Professional Skills: Demonstrate professional skills to navigate diverse career paths with confidence and adaptability.
PO4	Digital Intelligence: Demonstrate proficiency invaried digital and technological tools to understand and interact with the digital world, thus effectively processing complex information.
PO5	Scientific Awareness and Critical Thinking: Emerge as an innovative problem-solver and impactful mediator, applying scientific understanding and critical thinking to address challenges and advance sustainable solutions.
PO6	Human Values, Professional Ethics, and Societal and Environmental Responsibility: Become a responsible leader, characterized by an unwavering commitment to human values, ethical conduct, and dedication to the well- being of society and the environment.
PO7	Research, Innovation, and Entrepreneurship: Emerge as a researcher and entrepreneurial leader, forging collaborative partnerships with industry, academia, and communities to contribute enduring solutions for local, regional, and global development.

PROGRAMME SPECIFIC OUTCOMES (PSO):

At the end of the B.Sc. in Economics and Mathematics Honours programme at St Joseph's College Devagiri (Autonomous) affiliated to the Calicut University, a student would:

<table>
<tr><td rowspan="18" style="writing-mode: vertical-rl">PROGRAMME SPECIFIC OUTCOME</td><td>Ability to show the importance of mathematics as precursor to various scientific developments since the beginning of the civilization</td></tr>
<tr><td>Ability to employ critical thinking in understanding the concepts in every area of mathematics</td></tr>
<tr><td>Ability to analyse the results and apply them in various problems appearing in different branches of mathematics</td></tr>
<tr><td>Capability to solve problems using concepts of linear algebra.</td></tr>
<tr><td>Capability to solve various models such as growth and decay models, radioactive decay model, LCR circuits and population models using techniques of differential equations.</td></tr>
<tr><td>Ability to solve linear system of equations, linear programming problems and network flow problems.</td></tr>
<tr><td>Ability to provide new solutions using the domain knowledge of mathematics acquired during this programme</td></tr>
<tr><td>PSO11 Capability for inquiring about appropriate questions relating to the concepts in various fields of mathematics.</td></tr>
<tr><td>To know about the advances in various branches of mathematics</td></tr>
<tr><td>Capability to use appropriate software to solve system of equations and differential equations</td></tr>
<tr><td>Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning</td></tr>
<tr><td>The diversity of courses included in the programme makes the student understand the diverse nature of economic theories.</td></tr>
<tr><td>The Introduction of more quantitative course will help the student to acquire the fundamentals of economic model building.</td></tr>
<tr><td>A blending of the financial and public economics with core courses makes the student to face the real life situations of banking, share markets, budgetary practices etc.</td></tr>
<tr><td>To imbibe the student a new vision in economic studies by creating research content in every course.</td></tr>
<tr><td>The proposed project report in the syllabus will inculcate the students a practice of real research.</td></tr>
<tr><td>Students shall attain a strong foundation of mathematics so that they will be able to solve complicated problems in Economics</td></tr>
<tr><td>The programme will produce good Economists with a sound mathematical background</td></tr>
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MINIMUMCREDITREQUIREMENTSOFTHEDIFFERENTPATHWAYS IN THE THREE-YEAR PROGRAMME IN CUFYUGP

Sl. No.	Academic Pathway	Major	Minor/ Other Disciplines	Foundation Courses AEC:4 MDC:3 SEC:3 VAC:3	Intern -ship	Total Credits	Example
		Each course has 4credits		Each course has3credits			
1	Single Major (A)	68 (17 courses)	24 (6courses)	39 (13courses)	2	133	Major: Economics + six courses in different disciplines in different combinations
2	Major (A) with Multiple Disciplines (B, C)	68 (17 courses)	12+ 12 (3+3=6 courses)	39 (13courses)	2	133	Major: Economics + History and Political Science
3	Major(A) with Minor(B)	68 (17 courses)	24 (6courses)	39 (13courses)	2	133	Major: Economics Minor: History
4	Major (A) with Vocational Minor (B)	68 (17 courses)	24 (6courses)	39 (13courses)	2	133	Major: Economics Minor: Taxation Practices and Procedures
5	Double Major (A,B)	A: 48 (12 courses)	The 24 credits in the Minor stream are distributed between the two Majors. 2MDC, 2SEC, 2VAC and the Internship should be in Major A. Total credits in Major A should be 48 +20 = 68 (50% of 133)				Economics and Mathematics Double major
		B:44 (11 courses)	1MDC,1SEC and1VACshould be in Major B. Total credits in Major B Should be 44+9 = 53 (40% of 133)				
Exit with UG Degree/Proceed to Fourth Year with 133 Credits							

COURSE STRUCTURE (For Batch A1-Economics B2-Mathematics)
IN PATHWAY 5: DOUBLE MAJOR

A1: 68 credits in Major Economics
B2: 53 credits in Major Mathematics

Semester	Course Title	Total Hours	Hours/ Week	Credits	Marks		
					Internal	External	Total
1	Core Course 1 in Economics ECO1CJ101 Principles Of Economics	60	4	4	30	70	100
	Core Course 2 in Economics ECO1CJ103 Analytical Tools For Economics	45+30	3+2	4	30	70	100
	Core Course 1 in Major Mathematics – MAT1CJ 101: Differential Calculus	60	4	4	30	70	100
	Ability Enhancement Course 1 – English	60	4	3	25	50	75
	Ability Enhancement Course 2 – Additional Language	45	3	3	25	50	75
	Multi-Disciplinary Course 1 in Economics-ECO1FM 105 Security Trading Practices	45	3	3	25	50	75
	Total		23	21			525
2	Core Course 3 in Economics ECO2CJ102 Development Issues In Indian Economy	60	4	4	30	70	100
	Core Course 2 in Major Mathematics – MAT2CJ101 Integral Calculus	60	4	4	30	70	100

	Course						
	Core Course 3 in Major Mathematics – MAT2CJ102 Elementary Number Theory	60	4	4	30	70	100
	Ability Enhancement Course 3 – English	60	4	3	25	50	75
	Ability Enhancement Course 4 – Additional Language	45	3	3	25	50	75
	Multi-Disciplinary Course 2 in Economics ECO2FM 106 Digital Economy	45	3	3	25	50	75
	Total		22	21			525
3	Core Course 4 in Major Mathematics – MAT3CJ201 Multivariable Calculus	45+30	3+2	3+1	30	70	100
	Core Course 5 in Major Mathematics – MAT3CJ202 Matrix Algebra	45+30	3+2	3+1	30	70	100
	Core Course 4 in Economics ECO3CJ203 Intermediate Microeconomics	60	4	4	30	70	100
	Core Course 5 in Economics ECO3CJ204 Intermediate Macroeconomics	60	4	4	30	70	100
	Multi-Disciplinary Course 1 in Mathematics MAT3FM105(2) Matrices and Basics of Probability theory *or* Mathematics for Competitive Exams - Part I	45	3	3	25	50	75
	Value-Added Course 1 in Economics ECO3F V108 Financial Literacy and Personal Finance	45	3	3	25	50	75

	Total		23/25	22			550
4	Core Course 6 in Major Mathematics – MAT4CJ203 Real Analysis I	45+30	3+2	3+1	30	70	100
	Core Course 6 in Economics ECO4CJ206 Advanced Microeconomics	60/ 75	4/ 5	4	30	70	100
	Core Course 7 in Economics ECO4CJ207 Advanced Macroeconomics	60/ 75	4/ 5	4	30	70	100
	Value-Added Course 1 in Mathematics – History of Mathematics *or* MAT4FV109(2) Computational Logic	45	3	3	25	50	75
	Value-Added Course in Economics ECO4FV 110 Digital Marketing and E-Commerce Strategies	45	3	3	25	50	75
	Skill Enhancement Course in Economics ECO4FS 112 Big Data Analysis in Economics		4	3	25	50	75
	Total		22 / 24	21			525
5	Core Course 7 in Major Mathematics – MAT5CJ302 Abstract Algebra I	60	4	4	30	70	100
	Core Course 8 in Economics ECO5CJ303 Growth Theories In Economics	60/ 75	4/ 5	4	30	70	100
	Core Course 9 in Economics ECO5CJ302 International Trade Theories	60	4	4	30	70	100

	Course	Hours	Credits		Internal	External	Total
	Elective Course 1 in Major Mathematics	60	4	4	30	70	100
	Elective Course 1 in Major Economics	60	4	4	30	70	100
	Skill Enhancement Course 1 in Mathematics – MAT5FS112 Mathematical Type Setting System - LaTeX	45	3	3	25	50	75
	Total		24/ 25	23			575
6	Core Course 8 in Major Mathematics – MAT6CJ311 Complex Analysis	60	4	4	30	70	100
	Core Course 10 in Major Economics ECO6CJ305 Financial Economics	60/ 75	4/ 5	4	30	70	100
	Core Course 9 in Major Mathematics – MAT6CJ306 Methods of Differential Equations	45+30	3+2	3+1	30	70	100
	Elective Course 2 in Major Mathematics	60	4	4	30	70	100
	Elective Course 2 in Major Economics	60	4	4	30	70	100
	Skill Enhancement Course 2 in Economics	45	3	3	25	50	75
	Internship in Major Economics (Credit for internship to be awarded only at the end of Semester 6)	60		2	50	-	50
	Total		24/ 25	25			625
	Total Credits for Three Years			133			3325

CREDIT DISTRIBUTION FOR BATCH A1(B2) IN PATHWAY 5: DOUBLE MAJOR

Semester	Major Courses in Economics	General Foundation Courses in Economics	Internship/ Project in Economics	Major Courses in Mathematics	General Foundation Courses in Mathematics	AEC	Total
1	4+4	3	-	4	-	3+3	21
2	4	3	-	4+4	-	3+3	21
3	4+4	3	-	4+4	3	-	22
4	4+4	3+3	-	4	3	-	21
5	4+4+4	-	-	4+4	3	-	23
6	4+4	3	2	4+4+4	-	-	25
Total for Three Years	**48**	**18**	**2**	**44**	**9**	**12**	**133**
	68			**53**		**12**	**133**

	Major Courses in Economics	Minor Courses					
7	4+4+4+ 4+4	-			-	-	20
8	4+4+4	4+4+4	12*		-	-	24
*Instead of three Major courses							
Total for Four Years	**88+12= 100**	**12**					**177**

COURSE STRUCTURE FOR BATCH B1 Mathematics (A2 Economics)
IN PATHWAY 5: DOUBLE MAJOR
B1: 68 credits in Major Mathematics
A2: 53 credits in Economics

Semester	Course Title	Total Hours	Hours/ Week	Credits	Marks		
					Internal	External	Total
1	Core Course 1 in Mathematics MAT1CJ 101 Differential Calculus	60	4	4	30	70	100
	Core Course in Major Economics ECO1CJ101 Principles Of Economics	60/ 75	4/ 5	4	30	70	100
	Core Course 2 in Major Mathematics – MAT1CJ102 Elementary Number Theory	60	4	4	30	70	100
	Ability Enhancement Course 1 – English	30+30	2+2	2+1	25	50	75
	Ability Enhancement Course 2 – Additional Language	45	3	3	25	50	75
	Multi-Disciplinary Course 1 in Mathematics – Matrices and Basics of Probability theory *Or* Mathematics for Competitive Exams – Part I	45	3	3	25	50	75
	Total		24/ 25	21			525
2	Core Course 3 in Major Mathematics – MAT2CJ101 Integral Calculus	60	4	4	30	70	100
	Core Course in Major Economics ECO2CJ103 Analytical Tools For Economics	60/ 75	4/ 5	4	30	70	100

	Course						
	Core Course in Major Economics ECO2CJ102 Development Issues In Indian Economy	60/ 75	4/ 5	4	30	70	100
	Ability Enhancement Course 3 – English	30+30	2+2	2+1	25	50	75
	Ability Enhancement Course 4 – Additional Language	45	3	3	25	50	75
	Multi-Disciplinary Course in Economics: ECO2F M 106 Digital Economy	45	3	3	25	50	75
	Total		23 / 25	21			525
3	Core Course 4 in Major Mathematics – MAT3CJ201 Multivariable Calculus.	75	5	4	30	70	100
	Core Course 5 in Major Mathematics – MAT3CJ202 Matrix Algebra	60	4	4	30	70	100
	Core Course in Major Economics ECO3CJ203 Intermediate Microeconomics	60/ 75	4/ 5	4	30	70	100
	Core Course in Major Economics ECO3CJ204 Intermediate Macroeconomics	60/ 75	4/ 5	4	30	70	100
	Multi-Disciplinary Course 2 in Mathematics – Graph Theory and LPP Or Mathematics for Competitive Exams – Part II	45	3	3	25	50	75
	Value-Added Course 1 in Mathematics – History of Mathematics Or Computational Logic	45	3	3	25	50	75
	Total		23 / 25	22			550

4	Core Course 6 in Major Mathematics – MAT4CJ203 Real Analysis - I	45+30	3+2	2+2	30	70	100
	Core Course in Major Economics ECO4CJ206 Advanced Microeconomics	60/ 75	4/ 5	4	30	70	100
	Core Course 7 in Major Mathematics – MAT4CJ204 Basic Linear Algebra	60	4	4	30	70	100
	Value-Added Course 2 in Mathematics – Statistics and Mathematics with R *Or* The Mathematical Practices of Medieval Kerala	45	3	3	25	50	75
	Value-Added Course in Economics ECO4FV 110 Digital Marketing and E-Commerce Strategies	45	3	3	25	50	75
	Skill Enhancement Course in Economics ECO4 FS 112 Big Data Analysis in Economics	30+30	2+2	3	25	50	75
	Total		23/ 24	21			525
5	Core Course 8 in Major Mathematics – MAT5CJ301 Real Analysis II	45+30	3+2	2+2	30	70	100
	Core Course in Major Economics ECO4CJ207 Advanced Macroeconomics	60/ 75	4/ 5	4	30	70	100
	Core Course 9 in Major Mathematics – MAT5CJ302 Abstract Algebra I	60	4	4	30	70	100
	Elective Course 1 in Major Mathematics	60	4	4	30	70	100
	Elective Course 1 in Major Economics	60	4	4	30	70	100

	Course	Hours		Credits				Marks
	Skill Enhancement Course 1 in Mathematics – MAT5FS112 Mathematical Type Setting System - LaTeX	45	3	3	25	50	75
	Total		24/ 25	23			575
6	Core Course 10 in Major Mathematics – MAT6CJ311 Complex Analysis	60	4	4	30	70	100
	Core Course in Major Economics ECO5CJ302 International Trade Theories	60/ 75	4/ 5	4	30	70	100
	Core Course in Major Economics ECO6CJ305 Financial Economics	60	4	4	30	70	100
	Elective Course 2 in Major Mathematics	60	4	4	30	70	100
	Elective Course 2 in Major Economics	60	4	4	30	70	100
	Skill Enhancement Course 2 in Mathematics –MAT6FS113 Data Science with Python	45	3	3	25	50	75
	Internship in Major Mathematics (Credit for internship to be awarded only at the end of Semester 6)	60		2	50	-	50
	Total		24/ 25	25			625
				133			3325

CREDIT DISTRIBUTION FOR BATCH B1(A2) IN PATHWAY 5: DOUBLE MAJOR

Semester	Major Courses in Mathematics	General Foundation Courses in Mathematics	Internship/ Project in Mathematics	Major Courses in Economics	General Foundation Courses in Economics	AEC	Total
1	4+4	3	-	4	-	3+3	21
2	4	-	-	4+4	3	3+3	21
3	4+4	3+3	-	4+4	-	-	22
4	4+4	3	-	4	3+3	-	21
5	4+4+4	3	-	4+4	-	-	23
6	4+4	3	2	4+4+4	-	-	25
Total for Three Years	**48**	**18**	**2**	**44**	**9**	**12**	**133**
	68			**53**		**12**	**133**

	Major Courses in Mathematics	Minor Courses					
7	4+4+4+4+4	-			-	-	20
8	4+4+4	4+4+4	12*		-	-	24
*Instead of three Major courses							
Total for Four Years	**88+12= 100**	**12**					**177**

EVALUATION SCHEME

1.   The evaluation scheme for each course contains two parts: internal evaluation (about 30%) and external evaluation (about 70%). Each of the Major and Minor courses is of 4-credits. It is evaluated for 100 marks, out of which 30 marks are from internal evaluation and 70 marks, from external evaluation. Each of the General Foundation Course is of 3-credits. It is evaluated for 75 marks, out of which 25 marks are from internal evaluation and 50 marks, from external evaluation.

2.   The 4-credit courses (Major and Minor courses) are of two types: (i) courses with only theory and (ii) courses with 3-credit theory and 1-credit Practical/Practicum.

In 4-credit courses with only theory component, out of the total 5 modules of the syllabus, one open-ended module with 20% content is designed by the faculty member teaching that course, and it is internally evaluated for 10 marks. The internal evaluation of the remaining 4 theory modules is for 20 marks.

In 4-credit courses with 3-credit theory and 1-credit Practical/Practicum components, out of the total 5 modules of the syllabus, 4 modules are for theory and the fifth module is for Practical/Practicum. The Practical/Practicum component is internally evaluated for 20 marks. The internal evaluation of the 4 theory modules is for 10 marks.

3.   All the 3-credit courses (General Foundational Courses) in Mathematics are with only theory component. Out of the total 5 modules of the syllabus, one open-ended module with 20% content is designed by the faculty member teaching that course, and it is internally evaluated for 5 marks. The internal evaluation of the remaining 4 theory modules is for 20 marks.

Sl. No.	Nature of the Course		Internal Evaluation in Marks (About 30% of the Total)		External Exam on 4 Modules (Marks)	Total Marks
			Open-ended Module / Practical/Practicum	On the other 4 Modules		
1	4-credit course	only theory (5 modules)	10	20	70	100
2	4-credit course	Theory (4 modules) + Practical/Practicum	20	10	70	100
3	3-credit course	only theory (5 modules)	5	20	50	75

1. MAJOR AND MINOR COURSES
1.1. INTERNAL EVALUATION OF THEORY COMPONENT

Sl. No.	Components of Internal Evaluation of Theory Part of a Major / Minor Course	Internal Marks for the Theory Part of a Major / Minor Course of 4-credits			
		Theory Only		Theory + Practical/Practicum	
		4 Theory Modules	Open-ended Module	4 Theory Modules	Practical/Practicum
1	Test paper/ Mid-semester Exam	10	4	5	-
2	Seminar/ Viva/ Quiz	6	4	3	-
3	Assignment	4	2	2	-
Total		20	10	10	20[*]
		30		30	

[*] Refer the table in section 1.2 for the evaluation of Practical/Practicum component

1.2. EVALUATION OF PRACTICAL/PRACTICUM COMPONENT

The evaluation of Practical/Practicum component in Major and Minor courses is completely by internal evaluation.

- Continuous evaluation of Practical/Practicum by the teacher-in-charge shall carry a weightage of 50%.

- The end-semester Practical/Practicum examination and viva-voce, and the evaluation of Practical/Practicum records shall be conducted by the teacher in-charge and an internal examiner appointed by the Department Council.

- The process of continuous evaluation of Practical/Practicum courses shall be completed before 10 days from the commencement of the end-semester examination.

- Those who passed in continuous evaluation alone will be permitted to appear for the end-semester examination and viva-voce.

The scheme of continuous evaluation and the end-semester examination and viva-voce of Practical/Practicum component shall be as given below:

Sl. No.	Evaluation of Practical/Practicum Component of Credit-1 in a Major / Minor Course	Marks for Practical/Practicum	Weightage
1	Continuous evaluation of Practical/Practicum/ exercise performed in Practical/Practicum classes by the students	10	50%
2	End-semester examination and viva-voce to be conducted by teacher-in-charge along with an additional examiner arranged internally by the Department Council	7	35%
3	Evaluation of the Practical/Practicum records submitted for the end semester viva–voce examination by the teacher-in-charge and additional examiner	3	15%
Total Marks		20	

1.3. EXTERNAL EVALUATION OF THEORY COMPONENT

External evaluation carries 70% marks. Examinations will be conducted at the end of each semester. Individual questions are evaluated in marks and the total marks are converted into grades by the College based on 10-point grading system (refer section 5).

PATTERN OF QUESTION PAPER FOR MAJOR AND MINOR COURSES

Duration	Type	Total No. of Questions	No. of Questions to be Answered	Marks for Each Question	Ceiling of Marks
2 Hours	Short Answer	10	8 – 10	3	24
	Paragraph/ Problem	8	6 – 8	6	36
	Essay	2	1	10	10
Total Marks					70

2. INTERNSHIP

- All students should undergo Internship of 2-credits during the first six semesters in Research Institutions, Universities, Firms, Industry or Organizations, or training in labs with faculty and researchers of their own institution or other Higher Educational Institutions (HEIs) or research institutions.

- Internship can be for enhancing the employability of the student or for developing the research aptitude.

- Internship can involve hands-on training on a particular skill/ equipment/ software. It can be a short project on a specific problem or area. Attending seminars or workshops related to an area of learning or skill can be a component of Internship.

A faculty member/ scientist/ instructor of the respective institution, where the student does the Internship, should be the supervisor of the Internship

2.1. GUIDELINES FOR INTERNSHIP

1. Internship can be in Mathematics or allied disciplines.

2. There should be minimum 60 hrs. of engagement from the student in the Internship.

3. Summer vacations and other holidays can be used for completing the Internship.

4. In B.Sc. Mathematics Honours programme, institute/ industry visit or study tour is a requirement for the completion of Internship. Visit to minimum one national research institute, research laboratory and place of scientific importance should be part of the study tour. A brief report of the study tour has to be submitted with photos and analysis.

5. The students should make regular and detailed entries in to a personal log book through the period of Internship. The log book will be a record of the progress of the Internship and the time spent on the work, and it will be useful in writing the final report. It may contain mathematical results, ideas, expressions, experimental conditions, rough work and calculation, computer file names etc. All entries should be dated. The Internship supervisor should periodically examine and countersign the log book.

6. The log book and the typed report must be submitted at the end of the Internship.

7. The institution at which the Internship will be carried out should be prior-approved by the Department Council of the college where the student has enrolled for the UG Honours programme.

2.2. VALUATION OF INTERNSHIP

- The evaluation of Internship shall be done internally through continuous assessment mode by a committee internally constituted by the Department Council of the college where the student has enrolled for the UG Honours programme.

- The credits and marks for the Internship will be awarded only at the end of semester 6.

- The scheme of continuous evaluation and the end-semester viva-voce examination based on the submitted report shall be as given below:

Sl. No.	Components of Evaluation of Internship		Marks for Internship2 Credits	Weightage
1	Continuous evaluation of internship through interim presentations and reports by the committee internally constituted by the Department Council	Acquisition of skill set	10	40%
2		Interim Presentation and Viva-voce	5	
3		Punctuality and Log Book	5	
4	Report of Institute Visit/ Study Tour		5	10%
5	End-semester viva-voce examination to be conducted by the committee internally constituted by the Department Council	Quality of the work	6	35%
6		Presentation of the work	5	
7		Viva-voce	6	
8	Evaluation of the day-to-day records, the report of internship supervisor, and final report submitted for the end semester viva–voce examination before the committee internally constituted by the Department Council		8	15%
	Total Marks		50	

3. PROJECT

3.1. PROJECT IN HONOURS PROGRAMME

· In Honours programme, the student has the option to do a Project of 12-credits instead of three Core Courses in Major in semester 8.

· The Project can be done in the same institution/ any other higher educational institution (HEI)/ research centre/ training centre.

· The Project in Honours programme can be a short research work or an extended internship or a skill-based training programme.

· A faculty member of the respective institution, where the student does the Project, should be the supervisor of the Project.

3.2. PROJECT IN HONOURS WITH RESEARCH PROGRAMME

- Students who secure 75% marks and above (equivalently, CGPA 7.5 and above) cumulatively in the first six semesters are eligible to get selected to Honours with Research stream in the fourth year.

- A relaxation of 5% in marks (equivalently, a relaxation of 0.5 grade in CGPA) is allowed for those belonging to SC/ ST/ OBC (non-creamy layer)/ Differently-Abled/ Economically Weaker Section (EWS)/ other categories of candidates as per the decision of the UGC from time to time.

- In Honours with Research programme, the student has to do a mandatory Research Project of 12-credits instead of three Core Courses in Major in semester 8.

- The approved research centres of University of Calicut or any other university/ HEI can offer the Honours with Research programme. The departments in the affiliated colleges under University of Calicut, which are not the approved research centres of the University, should get prior approval from the University to offer the Honours with Research programme. Such departments should have minimum two faculty members with Ph.D., and they should also have the necessary infrastructure to offer Honours with Research programme.

- A faculty member of the University/ College with a Ph.D. degree can supervise the research project of the students who have enrolled for Honours with Research. One such faculty member can supervise maximum five students in Honours with Research stream.

The maximum intake of the department for Honours with Research programme is fixed by the department based on the number of faculty members eligible for project supervision, and other academic, research, and infrastructural facilities available.

- If a greater number of eligible students are opting for the Honours with Research programme than the number of available seats, then the allotment shall be based on the existing rules of reservations and merits.

3.3. GUIDELINES FOR THE PROJECT IN HONOURS PROGRAMME

AND HONOURS WITH RESEARCH PROGRAMME

1. Project can be in Mathematics or allied disciplines.

2. Project should be done individually.

3. Project work can be of theoretical/ experimental /computational in nature.

4. There should be minimum 360 hrs. of engagement from the student in the Project work in Honours programme as well as in Honours with Research programme.

5. There should be minimum 13 hrs./week of engagement (the hours corresponding to the three core courses in Major in semester 8) from the teacher in the guidance of the Project(s) in Honours programme and Honours with Research programme.

6. The various steps in project works are the following:

- Wide review of a topic.

- Investigation on a problem in a systematic way using appropriate techniques.

- Systematic recording of the work.

- Reporting the results with interpretation in a standard documented form.

Presenting the results before the examiners.

7. During the Project the students should make regular and detailed entries in to a personal log book through the period of investigation. The log book will be a record of the progress of the Project and the time spent on the work, and it will be useful in writing the final report. It may contain mathematical models and results, ideas, mathematical expressions, rough work and calculation, computer file names etc. All entries should be dated. The Project supervisor should periodically examine and countersign the log book.

8. The log book and the typed report must be submitted at the end of the Project. A copy of the report should be kept for reference at the department. A soft copy of the report too should be submitted, to be sent to the external examiner in advance.

9. It is desirable, but not mandatory, to publish the results of the Project in a peer reviewed journal.

10. The project report shall have an undertaking from the student and a certificate from the research supervisor for originality of the work, stating that there is no plagiarism, and that the work has not been submitted for the award of any other degree/ diploma in the same institution or any other institution.

11. The project proposal, institution at which the project is being carried out, and the project supervisor should be prior-approved by the Department Council of the college where the student has enrolled for the UG Honours programme.

3.4. EVALUATION OF PROJECT

- The evaluation of Project will be conducted at the end of the eighth semester by both internal and external modes.

- The Project in Honours programme as well as that in Honours with Research programme will be evaluated for 300 marks. Out of this, 90 marks are from internal evaluation and 210 marks, from external evaluation.

- The internal evaluation of the Project work shall be done through continuous assessment mode by a committee internally constituted by the Department Council of the college where the student has enrolled for the UG Honours programme. 30% of the weightage shall be given through this mode.

- The remaining 70% shall be awarded by the external examiner appointed by the College.

- The scheme of continuous evaluation and the end-semester viva-voce of the Project shall be as given below:

Sl. No	Components of Evaluation of Project	Marks for the Project (Honours/ Honours with Research)	Weightage
1	Continuous evaluation of project work through interim presentations and reports by the committee internally constituted by the Department Council	90	30%
2	End-semester viva-voce examination to be conducted by the external examiner appointed by the College	150	50%
3	Evaluation of the day-to-day records and project report submitted for the end-semester viva–voce examination conducted by the external examiner	60	20%
	Total Marks	300	

INTERNAL EVALUATION OF PROJECT

Sl. No	Components of Evaluation of Project	Marks for the Project (Honours/ Honours with Research)
1	Skill in doing project work	30
2	Interim Presentation and Viva-Voce	20
3	Punctuality and Log book	20
4	Scheme/ Organization of Project Report	20
Total Marks		90

EXTERNAL EVALUATION OF PROJECT

Sl. No	Components of Evaluation of Project	Marks for the Project (Honours/ Honours with Research) 12 credits
1	Content and relevance of the Project, Methodology, Quality of analysis, and Innovations of Research	50
2	Presentation of the Project	50
3	Project Report (typed copy), Log Book and References	60
4	Viva-Voce	50
Total Marks		210

4. GENERAL FOUNDATION COURSES

All the General Foundation Courses (3-credits) in Mathematics and Economics are with only theory component.

4.1. INTERNAL EVALUATION

Sl. No.	Components of Internal Evaluation of a General Foundation Course in Economics and Mathematics	Internal Marks of a General Foundation Course of 3-credits in Economics and Mathematics	
		4 Theory Modules	Open-ended Module
1	Test paper/ Mid-semester Exam	10	2
2	Seminar/ Viva/ Quiz	6	2
3	Assignment	4	1
Total		20	5
		25	

4.2. EXTERNAL EVALUATION

External evaluation carries about 70% marks. Examinations will be conducted at the end of each semester. Individual questions are evaluated in marks and the total marks are converted into grades by the College based on 10-point grading system (refer section 5)

PATTERN OF QUESTION PAPER FOR GENERAL FOUNDATION COURSES

Duration	Type	Total No. of Questions	No. of Questions to be Answered	Marks for Each Question	Ceiling of Marks
1.5 Hours	Short Answer	10	8 – 10	2	16
	Paragraph/ Problem	5	4 – 5	6	24
	Essay	2	1	10	10
Total Marks					50

5. LETTER GRADES AND GRADE POINTS

- Mark system is followed for evaluating each question.
- For each course in the semester letter grade and grade point are introduced in 10-point indirect grading system as per guidelines given below.
- The Semester Grade Point Average (SGPA) is computed from the grades as a measure of the student's performance in a given semester.
- The Cumulative GPA (CGPA) is based on the grades in all courses taken after joining the programme of study.
- Only the weighted grade point based on marks obtained shall be displayed on the grade card issued to the students.

LETTER GRADES AND GRADE POINTS

Sl. No.	Percentage of Marks (Internal & External Put Together)	Description	Letter Grade	Grade Point	Range of Grade Points	Class
1	95% and above	Outstanding	O	10	9.50 – 10	First Class with Distinction
2	Above 85% and below 95%	Excellent	A+	9	8.50 – 9.49	
3	75% to below 85%	Very Good	A	8	7.50 – 8.49	
4	65% to below 75%	Good	B+	7	6.50 – 7.49	First Class
5	55% to below 65%	AboveAverage	B	6	5.50 – 6.49	
6	45% to below 55%	Average	C	5	4.50 – 5.49	Second Class

7	35% to below 45% aggregate(internal and external put together) with a minimum of 30% in external valuation	Pass	P	4	3.50 – 4.49	Third Class
8	Below an aggregate of 35% or below 30% in external evaluation	Fail	F	0	0 – 3.49	Fail
9	Not attending the examination	Absent	Ab	0	0	Fail

- When students take audit courses, they will be given Pass (P) or Fail (F) grade without any credits.
- The successful completion of all the courses and capstone components prescribed for the three-year or four-year programme with 'P' grade shall be the minimum requirement for the award of UG Degree or UG Degree Honours or UG Degree Honours with Research, as the case may be.

5.1. COMPUTATION OF SGPA AND CGPA

- The following method shall be used to compute the Semester Grade Point Average (SGPA):

The SGPA equals the product of the number of credits (Ci) with the grade points (Gi) scored by a student in each course in a semester, summed over all the courses taken by a student in the semester, and then divided by the total number of credits of all the courses taken by the student in the semester,

$$\text{i.e. SGPA (Si)} = \Sigma i\ (Ci \times Gi) / \Sigma i\ (Ci)$$

where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course in the given semester. Credit Point of a course is the value obtained by multiplying the credit (Ci) of the course by the grade point (Gi) of the course.

ILLUSTRATION – COMPUTATION OF SGPA

Semester	Course	Credit	Letter Grade	Grade point	Credit Point (Credit x Grade)
I	Course 1	3	A	8	3 x 8 = 24
I	Course 2	4	B+	7	4 x 7 = 28
I	Course 3	3	B	6	3 x 6 = 18
I	Course 4	3	O	10	3 x 10 = 30
I	Course 5	3	C	5	3 x 5 = 15
I	Course 6	4	B	6	4 x 6 = 24
	Total	20			139
	SGPA				139/20 = 6.950

The Cumulative Grade Point Average (CGPA) of the student shall be calculated at the end of a programme. The CGPA of a student determines the overall academic level of the student in a programme and is the criterion for ranking the students.

CGPA for the three-year programme in FYUGP shall be calculated by the following formula.

CGPA for the four-year programme in FYUGP shall be calculated by the following formula.

● The SGPA and CGPA shall be rounded off to three decimal points and reported in the transcripts.

Based on the above letter grades, grade points, SGPA and CGPA, the College shall issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters.

Programme	B.Sc Economics and Mathematics				
Course Title	**PRINCIPLES OF ECONOMICS**				
Type of Course	**Major**				
Semester	I				
Academic Level	100 - 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	75
Pre-requisites	Basic Economics Course of 0 – 99 level				
Course Summary	This course explores important principles, basic theories and models, various economic systems and other fundamental aspects of economics.				

COURSE OUTCOMES (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the basic principles of economics and its real-world applications.	U	C	Instructor-created exams / Quiz
CO2	Develop and practice the skill of thinking like an economist.	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	Help the beginning student master the principles essential for understanding the economizing problem, specific economic issues, and policy alternatives.	U	P	Seminar Presentation / Group Discussion
CO4	Understand and apply the economic perspective and reason accurately and objectively about economic matters.	Ap	C	Instructor-created exams / Home Assignments
CO5	Instil in students a fascination with both the functioning of the economy and the power and breadth of economics	U	F	Writing assignments
CO6	Demonstrate critical thinking and problem-solving skills by applying the acquired knowledge to address complex economic challenges in the contemporary world.	Ap	P	Viva Voce

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)
Metacognitive Knowledge (M)

DETAILED SYLLABUS:

Module	Unit	Content	Hrs	Marks
		Basic Principles of Economics	**10**	**15**
		How People Make Decisions		
	1	People Face Trade-Offs	1	
	2	The Cost of Something Is What You Give	1	
	3	Rational People Think at the Margin	1	
	4	People Respond to Incentives	1	
		How People Interact		
	5	Trade Can Make Everyone Better Off	1	
	6	Markets Are Usually a Good Way to Organize Economic Activity	1	
	7	Governments Can Sometimes Improve Market Outcomes	1	
		How the Economy as a Whole Works		
	8	A Country's Standard of Living Depends on its Ability to Produce Goods and Services	1	
	9	Prices Rise When the Government Prints Too Much Money	1	
I	10	Society Faces a Short-Run Trade-Off between Inflation and Unemployment	1	
		Thinking like an Economist	**10**	**15**
	11	**The Economist as Scientist**: The Scientific Method: Observation, Theory, and More Observation, The Role of Assumptions, Economic Models, The Circular-Flow Diagram, The Production Possibilities Frontier, Microeconomics and Macroeconomics;	4	
	12	**The Economist as Policy Adviser**: Positive versus Normative Analysis, Why Economists' Advice Is Not Always Followed;	3	
II	13	**Why Economists Disagree:** Differences in Scientific Judgments, Differences in Values, Perception versus Reality	3	
		Limits, Alternatives, and Choices	**10**	**15**
	14	**The Economic Perspective**: Scarcity and Choice, Purposeful Behaviour, Marginal Analysis: Comparing Benefits and Costs	3	
	15	**Individual's Economizing Problem**	2	
	16	**Society's Economizing Problem**	2	
III	17	**Unemployment, Growth, and the Future**: A Growing Economy, Present Choices and Future Possibilities, A Qualification: International Trade	3	

		The Market System	15	25
IV	18	**Economic Systems**: Laissez-Faire Capitalism, The Command System, The Market System	4	
	19	**Characteristics of the Market System**: Private Property, Freedom of Enterprise and Choice, Self -Interest, Competition, Markets and Prices, Technology and Capital Goods, Specialization, Use of Money, Active but Limited Government		
	20	**Five Fundamental Questions**: What Will Be Produced? How Will the Goods and Services Be Produced? Who Will Get the Output? How Will the System Accommodate Change? How Will the System Promote Progress?	4	
	21	**The "Invisible Hand"**: The Demise of the Command Systems, The Incentive Problem	3	
	22	**How the Market System Deals with Risk**: The Profit System, Shielding Employees and Suppliers from Business Risk, Benefits of Restricting Business Risk to Owners	4	
V		**Open Ended Module**	30	
		Discussion based on different economic systems prevailing in the world		
		Practical Assignments on economic decision making in different economies in the world		
		Seminar on the influence of institutions, regional cooperations, blocks and international cartels on economic policies		

Note: The syllabus has five modules. There should be total 22 units in the first four modules together, composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. Internal assessments (30 marks) are split between the practical module (20 marks) and the first four modules (10 marks). The end-semester examination for the theory part will be based on the 22 units in the first four modules. The 70 marks shown in the last column, distributed over the first four modules, are only for the external examination.

REFERENCE:

1. Mankiw, N. G. (2021). *Principles of Economics,* 9TH EDITION*,* Cengage Learning. **(Module 1 and Module 2)**

2. Stiglitz, J. E., & Walsh, C. E. (2006). *Economics*. W. W. Norton. **(Module 2)**

3. McConnell, C. R., Brue, S. L., & Flynn, S. M. (2015). *Economics: Principles, Problems, and Policies*. TWENTIETH EDITION, McGraw-Hill Education. **(Module 3 and Module 4)**

ADDITIONAL READINGS

1. Team, C., & Press, O. U. (2017). The economy: Economics for a Changing World. Oxford University Press, USA.

2. Klein, G., & Bauman, Y. (2010). The cartoon Introduction to economics: Volume One: Microeconomics. Macmillan.

3. Sowell, T. (2015). Basic Economics: A Common Sense Guide to the Economy, FIFTH EDITION, Basic Books, New York.

4. Wheelan, C. (2010). Naked Economics: Undressing the Dismal Science (Fully Revised and Updated). W. W. Norton & Company.

MAPPING OF COS WITH PSOS:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO 1	3	-	-	-	-	-	-	3	-
CO 2	-	2	2	-	-	-	3	2	-
CO 3	-	3	2	-	1	-	1	1	-
CO 4	-	3	-	-	-	-	-	2	-
CO 5	-	-	-	-	-	-	2	3	-
CO 6	-	3	2	-	-	-	2	2	-

CORRELATION LEVELS:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

ASSESSMENT RUBRICS:

- Quiz / Assignment/ Viva Voce/ Discussion / Seminar
- Internal Exam
- Practical Assignments (20%)
- Final Exam (70%)

MAPPING OF COS TO ASSESSMENT RUBRICS:

	Internal Exam	Quiz / Assignment/ Viva Voce/ Discussion / Seminar	Practical Assignment	End Semester Examination
CO 1	✓	✓		✓
CO 2	✓		✓	✓
CO 3	✓	✓		✓

CO 4	✓	✓		✓
CO 5		✓	✓	
CO 6			✓	

Programme	BSc Economics and Mathematics				
Course Title	**ANALYTICAL TOOLS FOR ECONOMICS**				
Type of Course	**Major**				
Semester	**1**				
Academic Level	100				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Basic Mathematics and Statistics Course of 0 – 99 level				
Course Summary	Students shall acquire in-depth knowledge and able to explain the concepts of functions, differentiation, integration and their applications in Economics. This course also introduces students about statistical methods for economic analysis like probability, probability distributions, theory of estimation, hypothesis testing and their applications in economic analysis.				

COURSE OUTCOMES (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the basic concept in mathematics and apply in solving economic problems	U	C	Instructor created Exams/Practical sessions/Quiz
CO2	To equip the students to identify a problem, investigate to find out relevant facts and find a logical Conclusion	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	Identify various probability distributions and its applications	An	P	Assignment /Seminar/Group Discussion
CO4	Develop critical thinking and problem-solving skills by applying statistical methods in Economic theories and acquired knowledge to address complex economic	E	P	Practical Assignment / Observation of Practical Skills

	challenges in the contemporary world.			

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)
Meta cognitive Knowledge (M)

DETAILED SYLLABUS:

Module	Unit	Content	Hrs	Marks
		Differential calculus and Integral calculus (7 Hrs)	7	
	1	Functions-Types of Functions-Linear & Non-Linear (Quadratic and Cubic, Logarithmic and Exponential, Inverse)	2	
	2	Meaning of Derivative, Rules, Derivative of single variable and multi variable- Derivatives of implicit functions and Inverse functions	3	
I	3	Rules of Integration, Integration by substitution- Integration by parts, Area under a curve-estimation	2	15
		Probability theory and Random variables(12 Hours)	12	
	4	Random experiments, Definitions of Probability - classical, empirical and axiomatic approaches	3	
	5	Addition and multiplication laws - Conditional probability-Baye's theorem- Random variables- probability distribution	4	
II	6	Expectation- moments. Two random variables: joint, Marginal and conditional probability functions Computing expected values- Covariance and correlation coefficients.	5	15
		Probability distributions and law of large numbers(12 Hours)	12	
	7	Probability Distributions- Discrete Probability Distributions, Binomial , Poisson, Uniform -	2	
	8	simple applications Continuous probability distributions-	2	
	9	Normal, Lognormal and Exponential Distributions (Derivations are not expected)	3	
III	10	Concept of law of large numbers and Central limit theorem Distribution function- Distribution function of one random variable	5	15
		Theory of estimation and Testing of hypothesis (14 Hours)	14	
	11	Statistical Inference, Concept of population, sample- Sampling distributions- Standard error - Distributions of sample mean, Sample variance	2	
	12	Chi square ,Student's t, and F distributions Small and large sample properties of Z, t, Chi Square and F	2	
	13	Estimation of population parameters using method of moments, method of maximum lkelihood procedures	2	
	14	Point and interval estimation- Confidence intervals for population parameters - Properties of estimators.	2	
	15	Testing of Hypothesis - Simple and composite hypothesis- Null and alternative hypothesis- Type I and Type II error, Critical region- Level of significance, Power of a test	3	
IV	16	Test procedure - Test of significance in respect of Mean, Proportion,	3	15

	17	Variance and Correlation coefficient and their differences Chi Square test of goodness of fit, and test for independence of attributes		

		Application of basis statistics (using software)	30	
	18	Measures of central tendency (mean, median, mode)	6	
	19	Measures of dispersion (range, variance, standard deviation)	6	
	20	Estimation of simple linear regression model - Estimation of population parameters	6	
	21	Discrete vs. continuous probability distributions calculation of probabilities	6	
V	22	Basics of Hypothesis testing- t test, z test, chi square and F test - Goodness of fit	6	10

Note: The syllabus has five modules. There should be total 22 units in the first four modules together, composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. Internal assessments (30 marks) are split between the practical module (20 marks) and the first four modules (10 marks). The end-semester examination for the theory part will be based on the 22 units in the first four modules. The 70 marks shown in the last column, distributed over the first four modules, is only for the external examination.

REFERENCE:

1. Chiang, A and Wainwright, K. (2005). Fundamental methods of mathematical economics. Boston, Mass. McGraw- Hill/Irwin. EC (1262)-18.08.202219 (Module 1 & 2)

2. Hoy, M., Livernois, J., McKenna, C., Rees, R., Stengos, T. (2001). Mathematics for Economics, Prentice-Hall India. (Module 1 & 2)

3. Sydsaeter and P. Hammond, Mathematics for Economic Analysis, Pearson Educational Asia: Delhi, 2002.(Module 1 & 2

4. G Casella and R L Berger, Statistical Inference, Duxbury Advanced Series, Cengage Learning, 200 and William G. Cochran, Sampling Techniques, John Wiley, 2007(Module 3)

5. Mood, A.M., F.A.Greybill and D.C. Boes: Introduction to the theory of statistics, McGraw Hill (Module 4)

6. Goon, Gupta and Dasgupta, Fundamentals of Statistics, Volume 1, 2, World Press(Module 4)

ADDITIONAL READINGS

1. A.Chiang&K.Wainwright: Fundamental Methods of Mathematical Economics, McGraw Hill.
2. E. Silberberg & Suen: The Structure of Economics, McGraw Hill

3. Simon & Blume, Mathematics for Economists, Viva Books.
4. Rudin W.: Principles of Mathematical Analysis, McGraw-Hill
5. D. Varberg, E. J. Purcell, S. E. Rigdon. Calulus, Eighth Edition, Prentice Hall.
6. Taro Yamane, Statistics: An Introductory Analysis, Harper & Row, Edition 3,1973
7. Hoel PG: Introduction to Mathematical Statistics, John Wiley & Sons, Edition 4,1971
8. YP Agarwal: Statistical Methods: Concepts, Application and Computation, Sterling Publishers1986
9. Sidney Siegal, N. John Castellan: Non parametric Statistics for Behaviour Sciences, Edition 2, 1988, McGraw-Hill
10. Tulsian, P.C and Vishal Pandey: Quantitative Techniques, Pearson Education, NewDelhi
11. S.P. Gupta: Statistical Methods, Sulthan Chand and Sons, NewDelhi.
12. Hooda R.P: Statistics for Business and Economics, Mac Million, NewDelhi
13. Alpha C Chiang: Fundamental Methods of Mathematical Economics, 2 nd Ed. - International Student Edition, McGrawhill
14. Edward T Dowling: Introduction to Mathematical Economics, Third Edition, Shaum's outlines, Tata McGrawhill Publishing Co. Ltd, New Delhi.
15. SreenathBaruah: Basic Mathematics and its applications in Economics, Macmillan India Ltd.

MAPPING OF COS WITH PSOS:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	-	-		-	-	3	3	3
CO2	3	2	-	3	-	-	3	2	3
CO3	3	-	-	3	-	-	3	3	3
CO4	3	2	3	1	3	2	3	3	3

CORRELATION LEVELS:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

ASSESSMENT RUBRICS:

- Quiz / Assignment/ Viva Voce/ Discussion / Seminar
- Internal Exam
- Practical Assignments (20%)
- Final Exam (70%)

MAPPING OF COS TO ASSESSMENT RUBRICS:

	Internal Exam	Quiz / Assignment/ Viva Voce/ Discussion / Seminar	Practical Assignment	End Semester Examination
CO 1	✓	✓		✓
CO 2	✓		✓	✓
CO3	✓	✓		✓
CO4	✓	✓	✓	✓

Programme	B. Sc. Economics and Mathematics			
Course Code	MAT1CJ101 / MAT1MN100			
Course Title	**DIFFERENTIAL CALCULUS**			
Type of Course	**Major**			
Semester	I			
Academic Level	100-199			
Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	4	4	-	60
Pre-requisites	Basic knowledge of Sets, Relations and Functions, School Level Algebra and Real Numbers (0-99 level).			
Course Summary	The course covers fundamental concepts in calculus, including functions, shifting of graphs, limits, continuity, differentiation, extreme values, the Mean Value Theorem, graphing with derivatives, and limits at infinity with asymptotes. Students learn techniques for evaluating limits, finding extrema, and graphing functions using derivatives, preparing them for further studies in calculus and related fields.			

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Analyse a function for its limits, continuity and differentiability and evaluate limits and derivatives.	An	F	Internal Exam/Assignment /Seminar/Viva/ End Sem Exam
CO2	Apply first and second derivatives and related theorems to find extrema of functions.	Ap	F	Internal Exam/Assignment /Seminar/Viva/ End Sem Exam
CO3	Sketch the graph of functions by analysing critical points and asymptotes	An	F	Internal Exam/Assignment /Seminar/Viva/ End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge (F), Conceptual Knowledge (C), Procedural Knowledge (P), Metacognitive Knowledge (M)				

Detailed Syllabus:

Textbook		Calculus and Analytic Geometry, 9th Edition, George B. Thomas, Jr. Ross L. Finney, Pearson Publications, 2010, ISBN: 978-8174906168.		
Module	**Unit**	**Content**	**Hrs (48+12)**	**Marks**
				Ext: 70
I		**Module I**	12	**Min.15**
	1	Preliminaries: Section 3 - Functions		
	2	Preliminaries: Section 4 - Shifting Graphs.		
	3	Section 1.1-Rates of Change and Limits - Limits of Function Values onwards.		
	4	Section 1.2 - Rules for Finding Limits. Topics up to and including Example 3.		
	5	Section 1.2 - Rules for Finding Limits. Rest of the section.		
	6	Section 1.4- Extensions of the Limit Concept. Topics up to and including Example 6.		
II		**Module II**	15	**Min.15**
	7	Section 1.5 - Continuity.		
	8	Section 2.1 - The Derivative of a Function (The topic Graphing f' from estimated values is optional).		
	9	Section 2.2 - Differentiation Rules.		
	10	Section 2.3 - Rates of Change. Topics up to and including Example 5.		
	11	Section 2.5 - The Chain Rule. Topics up to and including Example 6.		
	12	Section 2.6- Implicit Differentiation and Rational Exponents. Topics up to and including Example 5.		
III		**Module III**	11	**Min.15**
	13	Section 3.1 - Extreme Values of Functions. Topics upto Finding Extrema.		
	14	Section 3.1 - Extreme Values of Functions- Topics from Finding Extrema onwards.		
	15	Section 3.2 - The Mean Value Theorem -Topics up to and including Example 4. (Proof of Theorem 3 is optional).		
	16	Section 3.2 - The Mean Value Theorem- Increasing Functions and Decreasing Functions		
	17	Section 3.3 - The First Derivative Test for Local Extreme Values.		
IV		**Module IV**	10	**Min.15**
	18	Section 3.4 - Graphing with y' and y'' - Topics up to and including Example 5.		
	19	Section 3.4 - Graphing with y' and y''- Topics from The Second Derivative Test for Local Extreme Values onwards.		

	20	Section 3.5 - Limits as x → ±∞, Asymptotes and Dominant Terms. - Topics up to and including Summary for Rational Functions.		
	21	Section 3.5 - Limits as x → ±∞, Asymptotes and Dominant Terms- Topics from Horizontal and Vertical Asymptotes up to and including Example 12.		
	22	Section 3.5 - Limits as x → ±∞, Asymptotes and Dominant Terms-Topics from Graphing with Asymptotes and Dominant Terms onwards.		
V		**Module V (Open Ended)**	**12**	
		Trigonometric Functions, Target Values and Formal Definitions of Limits, Derivatives of Trigonometric Functions, Power Rule of Differentiation for rational powers, Optimization, Linearization and Differentials.		

References
1. Howard Anton, Biven, & Stephen Davis, Calculus, 7th Ed., Wiley India
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Ed, John Wiley & Sons.
3. Robert T Smith and Roland B Minton, Calculus, 4th Ed. McGraw-Hill Companies
4. Soo T Tan, Calculus, 9th Ed.Brooks/Cole Pub Co.
5. Tom M. Apostol, Calculus, Vol 1: One Variable Calculus with an Introduction to Linear Algebra, 2nd Ed, John Wiley & Sons.
6. Michael Van Biezen Calculus Lectures: https://youtu.be/YZYxPclo2rg?si=qKCt6ty8m5dBR4DG

*Optional topics are exempted for end semester examination
**70 external marks are distributed over the first four modules subjected to a minimum of 15 marks from each module.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	1	3	0	2	1	3	0	1
CO 2	2	3	2	1	3	0	2	1	3	0	1
CO 3	2	3	2	1	3	0	2	2	3	0	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:
- Assignment/ Seminar
- Internal Exam
- Viva

- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓

Programme	B.Sc Economics and Mathematics				
Course Title	**SECURITY TRADING PRACTICES**				
Type of Course	MDC				
Semester	I				
Academic Level	100 – 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	Basic course on stock market of level 0 - 99				
Course Summary	This course is designed to provide a theoretical and practical background in the field of investments.				

COURSE OUTCOMES (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Students will acquire a conceptual foundation in the field of investments.	U	C	Instructor-created exams / Quiz
CO2	Learners will gain skills in designing and managing both bond and equity portfolios in real-world scenarios.	Ap	P	Practical Assignment using paper trading app
	Students will be able to value various			Seminar

CO3	financial instruments, including equity and debt securities	An	P	Presentation / Group Discussion
CO4	Evaluate the characteristics of various avenues of investment.	E	M	Instructor-created exams / Home Assignments
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

DETAILED SYLLABUS:

Module	Unit	Content	Hrs	
		Investment Environment, Markets and Instruments	**8**	
	1	Financial Market—Primary and Secondary market	1	
	2	instruments of secondary market;	1	
	3	Major Agencies of Secondary market: NSE, BSE, CDSL, NSDL, SEBI	2	
	4	Different types of trading—overview of derivative market, futures and options, Major indices of BSE and NSE.	2	
I	5	Different trader in the secondary market—FIIs, DIIs, retailers	2	
		Equity Selection	**8**	**11**
	6	**The Fundamental Analysis**: Meaning and importance	1	
	7	Important ratios; Price-to-Earnings (P/E) ratio-Price-to-Book (P/B) ratio -Dividend Yield, Earnings Per Share (EPS), ROCE and ROE, D/EBITDA, EV/ EBITDA	2	
	8	Technical Analysis: Meaning and importance	2	
II	9	important methods—chart, candle sticks-- important indicators namely, Support, resistance, RSI, Moving Average, volume, price channel, VIX –	3	
		Portfolio Creation	**8**	**11**
	10	Theories of portfolio creation: Capital Asset Pricing Model (CAPM), Arbitrage Pricing Theory (APT), Markowitz portfolio theory, Behavioural Portfolio Theory	4	
III	11	Different types of Brokers-- Process of opening a demat account with a discount broker--	2	
	12	Maintain trading account details— P& L statement-- capital gain – capital gain tax -- details that are to be included in the income tax return.	2	
		Trade Management	**12**	**17**
	13	Different Sectors in secondary market eg Banking, Auto, pharma, IT, infrastructure, FMCG etc.	2	
	14	Portfolio allocation and selection in different sectors. Maintaining risk- reward—Position sizing of equities	2	
	15	Capital building through cumulative investment	2	
IV	16	Trader psychology—need and approach to maintain good	2	

		psychology by a trader	
	17	Practice—download a virtual trading platform and selection	1
	18	Creating portfolio composing of multiple segments	1
	19	Getting familiar with the demat account of any one broker preferably select one who do not charge AMC or brokerage fees	2
	Open Ended Module		**9**
V		Analyze the current trend Draw accurate trend lines Identify crucial support and resistance levels Make informed decisions on entry and exit points Trade in range-bound markets Use trading signals with different indicators	

Note: The course is divided into five modules, with four modules together having total 19 fixed units and one open-ended module with a variable number of units. There are total 36 instructional hours for the fixed modules and 9 hours for the open-ended one. Internal assessments (25 marks) are split between the open-ended module (5 marks) and the fixed modules (20 marks). The final exam, however, covers only the 19 units from the fixed modules. The 50 marks shown in the last column, distributed over the first fo ur modules, is only for the external examination.

REFERENCE:

1. Investments" by Zvi Bodie, Alex Kane, and Alan J. Marcus (McGraw-Hill, 12th edition, 2023)
2. "The Stock Market Game" by Robert Hagstrom (John Wiley & Sons, 10th edition, 2022)
3. "Investing for Dummies" by Matthew Krantz (Wiley, 6th edition, 2023)
4. "The Intelligent Investor" by Benjamin Graham (HarperCollins, Revised edition by Jason Zweig, 2003)

ADDITIONAL READINGS
1. "Security Analysis" by Benjamin Graham, David L. Dodd, and Sidney B. Zweig (McGraw - Hill, 8th edition, 2014)
2. "Technical Analysis Explained" by Martin Pring (McGraw-Hill, 5th edition, 2018)

3. "Trading in the Zone" by Mark Douglas (Harriman House Publishers, 3rd edition, 2011)
4. "Demat and Trading Guide" by NSE Academy (Available online at nseindia.com)
5. "A Random Walk Down Wall Street" by Burton Malkiel (Norton, 13th edition, 2023)
6. "The Art of Asset Allocation" by Roger Ibbotson and Rex Sinquefield (Wiley, 5th edition, 2019)

MAPPING OF COS WITH PSOS:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9

CO 1	3	-	-	-	-	-	-	-	-
CO 2	-	3	-	1	-	-	2	-	-
CO 3	3	-	-	1	-	-	-	-	-
CO 4	-	3	1	2	-	-	3	-	-

CORRELATION LEVELS:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

ASSESSMENT RUBRICS:

1. Quiz / Assignment/ Viva Voce/ Discussion / Seminar
2. Internal Exam
3. Practical Assignments (20%)
4. Final Exam (70%)

MAPPING OF COs TO ASSESSMENT RUBRICS:

	Internal Exam	Quiz / Assignment/ Viva Voce/ Discussion / Seminar	Practical Assignment	End Semester Examination
CO 1	✓	✓		✓
CO 2	✓		✓	✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓

Programme	BSc Economics and Mathematics
Course Title	**DEVELOPMENT ISSUES IN INDIAN ECONOMY**
Type of Course	**Major**
Semester	II
Academic Level	300 - 399

Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60

Pre-requisites	Microeconomics and Macroeconomics course of 200 – 299 level
Course Summary	This course explores important issues related to Development such as Poverty, Unemployment, Inequality and Inflation. The measurements of Development Issues are also incorporated the topics.

COURSE OUTCOMES (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Help in understanding the major development issues faced by Indian Economy and its historical precedents.	U	C	Instructor-created exams / Group Discussion.
CO2	Help in analysing the impact of public policy framed to deal with development issues such as Poverty, inequality in income distribution, unemployment and fiscal deficit. .	An	F	Instructor-created exams/ Seminars/ Projects
CO3	Help in evaluating the conceptual framework methodology, trends and policy measures adopted regarding the development issues	E	C	Seminar Presentation / Group Discussion
CO4	After studying the development issues of Indian Economy, students will be exposed to economic reforms in India and problems of Indian economy	Ap	P	Instructor-created exams / Home Assignments
CO5	Students will learn how to think critically about public policy issues and made capable of measuring poverty and unemployment in a small region	E	M	Writing assignments/ Group Discussions

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)

\# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

DETAILED SYLLABUS:

Module	Unit	Content	Hrs	Marks
I		**Historical Precedents of Development Issues of Indian Economy**	6	9
	1	History of development Issues of Indian Economy	2	
	2	Basic indicators of Development: Real income, Health and Education	1	
	3	Basic issues in economic development	1	
	4	Institutional framework and policy regimes	2	
II		**Poverty**	14	20
	5	Concepts of poverty- Absolute Measurement of Poverty, Relative measurement of Poverty, Multi -Dimensional Poverty	3	
	6	Poverty Estimation-Poverty Line Calculation-Consumption verses Income levels- Data collection Methods -URP, MRP	4	
	7	Multi-dimensional poverty index.	1	
	8	Post-Independence Poverty Estimation- Tendulkar Committee (2009) -Rangarajan Committee.	2	
	9	Trends of Poverty	2	
	10	Poverty Alleviation Programmes	1	
	11	Economic Characteristics of High- Poverty Groups	1	
III		**Inequality**	13	19
	12	Income Inequalities in India -Causes of Income Inequalities in India	2	
	13	Measurements of Inequality-Lorenz Curve- Gini coefficient	2	
	14	The Ahluwalia- Chenery Welfare Index	2	
	15	Trends of Inequality in India.	3	
	16	Government Policy to tackle the problem of inequality	2	
	17	Policy Options on Income Inequality and Poverty	2	
IV		**Unemployment**:	15	22
	18	Types and Structure of unemployment	3	
	19	Conceptual framework of key employment and unemployment indicators:	4	
	20	Nature and Estimates of Unemployment in India	3	
	21	Government Policy for Removing Unemployment	3	
	22	Major Employment Programmes	2	
V		**Open ended module**	12	
		Discussion based on the trends in fiscal deficit and inflation in India	3	
		A simple project for the Measurement of poverty using MRP method in a Ward of LSG	5	

		A simple project for the Measurement of Unemployment in the local territory using any one methodology	5	

Note: The course is divided into five modules, with four modules together having total 22 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open -ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules. The 70 marks shown in the last column, distributed over the first four modules, are only for the external examination.

REFERENCE:

1. Nicholas C. Hope, et al. *Economic Reform in India : Challenges, Prospects, and Lessons* , edited by, Cambridge University Press, 2013. (Module 1)
2. V.K. Puri, S. K. Misra, Bharat Garg -. *Indian Economy including Union Budget 2023-24*, 2023, Himalaya Publishing House. (Module 2,3,4 and 5)
3. Uma Kapila: *Indian Economy Performance and Policies (23rd edition)*, Academic Foundation. (Module 2,3,4 and 5)
4. Singh, Shrawan Kumar. Understanding the Indian Economy from the Post-Reforms of 1991, Volume II : Anatomy of the Indian Economy, Business Expert Press, 2020. (Module 4)
5. Michael P. Todaro, Stephen C. Smith : Economic Development (12 th edition),Pearson (Module1,2,3 and 4)

ADDITIONAL READINGS

1. Sreenivasan, T., Banerjee, A. V., Bardhan, P., & Somanathan, R. (2019). *Poverty and Income Distribution in India,*Juggernaut.

MAPPING OF COS WITH PSOS:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO 1	3	-	-	-	-	-	-	-	-
CO 2	-	2	-	1	-	-	3	-	-
CO 3	-	-	-	2	-	-	3	-	-
CO 4	-	3	1	2	-	-	3	-	-
CO 5	-	3	-	-	2	-	2	3	-

CORRELATION LEVELS:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

ASSESSMENT RUBRICS:

- Quiz / Assignment/ Viva Voce/ Discussion / Seminar
- Internal Exam
- Field work and project report (20%)
- Final Exam (70%)

MAPPING OF COS TO ASSESSMENT RUBRICS:

	Internal Exam	Quiz / Assignment/ Viva Voce/ Discussion / Seminar	Field work-project	End Semester Examination
CO 1	✓	✓		✓
CO 2	✓		✓	✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5		✓	✓	
CO 6			✓	

Programme	BSc Mathematics Honours
Course Code	MAT2CJ101 / MAT2MN100
Course Title	**INTEGRAL CALCULUS**
Type of Course	**Major**
Semester	II
Academic Level	100-199

Course Details	Credit	Lecture/Tutorial per week	Practical per week	Total Hours
	4	4	-	60

Pre-requisites	Basic knowledge of Functions, Limits, Continuity and Differentiation (MAT1CJ101 - Differential Calculus).
Course Summary	The course provides a comprehensive exploration of integral calculus, covering techniques such as indefinite integrals, Riemann sums, definite integrals, properties of integrals, the Fundamental Theorem, L'Hopital's Rule, basic integration formulas, and applications in finding areas between curves, volumes of solids, lengths of plane curves, and areas of surfaces of revolution. Through these topics, students gain proficiency in solving a wide range of mathematical problems involving integration and its applications in various fields.

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Solve indefinite and definite integrals of functions.	Ap	F	Internal Exam/Assignment /Seminar/Viva/ End Sem Exam
CO2	Learn logarithmic, exponential, inverse trigonometric functions and to evaluate derivatives and integrals of the above transcendental functions and use it for computations of other limits	U	F	Internal Exam/Assignment /Seminar/Viva/ End Sem Exam
CO3	Apply integration formulas to find the area between two curves, the surface area and volume of a solid of revolution.	Ap	F	Internal Exam/Assignment /Seminar/Viva/ End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Textbook	Calculus and Analytic Geometry, 9th Edition, George B. Thomas, Jr. Ross L. Finney, Pearson Publications, 2010, ISBN: 978-8174906168.				
Module	**Unit**	**Content**	**Hrs (48+12)**	**Marks**	
				Ext: 70	
I		**Module I**	14	**Min.15**	
	1	Section 4.1 - Indefinite Integrals.			
	2	Section 4.3 - Integration by Substitution - Running the Chain Rule Backward.			
	3	Section 4.5 - Riemann Sums and Definite Integrals. (Example 9 is optional.)			
	4	Section 4.6 - Properties, Area, and the Mean Value Theorem - Topics up to and including Example 6.			
	5	Section 4.6 - Properties, Area, and the Mean Value Theorem- Topics from The Average Value of an Arbitrary Continuous Function onwards.			
II		**Module II**	11	**Min.15**	
	6	Section 4.7 – The Fundamental Theorem (Example 6 is optional).			
	7	Section 4.8 - Substitution in Definite Integrals.			
	8	Section 6.2 - Natural Logarithms- Topics up to and including The Graph and Range of ln x.			
	9	Section 6.2 - Natural Logarithms. -Topics from Logarithmic Differentiation onwards.			
	10	Section 6.3 - The Exponential Function- Topics up to and including Example 4.			
	11	Section 6.3 - The Exponential Function- Topics from The Derivative and Integral of e^x onwards.			
III		**Module III**	12	**Min.15**	
	12	Section 6.6 - L' Hopital's Rule			
	13	Section 6.9 - Derivatives of Inverse			

		Trigonometric Functions; Integrals.		
	14	Section 7.1 - Basic Integration Formulas.		
	15	Section 7.2 - Integration by Parts		
	16	Section 7.3 Partial Fractions.		
IV		**Module IV**	**11**	**Min.15**
	17	Section 5.1 - Areas Between Curves. - Topics up to and including Example 2.		
	18	Section 5.1 - Areas Between Curves- Topics from Boundaries with Changing Formulas		
	19	Section 5.2 - Finding Volumes by Slicing. (Example 2 may be done as open ended).		
	20	Section 5.3 - Volumes of Solids of Revolution- Disks and Washers - Topics up to and including Example 4.		
	21	Section 5.5 - Lengths of Plane Curves. - Topics up to and including Example 2.		
	22	Section 5.6 - Areas of Surfaces of Revolution- Topics up to and including Example 2.		
V		**Module V (Open Ended)**	**12**	
		Inverse Functions and their Derivatives, a^x and $\log_a x$, Inverse Trigonometric Functions and their derivatives, Hyperbolic Functions, Integrals and their derivatives, Integration using trigonometric substitutions,Moments and Center of Mass.		

References

1. Howard Anton, Biven, & Stephen Davis, Calculus, 7th Ed., Wiley India
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Ed, John Wiley & Sons.
3. Robert T Smith and Roland B Minton, Calculus, 4th Ed. McGraw-Hill Companies
4. Soo T Tan, Calculus, 9th Ed.Brooks/Cole Pub Co.
5. Tom M. Apostol, Calculus, Vol 1: One Variable Calculus with an Introduction to Linear Algebra, 2nd Ed, John Wiley & Sons.
6. Michael Van Biezen Calculus Lectures:
   https://youtu.be/YZYxPclo2rg?si=qKCt6ty8m5dBR4DG

*Optional topics are exempted for end semester examination
**70 external marks are distributed over the first four modules subjected to a minimum of 15 marks from each module.

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	1	3	0	3	1	3	0	1
CO 2	2	3	2	1	3	0	3	1	3	0	1
CO 3	2	3	2	1	3	0	3	2	3	0	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:
- Assignment/ Seminar
- Internal Exam
- Viva
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✓	✓	✓	✓	✓
CO 2	✓	✓	✓	✓	✓
CO 3	✓	✓	✓	✓	✓

Programme	B. Sc. Mathematics Honours
Course Code	MAT2CJ102
Course Title	**ELEMENTARY NUMBER THEORY**
Type of Course	**Major**
Semester	II
Academic Level	300-399

Course Details	Credit	Lecture/Tutorial per week	Practicum per week	Total Hours
	4	4	-	60

Pre-requisites	Arithmetic of integers, basic set theory and proof techniques.
Course Summary	We start number theory with the division algorithm, g.c.d., and the Euclidean algorithm for computing it, essential for solving Diophantine equations like ax + by = c. We then prove the Fundamental Theorem of Arithmetic, discuss the infinitude of primes and the sieve of Eratosthenes. Following that, we cover Linear Congruences, the Chinese Remainder theorem, and Fermat's Little Theorem. Finally, we explore Wilson's Theorem, Euler's Phi Function, and Euler's Theorem.

Course Outcomes:

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Apply the division algorithm and Euclidean algorithm to compute greatest common divisors (gcd) and solve related divisibility problems.	Ap	C	Internal Exam/ Assignment/ Seminar/ Viva/End Sem Exam
CO2	Solve Diophantine equations for integer solutions, deduce prime factorization through the fundamental theorem of arithmetic, and identify prime numbers using the sieve of Eratosthenes.	Ap	C	Internal Exam/ Assignment/ Seminar/Viva/ End Sem Exam
CO3	Apply the properties of congruence and the Chinese Remainder Theorem to solve systems of linear congruences.	Ap	C	Internal Exam/ Assignment/ Seminar/ Viva/ End Sem Exam
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Textbook	Elementary Number Theory, David Burton, M, Seventh Edition, Mcgraw – Hill (2007).			
Module	**Unit**	**Content**	**Hrs (60)**	**External Marks (70)**
I		**Module I**		
	1	Section 2.2 The division algorithm (proof of theorem 2.1 omitted).		**Min.15**
	2	Section 2.3 The greatest common divisor - up to and including theorem 2.3 and its corollary.	12	
	3	Section 2.3 The greatest common divisor - All topics from definition 2.3 onwards.		
	4	Section 2.4 The Euclidean algorithm - up to Theorem 2.7.		
	5	Section 2.4 The Euclidean algorithm - All topics from Theorem 2.7 onwards.		
II		**Module II**		
	6	Section 2.5 The Diophantine equation $ax+by = c$ -up to and including Theorem 2.9.		
	7	Section 2.5 -All topics from Example 2.4 onwards.		**Min.15**
	8	Section 3.1 The fundamental theorem of arithmetic - up to Theorem 3.2.		
	9	Section 3.1 The fundamental theorem of arithmetic - All topics from Theorem 3.2 onwards.	11	
	10	Section 3.2 The sieve of Eratosthenes (up to and including theorem 3.4 only)		
III		**Module III**		
	11	Section 4.2 Basic properties of congruence - up to Theorem 4.2.		
	12	Section 4.2 Basic properties of congruence - All topics from Theorem 4.2 onwards.		
	13	Section 4.4 Linear congruences and the Chinese remainder theorem - up to Theorem 4.8.		**Min.15**
	14	Section 4.4 Linear congruences and the Chinese remainder theorem - All Topics from Theorem 4.8 (proof of Theorem 4.8 omitted).	13	

15	Section 5.2 Fermat's little theorem and pseudo primes - up to Lemma. (omit a different proof for Fermat's theorem)	
16	Section 5.2 Fermat's little theorem and pseudo primes - All topics from Lemma onwards.	

IV		**Module IV**	12	**Min.15**
	17	Section 5.3 Wilson's theorem - Up to Theorem 5.5.		
	18	Section 5.3 Wilson's theorem - All topics from Theorem 5.5 onwards.		
	19	Section 7.2 Euler's phi-function - up to Lemma.		
	20	Section 7.2 Euler's phi-function - All Topics from Lemma onwards. (proof of Theorem 7.2 omitted).		
	21	Section 7.3 Euler's theorem. (Second proof of Euler's theorem omitted).		
	22	Section 7.4 Some properties of the phi-function (Proof of Theorem 7.8 omitted).		

V	**Module V (Open Ended)**	12
	Proof of Theorem 4.8. Chinese Remainder Theorem and remaining portions of Section 4.4 Section 6.1 The sum and the number of divisors Linear congruences and the Chinese remainder theorem. Section 6.3 The Greatest Integer Function - up to Theorem 6.11.	

References

1. Rosen, Kenneth H. *Elementary number theory*. London: Pearson Education, 2011.
2. Eynden, Charles Vanden. *Elementary number theory*. Waveland Press, 2006.
3. Gehring, F. W., and P. R. Halmos. G*raduate Texts in Mathematics*, 1976.
4. Hsiung, C. Y. *Elementary theory of numbers*. World Scientific, 1992.
5. Hoffman P., *The man who loved only numbers: The story of Paul Erdös and the search for mathematical truth*, Little Brown & Company, 1999.

*70 external marks are distributed over the first four modules subjected to a minimum of 15 marks from each module.

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PO1	PO2	PO3	PO4	PO5	PO6	PO7

CO 1	1	1	0	0	3	0	3	0	3	0	0
CO 2	1	1	0	0	3	0	3	0	3	0	0
CO 3	0	0	1	0	3	0	3	0	3	0	0

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:
- Assignment/ Seminar
- Internal Exam
- Viva
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Seminar	Viva	End Semester Examinations
CO 1	✔	✔	✔	✔	✔
CO 2	✔	✔	✔	✔	✔
CO 3	✔	✔	✔	✔	✔

Programme	B.Sc. Economics and Mathematics				
Course Title	**DIGITAL ECONOMY**				
Type of Course	MDC				
Semester	II				
Academic Level	100 – 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	Basic course on Economics of 0 – 99 level				
Course Summary	This course is designed to provide a theoretical and practical knowledge about digital economy				

COURSE OUTCOMES (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the Historical foundations and impact of the digital economy.	U	C	Instructor-created exams / Quiz, Assignment
CO2	Analyze business and innovation in the digital age.	An	P	Case Study Analysis,
CO3	Critically evaluate the role of data and analytics.	E	M	Research Paper, Debate Participation
CO4	Assess the policy and social implications of the digital economy.	Ap	p	Instructor-created exams / Home Assignments
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

DETAILED SYLLABUS:

Module	Unit	Content	Hrs	Marks
I		**Foundations of the Digital Economy**	12	17
	1	The Rise of the Digital Economy: Historical context, key technologies, economic impact of digital economy on economic growth, productivity and employment.	2	
	2	Definition and Meaning of Digital Economy	1	
	3	Digital Goodsand Services: Characteristics, pricing models, and distribution channels.	2	
	4	Platforms and Marketplaces: Two-sided markets, network effects, and platform power.	2	
	5	Data & Information Economics: The information value chain, big data.	2	
	6	Privacy: Data protection and security – privacy concerns	1	
	7	Theories of Digital Economy: Growth theory of digital economy –endogenous growth theory – monetary theory of digital economy	2	
II		**Business and Innovation in the Digital Age**	8	11
	8	E-commerce and Online Retail: Business models, customer behaviour, and logistics challenges.	2	
	9	Logistic – Logistic – models – challenges of E-commerce		
	10	The Sharing Economy: Collaborative consumption, platform competition, and regulatory issues.	2	
	11	Fintech and Financial Innovation: Digital payments, cryptocurrencies, and blockchain technology	2	
	12	Digital Transformation and Strategy: How businesses are adapting to the digital environment.	2	
		Data and Analytics	8	11
	13	The Role of Data and Analytics – Big data, data analytics, and their importance in the digital economy.	3	

III	14	Emerging trends and technologies shaping the future of the digital economy, such as AI, blockchain, and the metaverse.	4	
	15	The ethical implications of data collection and usage	1	
		Policy and Social Implications of the Digital Economy	**8**	**11**
IV	16	Competition Policy and Antitrust in the Digital Era: Regulating platform monopolies and market dominance	2	
	17	Intellectual Property and Copyright in the Digital Age: Challenges of protecting digital content and innovation.	2	
	18	Digital Divide and Inequality: Access to technology, skills development, and social justice concerns.	2	
	19	The Future of Work in the Digital Economy: Automation, job displacement, and new skills requirements.	2	
IV		**Digital Economy and India**	**9**	
		Discussion based on different digital systems, platforms, technologies, etc. prevailing in India		
		Practical Assignments on digital economy in India		
		Seminar on the digital economy and shaping of policies in India		

Note: The course is divided into five modules, with four modules together having total 19 fixed units and one open-ended module with a variable number of units. There are total 36 instructional hours for the fixed modules and 9 hours for the open-ended one. Internal assessments (25 marks) are split between the open-ended module (5 marks) and the fixed modules (20 marks). The final exam, however, covers only the 19 units from the fixed modules. The 50 marks shown in the last column, distributed over the first fo ur modules, are only for the external examination.

REFERENCE:
1. Harld Overby and Jan Arild Audestad (2021). *Introduction to Digital Economics: Foundation, Business Models and Case Studies*. Springer.
2. Don Tapscott and Anthony D. Williams (2016). *The Digital Economy: Concepts and Applications*. McGraw-Hill Education (Module I)
3. Liu, Z. (2022). *Principles of Digital Economics: Innovation Theory in the Age of Intelligence* . Springer Nature. (Module 1, Unit 7)

ADDITIONAL READINGS

1. Mayer-Schönberger, V., & Cukier, K. (2013). *Big data: A Revolution that Will Transform how We Live, Work, and Think*. Houghton Mifflin Harcourt.
2. Davenport, T., & Harris, J. (2017). *Competing on Analytics: Updated, with a New Introduction: The New Science of Winning*. Harvard Business Press.
3. Russell, S., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach*, Global Edition. Pearson Higher Ed.
4. Zuboff, S. (2019). *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power*. Profile Books.

MAPPING OF COS WITH PSOS:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO 1	3	2	-	1	1	-	1	-	-
CO 2	2	3	3	3	-	2	2	-	-
CO 3		1	-	2	2	3	2	-	-
CO 4	2	3	1	3	3	1	3	-	-

CORRELATION LEVELS:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

ASSESSMENT RUBRICS:

1. Quiz / Assignment/ Viva Voce/ Discussion / Seminar
2. Internal Exam
3. Practical Assignments (30%)
4. Final Exam (70%)

MAPPING OF COS TO ASSESSMENT RUBRICS:

	Internal Exam	Quiz / Assignment/ Viva Voce/ Discussion / Seminar	Practical Assignment	End Semester Examination
CO 1	✓			✓
CO 2	✓		✓	✓
CO 3	✓	✓	✓	✓
CO 4	✓	✓	✓	✓

APPENDIX-I

Format of the Question Paper Type I for Major Courses

I Semester B.Sc.(FYUGP) Degree Examinations November 2024

ECO1CJ101: Principles of Economics

(Credits: 4)

Maximum Time: 2 hours   **Maximum Marks: 70**

Section A

[Answer All. Each question carries 3 marks]   (Ceiling:24 Marks)

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Section B

[Answer All. Each question carries 6 marks]   (Ceiling:36 Marks)

11.
12.
13.
14.
15.
16.
17.
18.

Section C

[Answer any one. Each question carries 10 marks]   (1x10=10 marks)

19.
20.

Format of the Question Paper Type II for General Foundation Courses

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I Semester B.Sc.(FYUGP) Degree Examinations November 2024

ECO1CM101: Security Trading Practices

(Credits: 3)

Maximum Time: 1.5 hours   **Maximum Marks: 50**

Section A

[Answer All. Each question carries 2 marks]   (Ceiling: 16 Marks)

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Section B

[Answer All. Each question carries 6 marks]   (Ceiling: 24 Marks)

11.
12.
13.
14.
15.

Section C

[Answer any one. Each question carries 10 marks]   (1x10=10 marks)

16.
17.