RAMAIAH UNIVERSITY OF APPLIED SCIENCES

Programme Structure and Course Details of B.Sc. (Hons) in Applied Economics

2024 Onwards

School of Social Sciences

Department of Economics

Head of Department,
Department of Economics,
School of Social Sciences,
M.S.Ramaiah University of Applied Sciences
Bangalore-560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Ramanath K.V.
Dean - Academics
M.S. Ramaiah University of Applied Sciences
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University's Vision, Mission and Objectives

The M. S. Ramaiah University of Applied Sciences (MSRUAS) will focus on student-centric professional education and motivates its staff and students to contribute significantly to the growth of technology, science, economy and society through their imaginative, creative and innovative pursuits. Hence, the University has articulated the following vision and objectives.

Vision

MSRUAS aspires to be the premier university of choice in Asia for student centric professional education and services with a strong focus on applied research whilst maintaining the highest academic and ethical standards in a creative and innovative environment

Mission

Our purpose is the creation and dissemination of knowledge. We are committed to creativity, innovation and excellence in our teaching and research. We value integrity, quality and teamwork in all our endeavors. We inspire critical thinking, personal development and a passion for lifelong learning. We serve the technical, scientific and economic needs of our Society.

Objectives

1. To disseminate knowledge and skills through instructions, teaching, training, seminars, workshops and symposia in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to equip students and scholars to meet the needs of industries, business and society
2. To generate knowledge through research in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to meet the challenges that arise in industry, business and society
3. To promote health, human well-being and provide holistic healthcare
4. To provide technical and scientific solutions to real life problems posed by industry, business and society in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences
5. To instill the spirit of entrepreneurship in our youth to help create more career opportunities in the society by incubating and nurturing technology product ideas and supporting technology backed business
6. To identify and nurture leadership skills in students and help in the development of our future leaders to enrich the society we live in
7. To develop partnership with universities, industries, businesses, research establishments, NGOs, international organizations, governmental organizations in India and abroad to enrich the experiences of faculties and students through research and developmental programmes.

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Faculty	Social Sciences
Department	Economics
Programme Code	444
Programme Name	B.Sc. (Hons) in Applied Economics
Dean of the Faculty	Sri. Gurucharan Gollerkeri
Head of the Department	

1. **Title of the Award:** B.Sc. (Hons) in Applied Economics
2. **Mode of Study:** Full-Time
3. **Awarding Institution /Body:** M. S. Ramaiah University of Applied Sciences, Bengaluru
4. **Joint Award:** Not Applicable
5. **Teaching Institution:** School of Social Sciences, M. S. Ramaiah University of Applied Sciences, Bengaluru
6. **Date of Programme Specifications:** Dec 2023
7. **Date of Programme Approval by the Academic Council of MSRUAS:** 11.12.2023
8. **Next Review Date:** July 2028
9. **Programme Approving Regulating Body and Date of Approval:** KSHEC, 19.06.2024
10. **Programme AcCreditsed Body and Date of AcCreditsation: Not Applicable**
11. **Grade Awarded by the AcCreditsation Body: Not Applicable**
12. **Programme AcCreditsation Validity: Not Applicable**
13. **Programme Benchmark: Not Applicable**
14. **Rationale for the Programme**

B.Sc. (Hons.) in Applied Economics is an undergraduate honours degree programme designed to create motivated, energetic, thinking, and creative graduates. The programme aspires to prepare students for roles as economists, financial analysts, bank and commerce professions, trade markets experts and professionals like economic chief consultants, financial examiners, statistician, operations research analysts, Credits analysts and so on.

The curriculum is outcome-based, and it imbibes required theoretical concepts and practical skills in the domain. Students develop application-oriented learning skills, critical, analytical thinking, and problem-solving abilities for a smooth transition from academic to the real-life work environment by undergoing this programme. This programme is designed to enable students to solve real world economic problem. The programme is introduced considering increasing demand for intersection of economics and data science in the job market. This programme therefore entails theoretical constructs along with practical application of concepts and models.

15. **Programme Mission**

B.Sc. (Hons.) in Applied Economics is an undergraduate programme designed to create motivated, energetic, thinking and creative graduates. The programme aspires to prepare students for roles as economists, financial analysts, banking and commerce professions, trade markets experts and

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professionals like economic chief consultants, financial examiners, statisticians, operations research analysts, Credits analysts, etc.

16. Graduate Attributes (GAs)

GA-1. Economics knowledge: Ability to apply knowledge of mathematics, science fundamentals to solve complex problems in economics

GA-2. Problem Analysis: Ability to analyse economics problems, interpret data and arriveat meaningful conclusions involving mathematical inferences

GA-3. Design and Development of Solutions: Ability to design an economics system, component, or process to meet desired needs considering public health and safety, and the cultural, societal, and environmental considerations

GA-4. Conduct Instigations of Complex Problems: Ability to understand and solve complex economics problems by conducting experimental investigations

GA-5. Modern Tool Usage: Ability to apply appropriate tools and techniques and understand utilization of resources appropriately to complex economic activities

GA-6. The economist and Society: Ability to understand the effect of economics solutions on legal, cultural, social, and public health and safety aspects

GA-7. Environment and Sustainability: Ability to develop sustainable solutions and understand their effect on society and environment

GA-8. Ethics: Ability to apply ethical principles to economic practices and professional responsibilities

GA-9. Individual and Teamwork: Ability to work as a member of a team, to plan and to integrate knowledge of various economics disciplines and to lead teams in multidisciplinary settings

GA-10. Communication: Ability to make effective oral presentations and communicate technical ideas to a broad audience using written and oral means

GA-11. Project Management and Finance: Ability to lead and manage multidisciplinary teams by applying economics and management principles

GA-12. Life-long learning: Ability to adapt to the changes and advancements in technology and engage in independent and life-long learning

17. Programme Outcomes (POs)

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B.Sc. (Hons) (Applied Economics) graduates will be able to:

PO-1. Apply the knowledge of economics to the solution of complex societal problems.

PO-2. Identify problems by closely examining the situations around them and think holistically about the phenomena and generate viable solutions to these problems. Exhibit the skill of critical thinking and understand scientific texts and place scientific statements and themes in contexts and evaluate them in terms of generic conventions.

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PO-3. Demonstrate ability to accommodate the views of others and present their own opinions and complex ideas, in written or oral form, in a clear and concise manner in group settings. Exhibit thoughts and ideas effectively in writing and orally; communicate with others using appropriate media, build effective interactive and presenting skills to meet global competencies.

PO-4. Infer scientific literature, build a sense of enquiry and be able to formulate, test, analyze, interpret, and establish hypothesis and research questions; and to identify and consult relevant sources to find answers.

PO-5. Create new conceptual, theoretical, methodological innovations that integrate and transcend beyond discipline-specific approaches to address a common problem.

PO-6. Perform independently and collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.

PO-7. Demonstrate empathetic social concern and equity centered national development and act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.

PO-8. Analyze the impact of the scientific solutions in societal and environmental contexts for sustainable development.

PO-9. Demonstrate attitudes of being a life-long learner who passionately pursues self-determined goals in the broadest context of socio-technological changes.

18. Programme Goal

The programme goal is to produce graduates with critical, analytical and problem solving skills, and ability to think independently, to pursue a career in Economics and allied areas.

19. Programme Educational Objectives (PEOs)

The objectives of the B.Sc. (Hons) (Applied Economics) programme are to:

PEO-1. Create a community of informed purveyors of knowledge geared towards academic excellence and increase the knowledge base and skill sets aimed at enhancing their professional competence.

PEO-2. Promote innovation and research by instilling a sense of independent and critical thinking with sensitivity to social needs.

PEO-3. Inculcate strong human values and social, interpersonal and leadership skills required for professional success in evolving global professional environments.

20. Programme Specific Outcomes (PSOs)

At the end of the B.Sc. (Hons) in Applied Economics programme, the graduate will be able to:

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PSO-1. Apply the knowledge of economics to develop innovative and inclusive understanding to real-world issues.

PSO-2. Acquire the skills necessary to think critically and communicate effectively about economics and allied domains.

PSO-3. Demonstrate the understanding of life-long learning and leadership qualities through professional development and strive for the betterment of organization, environment, and society.

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21. Programme Structure:

Semester- I							
Sl. No	**Code**	**Course Title**	**Theory (H/W/S)**	**Tutorial (H/W/S)**	**Practical (H/W/S)**	**Total Credits**	**Max. Marks**
1	SSF101A	Maths 101 (Compulsory Foundation Course-1)	3	1		4	100
2	SSF102A	Statistics 101 (Compulsory Foundation Course-2)	3	1		4	100
3	AEC101A	Principles of Micro Economics-I	3	1		4	100
4	AEC102A	Introduction to R	3		1	4	100
5	AEO101A	Open Elective	2	1		3	100
6	AEU101A	Ability Enhancement Course-1	1	1		2	100
Total			**15**	**5**	**1**	**21**	**600**
Total Number of Contact Hours per week				21			

Semester- II							
Sl. No	**Code**	**Course Title**	**Theory (H/W/S)**	**Tutorial (H/W/S)**	**Practical (H/W/S)**	**Total Credits**	**Max. Marks**
1	SSF103A	Data Science 101 (Compulsory Foundation Course-3)	3	1		4	100
2	SSF104A	Computer Science 101 (Compulsory Foundation Course-4)	3	1		4	100
3	AEC103A	Mathematics for Economics	3	1		4	100
4	AEC104A	Principles of Macro Economics-I	3	1		4	100
5	AEC105A	Python Programming	3		1	4	100
6	AEO102A	Open Elective	2	1		3	100
7	AEU102A	Skill Enhancement Course-1	1	1		2	100
Total			**18**	**6**	**1**	**25**	**700**
Total Number of Contact Hours per week				25			

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Semester- III							
Sl. No	**Code**	**Course Title**	**Theory (H/W/S)**	**Tutorial (H/W/S)**	**Practical (H/W/S)**	**Total Credits**	**Max. Marks**
1	AEC201A	Principles of Micro Economics-II	3	1		4	100
2	AEC202A	Principles of Macro Economics-II	3	1		4	100
3	AEC203A	Advanced Statistics	3	1		4	100
4	AEC204A	Data Pre-Processing	3		1	3	100
5	AEO201A	Open Elective	2	1		3	100
6	AEU201A	Ability Enhancement Course-2	1	1		2	100
Total			**15**	**5**	**1**	**21**	**600**
Total Number of Contact Hours per week				21			

Semester- IV							
Sl. No	**Code**	**Course Title**	**Theory (H/W/S)**	**Tutorial (H/W/S)**	**Practical (H/W/S)**	**Total Credits**	**Max. Marks**
1	AEC205A	Introductory Econometrics	3	1		4	100
2	AEC206A	Development Economics	3	1		4	100
3	AEC207A	Operations Research and Optimisation Techniques	3		1	4	100
4	AEE201A	Public Economics (DSE)*	3	1		4	100
5	AEE202A	Labor Economics (DSE)*	3	1		4	100
6	AEO202A	Open Elective	2	1		3	100
7	AEU202A	Skill Enhancement Course-2	1	1		2	100
8	BAU201A	Entrepreneurial Mindset and Action	2	1		3	100
Total			**17**	**6**	**1**	**24**	**00**
Total Number of Contact Hours per week				25			

*Students must choose one of two DSEs

Semester- V							
Sl. No	**Code**	**Course Title**	**Theory (H/W/S)**	**Tutorial (H/W/S)**	**Practical (H/W/S)**	**Total Credits**	**Max. Marks**
1	AEC301A	Indian Economy	3	1		4	100
2	AEC302A	International Trade	3	1		4	100
3	AEC303A	Machine Learning	3		1	4	100
4	AEC304A	Advanced Econometrics	3	1		4	100

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5	AEE301A	Political Economy (DSE)*	3	1		4	100
6	AEE302A	Industrial Economics (DSE)*	3	1		4	100
7	AEE303A	Advanced Microeconomics (DSE)*	3	1		4	100
Total			**18**	**5**	**1**	**24**	**600**
Total Number of Contact Hours per week				24			

*Students must choose two of three DSEs

Semester- VI							
Sl. No	**Code**	**Course Title**	**Theory (H/W/S)**	**Tutorial (H/W/S)**	**Practical (H/W/S)**	**Total Credits**	**Max. Marks**
1	AEC305A	Research methodology in Economics	3	1		4	100
2	AEC306A	Dissertation	12			6	100
3	AEC307A	Resource and Environmental Economics	3	1		4	100
4	AEE307A	Advanced Macroeconomics (DSE)*	3	1		4	100
5	AEE304A	Money and Banking (DSE)*	3	1		4	100
6	AEE306A	Game Theory (DSE)*	3	1		4	100
Total			**24**	**4**		**22**	**500**
Total Number of Contact Hours per week				28			

*Students must choose two of three DSEs

By End of VI Semester: 137 Credits

Semester- VII							
Sl. No	**Code**	**Course Title**	**Theory (H/W/S)**	**Tutorial (H/W/S)**	**Practical (H/W/S)**	**Total Credits**	**Max. Marks**
1	AEE401A	Corporate and International Finance (DSE)*	3	1	0	4	100
2	AEE402A	Behavioral Economics (DSE)*	3	1	0	4	100
3	AEE405A	Health Economics (DSE)*	3	1	0	4	100
4	AEE406A	Law and Economics (DSE)*	3	1	0	4	100
5	AEE408A	Economics of Education (DSE)*	3	1	0	4	100
6	AEE409A	Economics of Microfinance (DSE)*	3	1	0	4	100

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Total	**15**	**5**		**20**	**500**
Total Number of Contact Hours per week		20			

*Students must choose five of six DSEs

Semester- VIII (For B.Sc. Economics (Hons. with Research))							
Sl. No	**Code**	**Course Title**	**Theory (H/W/S)**	**Tutorial (H/W/S)**	**Practical (H/W/S)**	**Total Credits**	**Max. Marks**
1	AEI401A	Research Project	24			12	100
Total			**24**			**12**	**100**
Total Number of Contact Hours per week			24				

	VIII Semester (For B.Sc. Economics (Hons))						
Sl. No	**Code**	**Course Title**	**Theory (H/W/S)**	**Tutorial (H/W/S)**	**Practical (H/W/S)**	**Total Credits**	**Max. Marks**
1	AEE403A	Urban Economics	3	1	0	4	100
2	AEE404A	Agriculture Economics	3	1	0	4	100
3	AEE407A	Growth Economics	3	1	0	4	100
	Total		**9**	**3**	**0**	**12**	**300**
Total Number of Contact Hours per week					12		

By End of VIII Semester: 169 Credits

22. Open Elective Courses

A number of Open Elective Courses from Faculties of engineering, management and commerce, art and design, hospitality management and catering technology, pharmacy, dental sciences are offered as mentioned in the University's website. Students can choose the Open Electives on their own choice.

23. Course Delivery: As per the Timetable

24. Teaching and Learning Methods

1. Face to Face Lectures using Audio-Visuals
2. Workshops, Group Discussions, Debates, Presentations
3. Demonstrations
4. Guest Lectures
5. Laboratory work/Field work/Workshop
6. Industry Visit
7. Seminars
8. Group Exercises
9. Project Work
10. Project

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11.Exhibitions
12.Technical Festivals

25. Assessment and Grading

25.1. Components of Grading

There shall be **two components** of grading in the assessment of each course:

Component 1, Continuous Evaluation (CE): This component involves multiple subcomponents (SC1, SC2, etc.) of learning assessment. The assessment of the subcomponents of CE is conducted during the semester at regular intervals. This subcomponent represents the formative assessment of students' learning.

Component 2, Semester-end Examination (SEE): This component represents the summative assessment carried out in the form an examination conducted at the end of the semester.

Marks obtained CE and SEE components have a weightage of 60:40 (CE: 60% and SEE: 40%) in determining the final marks obtained by a student in a Course.

The complete details of Grading are given in the Academic Regulations.

25.2. Continuous Evaluation Policies

Continuous evaluation depends on the type of the course as discussed below:

25.2.1 Theory Courses

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Terms Tests	Assignments	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

- CE components should have a mix of term tests, quiz and assignments
- Two Tests (15 each), Two Assignments (20 marks). (One written and another to be MCQs)
- Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

25.2.2 Laboratory Course

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For a laboratory course, the scheme for determining the CE marks is as under:

For Laboratory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ▶	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
CO-6			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The subcomponents can be of any of the following types:

a) Laboratory / Clinical Work Record
b) Experiments
c) Computer Simulations
d) Creative Submission
e) Virtual Labs
f) Viva / Oral Exam
g) Lab Manual Report
h) Any other (e.g. combinations)

Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

25.2.3 Course Having a Combination of Theory and Laboratory

For a course that contains the combination of theory and laboratory sessions, the scheme for determining the CE marks is as under:

For Combined Courses (Theory + Laboratory)					
Focus of COs on each Component or Subcomponent of Evaluation					
Course Outcome	CE (Weightage: 60 %) Four components including one Lab component			SEE (Weightage: 25 %)	Lab (Weightage: 15 %)
	Tests (30 %)	Written Assignments+ Lab (20 %)	Assignment +Lab CE (10%)	Written exam	LSEE: SEE
CO-1					
CO-2					
CO-3					
CO-4					
CO-5					
CO-6					

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The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

- CE components should have a mix of term tests, quiz and assignments
- Two Tests (15 each), Two Assignments (20 marks). (One written and another to be MCQs)
- In case of courses where laboratory is combined with theory, laboratory components to be assessed in both CE and SEE
- Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

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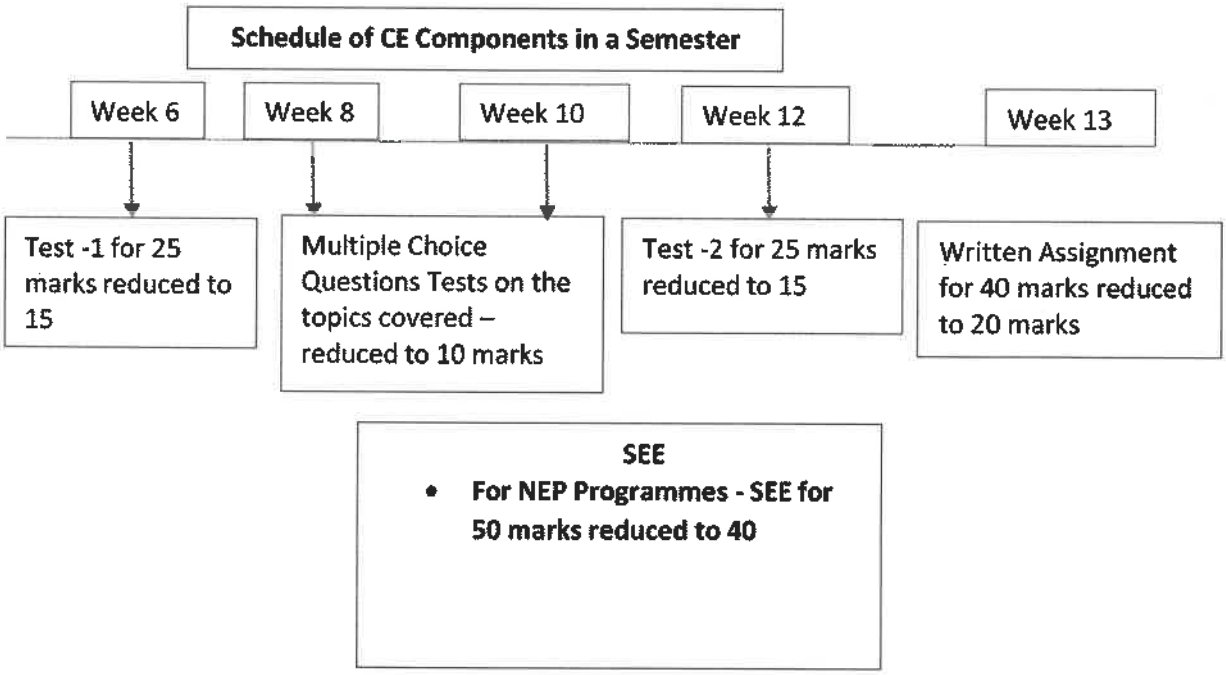
25.2.4 Ability Enhancement courses

For AECC Only		
Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: CE (50% Weightage)	Component 2: SEE (50% Weightage)
Subcomponent Type ▶	Terms Tests or Assignments	
CO-1		
CO-2		
CO-3		
CO-4		
CO-5		
CO-6		
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.		

- Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean



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26. Minor Programme

The details of the following aspects of the minor programmes are presented in the **Academic Regulations** for the B. Sc. Degree Programme:

1. Programme Structure
2. Eligibility to Minor Programme
3. Registration to Minor Programme
4. Certification for Minor Programme

27. Student Support for Learning

1. Course Notes
2. Reference Books in the Library
3. Magazines and Journals
4. Internet Facility
5. Computing Facility
6. Laboratory Facility
7. Workshop Facility
8. Staff Support
9. Lounges for Discussions
10. Any other support that enhances their learning

28. Quality Control Measures

1. Review of Course Notes
2. Review of Question Papers and Assignment Questions
3. Student Feedback
4. Moderation of Assessed Work
5. Opportunities for students to see their assessed work
6. Review by external examiners and external examiners reports
7. Staff Student Consultative Committee meetings
8. Student exit feedback
9. Subject Assessment Board (SAB)
10. Programme Assessment Board (PAB)

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29. Programme Map (Course-PO-PSO Map)

Sem.	Course Title	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
1	Compulsory Foundation Course 1 (CFC 1)	3		2			1				3	1	2
1	Compulsory Foundation Course 1 (CFC 2)	3		2				1		1	3	1	2
1	Principles of Microeconomics I	3		2			1				3	1	2
1	Introduction to R	3		3		2					3	1	1
1	Generic Elective 1			2		3			2	1	2	3	1
1	Ability Enhancement Course 1	2	3							1	3	2	1
2	Compulsory Foundation Course 3 (CFF 3)	3		2			1				3	1	2
2	Compulsory Foundation Course 4 (CFC 4)	3	2							1	3	2	1
2	Mathematical Methods in Economics	3	2						1		3	2	1
2	Principles of Macroeconomics I	3		2			2				2	3	1
2	Python Programming	3		3		2					3	1	1
2	Skill Enhancement Course – 1 (SEC-1)					3	2			2	2	3	1
3	Advanced Statistics	2		3		3	3		2		2	3	1
3	Principles of Microeconomics II	3		2			1				3	1	2
3	Principles of Macroeconomics II			1		2			3		3	2	1
3	Data Pre-Processing	3		3		2					3	1	1
3	Generic Elective 2			3	2			1			2	3	1
3	Ability Enhancement Course 1	3		2			1				3	1	2
4	Introductory Econometrics	3		2			1				3	1	2
4	Development Economics (CC)	2					1		3		3	2	1
4	Operations Research and Optimisation Techniques	3		3		2					3	1	1
4	Public Economics (DSE)		3	2						1	3	1	2
4	Labor Economics (DSE)	3		2			1				3	1	2
4	Generic Elective-3		3	1			2				3	2	1
5	Advanced Econometrics (CC)		3	2			1				3	2	1
5	Indian Economics (CC)				3		2			1	2	3	1
5	International Trade (CC)		3	1			2				3	2	1
5	Machine Learning	3		3		2					3	1	1
5	Political Economy (DSE)	2					1		3		3	2	1
5	Industrial Economics (DSE)			1		2			3		3	2	1
5	Advanced Microeconomics (DSE)		3	1			2				3	2	1
6	Research Methodology			2	3	1					2	3	1
6	Dissertation/Project (CC)				3	3			2		3	1	2
6	Resource and Environmental Economics (CC)			3				1	2		2	3	1
6	Advanced Macroeconomics (DSE)		3	1			2				3	2	1
6	Money and Banking (DSE)	2					1		3		3	2	1
6	Game Theory (DSE)	2					1		3		3	2	1
7	Corporate and International Finance (DSE)	2					1		3		3	2	1
7	Behavioral Economics (DSE)	3				2					3	2	1
7	Health Economics (DSE)	2		3		3	3		2		2	3	1
7	Law and Economics (DSE)	2				3					1	1	3
7	Economics of Education	2		3		3	3		2		2	3	1
7	Behavioral Economics	3				2					3	2	1

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8	Research Project				3	3			2		3	1	2
8	Urban Economics (DSE)	3				2					1	1	1
8	Agriculture Economics (DSE)	3								3	1	3	1
8	Growth Economics	2		3			1				2	3	1
3: Very Strong, 2: Strong Contribution, 1: Moderate Contribution													

30. Co-curricular Activities

Students are encouraged to take part in co-curricular activities like seminars, conferences, symposia, paper writing, attending industry exhibitions, project competitions and related activities for enhancing their knowledgeand networking.

31. Cultural and Literary Activities

Annual cultural festivals are held to showcase the creative talents in students. They are involved in planning andorganizing the activities.

32. Sports and Athletics

Students are encouraged to take part in sports and athletic events regularly. Annual sports meet will be held todemonstrate sportsmanship and competitive spirit.

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COURSE SPECIFICATIONS

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Semester I

CFC 1: Mathematics 101

Marks: 100 **Credits: 4**

Course Outcomes:

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

1. Understand the basic concepts like set theory and logic
2. Determine the domain and range of various functions
3. Perform operations on matrices and determinants
4. Analyse the intuition behind calculus
5. Apply the concepts of permutations and combinations

Unit 1. Logic: Propositions and truth values; Tautologies and Contradictions; Deduction and Induction; Different proof techniques.

Unit 2. Set Theory: Definition of a set and discussion of related concepts; Set types; Complement of a set; Operations on sets; Nested sets; Cartesian product; Concept of Euclidean Space.

Unit 3. Relations and Functions: Definitions; Concepts of 'range', 'domain' and 'mapping'; Relations; Types of Relations; Explicit and implicit functions; Types of functions - polynomial, exponential, logarithmic, power etc.

Unit 4. Matrices and Determinants: Concept of a matrix; Types of matrices; Operations on matrices; Transpose of a matrix; Symmetric and skew-symmetric matrices; Concept of Determinants; Adjoint and inverse of a matrix; Cramer's rule

Unit 5. Introduction to Differential Calculus: Discussion of concepts of limits and continuity, derivative, partial derivative, total differential and integral; Derivative of basic functions; Chain rule; Applications of differential and integral calculus to the study of functions: slope and curvature of functions, distinction between concave and convex functions; maxima and minima.

Unit 6. Permutations and Combinations: Introduction to factorial notation; Permutations and Combinations: Concepts and Applications.

References:

1. Mathematics NCERT Class XI & XII
2. Harcourt Mathematics 11: Functions/Relations
3. Calculus, H. Anton, I. Birens, S. Davis. John Wiley and Sons Inc., 2002
4. Schaum's Outline of Calculus, F. Ayres, E. Mendelson
5. An Introduction to Determinants and Matrices, Frank Bowman
6. Discrete Mathematics : An Open Introduction, Oscar Levin

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CFC 2: Statistics 101

Marks: 100 **Credits: 4**

Course Outcomes:

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

1. Collect, organize, and present data effectively using textual, tabular, and diagrammatic methods, including distinct types of charts and graphs.
2. Understand and calculate different measures of central tendency, such as arithmetic mean, median, and mode, and determine appropriate measures based on data characteristics.
3. Proficient in calculating measures of dispersion, including range, quartile deviation, mean deviation, and standard deviation, and interpreting their significance in analyzing data variability.
4. Able to create frequency distributions for both discrete and continuous variables and visualize them using relevant diagrammatic representations, such as histograms, frequency polygons, and ogives.
5. Will grasp the foundational concepts of probability, including key terminology, mutually exclusive and independent events, basic probability rules, and conditional probability, and apply these concepts to practical scenarios.

Unit 1. Introduction: Statistics as a Subject; Importance, Limitations and Misuse of Statistics; Descriptive and Inferential Statistics; Qualitative and Quantitative data; Types of variables - ordinal/nominal/ratio/interval; Descriptive vs. Inferential Statistics.

Unit 2. Collection, Organisation and Presentation of Data: Primary and Secondary Data; Methods of Collection; Scrutiny of Data; Presentation of Data: Textual and Tabular Presentations; Diagrammatic Representation of Data: Line Diagrams, Ratio Chart, Bar Diagrams, Pie Charts and Divided-Bar Diagrams.

Unit 3. Frequency Distributions: Variables and Attributes; Frequency Distribution of An Attribute; Discrete and Continuous Variables; Frequency Distributions of Discrete and Continuous Variables; Diagrammatic Representation of a Frequency Distribution: Case of An Attribute, Case of a Discrete Variable: Column Diagram, Frequency Polygon and Step Diagram, Case of a Continuous Variable: Histogram and Ogive, Frequency Polygon.

Unit 4. Measures of Central Tendency: Definition and Utility; Characteristics of Average; Different Measures of Average: Arithmetic Mean, Median, Mode; Partitioned Values: Quartile, Percentile and Deciles; Geometric and Harmonic Mean; Choice of a Suitable Measure of Central Tendency.

Unit 5. Measures of Dispersion: Meaning and Objective of Dispersion; Characteristics of a Good Measure of dispersion; Different measures of dispersion – Range, Quartile deviation, Mean deviation, Mean Absolute Deviation, Standard Deviation; Comparison of the Different Measures of Dispersion; Measures of Relative Dispersion: Coefficient of Variation; Moments; Skewness; Kurtosis.

Unit 6. Basics of Probability: Probability as a Concept; Some Important Terminology (random experiment, sample space, etc.); Mutually Exclusive Events and Independent Events; Basic Probability Rules; Addition and Multiplication Theorem of Probability; Applications; Conditional Probability: Basic formula and Applications; Bayes' Theorem: Statement, Applications.

References

1. Fundamentals of Mathematics and Statistics, SC Gupta and VK Kapoor
2. An Introduction to Probability and Statistics, VK Rohatgi and E Saleh
3. Applied General Statistics, Croxton and Cowden

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CC: Principles of Microeconomics-I

Marks: 100 **Credits: 4**

Objective: This course is designed to expose the students to the basic principles of microeconomic theory. The emphasis will be on thinking like an economist and the course will illustrate how microeconomic concepts can be applied to analyze real-life situations.

Course Outcome: The students will be able to

1. know the basic concepts and subject-matter of microeconomics;
2. learn about how price is determined through interactions between buyers and sellers
3. apprehend the consumer's choice under various conditions;
4. understand different concepts of costs and production and their role in determining the producer's behavior.

Unit 1: Exploring the subject matter of Economics (brief introduction)

1. Scope and method of economics: scarcity, choice and market; what to produce, how to produce and how to distribute output; scarcity of resources, opportunity cost and trade off; efficient product combination; positive vs. normative issues; partial equilibrium (ceteris paribus assumption) vs. general equilibrium (inter-dependence of markets); microeconomic issues vs. macroeconomic issues; economic systems/models
2. Concept of Market and prices: self-interested agents; competition as basic driving force; price as an invisible hand; price and value: value paradox; real and nominal prices
3. Market Regulation and government intervention: why and when should government intervene – Case of market failure (externality; public good); equity vs. efficiency (the issue of distribution); rationing; employment generation.

Unit 2: Demand and Supply Analysis in a Competitive Market

1. Perfectly competitive market – Features: atomistic agents, anonymity, homogeneous products, and perfect information
2. Demand: schedule and curve; law of demand and its exceptions; determinants of individual demand; shifts v/s movements along the demand curve; elasticity – own price elasticity and slope of demand curve; factors influencing own-price elasticity; cross-price elasticity; substitutes and complements; income elasticity; normal and inferior goods; derivation of market demand curve from individual demand curve.
3. Supply: schedule and curve (implication as marginal cost curve); determinants; shifts v/s movements along the curve; elasticity - price elasticity of supply and slope of supply curves; Marshal's time period analysis; Market supply from individual supply;
4. Equilibrium in a Competitive market: Concept of equilibrium; price adjustments under excess demand or excess supply; comparative statics: changes in demand; changes in supply.
5. Markets and Welfare - consumer surplus; producer surplus, social welfare.

Unit 3: The Consumer Theory

1. The consumption decision/choice problem - budget constraint and budget set.
2. Consumer preferences: Concept and properties of indifference curves; nature of commodities: good vs. bad (pollution); perfect substitutes, perfect complements; cardinal v/s ordinal utility
3. Consumer's optimum choice; marginal rate of substitution, tangency condition.

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4. Effect of change in price; derivation of demand curve; decomposition into income and substitution effects.
5. Effect of change in income: income consumption curve, Engel curve.

Unit 4: Production, Technology and Firm's Input Choices

1. Technology and production: concept of production function and cost minimising choice of inputs.
2. Iso-product curve/isoquant and properties; production technology v/s production technique.
3. Short-run and law of variable proportions (TP, AP, MP curves); long run and returns to scale (IRS, CRS, DRS).
4. Cost of production and Firm's input choices: Cost structure – explicit v/s implicit or opportunity cost; economic and accounting costs.
5. Cost equation, isocost line; Cost minimization and choice of technique; long run and short run expansion path

Unit 5: Cost Functions/cost curves

1. Concepts of different types of costs curves – fixed, sunk, variable costs; total, average, and marginal costs; short-run total, average, fixed cost curves, short run marginal cost curve. Relation between these curves with the product curves
2. Long-run cost functions; economies and diseconomies of scale and shape of the long-run average cost curve, derivation of LAC as envelope to SACs, long run marginal cost curve.
3. Product transformation curve, joint production, economies and diseconomies of scope.

Basic texts to follow:

1. Principles of Micro Economics - Gregory Mankiw
2. Microeconomics - Pindyck and Rubinfeld

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CC: Introduction to R

Marks: 100 **Credits: 4**

Course Outline:

1. Understand the fundamental syntax, variety of data formats of R through demonstrations, exercises and writing R script in RStudio
2. Get familiarise with the concepts data types, data structures, iteration, control flow structures, functions, and operators by writing R programs and through examples

3. Use R to read files of different formats, prepare or clean data for analysis, Learn to perform descriptive statistics in R

4. Learn data visualization through ggplot2 package

Course Contents :

Unit 1: Introduction

Introduction to R studio and R, Working directories, Variables, Atomic data types, Conditions and Loops, Functions, Default arguments, Packages in R, Basics of R Markdown

Unit 2: Data Structures

Vectors, Matrices, Lists, Data Frames, Dimensionality of data, indexing data structures, String operations using stringr package

Unit 3: Data Analysis

Tidyverse Package, Delimited files, reading and writing delimited files, Data transformation using dplyr verbs, frequency tables

Unit 4: Data Visualization in R

Scatter Plots, Box Plots, bar plot, Histograms, Use of different aesthetics and geometries in ggplot2 library, improve data visualizations using theme, scale and facets, Create reference variables using appropriate scope

Unit 5: Miscellaneous concepts

Debugging, Vector Operations, Variable scope, Apply functions

Measure of central tendency, Measure of variability, Skewness and kurtosis, Summary functions, describe functions and descriptive statistics by group, correlations

Basics of Regular Expressions, Basic discussion on web scrapping, NLP and the use of regex in them

References:

Venables W.N., Smith D.M. et al. (2022), An Introduction to R. CRAN

Wickham, H. & Grolemund, G. (2018). R for Data Science. O'Reilly

Peng R.D. (2022), R Programming for Data Science. Leanpub

Required software

- R: http://www.r-project.org/
- RStudio (additional libraries required): http://www.rstudio.com/

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Semester II

CFC 3: Introduction to Data Science

Marks: 100 **Credits: 4**

Course Overview:
Data Science 101 is an introductory course designed to give students at the School of Social Sciences with a foundational understanding of the concept of data science and its potential applications in the field of social science. The course emphasizes on some of the essential concepts, techniques for extracting information from data, finding significance and also conveying that information through visualization techniques. The course also imparts the ethical considerations related to data collection, analysis.

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

1. Understand the fundamental principles of data science and its applications in various domains of social sciences.
2. Demonstrate knowledge of different data collection methods and understand their relevance in various research contexts.
3. Apply exploratory data analysis techniques to gain insights, identify patterns, and detect outliers in datasets and perform basic statistical analysis to interpret data and draw meaningful conclusions.
4. Get introduced with some of the data visualization techniques to communicate insights and trends visually.
5. Recognize the ethical considerations and privacy implications associated with data science and data handling.

Unit 1: Introduction to Data Science and its Applications

- What is Data Science: Data as information carrier and the science behind it.
- Overview of data science and its importance in the field of social sciences
- Role of data in decision-making and problem-solving
- Key concepts in data science: data, variables, observations, and measurements
- Big data and Data Science hype

Unit 2: Data Collection and Types of Data

- Methods of data collection: surveys, interviews, experiments, observations
- Qualitative and quantitative data: definitions and characteristics
- Sampling techniques and their applications
- Data sources and data quality considerations

Unit 3: Exploratory Data Analysis (EDA)

- Descriptive statistics: measures of central tendency, dispersion, and distribution
- Data visualization techniques: histograms, scatter plots, bar charts
- Exploring relationships and patterns in data
- Identifying outliers and missing data
- Introduction to statistical analysis in data science

Unit 4: Data Visualization for Insights

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- Principles of effective data visualization
- Choosing appropriate visual representations for different types of data
- Designing clear and informative charts, graphs, and diagrams
- Communicating data insights visually

Unit 5: Analyzing Social Networks and Network Analysis

- Introduction to social network analysis
- Basics of network visualization and metrics
- Identifying key actors and relationships in social networks
- Applications of network analysis in psychology, sociology, economics, and public policy

Unit 6: Data Ethics and Privacy

- Ethical considerations in data science
- Privacy protection and data anonymization techniques
- Ensuring fairness and avoiding bias in data analysis
- Legal and regulatory frameworks for data privacy and protection

Reference Books:

1. Introducing Data Science Big data, machine learning, and more, using Python tools By Davy Cielen, Arno D. B. Meysman, and Mohamed Ali ; Manning Publication
2. Ethics and Data Science by Mike Loukides , Hilary Mason, DJ Patil ; O'Reilly publications
3. Doing Data Science: Straight Talk from the Frontline 1st Edition, by Cathy O'Neil , Rachel Schutt ; O'Reilly publications
4. Data Science from Scratch: First Principles with Python by Joel Grus O'Reilly publications

CFC-4
Computing and Programming Fundamentals

Marks: 100 **Credits: 4**

Course Outcomes:

On successful completion of this course, a student will be able to:

1. Handle a computer system for day to day use.
2. Enumerate different types of input/ output devices and types of memory.
3. Perform basic arithmatic operations using different number systems including binary arithmetic.
4. Differentiate between system and application software.
5. Prepare documents / spreadsheets.

Unit 1: Introduction to Computers

Characteristics of computers, uses of computers, components of a digital computer, types of computers.

Unit 2: Number Systems

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Binary, Octal and Hexadecimal number systems, Binary Coded Decimals (BCD), Binary Coded Octals (BCO), Binary Coded Hexadecimals (BCH), 1's complement, 2's complement, conversion from one number system to another, binary arithmetic (addition, subtraction), binary subtraction using 2's complement.

Unit 3: Input and Output Devices:

Keyboard, mouse, touch screen, joystick, scanner, web camera, MICR, OCR, OMR, bar-code reader, monitor, printer, plotter. Memory: Primary, secondary, auxiliary memory; RAM, ROM, cache memory, magnetic tape, magnetic disks, hard disk drives, optical disks, CD-R, DVD, flash drives, blue ray disc.

Unit 4: Computer Organization and Architecture:

C.P.U., registers, system bus, main memory unit, LOCF - Page: 1 of 35 processors, motherboard, ports and interfaces, expansion cards, ribbon cables, SMPS, memory chips.

Unit 5: Software:

System software, application software, operating system and its functions and types.

Unit 6: Overview of Emerging Technologies:

Bluetooth, cloud computing, big data, data mining, mobile computing. Practical Practical exercises based on the concepts mentioned in theory using relevant software.

CC : Mathematical Methods in Economics

Marks: 100 **Credits: 4**

Objective: The goal of this course is to give the students sufficient knowledge of fundamental principles, methods and a clear perception of mathematical tools needed in economics and to equip students with necessary analytic and technical skills to handle problems of mathematical nature.

Course Outcome: The students will be able to

CO 1: Know the basic concept of mathematics used in Economics;
CO 2: Understand the role and importance of the subject;
CO 3: Apply the various tools of mathematics in Economics;
CO 4: Evaluate the various policy options in economics quantitatively.

Course Content:

Unit 1: Logic: Propositions and truth values; Tautologies and Contradictions; Deduction and Induction; Different proof techniques.

Unit 2: Set Theory: Definition of a set and discussion of related concepts; Set types; Operations on sets; Nested sets; Cartesian product; Concept of Euclidean Space.

Unit 3: Functions and Correspondences: Definitions; Concepts of 'range', 'domain' and 'mapping'; Explicit and implicit functions; Types of functions and correspondences polynomial, exponential, logarithmic, power etc.

Unit 4: Brief Review of Differential and Integral Calculus: Discussion of concepts of limits and continuity, derivative, partial derivative, total differential and integral; Applications of differential and integral calculus to the study of functions: slope and curvature of functions, distinction between concave and convex functions; maxima and minima, area under a curve etc.

Unit 5: Mean value theorems of Derivative: Polynomial approximation of functions; Taylor's formula with remainder.

Unit 6: Other Topics: Permutations and Combinations; Various types of series (arithmetic, geometric, logarithmic, exponential, Taylor's; linearization of nonlinear series and McLaurin's); Brief review of trigonometric functions and associated curves.

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Unit 7: Vector, Matrix and Euclidian Space: Vectors, Points, Distance formula, Algebra of Vectors, Lines and Planes. System of simultaneous linear equations and matrix algebra including addition, subtraction, multiplication, laws of matrix algebra, transpose, square matrices, the determinant of a matrix, properties of determinants, cofactors, Cramer's rule.

References:

- Sydsaeter and Hammond: Mathematics for Economics Analysis. Pearson Education India.
- Michael Hoy, John Livernois, Chris McKenna, Ray Rees, Thanasis Stengos: Mathematics for Economics. PHI.
- Chiang, Wainwright: Fundamental Methods of Mathematical Economics. Mc Graw Hill Education.
- Simon and Blume: Mathematics for Economists. Viva Books

CC: Principles of Macroeconomics-I

Marks: 100 **Credits: 4**

Objective: This course aims to introduce the students to the basic concepts of Macroeconomics. Macroeconomics deals with the aggregate economy. This course discusses the preliminary concepts associated with the determination and measurement of aggregate macroeconomic variable like savings, investment, GDP, money, inflation, and the balance of payments. The emphasis will be on thinking like an economist and the course will illustrate how macroeconomic concepts can be applied to analyze real-life situations.

Course Outcome: The students will be able to

CO 1. Know the basic concepts and subject-matter of macroeconomics;
CO 2. Evaluate the circular flow of income and expenditure in various sectors of the economy;
CO 3. Measure and analyze the income and employment determination under classical and Keynesian economics;
CO 4. Conceptualize the various terminologies used in national income, consumption and investment;
CO 5. Understand the concepts of consumption, investment and evaluate its determining factors;
CO 6. Learn the concepts of multiplier and accelerator, government expenditure and tax multipliers.

Unit 1: Introduction to concepts of Macroeconomics

Unit 2: National Income Accounting: Basic concepts of National Income accounting; The circular flow; Concepts of GNP, GDP, NNP, and NDP; The measurement of National Income; expenditure and the circular flow; real versus nominal GDP; price indices; national income accounting for an open economy; balance of payments: current and capital accounts. The role of Government; Determinates of Saving-Investment; National Income accounting and cost of living. Inflation and Measurements; Basic idea of India's national income.

Unit 3: The Classical system: Income and Output Determination: Basic ideas of Classical Macroeconomics; Say's Law and Quantity Theory of Money, Loanable fund theory; the Classical Theory of Income and Employment determination; full Employment and wage-price flexibility; Classical Dichotomy and Neutrality of Money.

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Unit 4: Simple Keynesian Model (SKM): Income and Output Determination-The SKM in a Closed Economy without Government; Consumption Function; the Keynesian Saving Function; Income and Output determination; stability of equilibrium; the concept of effective demand- the concept of demand-determined output ; the Simple Keynesian Multiplier; the paradox of thrift; the SKM in a Closed Economy with Government; government expenditure and tax; the government expenditure multiplier and the tax rate multiplier; the balanced budget multiplier; the budget surplus; effects of tax changes and government purchases on budget surplus; the full employment budget surplus.

Unit 5: Macroeconomic Foundations: The bond market as the mirror image of the money market-the Walras' Law. Relationship between bond price and rate of interest- the concept of Keynesian liquidity preference schedule-speculative demand for money and liquidity trap. Investment function: Concepts of Marginal productivity of capital, marginal efficiency of capital (MEC) and marginal efficiency of investment (MEI)- Jorgenson's neo-classical theory- Acceleration principle- fixed and variable. Multiplier-accelerator interaction.

Textbooks for reference:

1. Dornbusch & Fischer. Macroeconomics. McGraw Hill. 11th edition, 2010.
2. N. Gregory Mankiw. Macroeconomics, Worth Publishers, 7th edition, 2010.
3. Richard T. Froyen, Macroeconomics, Pearson Education Asia, 2nd edition, 2005.
4. Ackley Gardner. Macroeconomics. Macmillan.
5. Andrew B. Abel and Ben S. Bernanke, Macroeconomics, Pearson Education, Inc., 7th edition, 2011.

CC : Programming in Python

Marks: 100 **Credits: 4**

Objective: The objective of the course is to provide a foundation in the Python programming language and its various libraries and tools. The course will focus on teaching the students the basic syntax, data structures, and programming concepts in Python. They will also learn how to use Python libraries such as numpy, pandas, and matplotlib for working with data. By the end of the course, students will be able to use Python to perform basic data science tasks such as data exploration, visualization, and modeling.

Course Outcomes:

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

CO-1: Understand the basis of algorithms, data types, variables and functions.

CO-2: Getting familiarized with widely used packages such as numpy, pandas, matplotlib, seaborn, scipy and sklearn.

CO-3: Using these packages for handling and visualizing data.

CO-4: Getting to apply programmatic thinking across a wide range of applications.

Course Content:

Unit 1: The Basics of Python:

Installing python and IDE (Jupyter), Operators, Inbuilt data-types, Loops, Conditional statements, Functions and Scope, Classes/Objects, Exception handling

Unit 2: The Basics of useful packages:

Numpy, Pandas, Matplotlib, Seaborn, Scipy, Scikit-learn

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Unit 3: Data Handling:
Reading and Writing Files, Data Cleaning and Wrangling, Data Sub-setting, Data Manipulation, Vectorization, Data Visualization

Unit 4: **Hands on experience**:
Sorting algorithms, Statistical analysis, Regression analysis, Making a simple game

Suggested Readings:

1. Documentations:
   1. Python: https://docs.python.org/3/tutorial/index.html
   2. Numpy: https://numpy.org/doc/stable/user/absolute_beginners.html
   3. Pandas: https://pandas.pydata.org/docs/getting_started/index.html#getting-started
   4. Matplotlib: https://matplotlib.org/stable/tutorials/introductory/quick_start.html
2. Books:
   1. Learning Python by Mark Lutz (O'Reilly Publication)
   2. How to Think Like a Computer Scientist: Learning with Python by Allen B. Downey, Jeffrey Elkner, Chris Meyers: https://openbookproject.net/thinkcs/python/english3e/
   3. Non-Programmer's Tutorial for Python3 (WikiBooks): https://en.wikibooks.org/wiki/Non-Programmer's_Tutorial_for_Python_3

Semester III

CC: Principles of Microeconomics-II

Marks: 100 **Credits: 4**

Objective: The objective of this course in to introduce different market structures. Also some aspects of advanced consumer behavior are covered. Finally, some aspects of modern microeconomics theories viz. game theory, asymmetric information are also introduced.

Course Outcome: The students will be able to

1. learn intermediate consumer behavior theory and its applications;
2. understand the idea behind a competitive market and its properties;
3. learn markets under imperfect competition; monopoly and oligopoly;
4. learn game theory and theory under asymmetric information.

Syllabus:

Unit 1: Theories of Consumer Behavior and Applications: Introduction to markets; Inter-temporal choice (saving and borrowing). Revealed preference. Choice under uncertainty – utility function and expected utility, risk aversion and risk preference.

Unit 2: The Firm and Perfect Market Structure: Organization, Firms and Profit Maximization. Marginal Revenue, Marginal Cost and Profit Maximization. Short run competitive equilibrium of the firm, short run supply curve of firm and industry, Output choice and competitive equilibrium in long run. Consumer and Producer surplus. Introduction to input markets.

Unit 3: Imperfect Competition: Monopoly; Oligopoly; Introduction to Game Theory; Introduction to models

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under asymmetric information.

References:

- Intermediate Microeconomics: A Modern Approach - Hal R Varian - Publisher: SPRINGER (INDIA) PVT. LTD
- Intermediate Microeconomics and Its Application - Walter Nicholson, Christopher M Snyder - Publisher: South-Western

CC: Principles of Macroeconomics-II

Marks: 100 **Credits: 4**

Objective: This course covers Keynesian theories, viz. IS-LM and Complete Keynesian Model. The difference between short run and long run macroeconomics is introduced. Finally, the course introduces open economy macroeconomics.

Course Outcome: The students will be able to

1. learn the macroeconomics in the long run – The Classical Model
2. learn the macroeconomics in the short run – The Keynesian Revolution
3. learn effectiveness of different government policies under short run and long run
4. learn basics of the open economy macroeconomics

Course Contents:

Unit 1: IS-LM Model: equilibrium, stability and comparative statics. Crowding out. Effects of fiscal and monetary policies.

Unit 2: Complete Keynesian Model: Derivation of aggregate demand curve. Derivation of aggregate supply curves both in the presence and absence of wage rigidity. Equilibrium, stability, and comparative statics-effects of monetary and fiscal policies (including effect of wage cuts).

Unit 3: Keynes vs. Classics: Hybrid Models. Friedman's restatement of classical ideas.

Unit 4: Open Economy Models: Concepts of exchange rates; nominal and real exchange rates; floating, fixed and pegged exchange rates; Balance of Payments; Absolute and Comparative advantages;

References:

- Macroeconomics - N. Gregory Mankiw - Publisher: Worth
- Macroeconomics: Theories and Policies - Richard T. Froyen - Publisher: Pearson Education India
- Macroeconomics: Theory And Policy - W. H. Branson - Publisher: East West Book Pvt Ltd

CC : Advanced Statistics

Marks: 100 **Credits: 4**

Objective: In Economics, the theories have been developed or confirmed on the basis of observed data. So, a study with regard to the statistical tools becomes necessary for the students in order to have clarity in Economics. This course tries to impart knowledge to the students in the field of statistics. The course is an attempt to let the students know about probability distribution and hypothesis testing, techniques of simple correlation and regression, statistical inference, theory of index numbers and time series.

Course Outcome: The students will be able to

CO 1: Learn various statistical tools;

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CO 2: Use these tools in different economic problems;
CO 3: Understand how by using statistical tools prediction for future can be done; so it can help in normative economics;
CO 4: Analyze the data pertaining to various economic variables.

Course Contents:

Unit 1: Correlation and Regression: Covariance and coefficient of correlation, regression and coefficient of determination.

Unit 2: Probability Distribution: Discrete probability distribution; Uniform, Binomial and Poisson distribution; Continuous probability distribution; Uniform, Normal, Chi-square, t and F distribution.

Unit 3: Statistical Inference and Hypothesis Testing: Point estimates and interval estimates, one tail and two tailed test, p-value, large and small sample tests.

Unit 4: ANOVA: One and two factors analysis of variance.

Unit 5: Time Series: components, measurement of trend and statistical fluctuations.

Unit 6: Index Numbers: Price and quantity indices; Different tests for index numbers.

References:

- Kenney and Keeping. Mathematical Statistics. Part 1 & Part II, Chapman and Hall.
- Croxton, Cowden and Klein. Applied Statistics, Prentice Hall.
- Hogg and Craig. Introduction to Mathematical Statistics, Prentice Hall.
- Goon, Gupta and Dasgupta. Fundamentals of Statistics, The World Press.
- N G Das, Statistical Methods, McGraw Hill Education

CC: Data Pre-processing

Marks: 100 **Credits: 4**

Course Outcomes:

1. To impart the knowledge and skill of handling structured and real-life unstructured data
2. Familiarise with the tools (Pandas, Numpy, Scikit-learn etc.) to get insight of information hidden in data
3. The basic understanding of Feature Engineering.
4. Empowering students with tools and techniques used in data science for data cleaning and data wrangling.

Course Contents:

Unit 1: Data Reading and Storage in different File formats

Understanding of Pandas Series and Data frames, Reading and writing data in Text Format, working with delimited and Binary data Formats, Interacting with Web API

Unit 2: Data Cleaning and Preparation

Different strategies to deal with Missing Values, Data Transformation, Cleaning Text Data, Outlier Treatment and Removal

Unit 3: Data Wrangling

Working with Date and Time, Filtering DataSet, Combining and Merging Dataset, Reshaping and Pivoting, Use Groupby method to organize data

Unit 4: Feature Extraction

Dealing with Categorical Variable, missing value imputation, Feature Scaling

References:

1. Python for Data Analysis (Data Wrangling with Pandas, NumPy, and Ipython) by Wes McKinney (O'Reilly Publication)

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2. https://www.python.org/
3. Python Cookbook by David Beazley and Brian K. Jones
4. https://numpy.org/
5. https://pandas.pydata.org/
6. https://scikit-learn.org/stable/
7. https://matplotlib.org/

Semester IV

CC: Introductory Econometrics

Marks: 100 **Credits: 4**

Objective: This course is designed to expose the students to the basic econometric theories. It provides some useful tools for student's future research. It also helps the students to develop a way of thinking in quantitative terms.

Course Outcome: The students will be able to

1. Understand the nature and scope of econometrics;
2. Learn Classical Linear Regression Model and its properties and applications
3. Learn the use of statistical inferences and hypothesis testing in econometrics

Course Contents:

Unit 1: Nature and Scope of Econometrics: Distinction between Economic Model and Econometric model. Concept of stochastic relation, Role of random disturbance in econometric model.

Unit 2: Types of data: Cross section, time series, panel and pooled cross sectional data.

Unit 3: Classical Linear Regression Model - Part 1: The classical assumptions. Concepts of population regression function and sample regression function. Estimation of model by method of ordinary least squares (both simple and multiple linear model). Simple correlation, partial correlation, and multiple correlation.

Unit 4: Classical Linear Regression Model - Part 2: Properties of the Least Squares Estimators (BLUE) in SLRM- Gauss-Markov theorem. Qualitative (dummy) independent variables – intercept dummy and slope dummy.

Unit 5: Statistical inference in linear regression model: Use of standard normal, chi2, t, and F statistics in linear regression model. Testing hypothesis, Single test and Joint test. Goodness of fit (in terms of R2, adjusted R2 and F statistic), Analysis of Variance (ANOVA).

Unit 6: Violations of Classical Assumptions: Multicollinearity - Consequences, Detection (Variance Inflationary Factor (VIF)) and Remedies. Heteroscedasticity - Consequences, Detection (Lagrange Multiplier test) and Remedies. Autocorrelation - Consequences, Detection (Durbin-Watsontest) and Remedies.

References:

- Basic Econometrics - Damodar Gujarati, Dawn Porter, Sangeetha Gunasekar - Publisher: McGraw Hill Education
- Introductory Econometrics: A Modern Approach - Jeffrey Wooldridge - Publisher: South-Western College Publishing
- Introduction to Econometrics - G S Maddala, Kajal Lahiri - Publisher: Wiley

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CC: Development Economics

Marks: 100 **Credits: 4**

Objective: This course is designed to expose the students to the understanding about economic growth, its benefits and costs, determinants and policies that promote growth, ways to measure, country experiences and implications for their overall future development.

Course Outcome:

The students will be able to understand –

1. learn and understand the development objectives of an economy
2. know the basic concepts and subject-matter of macro characteristics of underdeveloped economics;
3. conceptualize informational Asymmetries and market failure in Credits and labour markets;
4. understand the conceptual and measurement issues related to poverty, inequality and growth.
5. learn the models that explain Strategies of Development

Course Contents:

Unit 1. Development Discourse

1. The Present Setting: Growth- Inequality- Poverty debate: Economic Efficiency Versus Social Justice
2. Inclusive Growth: Top Down versus Bottom Up approach.
3. Conceptual issues about the relationship between growth and development-Human development index, its alternative forms and critique.

Unit 2. Strategies of Development

1. Rostow's Stages of Economic growth
2. The low level equilibrium trap in a multiple equilibrium situation (arguments offered by Nurkse, Rosenstein-Rodan and formalized by Murphy. Shleifer & Vishny)
3. Vicious circle of poverty and the critical minimum effort hypothesis-big push argument.
4. Hirschman's Balanced vs. unbalanced growth
5. Choice of Technique and Investment criteria

Unit 3. Informational Asymmetries and market failure:

1. Capital/Credits Market: FDI- Modes, types, determinants, technology access & consequences, Imperfections in Capital Market: organized and unorganized capital market
2. Labour Market: Informal Sector- Importance, Nature of employment, Linkages with Formal Sector.

Unit 4. Marco characteristics of underdeveloped economics:

1. Dual economy structure: open and disguised unemployment and migration: revisiting Lewis Model; Ranis-Fei-Harris-Todaro model of Rural-urban migration and their critiques.
2. Poverty - Conceptual Issues; Measurement; Functional Effects.

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3. Inequality: Conceptual Issue and Measurement Issues: income inequality, wage inequality. Piketty's hypothesis and recent controversies. Kuznets` inverted-U hypothesis: inequality as a constraint to growth; basics of Galore-Zeira model.

References:

1. Development Economics by Debraj Ray, Oxford University Press, 2009
2. Kaushik Basu, Analytical Development Economics, The Less Developed Economy Revisited, OUP (2000).
3. AP. Thirlwal, Growth and Development, 5th edition, MacMillan Press Ltd (1994).
4. M.P Todaro: Economic Development in the third world, London: Longman (1981).

CC : Operations Research and Optimization Techniques

Marks: 100 **Credits: 4**

Objective:

The course aims at building capabilities in the students for analysing different situations and applying optimization techniques in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints.

Course Outcomes:

The students will be able to:-

1. Understand the overview of optimization techniques, concepts of decision variables, constraint surfaces and objective function., Formulate real-life problems with Linear Programming.
2. Solve the Linear Programming models using graphical, Algebraic and simplex methods.
3. Formulate real-life transportation, assignment and travelling salesman problems to find the optimum solution using transportation algorithms
4. Use of Ortools, Pyomo framework and different Solver to solve lpp

Course Contents:

Unit 1: Introduction

Evolution of OR, Definitions of OR, Scope of OR, Applications of OR, Phases in OR study. Characteristics and limitations of OR, models used in OR.

Unit 2: Linear Programming Problem (LPP)

Part I: Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P. Solutions to LPP by graphical method (Two Variables).

Part II: Simplex method, Solutions to LPP by Simplex method, Big-M Method and Two Phase Simplex Method, Degeneracy in LPP. Concept of Duality, writing Dual of given LPP. Solutions to L.P.P by Dual Simplex Method.

Unit 3: Transportation Problem

Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem

Logic concepts and logic Programming: propositional calculus, Propositional logic, natural deduction system, semantic tableau system, resolution refutation, predicate logic, Logic programming.

Unit – 4: Hands-on

Use of different framework and solvers to solve different lpp problems:

- **Solvers**: CPLEX – Gurobi – GLPK – SCIP

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- **Frameworks**: Pyomo – Or-Tools – PuLP – Pymoo
- **Same Packages and tools**: Geneticalgorithm – Pyswarm – Numpy – Pandas – MatplotLib – Spyder – Jupyter Notebook

Unit 5: Game Theory
Definition, Pure Strategy problems, Saddle point, Max-Min and Min-Max criteria, Principle of Dominance, Solution of games with Saddle point.

References:

1. "Operations Research: An Introduction" by Taha, Hamdy A.
2. "Introduction to Operations Research" by Hillier, Frederick S., and Lieberman, Gerald J.
3. "Optimization Methods for Large-Scale Machine Learning" by Léon Bottou, Frank E. Curtis, and Jorge Nocedal

DSE: Public Economics

Marks: 100 **Credits: 4**

Course Summary: This course is designed to expose the students to the basics of public economic theories. It with discussing the fiscal functions of the government. Next it will discuss the differences between public and private goods. Finally, it will introduce the concepts of taxation and implications of taxation on the economy as a whole.

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

CO-1. Understand the nature and scope of public economics.

CO-2. Learn differences between public and private goods.

CO-3. Learn theories of taxation, viz. efficient taxation, optimal taxation etc.

Course Contents:

Unit 1: Fiscal functions: An overview: Allocation functions; Distribution functions; Stabilization functions.

Unit 2: Public provision for social goods: Social goods and market failure; Provision for social goods; mixed goods; Merit goods.

Unit 3: Social goods: Meaning of efficiency; Efficient provision of private goods; Efficient provision of public goods; social goods allocation in the budget.

Unit 4: Introduction to taxation: Desirable characteristics of any tax system; framework for choosing among tax systems.

Unit 5: Tax incidence: Tax incidence in competitive markets; Tax incidence without perfect competition.

Unit 6: Optimal Taxation: Two fallacies of optimal taxation; optimal and Pareto efficient taxation; Ramsey taxes; Deriving Ramsey taxes on commodities; Derivation of Ramsey formula for linear demand schedule.

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References:

1. Public Finance - Musgrave and Musgrave
2. Economics of the Public Sector - Stiglitz and Rosengard

DSE: Labour Economics

Marks: 100 **Credits: 4**

Course Summary: This course is designed to expose the students to the theoretical issues in labour economics and various methods to measure labour efficiency, productivity and migration. In addition, important issues related to discrimination in labour market are also covered. Various policy measures to combat unemployment and reduce discrimination in the labour market are also discussed.

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

CO-1. Understand the theoretical issues in Labour economics.

CO-2. Learn measurement of labour efficiency and productivity.

CO-3. Understand the problems in the labour market and policy interventions to correct the labour market discrimination and unemployment.

Course Contents:

Unit 1: Theoretical Issues in Labour Economics

1. Labour supply: Measuring the labour force, workers preferences, Time and budget constraints, Hours of work decision
2. Labour demand: Production function, Employment decision in the short run and long run, Long run demand for labour
3. Labour market equilibrium: Equilibrium in a single competitive labour market, Competitive equilibrium across labour markets, Non competitive labour markets, Cobweb model.

Unit 2: Wages, Alternative Pay Schemes and Labour efficiency

1. Wages: Perfect Competition – Homogenous workers and Jobs, Wage Differentials – Heterogeneous Workers and Jobs, The Hedonic Wage Function
2. Alternative pay schemes and labour efficiency: Economics of fringe benefits, Theory of optimal fringe benefits, Efficiency wage payments, deferred payments schemes
3. Labour Efficiency: Education in the labour market, Schooling model

Unit 3: Labour Productivity, Unemployment and Migration

1. Labour productivity: Concept and measurement, Wages, Prices and Employment.
2. Unemployment: Measurement, The Stock–Flow model, Frictional, Structural and Demand–Deficient unemployment, Public policies to reduce unemployment.
3. Labour mobility: Types- Migration as an investment in human capital, Determinants of migration, Consequences of migration

Unit 4: Labour Market Discrimination- Trade Union and Collective Bargaining

1. Labor market discrimination: Race and gender in the labour market, The Crowding Model- Employer and Employee discrimination- measuring discrimination, The Oaxaca Decomposition.
2. Trade Union – Determinants of union membership- Economic Impact of Unions - Union wage advantage- Efficiency and Productivity of Unionism

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3. Collective bargaining: Economic sanctions of collective bargaining, bargaining power in collective bargains, counteracting pressures, Employer's resistance- Potential impact on union

References:

1. George, J.B. (1996): Labour Economics, McGraw Hill, NY.
2. McConnell, C.R., S.L. Brue and D.A. Macpherson (2009): Contemporary Labour Economics, McGraw Hill, NY.

Entrepreneurial Mindset and Action

Credits: 3

Course Summary: Entrepreneurship is not only about creating new ventures but also about taking action in a variety of settings where one can make a positive difference. The course helps students cultivate an entrepreneurial mindset and build the attitudes, skills, and perspectives necessary to think creatively, take calculated risks, and identify opportunities for value creation. The reflective exercises and practical assignments encourage the students to step out of their comfort zone, face real life situations as entrepreneurs commonly do and explore their potential.

Course Outcomes:

After successful completion of this course, the students will:

CO-1: Understand concepts and the process of entrepreneurship and innovation.

CO-2: Comprehend effectual principles and apply entrepreneurship as a method.

CO-3: Learn to discover and create entrepreneurial opportunities.

CO-4: Develop the ability to evaluate and act on opportunities for value creation.

CO-5: Create essential artefacts required to present venture ideas to potential stakeholders.

Course Contents

Unit 1: Introduction to Entrepreneurship and Innovation

Entrepreneurship and You – why entrepreneurial skills are relevant in life; Creativity and Innovation; Debunking Popular Myths About Entrepreneurship; Entrepreneurship in Varied Contexts.

Unit 2: Entrepreneurial Mindset

Developing an entrepreneurial mindset; Effectual Principles; Causal vs Effectual Thinking; Entrepreneurship as a method, Entrepreneurial Thought and Action.

Unit 3: Recognizing and Evaluating Opportunities

Types of Innovation; Idea Generation; Discovery and Creation of opportunities; Design Thinking; Understanding Business Models and Revenue Models

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Unit 4: Customer Development

Customer Value Proposition; Customer Development – identifying and interviewing customers, understanding user requirements by talking to potential users/customers/stakeholders, analysing and applying customer/stakeholder feedback.

Unit 5: Experimentation and Action

Pilots, Prototypes and MVPs; Finding Resources; Building Teams and Partnerships.

Unit 6: Building Entrepreneurial Self-Efficacy

The Art of Pitching; Venture Financing; Equity Management; Essential artifacts for entrepreneurs – Business Model Canvas, Pitch Deck; Understanding Entrepreneurial Success and Failure.

Course Resources

1. *Entrepreneurship: The Practice and the Mindset*. Second Edition. By Heidi M. Neck, Christopher P. Neck, Emma L. Murray
2. *Effectual Entrepreneurship*. Second edition. By Stuart Read, Saras Sarasvathy, Nick Dew, Robert Wiltbank
3. *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*. By Eric Ries
4. *Blue Ocean Strategy: How to Create Uncontested Market Space and Make Competition Irrelevant* By W. Chan Kim, Renée Mauborgne
5. *Making Breakthrough Innovation Happen: How 11 Indians Pulled off the Impossible*. By Porus Munshi

Online Resources:

1. Babson Universal Learning Modules (Exclusive access for the registered students of Ramaiah University of Applied Sciences)
2. Build your creative confidence https://www.ideou.com/

Semester V

CC : Indian Economy

Marks: 100 **Credits: 4**

Objective: This course is designed to expose the students to various issues in Indian Economy. The course aims to explain nature, growth and challenges in various sectors of Indian economy including agriculture, industries, money and banking and foreign trade.

Course Outcome: The students will be able to

1. Know the basic characteristics of Indian Economy
2. Understand the structural issues and challenges faced by the Indian Economy
3. Know the recent policy developments in Indian Economy
4. Understand the various sources of data on Indian economy and its analysis.

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Unit 1: Structure of Indian Economy

1. Nature of Indian Economy- developing, mixed economy
2. Demographic issues- Demographic transition, India's population size and growth, demographic dividend, urbanization, migration.
3. Labour force growth, employment and unemployment- trends, structure, types of unemployment and estimates of unemployment.
4. Poverty and income Distribution, concept of poverty line, incidence of poverty, poverty alleviation programmes, pattern of income distribution, causes of income inequalities, government policy measures.

Unit 2: National Income

1. Concept- methods of measurement of National Income in India, Trends in National Income and Per Capita Income, structural composition of national income, trends in occupational structure, trends in savings and investment in Indian Economy.

Unit 3: Issues in Indian Agriculture

1. Land reforms, trends agriculture production and productivity
2. Green Revolution-achievements and drawbacks
3. Agriculture finance and marketing-NABARD
4. Agriculture prices, agriculture subsidies and food security in India.

Unit 4: Industrial development in India

1. Industrial development during Planning period
2. Major industries in India, Small-scale and cottage industries, Private Sector and Public Sector Industries
3. Industrial Policy in India, disinvestment programme in India, industrial sickness in India
4. Labour relations, social security and Exit policy in India.

Unit 5: Money and Banking Sector in India

1. Price trends and inflation in India
2. Indian Money Market- organized and unorganised sectors
3. Commercial banking in India- banking structure, nationalization, reforms.
4. Reserve Bank of India- functions & role
5. Capital Market in India- structure, growth, reforms and regulation-SEBI.

Unit 6: India's Foreign Trade and Foreign Capital

1. Value, composition and direction of Foreign Trade in India
2. India's Balance of Payments: meaning, BoP situation and management of BoP.
   India's Trade Policy: Import and Export policy, Foreign Trade Policy- recent developments.
   Special Economic Zones in India, WTO and India- WTO agreements.
3. Foreign Capital and Aid: Components of foreign capital, Foreign Investment inflows, External borrowings
4. Exchange Rate regime and exchange rate management, issues of capital account convertibility, management of Foreign Exchange Reserves
5. Globalisation and its effect on trade, MNCs- growth, controlling mechanism- FERA and FEMA

Unit 7: Databases on Indian Economy

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1. Introduction to databases on Indian Economy

References:

1. Misra and Puri. *Indian Economy*, Himalaya Publishing House
2. Ruddar Dutt and Sundaram. *Indian Economy*, S. Chand and Co.
3. Suresh Tendulkar. *Understanding Reforms*, Oxford University Press.
4. L M Bhole. *Financial Institutions and Markets- structure, growth and innovations*, Mc Graw Hill Education
5. RBI Website

CC: International Trade

Marks: 100 **Credits: 4**

Objective: This course is designed to expose the students to various theories, problems and policies related to International Trade. This course discusses prominent theories in International Trade and also the role of International Trade Organisations in regulation of international trade.

Course Outcomes: The student will be able to

1. Know the basis of trade
2. Understand the theories related gains from Trade and Trade Restrictions
3. Understand the international equilibrium in trade
4. Comprehend the neo classical theories of International Trade
5. Learn the role of International Trade Organisations

Unit 1: Basis of Trade

1. Arbitrage and Inter-industry trade, absolute and comparative advantages, regulation of externalities, basis of intra-industry trade

Unit 2: Gains from Trade (theorems)

1. Equilibrium in Open Economy and gains from Trade- Production Possibility Curve and Community Indifference Curve
2. Classical Theories of comparative Advantage- Theory of Absolute difference in Cost, Theory of Comparative Difference in Costs, Refinement of Comparative Costs theory
3. Haberler's Theory of Opportunity Costs
4. Mill's Theory of Reciprocal Demand

Unit 3: International Equilibrium

1. Offer Curves- derivation, properties, elasticities
2. Trade Indifference Curve and Box Diagram

Unit 4: Neo Classical Trade Models

1. The Heckscher-Ohlin Theory
2. Samuelson's Factor- Price Equalisation Theorem
3. Factor Intensity Reversals- Stopler-Samuelson theorem, Rybczynski Theorem, Leontief Paradox

Unit 5: Theory of Trade Restrictions

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1. Types tariffs, Effects of Tariff under Partial equilibrium, effects of Tariff under General Equilibrium,
2. Effects of a Tariff in a Large Country- Production and Consumption Effect, ToT effect
3. Optimum Tariff and Welfare- determination of Optimum Tariff, Optimum Tariff with Retaliation, Optimum Tariff Formula
4. Effects of Tariff on Income Distribution -Stopler-Samuelson Theorem, The Metzler Paradox, The Lerner Paradox. and Lerner Case, welfare effect and optimum effect, tariff retaliation, tariff and protection
5. Quantitative Restrictions- Import quotas and Voluntary Export Restraints, types of import quotas, effects of import quotas under partial equilibrium and general equilibrium, Equivalence of Tariffs and Quotas

Unit 6: Dumping

1. Types and objectives of dumping, price determination under dumping, effects of dumping

Unit 7: International Trade Organisations

1. GATT- objectives, provisions, criticisms
2. WTO- structure, objective, functions, agreement, TRIPs, TRIMs
3. SAARC- objectives, principles, provisions, trade and economic cooperation, critical appraisal
4. India's current trade agreements

References:

1. Krugman and Obstfeld- International Economics: Theory and Policy, Pearson Education
2. Salvatore- International Economics: Trade and Finance, Wiley publications

CC : Machine Learning

Marks: 100 **Credits: 4**

Objective:

The objective of the course is to introduce the concept of learning patterns from data and develop a strong theoretical foundation for understanding state of the art Machine Learning algorithms, familiarise the students to the techniques of Machine Learning and develop skills of using recent machine learning software for solving practical problems.

Course Outcomes:

The students will be able to:-

1. Understand machine learning concepts and range of problems that can be handled by machine learning, data-preprocessing

2. Understanding the theoretical concepts of Regressor and classifier along with hands-on activities using state-of-art algorithms from sklearn , evaluation of model performance

3. Discussion about broad range of algorithms under Supervised and Unsupervised learning

4. Apply the machine learning concepts in real life problems,

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Course Contents:

Unit 1: Introduction to ML:
Explain the intersection of ML with Data Science, History of machine learning, Introduction, Types of machine learning, Applications of Machine Learning, Perspectives and issues in machine learning, Tools in machine learning, basic types of data in machine learning
Data-preprocessing: Dealing with missing data, Feature scaling, Dealing categorical variables
Model evaluation: Confusion Matrix, Precision, Recall, F1-score, Bias-Variance, Overfitting and Underfitting, ROC, AUC.
Unit 2: Supervised Learning:
Linear Regression: Introduction to linear regression, mathematical intuition of linear regression, Cost function, Gradient Descent, Stochastics, Batch and Mini-batch Gradient Descent, estimating the coefficients, Accessing the accuracy of the coefficient estimates, Accessing the accuracy of the regression model, Multiple linear regression.
Logistic Regression : Introduction to Logistic Regression and Logistic Classification, Activation and cost function, Understanding of different ML algorithms used for solving regression and classification problems., Rugularization, Ridege(L2) and Lasso(L1) Regularizer
Basic decision tree learning (ID3) algorithm, Entropy, Gini impurity, Information Gain, Maths intuition of decision Tree, pre and post pruning, Hypothesis space search in decision tree learning algorithm.
Random Forest, Support Vector Machine algorithm and the maths intuition for supoort vectors, k-nearest neighbour, Ensemble method: Bagging and Boosting, AdaBoost, XGBoost algorithms.
Unit 3: Unsupervised Learning:
Intuition of clustering, type of data in clustering analysis, k-means, density-based clustering method (DBSCAN), Performance analysis of clustering algorithms.
Dimensionality reduction while retaining information, Principal Component Analysis, Visualization of high-dimensional data, Applications in image recognition, finance, Anomaly Detection.
Unit 4: Probabilistic and Stochastic Models: Basics of probability, Overview of probabilistic models in machine learning, Bayes' Theorem: Concept and significance, Maximum Likelihood Estimation (MLE) inBayesian Learning, Naïve Bayes Classifier: Understanding conditional independence assumption, Naïve Bayes algorithm, Applications of Naïve Bayes in text classification and spam filtering, Basics of Bayesian networks, Representing and reasoning with Bayesian networks(optional)
Unit 5: Fine-Tuning your model: Model Selection and Hyperparameter Training, Cross Validation, Grid Search, Randomised Seach, Pipelines, Data Leakage
Hands On: Numpy, Pandas, Matplotlib, Seaborn, Sklearn packages/modules for preprocessing, Regression and CLassification models, Model selection, model accuracy, Normalization, Standardisation, model evaluation etc.

Reference Books:

1. "Introduction to Machine Learning" by Alpaydin, Introduction to Machine Learning
2. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurelien Geron
3. "The Hundred-Page Machine Learning Book" by Burkov
4. "Machine Learning Yearning" by Ng, https://info.deeplearning.ai/machine-learning-yearning-book.

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CC: Advanced Econometrics

Objective: This course starts with econometrics modelling. It will also cover Qualitative response models, viz. logit, probit and tobit and linear probability model. Finally, basic time series analysis will be introduced to the students.

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

CO-1. Learn advanced econometrics concepts and its applications;

CO-2. Understand econometrics modelling;

CO-3. Learn qualitative response models;

CO-4. Learn basic time series analysis.

Course Contents

Unit 1: Econometric Modeling: Model Specification and Diagnostic Testing: Model selection criteria; Types of specification errors; Consequences of model specification errors; Tests of specification errors; Errors in measurements.

Unit 2: Qualitative Response Regression Models: Linear Probability Model; Logit Model, Probit Model; Tobit Model.

Unit 3: Time Series Econometrics: Some Basic Concepts: Stochastic process; Unit root stochastic process; trend stationary and difference stationary stochastic process; integrated stochastic process.

References:

1. Basic Econometrics - Gujarati and Potter
2. Introductory *Econometrics*: A Modern. Approach - Jeffrey M. Wooldridge

DSE: Political Economy

Marks: 100 **Credits: 4**

Course Description

This course explores changes in the organisation of production, labour market institutions and corporate structure. It goes on to study the consequences of globalization, especially of financial flows, for the role of the state, economic performance, gender issues, environment, human welfare and development.

Course Outline

Unit 1. Introduction and Historical Overview

Perspective on political economy with a historical overview: capitalist development in the pre-second world war period, the golden age and later.

Unit 2. Changing Dynamics of Capitalist Production, Organisational Form and Labour Process

Fordist and post-fordist production; changing dynamics of organisation of production, markets and labour process; the changing nature of job security and labour rights.

Unit 3. The State in the Era of Globalisation: Welfare, Development and Autonomy

Globalisation and the limits of the welfare state, development and state autonomy.

Unit 4. The Changing Role of Finance

The changing role of finance in capital accumulation and corporate structure; finance and globalisation - financialisation, financial liberalisation and financial crisis.

Unit 5. The Social Dimension

Globalisation and uneven development – growth, inequality and exclusion.

Unit 6. New Perspectives

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Gender in work, accumulation and globalisation; issues in environment and sustainability; alternatives ahead.

Readings:

1. Ghosh, Peu. Introduction to Political Economy, Sage Publications
2. Michel Beaud, A History of Capitalism, 1500-2000, trans. by Tom Dickman and Anny Lefebvre, New York: Monthly Review Press, 2001.
3. Ash Amin (ed.), Post-Fordism: A Reader, Blackwell, 1994.

DSE: Industrial Economics

Marks: 100 **Credits: 4**

Objective: This course is designed to expose the learners to various theories of firm, market structure and important competition policies and regulation. This course will enable the learners to apply and analyse various concepts of economics to industrial sector.

Course Outcomes: The students will be able to

1. Learn the theory of firm
2. Understand firm conduct and market structure
3. Comprehend on industrial policy and regulations

Unit 1: Theory of the firm

1. Size and structure of firms: The technological view of the firm, The transaction costs-property rights approach, Investment specificity, incomplete contracts and vertical integration, Empirical evidence.
2. Separation of ownership and control: separation of ownership and control, managerial incentives, the limits to managerial discretion, foundations of the profit-maximisation hypothesis.

Unit 2: Firm conduct and market structure

1. Short-run price competition: the Bertrand model, Bertrand competition with capacity constraints, The Cournot model.
2. Dynamic price competition: Repeated interaction, Collusion and cartel stability, Theories of price wars, Empirical analysis of market power and collusive behaviour.
3. Entry deterrence and entry accommodation: First-mover advantages and the value of irreversible decisions, Strategies to deter entry, Strategic substitutability vs. complementarity, A taxonomy of business strategies, Predation.
4. Product differentiation and non-price competition: Horizontal product differentiation, Brand proliferation and entry deterrence, Vertical product differentiation, Markets with asymmetric information.
5. Price discrimination: First-degree, second-degree and third-degree price discrimination, Non-linear pricing, Tie-in sales.
6. Vertical restraints: efficiency explanations for vertical restraints, vertical and horizontal externalities, vertical restraints as instruments that restrict competition, empirical evidence.

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7. The determinants of market structure: Theory of market structure in exogenous and endogenous sunk cost industries, Technology and market structure, Empirical evidence.

Unit-3: Competition policy and regulation

1. Competition and industrial policy: Competition policy in the EU, the USA, Japan and India, Current issues in competition policy, Industrial policy towards R&D.
2. Regulation: Regulation of firms with market power under symmetric information, Regulation under asymmetric information, Liberalisation and regulation, Empirical evidence.

References

1. Barthwal, R R. Industrial Economics-An introductory Textbook. New Age International Publishers.
2. Rapheal, Nisha. Industrial Economics: Text and Case Study. Regal Publications
3. Tirole, J. *The Theory of Industrial Organization.* Cambridge, MA: MIT Press.

DSE: Advanced Microeconomics

Marks: 100 **Credits: 4**

Course Objective: This course introduces fundamental concepts and topics developed in microeconomic theory. It will cover Theory of Distribution, Theory of General Equilibrium, Welfare Economics, Economics of Uncertainty, and Information Economics. The theoretical tools explained in these topics are essential in many different fields in economics.

Unit 1: Theory of Distribution

1. Neo-Classical theories, Marginal productivity theory of determination of factor prices, Factor shares and adding up problems.
2. Euler's theorem, Pricing of factors under imperfect competition, monopoly and bilateral monopoly.
3. Macro-distribution theories of Ricardo, Marx, Kaldor, Kalecki.

Unit 2: Theory of General Equilibriums

1. Introduction: partial equilibrium vis-à-vis general equilibrium approach.
2. Exposition of basic concepts.
3. An elementary general equilibrium model – the Robinson Crusoe economy.
4. Pure exchange economy – the Edgeworth Boxes, Pareto optimality, contract curve, core, Walras Law, Walras equilibrium.

Unit 3: Welfare Economics

1. First and second fundamental theorem of welfare economics (graphical exposition).
2. Interpersonal comparison and aggression problem, Public goods and externalities, Divergence between social and private welfare, compensation principle.
3. Pareto Optimality, Social choice and other recent schools, including Coase and Sen.
4. Measures of Individual Welfare: Consumer Surplus, Compensating variation and equivalent variation.

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Unit 4: Economics of Uncertainty

1. Measures of risk - Domar-Musgrave index, Roy's safety index, Mean-Variance, Semi variance.
2. Mini-max regret.
3. Lotteries, preference relation over lotteries, N-M expected utility theory – basic axiom and representation theorem; violations of EU theory
4. Subjective probabilities
5. Risk aversion – Jensen's inequality.

Unit 5: Information Economics

1. Introduction.
2. The elements of the problem.
3. Types of Asymmetric information problems – moral hazard, adverse selection, signaling.

Reference Materials:

1. Varian, Hal R. (1992), Microeconomic Analysis, 3rd Edition, International Student Edition, W. W. Norton and Company.
2. Pindyck, Robert S. and Rubinfield, Daniel L. (1998), Microeconomics, Prentice Hall

Semester VI

CC : Resource and Environmental Economics

Marks: 100 **Credits: 4**

Objective: This course is designed to equip the learners on various concepts, theories, methods and regulations in environmental economics. This course provides an ethical perspective to the study of environmental valuation and enables the learners to apply economic tools to solve environmental problems.

Course Outcomes: The students will be able to

1. Understand the various concepts and issues in Environmental economics
2. Understand the rationale and methods of regulating the market towards sustainability
3. Apply the economic tools to environmental problems
4. Understand global urgency on protecting the environment

Unit 1: Introduction to Environmental Economics

1. Nature, scope and history of environmental economics
2. Economy-Environment-Ecology inter-linkages
3. Material balance model
4. Efficiency and competitive Markets, Market Failure- Public Goods and Externalities, pricing Public Goods and Public Bads
5. Property Rights, Coase Theorem
6. Pigovian fees- single polluter and multiple polluter

Unit 2: Environmental economics and Sustainable Development

1. Uncertainty, irreversibility, inter-temporal efficiency, inter-generational equity

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2. Quality of Environment- air, water, soil, Depletion of resources- Hartwick Solow, Hotelling's Lemma
3. Environmental Justice- displacement, gender issues, poverty
4. Growth and Development debate- Sustainable Development, Green GDP
5. Tragedy of Commons
6. Environmental Kuznets Curve

Unit 3: Valuation of Environment

1. Valuation of Environmental Benefits, economic value of environment, Environmental demand theory
2. Methods for valuing environment- Cost Benefit analysis, Revealed Preference Methods-Hedonic Pricing method and Travel Cost Method
3. Stated Preference Methods- Contingent valuation, limitations

Unit 4: Regulation of Environment

1. Regulation Instruments- Command and control
2. Incentives in Environmental regulations, fees and permits
3. Carbon Trading
4. Asymmetric information, monitoring emissions and enforcement
5. Rationale for market solutions
6. Environmental impact assessment
7. Indian laws to protect environment- Carbon Tax

Unit 5: International and Interregional Competition and Environment

1. Income effect and demand for environmental quality, jurisdictional competition, international trade and environment, global bads, trans-boundary pollution, Circular Economy, The Three Rs
2. International Conventions

References:

1. Rabindra N Bhattacharya- Environmental Economics- an Indian Perspective, Oxford University Press
2. G K Kadekodi- Environmental Economics in Practice, Oxford University Press
3. Sankar Ulaganathan- Environmental Economics, Oxford University Press

CC- Research Methodology in Economics

Marks: 100 **Credits: 4**

Course Description

This course introduces undergraduate final-year economics students to the philosophy, logic, and practice of social science research with a specific focus on economics. The course equips students with conceptual clarity and practical skills required to identify research problems, design appropriate methodologies, collect and analyse quantitative and qualitative data, and present research findings in a systematic and ethical manner.

Course Objectives

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

- Understand the nature, scope, and relevance of research in economics

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- Distinguish between different research approaches, methods, and techniques
- Formulate clear and feasible research problems and hypotheses
- Design appropriate research strategies and sampling plans
- Collect, analyse, and interpret quantitative and qualitative data
- Write a structured and well-argued research report following academic conventions
- Apply ethical principles in social science research

Course Outcomes (COs)

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

- CO1: Explain the logic and methodology of economic research
- CO2: Identify and operationalize research problems in economics
- CO3: Apply quantitative and qualitative research methods
- CO4: Analyse and interpret economic data
- CO5: Prepare a coherent undergraduate-level research report

Unit I: Introduction to Research in Economics

Meaning and nature of research in economics, objectives and relevance of economic research, Types of research: basic vs. applied; exploratory, descriptive, analytical, and explanatory research, Macro-level and micro-level research in economics, Deductive and inductive reasoning in economic analysis, Logical framework of scientific investigation, Relationship between methodology, methods, and techniques, Problems of aggregation and measurement in economics, Historical analysis in economics: use of historical records.

Unit II: Research Design and Ethics

Nature and sources of research problems, Identification and formulation of research problems, Operationalization of concepts and variables, Development of research questions and working hypotheses, Research design: exploratory, descriptive, and causal designs, Time horizon: cross-sectional vs. longitudinal studies, Feasibility analysis: availability of data, time, and cost constraints, Ethics in economic and social science research: Informed consent, Confidentiality and anonymity, Plagiarism and academic integrity, Ethical issues in field surveys and experiments.

Unit III: Data Collection and Sampling Techniques

Types of data: primary and secondary data, Sources of secondary data in economics, Methods of primary data collection: Observation: participant and non-participant observation, Interviews: personal, group, structured, unstructured, Questionnaires and schedules: design principles, Reliability and validity of research instruments, Triangulation in social science research, Case study approach in economics, Sampling: Census vs. sample surveys, Sampling design and sampling frame, Types of sampling: Probability sampling: simple random, stratified, systematic, cluster, Non-probability sampling: convenience, purposive, quota, snowball, Choice of sampling technique, Sampling errors and non-sampling errors, Error minimization strategies.

Unit IV: Quantitative and Qualitative Research Methods

Quantitative Methods: Survey methods in economics: merits and demerits, Types of surveys: household, firm-level, labour force, consumption surveys, Sample surveys: design, implementation, and limitations, Introduction to basic quantitative analysis (tabulation, percentages, averages), Use of secondary datasets for economic research, Qualitative Methods: Case study method: relevance for economic research, Participant observation, Interview techniques: open vs. closed; structured vs. unstructured, Focus Group Discussions (FGDs), Merits and limitations of qualitative methods in economics.

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Unit V: Data Analysis, Interpretation, and Report Writing

Processing of collected data, Analysis of quantitative data: tables, graphs, and basic interpretation, Analysis of qualitative data: thematic analysis and narratives, Interpretation of results and linking findings to theory and literature, Research report writing: Structure of a research report, Formulating and arranging concepts and ideas, developing arguments and substantiating them with evidence, Referencing styles and bibliography, Qualities of a good research report.

Readings:

1. Ethridge, D. (2004). *Research Methodology in Applied Economics: Organizing, Planning and Conducting Economic Research.* Blackwell Publishing (2nd ed.).
2. Creswell, J. W. (2014). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (4th ed.). SAGE Publications.
3. Kothari, C. R., & Garg, G. (2013). Research Methodology: Methods and Techniques. New Age International Publishers.
4. Johnson, G. L. (1986). Research Methodology for Economists: Philosophy and Practice. Macmillan.
5. Bhattacherjee, A. (2019). Social Science Research: Principles, Methods, and Practices. University of Southern Queensland.

DSE: Advanced Macroeconomics

Marks: 100 **Credits: 4**

Objective: This course is designed to equip the learners on advanced macroeconomic theories and concepts. This course enables the learners to understand rational expectation theories, real business cycles, micro foundations for macroeconomics, interest rate theories and monetary institutions and monetary policy.

Course Outcomes: The students will be able to

1. Understand the Rational expectation theories and new classical macroeconomics
2. Understand the theories of Real Business Cycle school and New Keynesian School
3. Comprehend key interest rate theories
4. Understand monetary institutions and monetary policy

Unit 1: Rational Expectations and new Classical Macroeconomics

1. The basic concepts, Post Keynesian developments.
2. Inflationary gap, Demand Pull versus Cost Push inflation, the Phillips curve and Lucas Supply equation

Unit 2: Real Business Cycle School

1. Real Business Cycle School and inter temporal substitution of labour, Real Business Cycle theory, technology shocks, neutrality of money and flexibility of wages and prices, Real Business cycle view on great depression.

Unit 3: Micro Foundations of real and nominal rigidities

1. New Keynesian School: Imperfect competition and price setting, Real rigidity, Co-ordination failure models, Real Non Walrasian Theories, Small Menu Cost model and Staggering of prices, implicit wage contract theory, efficiency wage theory- Insider- Outsider model.

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Unit 4: Theories of the Interest Rate

1. Real and monetary theories of the interest rate: Keynesian theory, Wicksellian theory, Fisher's theory, Hicksian theory Credits market imperfections Adverse selection and moral hazard.

Unit 5: Monetary Institutions & Monetary Policy

1. Monetary transmission mechanism and targeting Inflation
2. Money growth and interest rates: Interest rate rules, Taylor rule, Rules versus discretion, Central Bank Autonomy, Dynamic inconsistency of monetary policy credibility and reputation, Co-ordination of fiscal and monetary policy.

References:

1. Dornbusch & Fischer. Macroeconomics. McGraw Hill. 11th edition, 2010.
2. N. Gregory Mankiw. Macroeconomics, Worth Publishers, 7th edition, 2010.
3. Richard T. Froyen, Macroeconomics, Pearson Education Asia, 2nd edition, 2005.
4. Ackley Gardner. Macroeconomics. Macmillan.
5. Andrew B. Abel and Ben S. Bernanke, Macroeconomics, Pearson Education, Inc., 7th edition, 2011.
6. Romer, D., Advanced Macroeconomics, second edition, McGraw-Hill, 2001

DSE: Money and Banking

Marks: 100 **Credits: 4**

Objective: This course is designed to equip the learners on various important concepts in money and banking system. This course enables the learners to understand financial system, differentiate banks and NBFCs, and role of central bank in an economy.

Course Outcomes: The students will be able to

1. Understand financial system and financial market
2. Understand various types of interest rate
3. Differentiate banks and NBFCs
4. Understand role of central bank in an economy

Course Contents:

Unit 1: Financial System and Money: Overview of Financial system and introduction to money, role of money in the payment system, financial instruments and financial markets.

Unit 2: Interest Rates: Meaning of interest rates, types of interest rates, interest rates and asset values, present value, future value, risk and term structure of interest rates

Unit 3: Banks and NBFCs: Banking regulation act 1949 and revision/re-regulation, nationalized and private banks, non-banking financial intermediaries

Unit 4: Central Bank: Role of central banks, central bank balance sheet and money supply process, conduct of monetary policy, Inflation targeting, central bank and foreign exchange, Basel norms

Unit 5: Financial Market: Capital markets- primary and secondary, Introduction to the stock market, rational expectations, efficient market hypothesis

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1. Money, Banking, and Financial Markets, Fourth Edition, Stephen G. Cecchetti, Kermit L. Schoenholtz
2. Money and Banking, Robert E. Wright, Vincenzo Quadrini

DSE: Game Theory

Marks: 100 **Credits: 4**

Objective: This course introduces learners to the basic ideas, concepts and methods of game theory, enabling them to follow the use of these methods in economics and other applied fields. The course enables students to understand important concepts like Nash equilibrium, mixed strategy in Nash equilibrium, games with perfect information and imperfect information.

Course Outcomes: The students will be able to

1. Understand game theory and uses of game theory in economics
2. Understand Nash equilibrium and mixed strategy equilibrium
3. Differentiate and understand games with perfect information and imperfect information.

Unit 1: Introduction

What is game theory? – History of game theory: an outline – Theory of rational choice – Use of game theory in economics

Unit 2: Nash-equilibrium

Strategic games – Examples: Prisoner's dilemma, Matching pennies – Nash equilibrium – Best response functions – Dominated actions – Illustrations: Cournot's model of oligopoly, Bertand's model of oligopoly, War of attrition, auctions

Unit 3: Mixed Strategy Equilibrium

Introduction – Mixed strategy Nash equilibrium – Dominated actions – Pure equilibria when randomization is allowed – equilibrium in a single population – Formation of the players' beliefs – Extension: Finding all mixed strategy Nash equilibria

Unit 4: Extensive Games with Perfect Information

Introduction – Strategies and outcomes – Nash equilibrium – Subgame perfect equilibrium – Finding subgame perfect equilibrium of finite horizon games: backward induction – Stackelberg's model of duopoly – Allowing for simultaneous moves – Allowing for exogenous uncertainty

Unit 5: Games with Imperfect Information

Bayesian games: General definitions, Cournot's duopoly game with imperfect information, auctions under imperfect information – Extensive games with imperfect information: Strategies, Nash equilibrium, Beliefs and sequential equilibrium, Signaling games

References:

1. Osborne, Martin.J (2004): *An Introduction to Game Theory*, Oxford University Press.
2. Mas-Colell,A., M.D. Whinston and J.R. Green (1995): *Microeconomic Theory*, Oxford University Press.
3. Gibbons, R.A (1992): *Primer in Game Theory*, Pearson Education.

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1. Credits in Indian agriculture: purposes of loans, Sources of finance, Factors determining demand for Credits
2. Recent policy changes in regard to farm Credits and their implications.

Unit 4: Agriculture Marketing

1. Marketing: Characteristics of primary agricultural markets in India, Regulated markets and market intervention, Marketing efficiency, Marketed and Marketable surplus, Marketing Channels and Functionaries

Unit 5: Agriculture Pricing

1. Farm prices, Trends in relative prices of farm products, Supply response to prices in agriculture; Behavior of marketed surplus,
2. Price policy in India and its basis, Minimum Support Prices

Unit 6: Agriculture and Climate Change

1. Climate change and challenges to Indian agriculture
2. Policy measures to combat climate change

References:

1. Soni, R.N., Leading Issues in Agricultural Economics (Vishal Publishing House), 2008.
2. Misra and Puri. Indian Economy, Himalaya Publishing House
3. Bhalla, G.S., 2007, Indian Agriculture since Independence, National Book Trust, India.
4. State of Indian Agriculture: Ministry of Agriculture, Government of India, New Delhi
5. Kumar, A., Singh, K.M. and Sinha, S., 2010, Institutional Credits to Agriculture Sector in India: Status, Performance and Determinants, Agricultural Economics Research Review, Vol. 23, July December 2010, pp. 253-264.

DSE: Growth Economics

Marks: 100 **Credits: 4**

Objective: This course is designed to expose the students to the understanding about economic growth, its benefits and costs, determinants and policies that promote growth, ways to measure, country experiences and implications for their overall future development.

Course Outcome:

The students will be able to:

2. Understand importance and sources of growth
3. Understand the role of capital, labour, technology and productivity in growth.
4. Understand inter-relationship between growth and income inequality

Unit 1: Economic Growth – Basic Issues (Introduction)

2. What is Economic growth and how is it measured; total v/s per capita growth; measuring growth rate; economic development v/s economic growth; stylised facts about growth experiences across countries - differences in level of income between countries, differences in the rates of income growth.

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3. Benefits of Growth; costs (adverse effects) of growth - jobless growth, Kuznet's hypothesis, dislocation; Inclusive growth; growth and welfare in open economy; fundamental sources of growth.

Unit 2: Physical Capital, Investment and Growth

2. Production function and the role of physical capital, sources of growth in capital; CRS production technology
3. The relationship between investment and capital formation and saving: Harrod-Domar theory of growth (actual, warranted, natural growth rates).
4. Lewis Model of capital accumulation.
5. The Solow Model, derivation of steady state, Cobb-Douglas production function, convergence to steady state.
6. Solow model with savings, Golden rule.

Unit 3: Productivity, Technology and Growth

2. Measuring productivity in the production function. Measuring productivity growth using Cobb Douglas function.
3. Differences in the level of productivity and growth rates of productivity across countries.
4. Technology and growth. The nature of technological progress: technology creation, technology transfer, R&D.
5. Relationship between technology creation and endogenous growth: the AK model.
6. The technology production function. Differential technological progress.

Unit 4: Population and Growth

2. The Malthusian Model; Population growth in the extended Solow Model.
3. Explaining concepts of population - mortality, life expectancy, mortality transition, fertility transition demographic transition.

Unit 5: Human Capital.

1. Contribution of Health
2. Contribution of Education.

Unit 6: Some Perspectives on stages of Growth and Lessons learnt

References:

1. Economic Growth by David N. Weil, Pearson publishing.
2. Macroeconomics by Gregory N. Mankiw
3. Analytical Development Economics by Kaushik Basu, Oxford India Paperback (Chpt 7).
4. Development Economics by Debraj Ray (Chpt 3, Chpt 7).

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