SACRED HEART COLLEGE (AUTONOMOUS), THEVARA

KOCHI, KERALA, 682013

Syllabus for Courses

Under the

Interdisciplinary Pathway

Econometrics Major

(Four Year Undergraduate Programmes)

Introduced from 2024-25 admissions onwards

Prepared by

Expert Committee for Interdisciplinary Major in Econometrics

Sacred Heart College, Thevara, Kochi

Expert Committee for Interdisciplinary Major in Econometrics

SACRED HEART COLLEGE (AUTONOMOUS), THEVARA, KOCHI, KERALA

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1. INTRODUCTION

The National Education Policy (NEP) 2020 envisages the revision of the Choice Based Credit System (CBCS) for instilling innovation and flexibility. It emphasizes on promoting interdisciplinary studies, introducing new subjects, and providing flexibility in courses and fresh opportunities for students. It also envisages setting up of facilitative norms for issues, such as credit transfer, equivalence etc., and a criterion-based grading system that assesses student achievement based on the learning goals for each programme.

The NEP document suggests several transformative initiatives in higher education. These include:

- Introduction of holistic and multidisciplinary undergraduate education that would help develop all capacities of human beings - intellectual, aesthetic, social, physical, emotional, ethical and moral - in an integrated manner; soft skills, such as complex problem solving, critical thinking, creative thinking, communication skills; and rigorous specialization in a chosen field (s) of learning.
- Adoption of flexible curricular structures in order to enable creative combinations of disciplinary areas for study in multidisciplinary contexts in addition to rigorous specialization in a subject
- Undergraduate degree programmes of either 3 or 4-year duration.
- The students are getting a chance to determine his/her own semester-wise academic load and will be allowed to learn at his/her pace, to the extent possible.
- Increase in the number of choices of courses available to students and the students are getting an opportunity to choose the courses of their interest from all disciplines.
- Multidisciplinary and holistic education with emphasizes on skill development, research and higher order thinking,
- Promotion of innovation and employability of the student.
- Flexibility for the students to move from one institution to another as per their choice.
- Flexibility to switch to alternative modes of learning (offline, ODL, and online learning, and hybrid modes of learning).

2. OUTCOME BASED EDUCATION (OBE)

Undergraduate courses in Mathematics follow the Outcome-based Education (OBE) framework. OBE is a system where all the parts and aspects of education are focused

on the outcomes of the course. The students take up courses with a certain goal of developing skills or gaining knowledge and they have to complete the goal by end of the course. Outcome-based education affirms teachers as facilitators, rather than lecturers. In this model, teachers guide the students and encourage them to develop their knowledge and skills. The undergraduate courses at the Department of Mathematics, Sacred Heart College (Autonomous), Thevara provides a learning approach in which students develop analytical ability and critical thinking and research acumen over different situations

3. PROGRAMME OUTCOME

The Undergraduate Programme Outcomes (POs) are as follows:

PO1: Critical thinking and Analytical reasoning

- Critical thinking guides the assessment and judgment of information, while analytical reasoning involves specific methods for analysis and conclusion drawing. It includes the ability to assess evidence, identify assumptions, formulate coherent arguments, understand complex relationships, and evaluate practices and theories critically. Additionally, critical sensibility involves self-awareness and reflection on personal and societal experiences.

PO2: Scientific reasoning and Problem solving

- Capacity to interpret and draw conclusions from data, critically evaluate ideas and evidence with an open-minded perspective; ability to apply learned competencies to solve unfamiliar problems and apply knowledge to real-life situations, avoiding mere replication of curriculum content.

PO3: Effective communication and leadership skill

- Proficiency in expressing thoughts verbally and non-verbally, utilizing appropriate communication media. Confidently sharing ideas, active listening, analytical reading and writing and presenting complex information clearly to diverse groups. Effective teamwork and leadership skills, including setting direction, inspiring vision, building and motivating teams, and guiding them efficiently towards common goals.

PO4: Social consciousness and responsible citizenship

- Social consciousness involves an empathetic and informed perspective, extending beyond personal concerns to embrace a responsibility for the collective good in nation-building. It includes reflecting on the impact of research on conventional

practices and a clear understanding of societal needs for inclusive and sustainable development. Responsible citizens contribute positively through civic engagement, environmental stewardship, and a commitment to social justice, abiding by laws and working for the advancement of society.

PO5: Equity, Inclusiveness and Sustainability

- Promoting equity, inclusiveness, sustainability, and diversity appreciation. Developing ethical and moral reasoning with values of unity, secularism, and national integration for dignified citizenship. Understanding and appreciating diversity, managing differences, and using an inclusive approach. Emphasizing creating environments where diverse individuals feel valued, addressing present needs without compromising future generations' ability to meet their own needs, considering environmental, economic, and social factors.

PO6: Moral and Ethical Reasoning

- Possessing the capacity to embody moral and ethical values in personal conduct, articulating positions and arguments on ethical matters from diverse perspectives, and consistently applying ethical practices in all endeavours. Proficient in recognizing and addressing ethical issues pertinent to one's work, steadfastly steering clear of any unethical behaviour.

PO7: Networking and Collaboration

- Cultivating networking skills in education entails establishing meaningful professional connections and relationships among educators, administrators, and stakeholders. It also involves fostering cooperative efforts among individuals, institutions, and research organizations within the educational realm. These practices are indispensable for nurturing a supportive, innovative, and dynamic learning environment.

PO8: Lifelong Learning

- Cultivating the ability to continually acquire knowledge and skills, including the art of "learning how to learn," becomes paramount for lifelong learning. This self-paced and self-directed approach serves personal development, aligns with economic, social, and cultural objectives, and facilitates adaptation to evolving workplace demands through skill development and reskilling. It equips individuals with competencies and insights, allowing them to adeptly respond to society's changing landscape and enhance their overall quality of life. Lifelong learning extends beyond

formal education, embracing diverse informal and non-traditional learning experiences.

4. MODE OF ASSESSMENT: The assessment shall be a combination of Continuous Comprehensive Assessment (CCA) and an End Semester Evaluation (ESE). The percentage weightage for CCA and ESE will be as per the undergraduate regulations of the college.

2. REGULATIONS FOR UNDERGRADUATE (HONOURS) DEGREE PROGRAMMES

PREAMBLE

Sacred Heart College (Autonomous), Thevara, Kochi is a grant-in-aid private college affiliated to Mahatma Gandhi University, Kottayam, Kerala. The College was established in 1944 as a higher educational institute for men on the basis of the minority rights. It started admitting girls in 1975 and currently serves all sections of the society without any discrimination of caste or creed.

The College was granted Autonomous Status by the University Grants Commission (UGC) in 2014.

Vision and Mission of the Institution

The vision of the College aims at the formation of holistic individuals who would champion the cause of justice, love, truth and peace. To this effect, Sacred Heart College envisions the **"Fashioning of an enlightened society founded on a relentless pursuit of excellence, a secular outlook on life, a thirst for moral values as well as an unflinching faith in God."** It seeks the creation of a world, guided by divine wisdom, governed by moral principles, inclusive by secular outlook and united by the principle of equity.

The Mission of the Institution is to provide an environment that

- **facilitates the holistic development of the individual**
- **enables the students to play a vital role in the nation-building process and contribute to the progress of humanity**
- **disseminates knowledge even beyond the academia**
- **instils in the students a feel for the frontier disciplines, and**
- **cultivates a concern for the environment**

by setting lofty standards in the ever-evolving teacher-learner interface.

Framing of the Regulations

As part of the implementation of the National Education Policy 2020 (NEP 2020), the University Grants Commission (UGC) has issued the Curriculum and Credit Framework for Undergraduate Programmes 2023 (CCFUP) which would provide a flexible choice-based credit system, multidisciplinary approach, multiple entry and exit options, and establish three Broad Pathways, (a) 3-year UG Degree, (b) 4-year UG Degree (Honours), and (c) 4-year UG Degree (Honours with Research).

The Kerala Higher Education Reforms Commission has recommended a comprehensive reform in the undergraduate curriculum for the 2023-24 academic year, adopting 4-year undergraduate programs to bring Kerala's undergraduate education at par with well acclaimed universities across the globe.

The Kerala State Curriculum Committee for Higher Education has been constituted, and have proposed a model Kerala State Higher Education Curriculum Framework (KSHECF) for Undergraduate Education.

Further, an Academic Committee and various sub committees were constituted for the implementation of the Regulations. The Academic Committee submitted the draft regulations on 15-03-2024, namely**: THE SACRED HEART COLLEGE (AUTONOMOUS) UNDERGRADUATE PROGRAMMES (HONOURS) REGULATIONS, 2024 {SHC-UGP (Honours)}** under the New Curriculum and Credit Framework, 2024.

REGULATIONS

Short Title and Commencement

i. These Regulations may be called THE SACRED HEART COLLEGE (AUTONOMOUS) UNDERGRADUATE PROGRAMMES (HONOURS) REGULATIONS, 2024 {SHC-UGP (Honours)} under the New Curriculum and Credit Framework 2024.
ii. These Regulations will come into effect from the academic year 2024-2025 and will have prospective effect.

Scope and Application

iii. These Regulations shall apply to all Undergraduate programmes under various Faculties conducted by THE SACRED HEART COLLEGE (AUTONOMOUS) for the admissions commencing in the academic year 2024-2025.
iv. Every programme conducted under the SHC-UGP shall be monitored by an SHC-UGP Academic Committee comprising members nominated by the Principal.

Definitions

Unless used in a context otherwise specified,

i. College means THE SACRED HEART COLLEGE (Autonomous), a grant-in-aid private college affiliated to Mahatma Gandhi University, Kottayam, Kerala.
ii. 'University' means the MAHATMA GANDHI University which is the affiliating University of Sacred Heart College (Autonomous).
iii. FYUGP means Four Year Undergraduate Programme.
iv. Academic Year: Two consecutive (one odd and one even) semesters followed by a vacation in one academic year.
v. Academic Coordinator/Nodal Officer: Academic Coordinator/Nodal Officer is a faculty nominated by the college council to co-ordinate the effective conduct of the FYUGP including Continuous Comprehensive Assessment (CCA) undertaken by various departments within the college. She/ he/ they shall be the convenor for the College level Academic Committee.
vi. Academic Week: A unit of five working days in which the distribution of work is organized, with at least five contact hours of one-hour duration on each day.

vii. Academic Credit: A unit by which the course work is measured. It determines the number of hours of instructions required per week in a semester. It is defined both in terms of student efforts and teacher's efforts. A course which includes one hour of lecture or tutorial or minimum 2 hours of lab work/ practical work/ field work per week is given one credit hour. Accordingly, one credit is equivalent to one hour of lecture or tutorial or two hours of lab work/ practical work/ field work/ practicum and learner engagement in terms of course related activities (such as seminars preparation, submitting assignments, group discussion, recognized club-related activities etc.) per week. Generally, a one credit course in a semester should be designed for 15 hours Lecture/ tutorials or 30 hours of practical/ field work/ practicum and 30 hours learner engagement.

viii. Academic Bank of Credits (ABC): An academic service mechanism as a digital/ virtual entity established and managed by Government of India to facilitate the learner to become its academic account holder and facilitating seamless learner mobility, between or within degree-granting Higher Education Institutions (HEIs) through a formal system of credit recognition, credit accumulation, credit transfers and credit redemption to promote distributed and flexible process of teaching and learning. This will facilitate the learner to choose their own learning path to attain a Degree/ Diploma/ Certificate, working on the principle of multiple entry and exit, keeping to the doctrine of anytime, anywhere, and any level of learning.

ix. Credit Accumulation: The facility created by ABC in the Academic Credit Bank Account (ABA) opened by the learner across the country in order to transfer and consolidate the credits earned by them by undergoing courses in any of the eligible HEIs.

x. Credit Recognition: The credits earned through eligible/ partnering HEIs and transferred directly to the ABC by the HEIs concerned.

xi. Credit Redemption: The process of commuting the accrued credits in the ABC of the learner for the purpose of fulfilling the credits requirements for the award of various degrees. Total credits necessary to fulfil the criteria to get a degree shall be debited and deleted from the account concerned upon collecting a degree by the learner.

xii. Credit Transfer: The mechanism by which the eligible HEIs registered with ABC are able to receive or provide prescribed credits to individual's registered with ABA in adherence to the UGC credit norms for the course(s) registered by the learner in any HEIs within India.

xiii. Credit Cap: Maximum number of credits that a student can take per semester, which is restricted to 30.

xiv. Continuous Comprehensive Assessment (CCA): The mechanism of evaluating the learner by the course faculty at the institutional level.

xv. End Semester Evaluation (ESE): The mechanism of evaluating the learner at the end of each semester.

xvi. Audit Course: a course that the learner can register without earning credits, and is not mandatory for completing the SHC-UGP. The student has the option not to take part in the CCA and ESE of the Audit Course. If the student has 75% attendance in an Audit Course, he/she/they is eligible for a pass in that course, without any credit (zero-credit).

xvii. Courses: refer to the papers which are taught and evaluated within a programme, which include lectures, tutorials, laboratory work, studio activity, field work, project work, vocational training, viva, seminars, term papers, presentations, assignments, self-study, group discussion, internship, etc., or a combination of some of these elements.

xviii. Choice Based Credit System (CBCS) means the system wherein students have the option to select courses from the prescribed list of courses.

xix. College-level Academic Committee: Is a committee constituted for the FYUGP at the college level comprising the Principal as the Chairperson, the Academic Co-ordinator/ Nodal Officer as its convenor.

xx. Academic Co-ordinator/ Nodal Officer: A senior faculty member nominated by the college council.

xxi. Course Faculty: A faculty member nominated by the Head of the Department shall be in charge of offering a particular course in a particular semester of FYUGP.

xxii. Department means any teaching department in a college offering a course of study approved by the College as per the regulations of the college and it includes a Department, Centre, or School of Teaching and Research conducted directly by the College.

xxiii. Board of Studies (BoS) means the academic body duly constituted to frame the syllabus of each department.

xxiv. Senior Faculty Advisor (SFA) is a faculty nominated by a Department Council to co-ordinate all the necessary work related to FYUGP undertaken in that department, including the continuous comprehensive assessment.

xxv. Department Council means the body of all teachers of a department in a college.

xxvi. Faculty Adviser (FA) means a teacher from the parent department nominated by the Department Council to advise students in academic matters.

xxvii. Graduate Attributes means the qualities and characteristics to be obtained by the graduates of a programme of study at the College, which include the learning outcomes related to the disciplinary areas in the chosen field of learning and generic learning outcomes. The College will specify graduate attributes for its programmes.

xxviii. Programme means the entire duration of the educational process including the evaluation leading to the award of a degree.

xxix. Programme Pathway: Combination of courses that can be chosen by a student that give options to pursue interesting and unconventional combinations of courses drawn from different disciplinary areas, like the sciences and the social sciences/ humanities. The pathways could be in terms of major- minor options with different complementary/ allied disciplines.

xxx. Regulatory Body means University Grants Commission (UGC), All India Council for Technical Education (AICTE), National Assessment and Accreditation Council (NAAC) and National Board of Accreditation (NBA) etc.

xxxi. Signature Courses: Signature courses are the specialized Discipline Specific Elective courses or skill-based courses designed and offered by the regular/ ad hoc/ visiting/ emeritus/ adjunct faculty member of a particular college with the prior recommendation of the BoS and the approval of Academic Council of the College.

xxxii. Letter Grade or simply 'Grade' in a course is a letter symbol (O, A+, A, B+, B, C, P, F, and Ab). Grade shall mean the prescribed alphabetical grade awarded to a student based on their performance in various examinations. The Letter grade that corresponds to a range of CGPA.

xxxiii. Grade Point: Each letter grade is assigned a 'Grade point' (G) which is an integer indicating the numerical equivalent of the broad level of performance of a student in each course. Grade Point means point given to a letter grade on 10-point scale.

xxxiv. Semester Grade Point Average (SGPA) is the value obtained by dividing the sum of credit points obtained by a student in the various courses taken in a semester by the total number of credits in that semester. SGPA shall be rounded off to two decimal places. SGPA determines the overall performance of a student at the end of a semester.

xxxv. Credit Point (P) of a course is the value obtained by multiplying the grade point (G) by the credit (C) of the course: $P = G \times C$

xxxvi. Cumulative Grade Point Average (CGPA) is the value obtained by dividing the sum of credit points in all the semesters earned by the student for the entire programme by the total number of credits in the entire programme and shall be rounded off to two decimal places.

xxxvii. Grade Card means the printed record of students' performance, awarded to them.

xxxviii. Words and expressions used and not defined in this regulation, but defined in the Mahatma Gandhi University Act and Statutes, being the Act and Statues of Sacred Heart College (Autonomous)'s affiliating University shall have the meaning assigned to them in the Act and Statutes.

Features and Objectives of SHC-UGP

The features and objectives of the SHC-UGP shall be:

v. The features, meaning, and purpose of FYUGP shall be as stipulated by the UGC and as adapted by the Kerala State Higher Education Curriculum Framework (KSHECF) for undergraduate education.

vi. The practice of lateral entry of students to various semesters exists, but an exit with a Degree shall be awarded only upon successful completion of 133 credits as per the conditions stipulated in this regulation.

vii. FYUGP shall have three Broad Pathways, (a) 3-year UG Degree, (b) 4-year UG Degree (Honours), and (c) 4-year UG Degree (Honours with Research).

viii. Students who choose to exit after 3 years shall be awarded UG Degree in their respective Discipline/ Disciplines after the successful completion of the required minimum Courses with 133 credits.

ix. A 4-year UG Degree (Honours) in the Discipline/ Disciplines shall be awarded to those who complete the FYUGP with a specific number of Courses with 177 credits including 8 credits from a graduate project/ dissertation in their major discipline.

x. Students who acquire minimum 75% in their graduation (upto 6th semester) are eligible for Honours with Research Programme. However if necessary, College may conduct screening test for the honours with research programme in accordance with College Regulations from time to time.

xi. 4-year UG Degree (Honours with Research): Students who aspire to pursue research as a career may opt for 4-year UG Degree Honours with Research stream under FYUGP with a specific number of Courses with 177 credits including 12 credits from a research project in their major discipline.

xii. The recognized research departments or departments with at least two faculty members having PhD shall offer the Honours with Research programme. Minimum 2 students (mentees) should be allotted to a faculty member (Mentor).

xiii. Students who have chosen the honours with research stream shall do their entire fourth year under the mentorship of a mentor.

xiv. The mentor shall prescribe suitable advanced level/capstone level courses for a minimum of 20 credits to be taken within the institutions along with the courses on research methodology, research ethics, and research topic-specific courses for a minimum of 12 credits which may be obtained either within the institution or from other recognized institutions, including online and blended modes.

xv. Students who have opted for the honours with research should successfully complete a research project under the guidance of the mentor and should submit a research report for evaluation. They need to defend successfully the research project to obtain 12 credits under a faculty member of the College. The research shall be in the Major/ allied discipline.

xvi. The research outcomes of their project work may be published in peer-reviewed journals or presented at conferences or seminars or patented.

xvii. The proposed FYUGP curriculum comprises Three Broad Parts: a) Foundation Components, b) Discipline Specific Pathway components (Major/ Minor), and c) Discipline Specific Capstone Components.

xviii. The Foundation component of the FYUGP shall consist of a Set of General Foundation Courses and a Set of Discipline Specific Foundation Courses.

xix. General Foundation Courses shall be grouped into 4 major baskets as Ability Enhancement Courses (AEC), Skill Enhancement Courses (SEC), Value Addition Courses (VAC), and Multi-Disciplinary Courses (MDC).

xx. Ability Enhancement Courses shall be designed specifically to achieve competency in English, other languages as per the student's choice with special emphasis on language and communication skills.

xxi. English or other language courses shall be designed to enable the students to acquire and demonstrate the core linguistic skills, including critical reading, academic and expository writing skills as well as the cultural and intellectual heritage of the language chosen. Separate courses will be designed for Science, Humanities and Commerce streams.

xxii. Multi-Disciplinary Courses (MDC) shall be so designed as to enable the students to broaden their intellectual experience by understanding the conceptual foundations of Science, Social Sciences, Humanities, and Liberal Arts. Students shall not be eligible to take the MDC in the same discipline that they have studied during their +2. Third semester MDC can be Kerala specific content.

xxiii. Skill Enhancement Courses (SEC) shall be designed to enhance 21st century workplace skills such as creativity, critical thinking, communication, and collaboration.

xxiv. Discipline Specific Courses shall include Discipline Specific Pathway Courses, both Major and Minor streams, enabling students to gain basic knowledge in the chosen discipline.

xxv. Discipline Specific Foundation Courses shall focus on foundational theories, concepts, perspectives, principles, methods, and critical thinking essential for taking up advanced/ Capstone Courses. Practical courses shall be included in discipline specific foundation courses.

xxvi. The curriculum of the SEC should be designed in a manner that at the end of year- 1, year-2, year-3, and year-4 students are able to meet the level descriptors for levels 5, 6, 7, and 8 of the UGC Guidelines on National Skills Qualifications Framework (NSQF). The detailed descriptors of the NSQF levels is provided as **Appendix I** below.

xxvii. Value Addition Courses (VAC) shall be so designed as to empower the students with personality development, perspective building, and self-awareness.

xxviii. Discipline Specific Pathway Components (Major/ Minor) shall provide the students with an opportunity to pursue in-depth study of a particular subject or discipline and develop competency in that chosen area, which includes Discipline Specific Core (DSC) courses and Discipline Specific Elective (DSE) courses as Major and Minor courses.

xxix. Major components consist of three types: Discipline Specific Core or the Discipline Specific Elective Courses, and the research /laboratory/ fieldwork.

xxx. Minor Courses can be selected from any discipline that may supplement or complement the Major Courses.

xxxi. Students who complete a sufficient number of Courses in a discipline or an interdisciplinary area of study other than their chosen Major shall qualify for a Minor in that discipline or in a chosen interdisciplinary area of study.

xxxii. Major Components shall be the main focus of study. By selecting a Major, the student shall be provided with an opportunity to pursue an in-depth study of a particular discipline.

xxxiii. Each Board of Studies (BoS) shall identify specific Courses or baskets of Courses towards Minor Course credits. Students shall have the option to choose Courses from disciplinary/ interdisciplinary minors and skill-based courses related to a chosen programme.

xxxiv. Students can opt for a change of Major at the end of the second semester to any Minor discipline studied among the foundation level courses. Students also can opt for a change of Major at the end of the second semester to any MDC.

xxxv. Students should opt their 5th and 6th semester VAC and SEC from their Major disciplines only.

xxxvi. Course cum Credits Certificate: After the successful completion of a semester as proof for re-entry to another institution this certificate is essential. This will help the learner for preserving the credits in the Academic Bank of Credits.

xxxvii. The Advanced Level/ Capstone Level Courses shall be designed in such a manner as to enable students to demonstrate their cumulative knowledge in their main field of study, which shall include advanced thematic specialization or internships or community engagement or services, vocational or professional training, or other kinds of work experience.

xxxviii. Advanced/ Capstone level Major Specialization shall include Courses focused on a specific area of study attached to a specific Major, which could be an Elective Course. They shall include research methodology as well.

xxxix. The student has the option to register for and attend a course without taking part in the CCA and ESE of that course. Such a course is called the Audit Course. If the student has 75% attendance in an Audit Course, he/she/they is/are eligible for a pass in that course, without any credit (zero-credit). The Audit Course will be recorded in the final grade card of the student.

xl. All students shall undergo Summer Internship or Apprenticeship in a Firm, Industry or Organization; or Training in labs with faculty and researchers or other Higher Education Institutions (HEIs) or Research Institutions. The College will adhere to the guidelines on internship published by the University.

xli. Students will be provided the opportunities for internships with local industries, business organizations, agriculture, health and allied sectors, Local Government institutions (such as panchayats, municipalities), State Planning Board, State Councils/ Boards, Research Institutions, Research Labs, Library, elected representatives to the parliament/ state assembly/ panchayat, media organizations, artists, crafts persons etc. These opportunities will enable the students to actively engage with the practical aspects of their learning and to improve their employability.

xlii. The College will provide opportunities for field-based learning/minor projects enabling them to understand the different socio-economic and development-related issues in rural and urban settings. The College will provide the students with opportunities for Community engagement and services, exposing them to socio-economic issues to facilitate theoretical learning in real-life contexts.

xliii. Additional Credits will be awarded for those who actively participating in Social Activities, which may include participation in National Service Scheme (NSS), Sports and Games, Arts, participation in College union related activities (for respective elected/ nominated members), National Cadet Corps (NCC), adult education/ literacy initiatives, mentoring school students, and engaging in similar social service organizations that deemed appropriate to the College.

xliv. Grace marks shall be awarded to a student for meritorious achievements in co-curricular activities (in Sports/ Arts/ NSS/ NCC etc.). Such a benefit is applicable in the same academic year spreading over two semesters, in which the said meritorious achievements are earned. The Academic Council will decide from time to time the eligibility and other rules of awarding the grace marks.

xlv. Options will be made available for students to earn credit by completing quality- assured remote learning modes, including Online programmes offered on the Study Webs of Active-Learning for Young Aspiring Minds (SWAYAM) or other Online Educational Platforms approved by the competent body/university from time to time.

xlvi. Students shall be entitled to gain credits from courses offered by other recognized institutions directly as well as through distance learning.

xlvii. For the effective operation of the FYUGP, a system of flexible academic transaction timings shall be implemented for the students and teachers.

Eligibility for Admission and Reservation of Seats

i. The eligibility for admissions and reservation of seats for various FYUG Degree Programmes shall be in accordance with the norms/ rules made by the Government/ University from time to time.

ii. No student shall be eligible for admission to FYUG Degree Programmes in any of the disciplines unless he/she/they has successfully completed the examination conducted by a Board/University at the +2 level of schooling or its equivalent.

iii. Students shall be admitted and enrolled in the respective programmes solely based on the availability of the academic and physical facilities within the institution. The College shall provide all students with a brochure detailing the Courses offered by the various departments under the various Programmes and the number of seats sanctioned by the University for each Programme.

iv. During the time of admission each student may be provided with a unique higher education student ID which may be linked with the Aadhar number of the student so that this ID can be transferred if required to other higher education institutions as well.

v. The students at the end of second semester may be permitted to change their major programme of study to any course/ institution/ university across the state. Based on the availability of seats and other facilities, the students may be permitted to opt any discipline which he/she/they had studied during the first two semesters as Discipline Specific Foundation courses/ Multidisciplinary Foundation courses. If ranking is required it will be in the order of the highest-grade points secured in the discipline to which the switching of Major is sought.

vi. Students shall be allowed to change their major programmes, if required, to a maximum of 10% of the sanctioned strength of that particular programmes depending upon the academic and infrastructural facilities available in the Institution.

vii. Depending upon the availability of academic and infrastructural facilities, the College may also admit a certain number of students who are registered for particular programmes in each semester by transfer method, if required, from other Institutions subject to conditions as may be issued by the University.

viii. A student who has already successfully completed a First-Degree Programme and is desirous of and academically capable of pursuing another First-Degree Programme may also be admitted with the prior approval of the University as per the conditions regarding programme requirements specified by the University.

ix. A Student can also be admitted for an additional major/ second major/ additional minor and on completion of the required credits he/she/they can be awarded a second major/ additional major/ minor. He/she/they may be exempted from minor pathway and general foundation course requirement.

x. The College can also enroll students in certain courses as per their choice depending upon the availability of infrastructure and other academic facilities from other recognized HEIs who are already registered for a particular programme there either through regular/ online/ distance mode irrespective of the nature of programme (Govt./ Aided/ Self- finance/ Autonomous). On

successful completion of the course the credits may be transferred through the Academic Bank of Credit.

Academic Monitoring and Student Support

The academic monitoring and student support shall be in the following manner, namely

i. The College shall appoint a Senior Faculty member as Academic Co-ordinator/ Nodal officer for the smooth conduct of FYUGP.
ii. Advisory System: There shall be one Senior Faculty Advisor (SFA) for each department and one Faculty Advisor (FA) for 20 to 30 students of the class to provide advice in all relevant matters. The Head of the Department, in consultation with the SFA, shall assign FA for each student.
iii. The documents regarding all academic activities of students in a class shall be kept under the custody of the FA/ SFA.
iv. All requests/ applications from a student or parent to higher offices are to be forwarded/ recommended by FA/ SFA.
v. Students shall first approach their FA/ SFA for all kinds of advice, clarifications, and permissions on academic matters.
vi. It is the official responsibility of the institution to provide the required guidance, clarifications, and advice to the students and parents strictly based on the prevailing academic regulations.
vii. The SFA shall arrange separate or combined meetings with FA, faculty members, parents, and students as and when required and discuss the academic progress of students.
viii. The FA/ SFA shall also offer guidance and help to solve the issues on academic and non-academic matters, including personal issues of the students.
ix. Regular advisory meetings shall be convened immediately after the commencement of the semester and immediately after announcing the marks of the Continuous Comprehensive Assessment (CCA).
x. The CCA related results shall be displayed on the department notice board/ other official digital platforms of the college at least for two working days.
    a. Any concern raised by the students regarding CCA shall be looked into in the combined meetings of advisors, HOD, course faculty, and the students concerned.
    b. If the concerns are not resolved at the advisor's level, the same can be referred to the properly constituted college-level grievance redressal committees as per the existing UGC/ University/ Government norms.
    c. The Principal/ HOD shall ensure the proper redressal of the concerns raised by the students regarding CCA.
    d. If the students raise further concerns about the issue, the principal shall refer the issue to the appropriate authorities with proper documents and minutes of all the committees.
xi. The FA/ SFA shall be the custodian of the minutes and action taken reports of the advisory meetings. The SFA shall get the minutes and action taken reports of advisory meetings approved by the Head of Department and the Principal.

xii. The Principal shall inform/forward all regulations, guidelines, communications, announcements, etc. regarding student academic and other matters to the HODs/ SFA for information and timely action.

xiii. It shall be the official responsibility of the Principal to extend the required administrative and financial support to the HODs, SFAs and FAs to arrange necessary orientation programmes for students regarding student counselling, the prevailing norms, regulations, guidelines and procedures on all academic and other related matters.

xiv. An integrated educational planning and administration software will be made available by the College to manage the academic information of all students including student admissions and registration, managing students' personal and academic information, course registrations, attendance management, all process related to assessments including regular & online examinations, grading, publishing of results, supplementary examinations, LMS, stakeholders' feedback, etc.

xv. Faculty, staff, students, and parents shall be allowed to access this software system over a highly secure authenticated mechanism from within the campus.

Course Registration

i. Each department shall publish well in advance the relevant details of courses offered, such as the name, academic level, expected outcomes, time slot, and course faculty members.

ii. Students shall be allowed to visit and interact with respective faculty members during the first week of each semester, to gather more information about the courses and the availability of seats.

iii. Based on consultations and advice from the faculty adviser, each student shall complete course registration within one week from the commencement of each semester.

iv. The number of credits that a student can take in a semester is governed by the provisions in these Regulations, subject to a minimum of 16 and a maximum of 30 Credits.

v. A student can opt out of a Course or Courses registered, subject to the minimum Credit/ Course requirement, if he/she/they feels that he/she/they has registered for more Courses than he/she/they can handle, within 30 days from the commencement of the semester.

vi. The college shall publish a list of the students registered for each course including audit course, if any, along with the chosen Programmes, repeat/ reappearance courses, if any.

vii. The higher education institutions shall admit candidates not only for programmes, but also for courses.

Re-admission and Scheme Migration

i. Students who opt out before the completion of the third year shall be provided with a 'Course cum Credits Certificate' after the successful completion of a semester as proof for re-entry to another institution.

ii. Students who have successfully completed a particular programme pathway may be permitted to take an additional minor or second major.

iii. Those students who are opting for a second major are eligible for getting certain credit transfer/ credit exemption from their previous minor programs of study, subject to the prior recommendation of the BoS that, those credits are relevant for the present major programme of study.

Duration of Programme, Credits, Requirements and Options

i. Students will be offered the opportunity to take breaks during the programme and resume after the break, but the total duration for completing the FYUG programme shall not exceed 7 years.
ii. Students who wish to complete the undergraduate programmes faster may do so by completing different courses equivalent to the required number of credits and fulfilling all other requirements in N-1 semesters, where N is the number of semesters in the FYUGP.
iii. Provided further that the students may complete the undergraduate programme in slower pace, they may pursue the three years or six semester programme in 4 to 5 years (8 to 10 semesters), and four years, or eight semester programme in 5 to 6 years (10 to 12 semesters) without obtaining readmission.
iv. For students who crossed 6 semesters at a slower space, the requirement of 16 credits per semester from the institutions where they enrolled may be relaxed.

Credit Structure

The proposed number of credits per course and the credit distribution of them for the FYUG Programmes are given below:

i. An academic year shall consist of 200 working days; one semester consists of 90 working days; and an academic year consists of two semesters.
ii. Ten working days in a semester shall be used for extracurricular activities. One semester consists of 18 weeks with 5 working days per week. In each semester, 15 days (3 weeks) should be kept aside for End Semester Evaluation (ESE) and CCA.
iii. The maximum number of available weeks for curriculum transactions should be fixed at 15 in each semester. A minimum of 5 teaching or tutorial hours could be made available for a day in a 5-day week.
iv. A course that includes one hour of lecture/ tutorial or two hours of lab work/ practical work/ field work/ practicum per week is given one credit hour.
v. One credit in a semester should be designed for 15 hours of lectures/ tutorials or 30 hours of lab work/ practical work/ field work/ practicum and 30 hours of learner engagement in terms of course-related activities such as seminar preparation, submitting assignments, etc.
vi. A one-credit seminar or internship or studio activities or field work/ projects or community engagement and service will have two-hour engagements per week (30 hours of engagement per semester).
vii. A course can have a combination of lecture credits, tutorial credits, and practicum credits.
viii. Minimum credit for one Course should be 2 (Two), and the maximum credit should be 4 (Four).
ix. All Discipline Specific Major/ Minor Courses shall be of 4 (Four) credits.
x. For all Discipline Specific Major/ Minor Courses, there may be practical/ practicum of two or four hours per week.

xi. All Courses under the Multi-Disciplinary, Ability Enhancement, Value Addition and Skill Enhancement categories are of 3 credits.

xii. Summer Internship, Apprenticeship, Community outreach activities, etc. may require sixty hours (or as appropriate) of engagement for acquiring one credit.

xiii. A student shall be able to opt for a certain number of extra credits over and above the requirements for the award of a degree.

xiv. Maximum number of credits that a student can earn per semester shall be restricted to 30. Hence, a student shall have the option of acquiring credits to a maximum of 180 credits for a 6-semester UG programmes and 240 credits for a 4-year (8-semester) programmes.

xv. Each faculty member shall offer a maximum of 16 credits per semester. However those who are offering both practical and theory courses shall offer a maximum of 12-16 credits per semester.

xvi. For a four-credit theory course, 60 hours of lecture/ tutorial class shall be assured as a mandatory requirement for the completion of that course.

Course Structure of the SHC-UGP Programme

The SHC-UGP consists of the following categories of courses and the minimum credit requirements for pathway option-one shall be as follows;

Sl. No.	**Categorization of Courses for all Programme**	**Minimum Number of Credit Required**	
1.	Major	68	88
2.	Minor	24	24+12*
3.	Multi-Disciplinary Courses (MDC)	9	9
4.	Skill Enhancement Courses (SEC)	9	9
5.	Ability Enhancement Courses (AEC)	12	12
6.	Value Addition Courses (VAC)	9	9
7.	Summer Internship, field basedlearning etc.	2	2
8.	Research Project / Dissertation		12/8**

* The students can acquire advanced/ capstone level courses with 12 credits from their DSC/ DSE/ Minor courses depending up on their pathway choice. The Minor courses can be of level 300 or above.

** The students pursuing the 4-year honours with research have to complete a project with 12 credits and for the 4-year honours degree students have to complete a project with 8 credits and DSC/ DSE capstone/ advanced level course in the 8th semester.

i. 20% syllabus of each course will be prepared by the teacher as 'Teacher Specific Content' and will be evaluated under CCA.

ii. In case of MDC, SEC, VAC courses coming under 3rd & 4th semester, college should make necessary arrangements to give adequate preference to courses designed by language departments. MDC in the 3rd semester can be Kerala Specific Content.

Academic Levels of Pathway Courses

Semester	Difficulty level	Nature of Course
1 & 2	100-199	Foundation-level or introductory courses
3 & 4	200-299	Intermediate level courses
5 & 6	300-399	Higher level courses
7 & 8	400-499	Advanced/Capstone level courses

Signature Courses

i. With a prior recommendation of BoS and the approval of academic council, each faculty member can design and offer at least one signature course in every semester, which may be offered as DSE /SEC/ VAC.
ii. The College will publish a list of signature courses in DSE/ SEC/ VAC offered by the faculty members with a prior recommendation of BoS and the approval of academic council.
iii. The College may empanel distinguished individuals who have excelled in their field of specialization like science and technology, industry, commerce, social research, media, literature, fine arts, civil services etc. as adjunct faculty as per the UGC guidelines with the approval of the College. With a prior recommendation of BoS and the approval of academic council, the adjunct faculty can offer SEC/VAC as signature course.
iv. Ad hoc/ Guest faculty/ Visiting faculty/ Visiting Scholars can also offer DSE/ SEC/ VAC as signature courses with a prior recommendation of BoS and the approval of academic council.
v. The faculty concerned may design the particular course and it should be forwarded to the concerned BoS after the approval of the Academic Committees formed as part of this regulations.
vi. The examinations and evaluation of the signature courses designed by the faculty shall be conducted by the faculty themselves and an external expert faculty chosen by the college from a panel of experts submitted by the faculty and recommend by the BoS concerned.

Programme Pathways and Curriculum Structure

Students who have joined for any programme under these regulations shall have the option to choose the following pathways for their UG degree and Honours programme.

i. **Degree with single Major**: A student pursuing the FYUG programme in a specific discipline shall be awarded a Major degree if he secures at least 50% of the total credits in the specific discipline required for the award of the Degree in that Discipline. Example: Physics Major/ Economics Major/ Commerce Major
ii. **Degree Major with Minor**: If a student pursuing the FYUG Programme is awarded a Major Degree in a particular discipline, he/she/they are eligible to be awarded a Minor in another discipline of his choice, if he earns a minimum of 32 credits (approximately 25% of credit required for the three-year programme) from 8 pathway courses in that discipline. Example: Physics Major with Chemistry Minor/ Chemistry Major with

English Minor/ Commerce Major with Economics Minor/ English Major with Functional English Minor/ Hindi Major with Malayalam Minor etc.

iii. **Major with Multiple Disciplines** of Study: This pathway is recommended for students who wish to develop core competencies in multiple disciplines of study. In this case, the credits for the minor pathway shall be distributed among the constituent disciplines/ subjects. If a student pursuing FYUG Degree Programme is awarded a major Degree in a particular discipline, he/she/they are eligible to get mentioned his core competencies in other disciplines of his choice if he has earned 12 credits from the pathway courses of that discipline. Example: Physics Major with Minors in Chemistry and Mathematics, Economics Major with Minors in History and English, Commerce Major with Minors in Economics and Statistics.

iv. **Interdisciplinary Major**: For these programme pathways, the credits for the major and minor pathways shall be distributed among the constituent disciplines/subjects to attain core competence in the interdisciplinary programme. Example: Econometrics Major, Global Studies Major, Biostatistics Major.

v. **Multi-Disciplinary Major**: For multidisciplinary major pathways, the credits for the major and minor pathways will be distributed among the broad disciplines such as Life Sciences, Physical Sciences, Mathematical and Computer Sciences, Data Analysis, Social Sciences, Humanities, etc. Example: Life Science, Data Science, Nano Science.

vi. **Degree with Double Major**: A student who secures a minimum of 50% credits from the first major will be awarded a second major in another discipline if he could secure 40% of credit from that discipline for the 3-year/ 4-year UG degree to be awarded a double major degree. Example: Physics and Chemistry Major, Economics and History Major, Economics and History Major, Commerce and Management Major.

Pathway Option 1 - Degree Major or Major with Multiple Disciplines of Study

Course Components	No. of Courses											
	Semester 1	**Semester 2**	**Semester 3**	**Semester 4**		**Semester 5#**	**Semester 6#**	**Total**	**Remarks**	**Semester 7**	**Semester 8**	**Total**
DSC A (4 Credit /Course)	1(P)	1(P)	3 (2P)	3 (2P)		5	4	17	7 Out of 17 can be opted as DSE	3	2	22
DSC B & C (4 Credit /Course)	2(P)	2(P)	1(P) (B or C)	1(P) (C or B)				6		3		9
Multidisciplinary Courses (MDC) (3 Credit /Course)	1(P)	1(P)	1*					3	*Recommended that the course offered be related to Indian Knowledge Systems or allied areas.			3
Ability Enhancement Courses (AEC) (3 Credit /Course)	1 (English)1 (OL)	1 (English)1 (OL)						4				4
Skill Enhancement Courses (SEC) (3 Credit /Course)				1*		1**	1**	3	*Recommended that the course may be offered by the English Department ** From DSC Aonly			3
Value Addition Courses (VAC) (3 Credit /Course)			1*	1*			1**	3	*Recommended that one VAC be offered by the English Department and one by Other Languages Department ** From DSC Aonly			3
Project/ Dissertation 12 credits for Honours with Research & 8 for Honours											**12/8 (1 DSC / DSE for Honours**	
Total Courses	**6**	**6**	**6**	**6**		**6**	**6**	**36**		**6**	**2+1**	
Total Credits	**21**	**21**	**22**	**22**	**2**	**23**	**22**		**Total Credits 133**	**24**	**20**	**Total Credits 177**
Total Hours per Week	**25**	**25**	**25**	**25**		**25**	**25**		**Exit option available**	**25**	**25**	

Internship of 2 Credits

BoS can include 2 practical courses in 5th semester and 3 practical courses in 6th semester in any of the 6 courses distributed in each semester.

Pathway Option 2 - Major with Minor

Course Components	No. of Courses											
	Semester 1	Semester 2	Semester 3	Semester 4		Semester 5#	Semester 6#	Total	Remarks	Semester 7	Semester 8	Total
DSC A (4 Credit /Course)	1(P)	1(P)	3 (2P)	3 (2P)		4	3	15	7 Out of 15 can be opted as DSE	3	2	20
DSC B (4 Credit /Course)	2(P)	2(P)	1(P)	1(P)		1	1	8	1 Out of 8 can be opted as DSE	3		11
Multidisciplinary Courses (MDC)/ (3 Credit /Course)	1(P)	1(P)	1*					3	*Recommended that the course offered be related to Indian Knowledge Systems or allied areas.			3
Ability Enhancement Courses (AEC) (3 Credit /Course)	1 (English)1 (OL)	1 (English)1 (OL)						4				4
Skill Enhancement Courses (SEC) (3 Credit /Course)				1*		1**	1**	3	*Recommended that the course may be offered by the English Department ** From DSC A only			3
Value Addition Courses (VAC) (3 Credit /Course)			1*	1*			1**	3	*Recommended that one VAC be offered by the English Department and one by Other Languages Department ** From DSC Aonly			3
Project/ Dissertation 12 credits for Honours with Research & 8 for Honours											**12/8 (1 DSC/ DSE for Honours**	
Total Courses	**6**	**6**	**6**	**6**		**6**	**6**	**36**		**6**	**2+1**	
Total Credits	**21**	**21**	**22**	**22**	**2**	**23**	**22**		**Total Credits 133**	**24**	**20**	**Total Credits 177**
Total Hours per Week	**25**	**25**	**25**	**25**		**25**	**25**		**Exit option available**	**25**	**25**	

Internship of 2 Credits

BoS can include 2 practical courses in 5th semester and 3 practical courses in 6th semester in any of the 6 courses distributed in each semester.

Pathway Option 3 - Double Major

Course Components	No. of Courses											
	Semester 1	Semester 2	Semester 3	Semester 4		Semester 5#	Semester 6#	Total	Remarks	Semester 7	Semester 8	Total
DSC A (4 Credit /Course)	1(P)	1 (P)	2(2P)	2(1P)		4	3	13	7 Out of 13 can be opted as DSE	3	2	18
DSC B (4 Credit /Course)	2(P)	2(P)	2(1P)	2(2P)		1	1	10	2 Out of 10 can be opted as DSE	3		13
Multidisciplinary Courses (MDC) (3 Credit /Course)	1(P)	1(P)	1*					3	*Recommended that the course offered be related to Indian Knowledge Systems or allied areas.			3
Ability Enhancement Courses (AEC) (3 Credit /Course)	1 (English)1 (OL)	1 (English)1 (OL)						4				4
Skill Enhancement Courses (SEC) (3 Credit /Course)				1*		1	1	3	*Recommended that the course may be offered by the English Department			3
Value Addition Courses (VAC) (3 Credit /Course)			1*	1*			1	3	*Recommended that one VAC be offered by the English Department and one by Other Languages Department			3
Project/ Dissertation 12 credits for Honours with Research & 8 for Honours											**12/8 (1 DSC/ DSE for Honours**	
Total Courses	**6**	**6**	**6**	**6**		**6**	**6**	**36**		**6**	**2+1**	
Total Credits	**21**	**21**	**22**	**22**	**2**	**23**	**22**		**Total Credits 133**	**24**	**20**	**Total Credits 177**
Total Hours per Week	**25**	**25**	**25**	**25**		**25**	**25**		**Exit option available**	**25**	**25**	

Internship of 2 Credits

BoS can include 2 practical courses in 5th semester and 3 practical courses in 6th semester in any of the 6 courses distributed in each semester.

Note: In all the above 3 tables "(P)" means courses with practical

Pathway Option 4 – Interdisciplinary Major in Econometrics

Course Components	No. of Courses											
	Semester 1	**Semester 2**	**Semester 3**	**Semester 4**		**Semester 5**	**Semester 6**	**Total**	**Remarks**	**Semester 7**	**Semester 8**	**Total**
Constituent Discipline 1 (4 Credit /Course)	1(P)	1 (P)	2(2P)	2(1P)		2	2(2P)	10		3	2	15
Constituent Discipline 2	1(P)	1(P)	1	1(P)		2(1P)	1(P)	7		1		8
Constituent Discipline 3	1(P)	1(P)	1(P)	1		1(P)	1	6		2(1P)		8
MultidisciplinaryCourses (MDC) (3 Credit /Course)	1(P)	1(P)	1*					3	*Recommended that the course offered be related to Indian Knowledge Systems or allied areas.			3
Ability Enhancement Courses (AEC) (3 Credit /Course)	1(English) 1(OL)	1(English) 1(OL))						4				4
Skill Enhancement Courses (SEC) (3 Credit /Course)				1*		1	1	3	*Recommended that the course may be offered by the English Department			3
Value Addition Courses (VAC) (3 Credit /Course)			1*	1*			1	3	*Recommended that one VAC be offered by the English Department and one by Other Languages Department			3
Project/ Dissertation 12 credits for Honours with Research & 8 for Honours											**12/8 (1 DSC/ DSE for Honours**	
Total Courses	**6**	**6**	**6**	**6**		**6**	**6**	**36**		**6**	**2+1**	
Total Credits	**21**	**21**	**22**	**22**	**2**	**23**	**22**		**Total Credits 133**	**24**	**20**	**177**
Total Hours per Week	**25**	**25**	**25**	**25**		**25**	**25**		**Exit option available**	**25**	**25**	

Internship of 2 Credits

BoS can include 2 practical courses in 5th semester and 3 practical courses in 6th semester in any of the 6 courses distributed in each semester.

Note: In all the above 3 tables "(P)" means courses with practical

Course Structure of Various Pathways based on Credit Requirements

The FYUG Programmes consist of the following categories of courses and the minimum credit requirements for each of them shall be as follows:

Table 1: FYUGP Course Structure – Major with Minors

Sl. No.	Categorization of courses for all Programmes	Minimum number of credits required	
		3-year UG	4-year UG
1	Major	68	88
2	Minor/ Minors	24	24+12*
3	Multi-disciplinary Courses (MDC)	9	9
4	Skill Enhancement Courses (SEC)	9	9
5	Ability Enhancement Course (AEC)	12	12
6	Value Addition Courses (VAC)	9	9
7	Summer Internship, field-based learning etc.	2	2
8	Project / Dissertation		12**
	Total Credits	133	177

* Students can acquire 12 credits from their DSC/ DSE- Minor courses (300-399 level) depending upon their pathway choice.

** Students pursuing a four-year Honours degree are required to complete an 8-credit project as well as one capstone course from their chosen pathway, either DSC or DSE (400-499 level).

Table 2: FYUGP Course Structure – Double Major

Sl. No.	Categorization of courses for all Programmes	Minimum number of credits required	
		3-year UG	4-year UG
1	First Major	52	72
2	Second Major	40	52
3	Multi-disciplinary Courses (MDC)	9	9
4	Skill Enhancement Courses (SEC)	9	9
5	Ability Enhancement Course (AEC)	12	12
6	Value Addition Courses (VAC)	9	9
7	Summer Internship, field-based learning etc.	2	2
8	Project/(8 Credit project + 1 capstone course)		12
	Total Credits	133	177

Table 3: FYUGP Course Structure – Multidisciplinary

Sl. No.	Categorization of courses for all Programmes	Minimum number of credits required	
		3-year UG	4-year UG
1	Multidisciplinary Major	52	72
2	Multidisciplinary Minors	40	52
3	Multi-disciplinary Courses (MDC)	9	9
4	Skill Enhancement Courses (SEC)	9	9
5	Ability Enhancement Course (AEC)	12	12
6	Value Addition Courses (VAC)	9	9
7	Summer Internship, field-based learning etc.	2	2
8	Project / (8 Credit project + 1 capstone course)		12
	Total Credits	**133**	**177**

Table 4: FYUGP Course Structure – Interdisciplinary Major

Sl. No.	Categorization of courses for all Programmes	Minimum number of credits required	
		3-year UG	4-year UG
1	Interdisciplinary Major Constituent Discipline 1 – Economics Constituent Discipline 2 – Mathematics Constituent Discipline 3 - Statistics	 40 28 24	 60 32 32
2	Multi-disciplinary Courses (MDC)	9	9
3	Skill Enhancement Courses (SEC)	9	9
4	Ability Enhancement Course (AEC)	12	12
5	Value Addition Courses (VAC)	9	9
6	Summer Internship, field-based learning etc.	2	2
7	Project / (8 Credit project + 1 capstone course)		12
	Total Credits	**133**	**177**

Guidelines for Acquiring Credit from Other Institutions/Online/Distance Mode

i. A student shall register to a minimum of 16 credit per semester from the college/ department where he/she/they officially admitted for a particular programme. However, students enrolled for a particular programme in one institution can simultaneously enroll for additional credits from other HEIs within the University

or outside University subject to a maximum of 30 credits per semester including the 16 institutional credits.

ii. The College shall publish a list of courses that are open for admission for students from other institutions well in advance before the commencement of each semester.

iii. Each BoS shall prepare and publish a list of online courses at different levels before the commencement of each semester offered in various online educational platforms recognized by the Academic Council of the college, which can be opted by the students for acquiring additional credits.

iv. BoS shall prepare and publish a list of allied/ relevant pathway courses before the commencement of each semester offered by other Board of Studies that can be considered as pathway course for major/ minor for their disciplines at different levels.

v. At the end of each semester the college will include the credit acquired by the student through online courses in their semester grade card subject to a maximum of 30 credits.

Attendance

i. A student shall be permitted to register for the end-semester evaluation of a specific course to acquire the credits only if he has completed 75% of the prescribed classroom activities in physical, online, or blended modes, including any makeup activities as specified by the course faculty of that particular course.

ii. A student is eligible for attendance as per the existing university and government orders which includes participation in a meeting, or events organized by the college or the university, a regularly scheduled curricular or extracurricular activity prescribed by the college or the university. Due to unavoidable or other legitimate circumstances such as illness, injury, family emergency, care-related responsibilities, bad or severe weather conditions, academic or career-related interviews students are eligible for authorized absence. Apart from this, all other eligible leaves such as maternity leave, and menstrual leave shall also be treated as authorized absences.

iii. The condonation facility can be availed as per the university norms.

Workload

i. The workload of a faculty who offers only lecture courses during an academic year shall be 32 credits.

ii. The workload of a faculty offering both practical courses and theory courses may be between 24-32 credits per academic year.

iii. An academic year shall consist of two semesters.

iv. To protect the existing language workload, college should make necessary arrangements to give adequate preference to those courses designed by language departments coming under MDC, SEC and VAC of 3rd & 4th semester. It is recommended that the MDC offered in the third semester shall be based on Indian Knowledge Systems or Nation-specific topics and may be offered by the Other Languages department or any other department as may be seen fit. Additionally, the SEC in the fourth semester may be offered by the English Department and of the VACs in the third and fourth semesters, one may be offered by the Other Languages

Department and the other may be offered by the English Department. These recommendations may be modified as per the recommendations of the SHC-UGP Academic Monitoring Committee.

v. Programme wise workload calculation will be as per the FYUGP workload ordinance 2024.
vi. The teachers given the administrative responsibilities in the department and college level may give a relaxation in their work load as specified in the UGC regulations 2018.

Credit Transfer and Credit Accumulation

i. The college will establish a digital storage (DIGILOCKER) of academic credits for the credit accumulation and transfer in line with ABC.

ii. The validity of credits earned shall be for a maximum period of seven (7) years or as specified in the university/ UGC regulations.The students shall be required to earn at least 50% of the credits from the College.

iii. Students shall be required to earn the required number of credits as per any of the pathway structure specified in this regulation for the award of the degree.

Outcome Based Approach

The curriculum will be designed based on Outcome Based Education (OBE) practices. The Graduate Attributes (GA) and Programme Outcomes (PO) will be defined and specified in the syllabus of each programme.

Assessment and Evaluation

i. The assessment shall be a combination of Continuous Comprehensive Assessment (CCA) and an End Semester Evaluation (ESE).

ii. 30% weightage shall be given for CCA. The remaining 70% weight shall be for the ESE.

iii. Teacher Specific Content will be evaluated under CCA.

iv. CCA will have two subcomponents Formative Assessment (FA) and Summative Assessment (SA). Each of these components will have equal weightage and to be conducted by the course faculty/ course coordinator offering the course.

v. FA refers to a wide variety of methods that teachers use to conduct in-process evaluations of student comprehension, learning needs, and academic progress during a lesson, unit, module or course. FA is to encourage students to build on their strengths rather than fixate or dwell on their deficits. FA can help to clarify and calibrate learning expectations for both students. FA will help students become more aware of their learning needs, strengths, and interests so they can take greater responsibility over their own educational growth. FA will be prerogative of the course faculty/ course coordinator based on specific requirement of the student.

vi. Suggestive methods of FA are as follows: (anyone or in combinations as decided by the course faculty/ course coordinator)

   a. Practical assignment
   b. Observation of practical skills
   c. Viva voce
   d. Quiz
   e. Interview
   f. Oral presentations
   g. Computerized adaptive testing
   h. In-class discussions
   i. Group tutorial work
   j. Reflection writing assignments
   k. Home assignments
   l. Self and peer Assessments
   m. Any other method as may be required for specific course/ student by the course faculty/ course coordinator.

vii. Summative Assessments (SA) are used to evaluate student learning, skill acquisition, and academic achievement at the conclusion of a defined instructional period- typically at the end of a project, unit, module, course or semester. SA may be a class tests, assignments, or project, used to determine whether students have learned what they were expected to learn. It will be based on evidence, collected using single or multiple ways of assessment. The systematically collected evidences should be kept in record by course faculty/ course coordinator and the marks should be displayed on the college notice board/ other official digital platforms of the college before the end semester examinations.

viii. The method of SA will be as follows: (any one as decided by the course faculty/ course coordinator)

   a. Written test
   b. Open book test
   c. Laboratory report
   d. Problem based assignments
   e. Individual project report
   f. Case study report
   g. Team project report
   h. Literature survey
   i. Standardized test
   j. Any other pedagogic approach specifically designed for a particular course by the course faculty/ course coordinator.

ix. A student may repeat SA only if for any compulsive reason due to which the student could not attend the assessment.

x. The prerogative of arranging a CCA lies with the course faculty/ course coordinator with the approval of SHC-UGP Academic Committee based on justified reasons.

xi. The course faculty/ course coordinator shall be responsible for evaluating all the components of CCA. However, the college may involve any other person (External or Internal) for evaluation of any or all the components as decided by the Principal/Controller of Examinations from time to time in case any grievances are raised.

xii. Written tests shall be precisely designed using a variety of tools and processes (e.g., constructed responses, open-ended items, multiple-choice), and the students should be informed about the evaluation modalities before the commencement of the course.

xiii. The course faculty may provide options for students to improve their performance through continuous assessment mechanism.

xiv. There shall be theory and practical examinations at the end of each semester.

xv. Regarding evaluation, one credit may be evaluated for 25 marks in a semester; thus, a 4-credit course will be evaluated for 100 marks; 3-credit courses for 75 marks and 2-credit courses for 50 marks.

xvi. All examinations will be conducted by the College and will be evaluated at the College itself.

xvii. Individual Learning Plans (ILPs) and/ or specific assessment arrangements may be put in place for differently abled students. Suitable evaluation strategies including technology assisted examinations/ alternate examination strategies will be designed and implemented for differently abled students.

Practical Examination

i. The end semester practical examination will be conducted and evaluated by the institution.

ii. There shall be a CCA for practical courses conducted by the course faculty/ course coordinator.

iii. The scheme of evaluation of practical courses will be as given below:

Components for the Evaluation of Practical Courses	Weightage
CCA of practical/practicum.	30%
ESE of practical/practicum.	70%

iv. Those who have completed the CCA alone will be permitted to appear for the ESE.

v. For grievance redressal purpose, the university shall have the right to call for all the records of CCA.

vi. Duration of Examination: Questions shall be set as per the defined Outcome .The duration of the examinations shall be as follows.

Mode	Time (in Hours)
Written Examination	2
Multiple Choice	1.5
Open Book	2
Any Other Mode	2

Evaluation of Project/Dissertation

The evaluation of project work shall be CCA with 30% and ESE 70%. The scheme of evaluation of the Project is given below:

Project type	Maximum Marks	CCA	ESE
Research Project of Honours with Research (12 credits)	200	60	140
Project of Honours (8 credits)	100	30	70

Evaluation of Internship

The evaluation of internship shall be done by a committee constituted by the Department Council. The scheme of CCA and ESE is given below:

Components of Evaluation of Internship	Weightage	Marks for Internship2 Credits/ 50 Marks
CCA	30%	15
ESE	70%	35

The department council may decide any mode for the completion of the Internship. If in case evaluation is not specified in any of the selected internship programme, institution can adopt a proper evaluation method as per the weightage specified in the table above.

Letter Grades and Grade Points

Mark system is followed for evaluating each question. For each course in the semester, letter grade and grade point are introduced in 10-point indirect grading system as per guidelines given below,

i. The Semester Grade Point Average (SGPA) is computed from the grades as a measure of the student's performance in a given semester. The SGPA is based on the grades of the current term, while the Cumulative Grade Point Average (CGPA) is based on the grades in all courses taken after joining the programme of study.

ii. Based on the marks obtained, the weighted grade point will be mentioned in the student's grade cards.

Letter Grade	Grade Point	Percentage of Marks (Both Internal & External Marks put together)	Class
O (Outstanding)	10	95% and above	First Class with Distinction
A+ (Excellent)	9	85% and above but below 95%	
A (Very good)	8	75% and above but below 85%	
B+ (Good)	7	65% and above but below 75%	First Class
B (Above average)	6	55% and above but below 65%	
C (Average)	5	45% and above but below 55%	Second Class

P (Pass)	4	35% and above below 45% Aggregate (external and internal put together) with a minimum of 30% in external	Third Class
F (Fail)	0	Below an aggregate of 35%or below 30% in external evaluation	Fail
Ab (Absent)	0		Fail

iii. When students take audit courses, they may be given pass (P) or fail (F) grade without any credits.

Computation of SGPA and CGPA

The following method is recommended to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

iv. The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in the semester, i.e.

SGPA (Si) = Σ(Ci x Gi) / ΣCi

Where Si is the SGPA in the i^{th} semester, Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

$$\textbf{SGPA} = \frac{\text{Sum of the credit points of all courses in a semester}}{\text{Total Credits in that Semester}}$$

Illustration – Computation of SGPA

Semester	**Course**	**Credit**	**Letter Grade**	**Grade point**	**Credit Point** (Credit x Grade)
I	DSC A	4	A	8	4 x 8 = 32
I	DSC B	4	B+	7	4 x 7 = 28
I	DSC C	4	B	6	4 x 6 = 24
I	MDC	3	B	6	3 x 6 = 18
I	AEC 1	3	O	10	3 x 10 = 30
I	AEC 2	3	C	5	3 x 5 = 15
	Total	21			147
	SGPA				147/21 = 7

The CGPA is also calculated in the same manner considering all the courses undergone by a student over all the semesters of a programme, i.e.

$$\textbf{CGPA} = \frac{\text{Sum of the credit points of all courses in six or eight semesters}}{\text{Total Credits in Six (133) or Eight (177) semesters}}$$

v. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Implementation and Monitoring of SHC-UGP

i. The implementation and monitoring of SHC-UGP will be carried out by duly appointed bodies/committees of the college such as the Academic Council, the various Boards of Studies and the Academic Monitoring Committee.

ii. Academic Council

Among its other functions, the Academic Council of the College shall:

i. Scrutinize and approve all the proposals submitted by the Board of Studies of each Department with regard to the SHC-UGP details such as, academic pathways, allowed syllabi enrichment/ updating, details of elective courses, Online courses, blended teaching, courses offering to the students of other HEIs, panel of examiners, summative and formative evaluation tools proposed by the course faculty concerned, new courses and syllabus proposed by the faculty members as signature courses etc.
ii. The Academic Council can differ on any proposal and it shall have the right to return the matter for reconsideration to the Board of Studies concerned or reject it, after giving sufficient reasons to do so.
iii. Undertake the scrutiny of all documents related to Teacher Specific Content.
iv. Recommend to the College Governing Council for starting innovative programmes using the flexibility and holistic nature of the SHC-UGP curriculum frame work.

iii. Board of Studies

Among its other functions, the Board of Studies of each Department shall:

i. Prepare teacher specific content of syllabi for various courses keeping in view the objectives of the SHC-UGP and submit the same for the approval of the Academic Council.
ii. Scrutinize the signature course content and its evaluation techniques.
iii. Suggest methodologies for innovative teaching and evaluation techniques.
iv. Suggest panel of examiners to the Office of the Controller of Examinations.
v. Coordinate research, teaching, extension and other academic activities in the department.

iv. Expert Committee for Interdisciplinary Major in Economics

There shall be an expert committee to frame the syllabus and to monitor the introduction of the Interdisciplinary Major in Econometrics as envisaged in the clause (iv) of program pathways and structure. The faculty members who are also members of the Board of studies of the constituent disciplines shall be the members of the expert committee.

The total credits for the courses from constituent disciplines shall be 124 for the 4 year honours programme. Total credits for the first, second and third constituent disciplines shall be 60, 32 and 32 respectively.

v. SHC-UGP Academic Monitoring Committee

The SHC-UGP Academic Monitoring Committee shall be constituted under the Chairmanship of the Principal, with the Academic Coordinator as the Convenor, shall be entrusted to oversee the implementation and monitoring of the SHC-UG programme.

i. The Academic Monitoring Committee will collect and whet the proposals submitted by the Board of Studies of each Department with regard to the SHC-UGP and duly forward them to the Academic Council.
ii. It will oversee and coordinate the activities undertaken for the successful implementation of SHC-UGP in the College and will function as an advisory body in such matters.

Power to Remove Difficulties

If any difficulty arises in giving effect to the provisions of these Regulations, the Principal may by order make such provisions which appears to him/her to be necessary or expedient for removing the difficulty. Every order made under this rule shall be subject to ratification by the appropriate authorities.

Modifications to the Regulations

Notwithstanding anything contained in these Regulations, any amendments or modifications issued or notified by the University Grants Commission or the State Government or the Mahatma Gandhi University from time to time, shall be incorporated into these Regulations by the appropriate regulatory bodies of the College and shall constitute an integral part thereof.

LIST OF COURSES OFFERED UNDER THE CONSTITUENT DISCIPLINES

Course Code	Course title	Discipline	Semester	CREDITS
24UEMSDSC101	Introduction to Economics-1	Economics	I	4
24UEMSDSC102	Essential Mathematics for Economics	Mathematics	I	4
24UEMSDSC103	Fundamentals of Statistics and Data visualisation	Statistics	I	4
24UEMSDSC104	Introduction to Economics-II	Economics	II	4
24UEMSDSC105	Differential Calculus and applications	Mathematics	II	4
24UEMSDSC106	Theory of Random Variables and Statistical Distributions	Statistics	II	4
24UEMSDSC201	Microeconomic Analysis	Economics	III	4
24UEMSDSC202	Macroeconomic Analysis	Economics	III	4
24UEMSDSC203	Integral Calculus and applications	Mathematics	III	4
24UEMSDSC204	Data Analysis in inferential Statistics using R/Python	Statistics	III	4
24UEMSDSC205	Economics of Growth, Development and Environment	Economics	IV	4
24UEMSDSC206	Public Finance	Economics	IV	4
24UEMSDSC207	Intermediate Matrix Algebra and Applications	Mathematics	IV	4
24UEMSDSC208	Statistical Tools for Qualitative Research	Statistics	IV	4
24UEMSDSC301	Indian Economy	Economics	V	4
24UEMSDSC302	Introduction to Econometrics	Economics	V	4
24UEMSDSC303	Advanced Matrix Algebra and applications	Mathematics	V	4
24UEMSDSC304	Intermediate Optimization Methods	Mathematics	V	4
24UEMSDSC305	Sample Survey Analysis and Design of Experiments	Statistics	V	4

24UEMSDSC306	International Economics	Economics	VI	4
24UEMSDSC307	Intermediate Econometrics	Economics	VI	4
24UEMSDSC308	Advanced optimization Methods	Mathematics	VI	4
24UEMSDSC309	Time Series Analysis and Stochastic Process	Statistics	VI	4
24UEMSDSC401	Research Methodology for Economics	Economics	VII	4
24UEMSDSC402	Mathematical Economics	Economics	VII	4
24UEMSDSC403	Advanced Microeconomic Theory	Economics	VII	4
24UEMSDSC404	Differential Equations and Difference Equations	Mathematics	VII	4
24UEMSDSC405	Multivariate Data Analysis	Statistics	VII	4
24UEMSDSC406	Analytical Tools for Multivariate Analysis and Multivariate Distributions	Statistics	VII	4
24UEMSDSC407	Advanced Econometrics	Economics	VIII	4
24UEMSDSC408	Financial Markets	Economics	VIII	4

3. SYLABUS FOR INTERDISCIPLINARY PROGRAMME (ECONOMETRICS)

CONSTITUENT DISCIPLINE 1 – ECONOMICS

DICIPLINE SPECIFIC COURSES

SEMESTER- I

24UEMSDSC101: INTRODUCTION TO ECONOMICS-I

Constituent Discipline - 1	Economics
Semester	1
Type of Course	Discipline Specific Course
Course Code	24UEMSDSC101
Course Title	Introduction to Economics-1
Course Level	100-199
Course Summary	The course provides students with an introduction to economic methodologies and fundamental concepts. They will gain a basic understanding of microeconomics, macroeconomics, and mathematical economics.
Lecture/Practical Hours	75 (45/30)
Credits	4
Pre-requisites if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Comprehend the overarching aspects of Economics, including its methodologies and concepts.	U	1
2	Understands the basics of micro economics and the related concepts.	U	1, 2
3	Ability to grasp the foundational concepts of macroeconomics, which addresses the economy as a whole.	U	1, 2
4	Apply basic mathematical techniques to analyze economic models and concepts.	A	4
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course Description	Hours	CO No.
1		Methodology and Concepts of Economics	10	1
	1.1	Meaning, definition and Subject matter of Economics, Pure and applied Economics, Positive and normative Economics, Micro and macroeconomics.	4	1
	1.2	Economics as a social science – Need for interdisciplinary approach in Economics – Role of Economics in solving contemporary issues in a society.	3	1
	1.3	Nature and reality of assumptions in Economics, Method vs methodology - Deductive and inductive methodology.	3	1
Practicum: 1. Debate/discussion on various definitions of Economics with its merits and drawbacks. 2. Role play: Students can take on the roles of policy makers to suggest some remedial measures to solve contemporary social and economic issues.			5	1
Module	Units	Course Description	Hours	
2		Introduction to Micro Economics	10	2
	2.1	Nature and scope of Micro Economics, Central problems of the economy –Scarcity and choice - Market mechanism - Production Possibility Curve.	4	2
	2.2	Concepts of Equilibrium: Stable and unstable, static, comparative static and dynamic - General and partial equilibrium analysis – short run and long run.	4	2
	2.3	Goals of micro economic policy: Efficiency and equity - Microeconomic models - Need for governmental intervention.	2	2
Practicum: 1. Prepare a budget that you can maximizes the utility with your limited income, taking into account opportunity costs and trade-offs. 2. Discuss the concept of equilibrium and identify real-world examples where we can observe equilibrium in action.			5	2

Module	Units	Course Description	Hours	
3		Introduction to Macro Economics	15	3
	3.1	Macro Economics- Statics: comparative and dynamics – Circular flow of economic activity in the two-sector model – stock and flow concepts - endogenous and exogenous variables	3	3
	3.2	Definitions of related aggregates of national income - Methods of estimating national income – Limitations of national income accounting - GDP as a measure of economic welfare and quality of life- Real and Nominal GNP -actual GNP and Potential GNP- green GNP.	6	3
	3.3	Introduction to fiscal and monetary policies: Objectives, Major components - Role of Monetary and Fiscal policy in developing countries.	4	3
	3.4	Basic issues in Macroeconomic studies; Growth and Development, Inflation, Unemployment.	2	3
Practicum: 1. Debate / panel discussion on current macroeconomic policy issues such as government budget deficits, inflation, or unemployment. 2. Seminar presentations: Comparative analysis of India's GDP with the neighbouring countries 3. Create visual representations of macroeconomic data using charts, graphs, or info graphics.			10	3
Module	Units	Course Description	Hours	
4		Mathematical Economics and econometrics	10	4
	4.1	Nature and scope of Mathematical economics, Role of mathematics in economic theory, Mathematical and nonmathematical economics.	3	4
	4.2	Use of mathematics in economics, Scientific method in the empirical sciences, models and reality, uses of mathematical tools in economic analysis	3	4
	4.3	Econometrics – what is it about, uses of econometrics, methodology of econometrics, econometrics and mathematical economics, Econometrics and statistics, Goals of Econometrics.	4	4

Practicum: Collect data for estimating the demand function using sample data. Plot the estimated line against the scatter plot of collected bivariate data.	10	4
Teacher specific course components:		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, lecture-based learning, experiential learning, peer teaching, group discussions, discussion-based learning, inquiry-based learning, blended learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Theory: Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Group discussion. Any other metho1d as may be required for specific course by the course faculty. Practical: Any relevant method as may be required for specific course by the course faculty.
	End Semester Examination (ESE) Theory: Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. Practical: Nil

References:

1. Blaug, M. (1998). The Methodology of Economics, Cambridge Surveys of Economic Literature, New York.

2. Boland, Lawrence A. (2000), The Methodology of Economic Model Building Methodology after Samuelson, Routledge, London and New York.

3. Stiglitz J.E. and Walsh C.E. (2011), Principles of Economics, W.W. Norton & Co, New York.

4. Dominick Salvatore. Micro Economics Theory and Application. 4th Ed. New Delhi: Oxford University Press.

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7. Sundharam KPM, Banking: Theory, Law and Practice, Sultan Chand & Sons, New Delhi.

8. A. C. Chiang (1984): Fundamental Methods of Mathematical Economics, McGraw Hill International Edition.

9. K. Sydsaeter and P. J. Hammond (2002): Mathematics for Economic Analysis. Pearson Educational Asia

SEMESTER- II

24UEMSDSC104: INTRODUCTION TO ECONOMICS- II

Constituent Discipline - 1	Economics
Semester	2
Type of Course	Discipline Specific Course
Course Code	24UEMSDSC104
Course Title	Introduction to Economics-II
Course Level	100-199
Course Summary	The course covers the fundamentals of demand and supply theories, trade cycles, and the concept of inflation. It also addresses the nature and structure of public finance.
Lecture/Practical Hours	75 (45/30)
Credits	4
Pre-requisites if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand the fundamental concepts of demand, supply and elasticity in microeconomics	U	1
2	Understands the basics of macroeconomic concepts such as trade cycles, inflation and deflation.	U	1, 2
3	Analyse the concepts of economic growth, development, social poverty and inequality.	An	4, 5
4	Apply public finance concepts to understand fiscal tools, functions, and the government's role in addressing market failures.	A	1
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course Description	Hours	CO No.
1		Demand and Supply Analysis	15	1
	1.1	Concept of Demand - Law of demand - Determinants of demand - Types of demand - Demand function - Market demand curve.	5	1
	1.2	Elasticity of demand - Price, income and cross elasticity of demand - Measures of elasticity of demand.	5	1
	1.3	Concept of Supply - Law of supply - Determinants of supply - Supply function – Elasticity of supply – Market supply curve - Market equilibrium.	5	1
Practicum: 1. Choose a specific market (e.g., smartphones, fast food, clothing) and analyse the factors affecting demand and supply. 2. Select a product or service and investigate its price elasticity of demand. You can examine how changes in price affect the quantity demanded and explore real-life examples of elastic and inelastic goods.			5	1
Module	Units	Course Description	Hours	
2		Trade Cycles and Inflation	10	2
	2.1	Trade Cycles: Meaning - Stages of trade cycles - Monetary and non-monetary theories of trade cycles	4	2
	2.2	Inflation: Definition - Types of inflation - Causes and effects – Measures to control inflation	4	2
	2.3	Concept of Deflation – Causes and effects.	2	2
Practicum: 1. Examine historical case studies of economic recessions or downturns and analyse the underlying causes and consequences. 2. Study the dynamics of inflation in an economy and make a presentation on its impact on different stakeholders.			5	2
Module	Units	Course Description	Hours	
3		Introduction to Public Finance	10	3

	3.1	Meaning and scope of Public Finance – Fiscal tools-comparison between Public and Private Finance.	2	3
	3.2	Fiscal Functions-Allocation, distribution and stabilization-Principles of Maximum Social Advantage: Dalton, Musgrave	4	3
	3.3	Public Goods: Pure and Impure Public Goods, Free rider problem. Private Goods, Mixed Goods and Merit Goods, - Market failure and role of government.	4	3
Practicum: 1. Analyze government budgets at various levels for compliance with economic goals and public finance principles, identifying areas for improvement or consequences. (prepare for seminar presentation) 2. Compare the financial practices of a public organization and a private company, identifying key differences and best practices. (Discussion)			10	3
Module	Units	Course Description	Hours	
4		Nature and Structure of Indian Economy	10	4
	4.1	Nature and structure of Indian economy - Basic Features, problems and prospects.	3	4
	4.2	Sectoral composition of Indian Economy - Primary sector, secondary sector, tertiary sector - India's knowledge economy.	4	4
	4.3	India's demographic profile - Demographic dividend – Advantages and challenges.	3	4
Practicum: 1. Compare the share of agriculture, industry, and services in total GDP and examine how it has evolved over time (Assignment, presentation) 2. Study the sectoral distribution of employment in India and analyse trends in labour force participation rates across different sectors.			10	4
Teacher specific course components:				

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, lecture-based learning, experiential learning, peer teaching, group discussions, discussion-based learning, inquiry-based learning, blended learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA)

	Theory: Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Group discussion. Any other method as may be required for specific course by the course faculty. Practical: Any relevant method as may be required for specific course by the course faculty.
	End Semester Examination (ESE) Theory: Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. Practical: Nil

References:

1. Dominick Salvatore (2003), Microeconomics: Theory and Applications- 4thEdition, Oxford University Press.

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SEMESTER III

24UEMSDSC201: MICROECONOMIC ANALYSIS

Constituent Discipline - 1	Economics
Semester	3
Type of Course	Discipline Specific Course
Course Code	24UEMSDSC201
Course Title	Microeconomic Analysis
Course Level	200-299
Course Summary	This course provides an in-depth understanding of consumer behaviour, exploring how individuals make decisions to maximize utility. It also examines production behaviour, concepts of revenue and cost, and different market structures, illustrating how firms strive for efficiency and profit maximization in various competitive settings.
Lecture/Practical Hours	75 (45/30)
Credits	4
Pre-requisites if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand the fundamentals of consumer behaviour	U	1
2	Develops knowledge on the basics of production, cost and revenue in the economy	U, A	1
3	Distinguish different market forms existing in the economy	A, An	2
4	Application of micro economic concepts to analyze real life situations.	A	2
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course Description	Hours	CO No.
1		Theory Of Consumer Behaviour	11	1
	1.1	The consumption decision and consumer preferences- meaning of utility and its concepts- Marshall's Cardinal utility analysis- law of diminishing marginal utility- consumer equilibrium	3	1
	1.2	Ordinal utility analysis-indifference curve-properties- Marginal Rate of Substitution- Budget Line and its slope - Consumer Equilibrium-Price Consumption Curve-Income Consumption Curve	5	1
	1.3	Breaking price effect into income and substitution effects – Hicksian and Slutky's approch - Revealed Preference Theorem – critical appraisal.	3	1
Practicum: 1. Derivation of Indifference curve, Budget Line and Consumer Equilibrium (Non-Evaluative).			5	1
Module	Units	Course Description	Hours	
2		Theory of Production, Cost and Revenue	10	2
	2.1	Production function-production concepts (TP, AP, MP) - Time element in production function-law of variable proportions	2	2
	2.2	Isoquant - properties - MRTS - Iso cost Line - Optimal input combination - Producer equilibrium	3	2
	2.3	Cost concepts - TC, AC, MC - Traditional theory of costs - short run and long run - explicit and implicit cost - envelope curve - modern theory of cost	3	2
	2.4	Revenue concepts- TR, AR, MR- Relationship between AR and MR curves- AR, MR and Price elacticity	2	2
Practicum: 1. Derivation of MRTS, Producer Equilibrium (Non-evaluative)			5	2
Module	Units	Course Description	Hours	
3		Pricing in Perfect Competition and Monopoly	12	3,4

	3.1	Meaning of market- classification of market forms- Profit maximization objective of firms, TR-TC Approach, MR-MC Approach.	1	3,4
	3.2	Perfect Competition –Features-Long run and Short run equilibrium of firm and industry-supply curve-shut down point	4	3,4
	3.3	Monopoly – Nature of AR and MR curves- Short run and long run equilibrium - discriminating monopoly-degrees and types of price discrimination	4	3,4
	3.4	Monopoly power-meaning and sources- Measurement of monopoly power- dead weight loss under monopoly-concept of dumping.	3	3,4
Practicum: 1.Case Study-to analyse real world examples of dumping and its effect on domestic industries			10	4
Module	Units	Course Description	Hours	
4		Pricing in Monopolistic Competition & Oligopoly	12	3,4
	4.1	Monopolistic competition – Features - Short and long run equilibrium – Importance of selling cost and advertising-Chamberlin's alternative approach.	3	3,4
	4.2	Oligopoly – Nature of oligopoly – price stickiness – Sweezy's demand curve- collusive oligopoly – cartels and price leadership – low-cost firm, dominant and barometric	5	3,4
	4.3	Prisoner's dilemma and Oligopolistic behaviour– Duopoly – market with asymmetric information (concept only)	4	3,41
Practicum: Debate- a debate on the advantages and disadvantages of collusion in oligopolistic markets Discussion on markets with asymmetric information and their impact on efficiency			10	3,4
Teacher specific course components:				

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, lecture-based learning, experiential learning, peer teaching, group discussions, discussion-based learning, inquiry-based learning, blended learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Theory: Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Group discussion. Any other method as may be required for specific course by the course faculty. Practical: Any relevant method as may be required for specific course by the course faculty.
	End Semester Examination (ESE) Theory: Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. Practical: Nil

References:

1. A Koutsoyiannis (1979). Modern Microeconomics. Palgrave McMillan.

2. Dominic Salvatore. Micro Economic Theory and Application.4th Ed. New Delhi: Oxford University Press.

3. Robert S. Pindyck, et al. (recent edition). Microeconomics. Delhi. Pearson Education.

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Semester : 3

24UEMSDSC202: MACROECONOMIC ANALYSIS

Constituent Discipline - 1	Economics
Semester	3
Type of Course	Discipline Specific Course
Course Code	24UEMSDSC202
Course Title	Macroeconomic Analysis
Course Level	200-299
Course Summary	By the end of this course, students will be able to understand and apply classical theory of output, as well as consumption and investment theories. They will also gain knowledge of the Keynesian model of income determination and the equilibrium between money and product markets.
Lecture/Practical Hours	75 (45/30)
Credits	4
Pre-requisites if any:	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Develops ability to compare and contrast micro and macroeconomics and understand the basics, importance, and application of macroeconomics.	U	1
2	Understands the contributions made by classical economics and analyze the relevance of those theories.	An	1
3	Evaluates the transformation of the understanding of the economy based on macro variables.	E	2
4	Able to demonstrate the Keynesian model of income determination and the IS-LM model	A	1, 2
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course Description	Hours	CO No.
1		Classical Theory of Output and Employment	10	1,2
	1.1	Say's Law of Markets - Classical Theory of Employment and Output determination – Wage-price flexibility and full employment equilibrium	4	1,2
	1.2	Classical theory of interest – Quantity Theory of money (Fisher's version) – Cash transactions and cash balance approach – Pigou effect – Neutrality of money -Classical Dichotomy.	5	1,2
	1.3	Keynes' Criticism of Classical Theory.	1	1,2
Practicum: 1. Seminar Presentation on National Income for the past 10 Years			10	1,2
Module	Units	Course Description	Hours	
2		Theories of Consumption & Investment	13	1,3
	2.1	Consumption function- Savings function- Graphical, algebraic, and numerical illustration and estimation of APC, MPC, APS, and MPS- psychological law of consumption – Factors determining consumption.	4	1,3
	2.2	Keynesian absolute income hypothesis – Duesenberry's relative income hypothesis – Friedman's permanent income hypothesis – Ando & Modigliani's Life-Cycle hypothesis	5	1,3
	2.3	The Keynesian approach of theory of investment and capital accumulation: investment decision – change in interest rate, MEC and Capital accumulation – the multiplier and accelerator theory of Investment	4	1,3
Practicum: 1. Quiz			5	1.,3
Module	Units	Course Description	Hours	
3		Keynesian Model of Income Determination	13	4

	3.1	Two sector Keynesian cross model of income determination - Algebraic derivation- Underemployment equilibrium – Multiplier and its types.	5	4
	3.2	Three-sector Keynesian Cross model - The effects of changes in taxes and public expenditure on income- Balanced budget multiplier.	5	4
	3.3	Four-sector Keynesian Cross model - foreign trade multiplier (concept only).	3	4
Practicum: 1. Prepare an expenditure diary of students for a month			10	4
Module	Units	Course Description	Hours	
4		Product and Money Market Equilibrium	9	4
	4.1	Product market equilibrium – derivation of IS curve – money market equilibrium – derivation of LM curve.	2	4
	4.2	The interdependence of product and money market – IS-LM model – from disequilibrium to equilibrium the dynamics of adjustment	3	4
	4.3	Shifts in IS and LM curves and the General Equilibrium	2	4
	4.4	IS-LM model with Balance of payments	2	4
Practicum: 1. Debate on Classical and Keynesian Views of Economics			5	4
Teacher specific course components:				

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, lecture-based learning, experiential learning, peer teaching, group discussions, discussion-based learning, inquiry-based learning, blended learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Theory: Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Group discussion. Any other method as may be required for specific course by the course faculty. Practical:

	Any relevant method as may be required for specific course by the course faculty.
	End Semester Examination (ESE) Theory: Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. Practical: Nil

References:

1. N. Gregory Mankiw (recent edition), Macro Economics, Worth Publications, New York

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7. Sampat Mukerjee (2008), Analytical Macro Economics: From Keynes to Mankiw, New Central Book Agency, Calcutta.

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SEMESTER- IV

24UEMSDSC205: Economics of growth, development and environment

Constituent Discipline - 1	Economics
Semester	4
Type of Course	Discipline Specific Course
Course Code	24UEMSDSC205
Course Title	Economics of Growth, Development and Environment
Course Level	200-299
Course Summary	By the end of this course, students will understand the multifaceted aspects of economic development, including growth determinants, measures of development, poverty, inequality, and environmental sustainability. They will also be able to analyze various growth and development theories, the role of agriculture and trade, human resource factors, and the complex relationship between economics and the environment.
Lecture/Practical Hours	75 (45/30)
Credits	4
Pre-requisites if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand the concepts of development and growth while understanding its relevance.	U	5
2	Understand various theories of growth and development and apply the same in various circumstances.	U, A	4, 5
3	Measure the level of attainment of development with the help of various indices of growth and development.	A	4, 5

4	Examine the relationship between environment and economy in the process of development.	An	2
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course Description	Hours	CO No.
1		Economic Development and Growth	10	1,3,4
	1.1	Growth and Development – meaning – features– determinants.	1	1
	1.2	Measures of economic growth and development- income and non income measures.	2	1,3
	1.3	Development redefined: Development as a total social process - Development as freedom- Environmental sustainability and development.	3	1,4
	1.4	Poverty – meaning- related concepts- measures.	1	1
	1.5	Inequality - measurement of income inequality. Gini coefficient – Kuznet's inverted Hypothesis, impact of inequality on development.	3	1,3
Practicum: 1. Analyse HDI, MPI of a particular locality and submit a report. 2. Examine the level of poverty and inequality in India.			7	1
Module	Units	Course Description	Hours	
2		Theories of Growth and Development	10	2
	2.1	Structuralist – dependency - market- friendly approaches to development.	2	2
	2.2	Vicious circle of poverty- Rostow's stages of growth– low level equilibrium trap	3	2
	2.3	Critical minimum effort thesis – Big push theory – Lewis dual sector model- Harrod-Domar growth model	3	2
	2.4	balanced vs unbalanced growth strategy – Dualistic theories.	2	2

Practicum: 1. A debate on the appropriate strategy for development of the state of Kerala.			5	2
Module	Units	Course Description	Hours	
3		Theories and Factors in the Development Process	15	2,3
	3.1	Classical, Marxian and Schumpeterian theories of development- Role of agriculture in development.	3	2
	3.2	Choice of technique of production: capital intensive, labour intensive, and appropriate technology.	2	3
	3.3	Trade and economic development- Process of cumulative causation.	2	3
	3.4	Human Resource and Development - Intellectual capital- Sen's capability approach- population growth and economic development – missing women.	4	3
	3.5	Malthusian theory of population- Optimum theory of population – theory of demographic transition. – ageing and younging of population.	4	2,3
Practicum: Panel discussion on the role of agriculture, industry, and services on development A debate on the choice of technique for India.			8	3
Module	Units	Course Description	Hours	
4		Economics and Environment	10	4
	4.1	Environmental Economics – Definition – Scope – Meaning – importance	2	1,4
	4.2	Environment-Economy interaction (linkages) – material balance model – relation between environment and development	3	2,4
	4.3	Environment as a necessity and luxury-environmental issues and global concern	2	1,4
	4.4	Population growth and Environment – market failure – tragedy of commons	3	4
Practicum:			10	4

Analyze any selected country's environmental policies, focusing on how these policies address the interaction between the economy and the environment. (case study) Debate the effectiveness of government regulation versus market-based solutions in addressing environmental issues.		

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, lecture-based learning, experiential learning, peer teaching, group discussions, discussion-based learning, inquiry-based learning, blended learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Theory: Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Group discussion. Any other method as may be required for specific course by the course faculty. Practical: Any relevant method as may be required for specific course by the course faculty.
	End Semester Examination (ESE) Theory: Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. Practical: Nil

References:

1. Meier, G. M., & Rauch, James. E. (2007). Leading Issues in Economic Development (9th ed.). Oxford University Press.

2. Taneja, M. L., & Myer, R. M. (2011). Economics of Development and Planning. Vishal Publishing Co.

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4. Todaro, M., & Smith, S. (2017). Economic Development (12th ed.). Pearson Education.

5. Agarwal,K.C 2001 Environmental Biology, Nidi Publ. Ltd, Bikaner.

6. Bharucha Erach, Text Book of Environmental Studies for undergraduate Courses. University Press, IInd Edition 2013 (TB)

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Semester: 4

24UEMSDSC206: PUBLIC FINANCE

Constituent Discipline - 1	Economics
Type of Course	Discipline Specific Course
Semester	4
Course Code	24UEMSDSC206
Course Title	Public Finance
Course Level	300-399
Course Summary	This course provides a comprehensive overview of public finance, covering budget classification, fiscal deficits, and fiscal policy. It explores sources and principles of taxation, public expenditure and debt, and the dynamics of federal finance in India. Students will gain a deep understanding of economic policies, resource allocation, and the financial interactions between different government levels.
Lecture/Practical Hours	60
Credits	4
Pre-requisites if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand the process of budgeting and related concepts.	U	5
2	Review the concept of Public Revenue and taxation.	U	1
3	Examine the role of public expenditure and public debt in an economy.	An	1, 5
4	Assess the role and significance of governments of different tiers in public policy making.	A	1
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course Description	Hours	CO No.
1		Budget	15	1
	1.1	Classification of budget Concepts: Revenue Account, Capital Account.	4	1
	1.2	Types of deficits- Fiscal Deficit, Revenue Deficit, Primary Deficit.	4	1
	1.3	Budgetary Procedure in India- Gender Budgeting-Fiscal Policy.	4	1
	1.4	Deficit financing- causes and consequences- FRBM Act.	3	1
Module	Units	Course Description	Hours	
2		Public Revenue	15	2
	2.1	Sources of public revenue -Classification of Taxes - Canons of Taxation.	3	1,2
	2.2	Principles of Taxation-Ability, Benefit and cost of service-Impact, Incidence and shifting of Tax Burden.	4	1,2
	2.3	Effects of Taxation – Measurement of Deadweight loss - Taxable Capacity-Laffer curve.	4	1,2
	2.4	Major Taxes in India–Goods and Service Tax- non-tax revenues in India.	4	1,2
Module	Units	Course Description	Hours	
3		Public Expenditure and Public Debt	15	3
	3.1	Meaning— Canon's of Public Expenditure-Plan and Non-plan Expenditure-Developmental and Non-developmental expenditure.	3	1,3
	3.2	Wagner's Hypothesis, Peacock - Wiseman Hypothesis, critical limit hypothesis– Effects of Public Expenditure.	5	1,3
	3.3	Public expenditure in India: Its pattern and growth.	3	`1,3
	3.4	Public Debt- Types- debt redemption –burden of public debt – public debt in India.	4	1,3

Module	Units	Course Description	Hours	
4		Fiscal Federalism	15	4
	4.1	Meaning – Principles of Federal Finance- vertical and horizontal equity in fiscal federalism - fiscal federalism in India.	6	4
	4.2	Finance commission – Current Finance Commission- resource transfer from union to states – criteria for transfer of resources.	5	4
	4.3	State Finance Commission and Panchayati Raj institutions.	4	4

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, lecture-based learning, experiential learning, peer teaching, group discussions, discussion-based learning, inquiry-based learning, blended learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Theory: Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Group discussion. Any other method as may be required for specific course by the course faculty. Practical: Any relevant method as may be required for specific course by the course faculty.
	End Semester Examination (ESE) Theory: Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. Practical: Nil

References:

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SEMESTER-V

24UEMSDSC301: INDIAN ECONOMY

Constituent Discipline - 1	Economics
Semester	5
Type of Course	Discipline Specific Course
Course Code	24UEMSDSC301
Course Title	Indian Economy
Course Level	300-399
Course Summary	This course provides an understanding of the process of growth achievements of the Indian economy as an emerging economic power.
Lecture/Practical Hours	60
Credits	4
Pre-requisites if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand the overview of the Indian Economy.	U	4
2	Analyse the characteristics of the Indian economy after the New Economic Policy.	A	1, 4
3	Evaluate the demography and population policies adopted by India as a nation.	E	1, 4
4	Analyse the issues faced by Indian economy and suggest remedies for the same.	A	1, 4
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course Description	Hours	CO No.
1		Overview of Indian Economy	15	1,2
	1.1	Historical glimpses of Indian economy - features of Indian economy	2	1
	1.2	Economic planning in India- Policy of Mixed Economy and significance.	2	1
	1.3	Five-year plans; objectives, achievements and failures of five year plans.	4	1
	1.4	Role of NITI Aayog and modernisation strategy of the nation	2	1,2
Module	Units	Course Description	Hours	
2		Indian Economy since 1991	15	2
	2.1	Crisis of 1991- New Economic Policy and its impact on the Indian Economy.	4	2
	2.2	Effects of liberalisation, privatisation, and globalisation on Indian economy.	4	2
	2.3	India during the Global Economic Crisis of 2008.	2	2
	2.4	External Sector Reforms since 1991 - Trade and Currency Reforms, - foreign capital - FDI, portfolio investments and MNCs.	5	2
Module	Units	Course Description	Hours	
3		Demographic Features of India	15	3
	3.1	Population: characteristics, size and structure since 1921.	3	3
	3.2	Occupational distribution, rural-urban migration.	3	3

	3.3	Problems of overpopulation and demographic dividend.	3	3
	3.4	Population policy of the country.	3	3
	3.5	Women empowerment and gender inequality in India.	3	3
Module	Units	Course Description	Hours	
4		National Income and Development Issues	15	4
	4.1	Trends in India's National Income and per capita income.	4	1,4
	4.2	Development issues: unemployment, black money and corruption, inflation, energy crisis.	6	4
	4.3	Microfinance and its significance to growth.	2	4
	4.4	Role of infrastructure in India's development.	3	4
Teacher specific course components:				

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, lecture-based learning, experiential learning, peer teaching, group discussions, discussion-based learning, inquiry-based learning, blended learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Theory: Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Group discussion. Any other method as may be required for specific course by the course faculty. Practical: Any relevant method as may be required for specific course by the course faculty.
	End Semester Examination (ESE) Theory: Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. Practical: Nil

References:

Agrawal, A. N., & Agarwal, M. K. (2023). Indian Economy Problems of Development and Planning (Vol. 44th). New Age International.

Datt, G., & Mahajan, A. (2022). Indian Economy (Vol. 72nd). S. Chand.

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Semester: 5

24UEMSDSC302: INTRODUCTION TO ECONOMETRICS

Constituent Discipline - 1	Economics
Semester	5
Type of Course	Discipline Specific Course
Course Code	24UEMSDSC302
Course Title	Introduction to Econometrics
Course Level	300-399
Course Summary	The course is designed to equip students with the skills to create predictive models for informed decision-making and to conduct social science research using empirical data and econometric methods. It fosters an understanding of how these econometric tools function in real-world applications.
Lecture/Practical Hours	60
Credits	4
Pre-requisites if any:	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand the fundamental concepts, nature, and scope of econometrics	U	1
2	Demonstrate the interpretation of regression analysis, construct and interpret two-variable regression models.	A	2
3	Apply the method of ordinary least squares to estimate parameters in regression models and utilize the properties of these estimators for accurate predictions.	A	1, 2
4	Able to perform interval estimation and hypothesis testing for two-variable regression model.	An	4, 6, 2
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course Description	Hours	CO No.
1		Introduction to Econometrics	10	1
	1.1	Meaning and definition of Econometrics- Nature and scope of Econometrics- Uses of econometrics	5	1
	1.2	Economic theory and mathematical economics	2	1
	1.3	Methodology of Econometrics	3	1
Module	Units	Course Description	Hours	
2		Regression Analysis	15	2
	2.1	Origin and interpretation of Regression analysis- two variable regression analysis.	5	2
	2.2	Population Regression function- Meaning of the term linear- Stochastic specification of population regression function- Significance of error term.	6	2
	2.3	Sample regression function.	4	2
Module	Units	Course Description	Hours	
3		The problem of estimation of two variable regression model	18	3
	3.1	Method of ordinary least square-Derivation of parameters of two variable model- Regression through origin.	5	3
	3.2	Properties of ordinary least square estimators-Gauss Markov Theorem.	5	3
	3.3	Derivation of least square estimators for regression through origin-Regression on standardised variable- Mean and variance of standardised variable.	8	3
Module	Units	Course Description	Hours	
		Interval Estimation and Hypothesis testing of two variable regression model	17	4
	4.1	Interval estimation- confidence interval for estimators of two variable model- Confidence interval for $\sigma 2$.	6	4

	4.2	Hypothesis testing- Approaches of testing hypotheses- confidence interval approach and test of significance approach	6	4
	4.3	Test of significance of regression coefficient-t test and $\chi 2$ test- p value - Coefficient of determination.	5	2,4
Teacher specific course components:				

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, lecture-based learning, experiential learning, peer teaching, group discussions, discussion-based learning, inquiry-based learning, blended learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Theory: Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Group discussion. Any other method as may be required for specific course by the course faculty. Practical: Any relevant method as may be required for specific course by the course faculty.
	End Semester Examination (ESE) Theory: Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. Practical: Nil

REFERENCE

Gujarati, D. N., Porter, D. C., & Gunasekhar, T. (2007). Basic Econometrics (5th ed.). Tata M Hill.

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SEMESTER- VI

24UEMSDSC306: INTERNATIONAL ECONOMICS

Constituent Discipline - 1	Economics
Semester	6
Type of Course	Discipline Specific Course
Course Code	24UEMSDSC306
Course Title	International Economics
Course Level	300-399
Course Summary	This course offers students a comprehensive grasp of the fundamental principles that typically regulate the global trade of goods and services. The curriculum, divided into various modules, highlights both the theoretical and practical aspects of the subject.
Lecture/Practical Hours	75(45/30)
Credits	4
Pre-requisites if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain the basic concepts and tools of international economics and the basis of international trade	U	1
2	Apply major concepts and theories in international economics to analyse real-world economic scenarios.	A	1
3	Assess and interpret global events, fostering a nuanced perspective on international affairs.	An	1
4	Familiarise policies, rules, and regulations in international trade and assess the role of international organizations in shaping global economic policies.	U, An	2,4
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course Description	Hours	CO No.
1		Introduction to the Theory of International Trade	8	1,2
	1.1	International Economics – Meaning and Significance – Pure theory of international trade	2	1,2
	1.2	Basic concepts – terms of trade - offer curve – community indifference curve –opportunity cost- gains from trade	3	1,2
	1.3	Absolute advantage –Comparative advantage- Reciprocal Demand –Heckscher– Ohlin theory –Factor price equalization theorem- Leontief Paradox	3	1,2
Practicum: Compare and contrast absolute advantage and comparative advantage theories in international trade. Use real-world examples to demonstrate the application of each theory. Explore the Leontief Paradox and its implications for understanding the relationship between a country's factor endowments and the goods it exports and imports. Engage in a discussion on possible explanations for the paradox.			10	1,2
Module	Units	Course Description	Hours	
2		Balance of Payments	12	2,3
	2.1	Meaning and structure of BOP	3	2,3
	2.2	Equilibrium and disequilibrium in the BOP – measures to correct disequilibrium	4	2,3
	2.3	Devaluation and BOP –effects of currency depreciation and capital movements on BOPs-Marshall Lerner condition- J-curve effect.	5	2,3
Practicum: Analyze India's current account balance over the past five years. Identify the major components contributing to the current account balance, such as trade balance, remittances, and services trade. Discuss the trends observed and their implications for India's economy.			8	2,3
Module	Units	Course Description	Hours	
3		Foreign Exchange Rate	15	2

	3.1	Foreign Exchange Market - Demand for, and Supply of, foreign exchange; real and effective exchange rates	3	2
	3.2	Theories of exchange rate determination –Mint parity theory-purchasing power parity theory – BOP theory.	4	2
	3.3	Fixed and flexible exchange rate - forward rate – spot rate – nominal, real, and effective rate of exchange.	4	2
	3.4	Arbitrage- Foreign exchange risks – hedging and speculation –currency derivatives –future options – currency swaps- international liquidity.	4	2
Practicum: Choose a specific currency pair or pairs and analyze the factors driving their exchange rate movements over a specified period.			6	2
Module	Units	Course Description	Hours	
4		Trade Policy and Financial Systems	10	3,4
	4.1	Commercial policy – free trade vs protection – Tariffs and Quotas - their effects.	4	3,4
	4.2	Gold standard- operation and collapse- Bretton Woods System - IMF – IBRD	3	3,4
	4.3	WTO -Economic integration- Trade Creation and Trade diversion	3	3,4
Practicum: Analyze the trade policies of a selected country or region. Discuss the objectives, instruments, and outcomes of these policies, including tariffs, quotas, subsidies, and trade agreements. Evaluate the impact of trade policy on domestic industries, consumers, and the overall economy.			6	
Teacher specific course components:				

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, lecture-based learning, experiential learning, peer teaching, group discussions, discussion-based learning, inquiry-based learning, blended learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Theory:

	Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Group discussion. Any other method as may be required for specific course by the course faculty. Practical: Any relevant method as may be required for specific course by the course faculty.
	End Semester Examination (ESE) Theory: Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. Practical: Nil

References:

1. Dominic Salvatore, Schaum's Outlines, Theory and Problems of International Economics. Tata McGraw Hill, Delhi.

2. Dominic Salvatore, (Recent Edition), International Economics: Trade and Finance, John Wiley and Sons, Limited.

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Semester: 6

24UEMSDSC307: INTERMEDIATE ECONOMETRICS

Constituent Discipline - 1	Economics
Semester	6
Type of Course	Discipline Specific Course
Course Code	24UEMSDSC307
Course Title	Intermediate Econometrics
Course Level	300-399
Course Summary	The course offers knowledge on Multiple regression models and detailed discussions about the same by relaxing OLS assumptions. It also informs students about the specification of econometric models and the usage of dummy variables in various scenarios.
Lecture/Practical Hours	75(45/30)
Credits	4
Pre-requisites if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain the Multiple regression models and its OLS estimation process.	U	1
2	Apply OLS method on models with relaxed assumptions to see their econometric consequences.	A	1
3	Assess various criterions for selecting appropriate models for econometric methodology and the estimation for non-linear models.	An	1
4	Familiarise the usage of dummy variables and its various functions in dealing with qualitative data.	U, An	2,4
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course Description	Hours	CO No.
1		Multiple regression model	12	1
	1.1	Three variable regression model- Assumptions – Interpretation of multiple regression model – meaning of partial regression coefficient-	4	1
	1.2	Estimation of three variable regression model- derivation of OLS estimators- variance and standard error of OLS estimators.	4	1
	1.3	Properties of OLS estimators-coefficient of determination R2.	4	1
Practicum: Choose any three economic variables with data available for the past 20 years and carry out a regression analysis using Microsoft Excel. Analyse the results to give their interpretation,			10	1
Module	Units	Course Description	Hours	
2		Relaxing the assumptions of Classical Linear Regression Model	15	2
	2.1	Nature- estimation in the presence of multicollinearity- consequences of multicollinearity- Detection of multicollinearity- Remedial measures.	5	2
	2.2	Heteroscedasticity-Nature- OLS estimation in the presence of heteroscedasticity-Generalised least square method- consequences- detection- remedial measures.	5	2
	2.3	Autocorrelation-Nature- OLS estimation in the presence of Autocorrelation- consequences-detection- remedial measures.	5	2
Practicum: Find real life scenarios where the presence of Multicollinearity could be witnessed. Provide reasons for the same.			5	2
Module	Units	Course Description	Hours	
3		Model specification and diagnostic testing	10	3
	3.1	Model selection criteria by Hendry and Richard- types of specification error.	3	3

	3.2	Errors of measurement- Model selection criteria.	3	3
	3.3	Nonlinear regression models- Estimation methods- approaches to nonlinear regression model estimation	4	3
Practicum: Choose a model selection-criteria and discuss its advantages and disadvantages.			5	3
Module	Units	Course Description	Hours	
4		Dummy variable models	8	3,4
	4.1	Dummy variable- meaning, use, and precautions-Dummy variable trap	3	3,4
	4.2	Analysis of Variance (ANOVA) models- Analysis of Covariance (ANCOVA) models.	6	3,4
	4.3	Dummy variables and seasonal analysis-Structural Analysis-Piecewise linear regression	6	3,4
Practicum: Utilizing dummy variables, construct models for both Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA), showcasing real-world relationships.			10	3,4
Teacher specific course components:				

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, lecture-based learning, experiential learning, peer teaching, group discussions, discussion-based learning, inquiry-based learning, blended learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Theory: Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Group discussion. Any other method as may be required for specific course by the course faculty. Practical: Any relevant method as may be required for specific course by the course faculty.
	End Semester Examination (ESE) Theory:

	Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. Practical: Nil

REFERENCE

Gujarati, D. N., Porter, D. C., & Gunasekhar, T. (2007). Basic Econometrics (5th ed.). Tata McGraw Hill.

Koutsoyiannis, A. (Year of Publication). Theory of Econometrics (2nd ed.). Palgrave Macmillan.

Mukherjee, C., White, H., & Wytus, M. (Year of Publication). Econometrics and Data Analysis for Developing Countries. Routledge.

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Maddala, G. S., & Lahiri, K. (Year of Publication). Introduction to Econometrics. Wiley India.

SEMESTER- VII

24UEMSDSC401: RESEARCH METHODOLOGY FOR ECONOMICS

Constituent Discipline - 1	Economics
Semester	7
Type of Course	Discipline Specific Course
Course Code	24UEMSDSC401
Course Title	Research Methodology for Economics
Course Level	400-499
Course Summary	The course offers a detailed guide for research scholars in Economics, outlining the principles necessary for organizing, planning, designing, and conducting research. It emphasizes the importance of a systematic, rigorous, and objective approach to ensure the highest standards of academic research are met.
Lecture/Practical Hours	60
Credits	4
Pre-requisites if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Develops knowledge on the basic concepts and principles of economic research.	U	1
2	Capable to formulate a research design with valid hypothesis.	An	1, 2
3	Develops skills in the collection of data, processing and its analysis	A	2
4	Ability to apply acquired knowledge to address real-world economic issues through a culminating research project.	A	2
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course Description	Hours	CO No.
1		Introduction to Research Methodology	15	1
	1.1	Meaning and definition of research - Classification of research (pure, applied, exploratory, descriptive, historical, diagnostic, experimental, qualitative, quantitative), Criteria of Good Research.	5	1
	1.2	Importance, applications and limitations of social science research - Interdisciplinary and trans-disciplinary approaches in social science research.	5	1
	1.3	Identifying and defining research problems - Mode of selection of research problem - Sources of problems- Formulating research questions and objectives.	5	1
Practicum: 1. Identify some relevant research problems and evaluate the viability for research work.			5	1
Module	Units	Course Description	Hours	
2		Research Design and Sample Design	15	2
	2.1	Research Design - Meaning, features. Types of research design - Evaluation of research design and steps.	6	2
	2.2	Panel studies, Blind Studies, Case study method	3	2
	2.3	Sample design - Probability and non-probability sampling - Sampling errors.	6	2
Practicum: 1. Seminar presentations on Research design and sampling design.			5	2
Module	Units	Course Description	Hours	
3		Data Collection and Processing	15	3
	3.1	Methods of collecting primary data- questionnaire and schedules- sources of secondary data.	3	3
	3.2	Levels of measurement: Nominal, Ordinal, Interval and Ratio, Data coding- Data entry- Editing – Recoding - Exploring the data: Stem and Leaf- Histogram-Box Plots-	5	3

		Scatter plots-finding Outliers in the data and Descriptive statistics.		
	3.3	Sources of hypothesis - Procedure for testing hypothesis - One tailed and two tailed tests - Basics of the important parametric and non-parametric tests.	4	3
	3.4	Processing of data - Use of statistical packages for data analysis (SPSS and EXCEL).	3	3
Practicum: 1. Prepare survey questionnaires on a topic of interest and present before the class. 2. Invited talk on SPSS / Excel.			10	3
Module	Units	Course Description	Hours	
4		Data Analysis, Interpretation of Data and Research Report	15	4
	4.1	Analysis and Interpretation of data, Methods of footnotes and referencing, Bibliography,	6	4
	4.2	Style Manuals (APA, MLA)	3	4
	4.3	Structure of a research report- Types of reports - Precautions for writing research reports- Ethics in publication, plagiarism.	6	4
Practicum: 1. Students are asked to collect data on certain relevant topic and perform analyses, interpret results, and draw conclusions.			10	4
Teacher specific course components:				

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, lecture-based learning, experiential learning, peer teaching, group discussions, discussion-based learning, inquiry-based learning, blended learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Theory:

	Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Group discussion. Any other method as may be required for specific course by the course faculty. Practical: Any relevant method as may be required for specific course by the course faculty.
	End Semester Examination (ESE) Theory: Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. Practical: Nil

References:

1. Trivedi, P. (2016). Research Methodology: A Step-by-Step Guide for Beginners. SAGE Publications.

2. Yadav, R. (2016). Research Methodology: A Step-by-Step Guide for Beginners. Pearson.

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6. Marc Blaug (1992), The Methodology of Economics, or How Economics Explain, Cambridge University Press, New York.

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Semester: 7

24UEMSDSC402: MATHEMATICAL ECONOMICS

Constituent Discipline - 1	Economics
Semester	7
Type of Course	Discipline Specific Course
Course Code	24UEMSDSC402
Course Title	Mathematical Economics
Course Level	400-499
Course Summary	This course provides a comprehensive understanding of microeconomic analysis, focusing on consumer behaviour, demand elasticity, firm theory, and pricing strategies under various market structures. Through theoretical frameworks and practical applications, students will develop critical thinking skills to analyze real-world economic scenarios.
Lecture/Practical Hours	60
Credits	4
Pre-requisites if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Analyze the consumer behaviour and evaluate the equilibrium situation using mathematical tools.	E	1,2
2	Analyze the demand theory using differential calculus.	An	1,2
3	Analyze the production functions for homogeneity, degree and returns to scale.	An	1,2
4	Analyze the price mechanisms of markets using mathematical tools.	An	1,2
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course Description	Hours	CO No.
1		The Indifference Curve Analysis and Derivation of Demand Theorem	15	1
	1.1	Consumer's optimizing behaviour and equilibrium, changes in prices and consumer's demand curve.	5	1
	1.2	Price effect into Income effect and substitution effect- Hicksian and Slutksy's methods.	5	1
	1.3	Comparative demand curves, substitutes, complements and Cross effects, Consumers surplus.	5	1
Module	Units	Course Description	Hours	
2		Elasticity of Demand	15	2
	2.1	Demand and Elasticities, Price elasticity of demand, Total outlay method, Arc elasticity of demand, Point elasticity of demand functions.	5	2
	2.2	Elasticity and Indifference curve analysis, Revenue functions and price elasticity of demand.	5	2
	2.3	Cross Elasticities of demand and partial Elasticities, Income Elasticity of demand, Elasticity of substitution, factors affecting elasticity of demand.	5	2
Module	Units	Course Description	Hours	
3		Theory of firms	15	3
	3.1	Objective of the firm- profit maximization, utility maximization.	3	3
	3.2	Meaning and Nature of Production function, Types of Production functions- linear production functions, Cobb-Douglas Production function, Input-Output production functions, Activity analysis production function, CES production function	10	3
	3.3	Linearly Homogeneous production function.	2	3

Module	Units	Course Description	Hours	
4		Pricing under imperfect market forms	15	4
	4.1	Monopoly, Degree of Monopoly, Price Discrimination, Taxation in Monopoly.	4	4
	4.2	Monopsony, Bilateral Monopoly, Monopolistic competition.	3	4
	4.3	Oligopoly with homogeneous products, The Cournot Model, Reaction functions, The Collusion Solution, Stackelberg Model, Market share model,	4	4
	4.4	Product Differentiation- Heterogeneous Products, Price discrimination, Kinked Demand curve model.	4	4
Teacher specific course components:				

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, lecture-based learning, experiential learning, peer teaching, group discussions, discussion-based learning, inquiry-based learning, blended learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Theory: Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Group discussion. Any other method as may be required for specific course by the course faculty. Practical: Any relevant method as may be required for specific course by the course faculty.
	End Semester Examination (ESE) Theory: Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. Practical: Nil

REFERENCE

Gujarati, D. N., Porter, D. C., & Gunasekhar, T. (2007). Basic Econometrics (5th ed.). Tata McGraw Hill.

Koutsoyiannis, A. (Year of Publication). Theory of Econometrics (2nd ed.). Palgrave Macmillan.

Mukherjee, C., White, H., & Wytus, M. (Year of Publication). Econometrics and Data Analysis for Developing Countries. Routledge.

Ramanathan, R. (Year of Publication). Introductory Econometrics with Applications (5th Revised ed.). S. Chand & Company Ltd.

Dougherty, C. (Year of Publication). Introduction to Econometrics. Oxford University Press.

Johnston, J. (Year of Publication). Econometric Methods. McGraw-Hill.

Maddala, G. S., & Lahiri, K. (Year of Publication). Introduction to Econometrics. Wiley India.

Semester: 8

24UEMSDSC403: ADVANCED MICROECONOMIC THEORY

Constituent Discipline - 1	Economics
Semester	7
Type of Course	Discipline Specific Course
Course Code	24UEMSDSC403
Course Title	Advanced Microeconomic Theory
Course Level	400-499
Course Summary	Advanced Microeconomics delves into recent developments in consumer behaviour theory, explores decision-making under uncertainty, and analyses the intricate relationship between production, costs, and firm behaviour. It also gives an idea on general equilibrium and welfare economics.
Lecture/Practical Hours	60
Credits	4
Pre-requisites if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Gain insight into consumer behaviour through recent advancements in traditional demand theories and evaluate the enhanced efficacy of these theories compared to traditional models.	U, E	1
2	Get equipped with the knowledge and skill in effective decision making under uncertain market situations	U, A	1,2
3	Understands various production functions and analyse the superiority of modern theory of cost over traditional theory	U	1
4	Proficient in analysing various welfare theories and equipping them with the skills to evaluate policies for maximizing societal well-being	An	4,5
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course Description	Hours	CO No.
1		Recent Developments in the Theory of Consumer Behaviour	15	1
	1.1	Recent developments in the theory of market demand: Pragmatic approach and Linear expenditure system	4	1
	1.2	Homothetic utility functions - Dynamic demand functions: Nerlove, Houthakker	4	1
	1.3	Household Time Allocation model of Garry S. Becker-Characteristics model of Kelvin Lancaster	4	1
	1.4	Network externalities: positive and negative (Bandwagon, Snob and Veblen effects)	3	1
Module	Units	Course Description	Hours	
2		Choice under Uncertainty	15	2
	2.1	St. Petersburg Paradox and Bernoullian Hypothesis	4	2
	2.2	Neumann-Morgenstern Utility Index- Inter temporal Consumption- Attributes model of Kevin Lancaster-Becker's Time Allocation model.	4	2
	2.3	Attitudes (Preferences) towards risk: Risk averse, risk loving & risk neutral	3	2
	2.4	Friedman and Savage Hypothesis-Markowitz Hypothesis	4	2
Module	Units	Course Description	Hours	
3		Theory of Production and Costs	15	3
	3.1	Homogeneous and non-homogeneous production function-Technical progress and production function	3	3
	3.2	Cobb Douglas, CES and VES (Variable Elasticity Substitution) and Translog Production functions and their properties	5	3
	3.3	Modern theory of cost, Derivation of cost functions from production functions	3	3

	3.4	Economics of scale and economics of scope, -learning curve	2	3
Module	Units	Course Description	Hours	
4		General Equilibrium and Welfare Economics	15	4
	4.1	Partial and general equilibrium - 2x2x2 model of general equilibrium (Walrasian system) - Existence, Uniqueness and stability of equilibrium	4	4
	4.2	Welfare Economics - Pareto optimality – Kaldor - Hicks compensation criterion- Scitovsky's paradox	4	4
	4.3	Social welfare function of Bergson - Arrow's Impossibility Theorem and Sen's Capability Theory - Rawls' Theory of Justice	4	4
	4.4	Contemporary issues and case studies - Easterlin Paradox and Human Happiness Index	3	4
Teacher specific course components:				

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, lecture-based learning, experiential learning, peer teaching, group discussions, discussion-based learning, inquiry-based learning, blended learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Theory: Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Group discussion. Any other method as may be required for specific course by the course faculty. Practical: Any relevant method as may be required for specific course by the course faculty.
	End Semester Examination (ESE) Theory: Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. Practical: Nil

References:

1. Koutsoyiannis A. (1979), Microeconomic Theory (2nd edition), Macmillan, London.

2. Hal R. Varian, Intermediate Microeconomics - A Modern Approach, East - West Press Pvt. Ltd. New Delhi, 2010.

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SEMESTER- VIII

24UEMSDSC407: ADVANCED ECONOMETRICS

Constituent Discipline - 1	Economics
Semester	8
Type of Course	Discipline Specific Course
Course Code	24UEMSDSC407
Course Title	Advanced Econometrics
Course Level	400-499
Course Summary	The advanced econometrics course extends beyond basic econometric principles and methods, introducing more advanced techniques for economic data analysis. It places a strong emphasis on modern econometric methodologies, covering both the technical aspects and their practical uses. Throughout the course, students will engage with applications relevant to microeconomics, macroeconomics, and finance.
Lecture/Practical Hours	60
Credits	4
Pre-requisites if any	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Demonstrate a comprehensive understanding of the concepts underlying multiple regression analysis.	U	1
2	Achieves mastery in interpreting models that incorporate qualitative information.	A	2
3	Provide students with the requisite knowledge and skills to comprehend, estimate, and interpret models that encompass simultaneous equations within economic contexts.	E	1, 2
4	Develop critical thinking skills to assess the assumptions, limitations, and potential biases in dynamic econometric modelling.	A	4, 2
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course Description	Hours	CO No.
1		Qualitative response regression models and Panel Data Model	15	1
	1.1	The linear probability model (LPM) - The logit model- The Probit model- The Tobit model. -	5	1
	1.2	Meaning and importance of panel data models- Estimation of panel data models	5	1
	1.3	Fixed effects regression model-The random effects model	5	1
Module	Units	Course Description	Hours	
2		Dynamic Econometric Models	15	2
	2.1	Autoregressive and distributed-lag models-Role of lag in economics.	2	2
	2.2	The Koyck approach-The adaptive expectations model-Stock adjustment model.	4	2
	2.3	Estimation of autoregressive models- The method of instrumental variable (IV) - Durbin h test- Almon approach to distributed lag models.	5	2
	2.4	Causality Test, Granger Test, Unit Root and Random walk.	4	2
Module	Units	Course Description	Hours	
3		Time Series Econometrics	15	3
	3.1	Stochastic processes, stationary versus non stationary stochastic processes.	5	3
	3.2	Unit roots- Trend Stationary versus difference stationary stochastic processes- Spurious Regression.	5	3
	3.3	Testing for unit roots- Dickey Fuller and Augmented Dickey Fuller tests-Co integration and error correction models.	5	3
Module	Units	Course Description	Hours	

4		Modelling Stochastic Processes	15	4
	4.1	The Box Jenkins methodology -AR, MA, ARMA and ARIMA models.	5	4
	4.2	Estimation and forecasting-Vector auto regression (VAR)	5	4
	4.3	Measuring volatility- The ARCH and GARCH models.	5	4

Teacher specific course components:

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, lecture-based learning, experiential learning, peer teaching, group discussions, discussion-based learning, inquiry-based learning, blended learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Theory: Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Group discussion. Any other method as may be required for specific course by the course faculty. Practical: Any relevant method as may be required for specific course by the course faculty.
	End Semester Examination (ESE) Theory: Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. Practical: Nil

REFERENCE

Gujarati, D. N., Porter, D. C., & Gunasekhar, T. (2007). Basic Econometrics (5th ed.). Tata McGraw Hill.

Koutsoyiannis, A. (Year of Publication). Theory of Econometrics (2nd ed.). Palgrave Macmillan.

Mukherjee, C., White, H., & Wytus, M. (Year of Publication). Econometrics and Data Analysis for Developing Countries. Routledge.

Ramanathan, R. (Year of Publication). Introductory Econometrics with Applications (5th Revised ed.). S. Chand & Company Ltd.

Dougherty, C. (Year of Publication). Introduction to Econometrics. Oxford University Press.

Semester VIII

24UEMSDSC408: FINANCIAL MARKETS

Constituent Discipline - 1	Economics
Semester	8
Type of Course	Discipline Specific Course
Course Code	24UEMSDSC408
Course Title	Financial markets
Course Level	300-399
Course Summary	This course offers a thorough investigation of financial and derivative markets, focusing on the mechanisms, instruments, participants, and regulations that influence them. By integrating theoretical models, real-world case studies, and practical applications, students will develop a comprehensive understanding of how financial and derivative markets operate and their importance in the global economy.
Lecture/Practical Hours	60
Credits	4
Pre-requisites if any:	

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Develops better understanding of Indian financial system	U	1
2	Get familiar with money market operations in the country.	A	2
3	Understand and practice basic capital market operations.	A	1, 2
4	Attain knowledge about derivative markets and its working.	U	8
*Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

Module	Units	Course Description	Hours	CO No.
1		Indian Financial System	10	1
	1.1	Structure of Indian financial system – Role and functions of financial system in economic development	3	1
	1.2	Monetary and non-monetary (banking and non-banking) financial intermediaries.	3	1
	1.3	Insurance companies, pension funds and provident funds, mutual funds, investment banks, asset management companies, venture capital funds.	4	1
Practicum: 1. Quiz / seminar on India's financial system.			5	1
Module	Units	Course Description	Hours	
2		Money Market	10	2
	2.1	Money market – Meaning, features, functions.	2	2
	2.2	Money market instruments: T-bills, Commercial papers, Certificate of deposits, Bankers' acceptance, Participation certificate, Call money, notice money & term money, Gilt-edged securities, REPOs, CBLOs.	4	2
	2.3	Sub-markets of money market: Call money market, Collateral loan market, Acceptance market, Bill market, Market for CDs and CPs, Short term loan market.	4	2
Practicum: 1. Conduct seminar sessions on money market instruments 2. Make a presentation on various sub-markets of money market.			5	2
Module	Units	Course Description	Hours	
3		Capital Market	15	3
	3.1	Capital market- Meaning, Functions – Role of capital market in economic development.	3	3
	3.2	Instruments of Capital market: Equity shares, preference shares, deferred shares, bonds and debentures, ESOPs, depository receipts, Exchange Traded Funds (ETFs).	4	3

	3.3	Primary market (New Issue market): Functions of NIM - Methods of public issue: IPO and FPO – Bonus shares, Rights, stock splits – Private placement.	4	3
	3.4	Secondary Market: Nature and functions - Stock exchanges in India: BSE, NSE, MCX. Online trading – Demat account.	4	3
Practicum: 1. Conduct seminar on capital market instruments 2. Conduct online trading demonstration.			10	3
Module	Units	Course Description	Hours	
4		Derivative markets	10	4
	4.1	Derivatives Market: Derivatives – meaning, benefits – types of derivative contracts: Forwards, futures, options, warrants and swaps.	3	4
	4.2	Derivative assets - Pricing Forward contracts, Mechanism of Future trading – Put-Call parity	3	4
	4.3	Option pricing models – Binomial Option Pricing and Black-Scholes Option Pricing models, Swap operation.	4	4
Practicum: 1. Utilize a paper trading platform to engage in live trading. 2. Facilitate a comprehensive exploration and debate on the significance of derivative markets in managing financial risks and their impact on the global economy.			10	4
Teacher specific course components:				

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Interactive lectures, lecture-based learning, experiential learning, peer teaching, group discussions, discussion-based learning, inquiry-based learning, blended learning, and other innovative learning approaches.
Assessment Types	MODE OF ASSESSMENT Continuous Comprehensive Assessment (CCA) Theory: Quiz, Oral Presentation, Self and Peer assessments, Written test, Problem based assignment, Group discussion. Any other method as may be required for specific course by the course faculty. Practical:

	Any relevant method as may be required for specific course by the course faculty.
	End Semester Examination (ESE) Theory: Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report. Practical: Nil

References:

1. S.B. Gupta (2001). Monetary Economics: Institutions, Theory and Policy, S. Chand & Co, New Delhi, Part I

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10. Chance D M. (2004). An Introduction to Derivatives And Risk Management. Ed. 6 Thomson South – Western

CONSTITUENT DISCIPLINE 2 – MATHEMATICS

Semester :1

24UEMSDSC102: ESSENTIAL MATHEMATICS FOR ECONOMICS

Constituent Discipline - 2	Mathematics					
Semester	1					
Type of Course	DSC					
Course Code	24UEMSDSC102					
Course Title	**ESSENTIAL MATHEMATICS FOR ECONOMICS**					
Course Level	100 -199					
Course Summary	The objective of this course is to transmit the body of elementary mathematics that enables the study of economic theory at the undergraduate level, specifically for the study of courses on microeconomic theory, macroeconomic theory and econometrics set out in this Syllabus.					
Lecture/Tutorial/Practical Hours	45/0/30					
Credits	Total	4	Theory	3	Practical	1
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand the number system and its applications in Business and economics analysis	A	1 2
2	Understand the concept of permutations and combinations and apply them for solving problems	A	1 2
3	Understand and apply the concept of various sequences and series in the study of economics	A	1 2
4	Understand the concept and applications of set theory in economic analysis	A	1 2
5	Understand the functions and its types and applications in business related problems	A	1
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Number system and Set theory (8 Hours)**			
	1.1	Natural numbers, whole numbers, rational and irrational numbers, real, imaginary and complex numbers, prime numbers, properties of real numbers,	2	1
	1.2	Exponents and their properties, Logarithm, antilogarithm and properties of logarithm	3	1
	1.3	Permutations and combinations, Binomial theorem	3	2
2	**Sequence, Progression and series and growth rates (10 hours)**			
	2.1	Sequence – definition and example, series – definition and example, progression	1	3
	2.2	Arithmetic progression, Geometric progression, Harmonic progression, Arithmetico-Geometric series – definition, nth term, sum of n terms, general results on progression	5	3
	2.3	Exponential, Logarithmic and trigonometric series	2	3
	2.4	Growth rates, Annual growth rate, compound rate of growth, Exponential growth rate, simple growth rate, present value	2	3
3	**Sets, relations and functions (12 hours)**			
	3.1	Set – definition and examples, representation of sets, Types of sets – Finite and infinite sets, Null set, Unit set, Universal set, subsets and proper subsets, Equal sets, equivalent sets, disjoint sets, comparable and incomparable sets, [power set	3	4
	3.2	Basic set operations and properties – Union and intersection of sets, complement of a set, difference of sets, symmetric difference. Laws on set operations – idempotent laws. Identity laws, Commutative law, Associative law, distributive law, complement laws, De'Morgans laws	6	4
	3.3	Ordered pairs and Cartesian product of sets, Results on Cartesian product. Relation, representation of relation, domain and range of relation, inverse relation	3	4
4	**Functions and their applications in Economics**			

	4.1	Function –as a special kind of relation, as a correspondence, Domain, co-domain and range of a function	1	5
	4.2	Classification of functions – Algebraic and transcendental functions. Transcendental functions – exponential function, trigonometric functions, logarithmic functions, inverse trigonometric functions, incommensurable function	3	5
	4.3	Algebraic functions and their graphs – Single valued and multiple valued functions, Explicit and implicit functions, Polynomial function, quadratic function, modulus function, monotone function, composite function, even and odd function, periodic function, inverse function, bounded function.	3	5
	4.4	Functional relationships in economics – demand function, supply function, cost function, revenue function, production function, utility function, consumption function, saving function	3	5
5	**Practicum (30 hours)**			
	5.1	Problem solving – Permutations and combinations, Use of Binomial theorem	5	1
	5.2	Problem solving – sequences, series and progressions	5	2
	5.3	Problem solving – calculation of growth rates and its interpretation	5	3
	5.4	Problems solving – basic set operations and verification of properties	5	4
	5.5	Estimation of suitable functions for economic analysis, estimation of demand , supply, cost functions etc using sample data	10	5
	Teacher specific course components			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.

<table>
<tr><td rowspan="2">Assessment Types</td><td>MODE OF ASSESSMENT
A. Continuous Comprehensive Assessment (CCA)
Theory:
Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. Any other method as may be required for specific course by the course faculty.
Practical:
Observation of practical skills, , Laboratory record, Any other method as may be required for specific course by the course faculty.</td></tr>
<tr><td>B. End Semester Examination (ESE)
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Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report.
Practical:
Practical based assessment, Record, Any other method as may be required for specific course by the course faculty.</td></tr>
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References

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2. A. C. Chiang (1984): Fundamental Methods of Mathematical Economics, McGraw Hill International Edition.
3. K. Sydsaeter and P. J. Hammond (2002): Mathematics for Economic Analysis. Pearson Educational Asia
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6. Taro Yamane (1975), Mathematics for Economists: An Elementary Survey, 2 nd edition, PHI, Tokyo
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Semester :2

24UEMSDSC105: Differential Calculus and applications

Constituent Discipline - 2	Mathematics					
Semester	2					
Type of Course	DSC					
Course Code	24UEMSDSC105					
Course Title	**Differential Calculus and applications**					
Course Level	100 -199					
Course Summary	The objective of this course is to transmit the body of differential calculus that enables the study of economic theory at the undergraduate level, specifically the courses on microeconomic theory, statistics and econometrics set out in this Syllabus. In this course, particular economic problems are solved using the methods of differential calculus.					
Lecture/Tutorial/Practical Hours	45/0/30					
Credits	Total	4	Theory	3	Practical	1
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand the concept of limit and continuity and to evaluate the limits of functions	U	1 2
2	Understand the concept of differentiation and apply the rules to find the derivative of functions	A	1 2
3	Evaluate the optimum values of Mathematical and economic functions using derivatives	E	1 2
4	Analyze whether a given production function is homogeneous or not and also to identify its degree and verify Euler's theorem	An	1 2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Limits and continuity (8 Hours)**			
	1.1	Intervals and neighbourhood –interval, open interval, closed interval, neighbourhood, deleted neighbourhood, symmetric neighbourhood.	2	1
	1.2	Limit of a variable, limit of a function, one sided limits, meaning of $x \rightarrow 0$, $x \rightarrow a$, $x \rightarrow \infty$. Theorems on limits, Rules to find the limit of functions. Economic applications of limit	3	1
	1.3	Continuity of a function, continuity in an interval, continuous and discontinuous functions, properties of continuous functions. Economic applications of continuity	3	1
2	**Simple differentiation and its applications (15 hours)**			
	2.1	Average rate of change and instantaneous rate of change. Derivative or differentiation, differentiation using first principle derivative as rate of change, derivative as marginal functions	2	2
	2.2	Derivatives of standard functions and rules of differentiation	5	2
	2.3	Differentiation of implicit functions, function of a function, parametric functions, logarithmic functions, function with respect to another function, exponential functions	5	2
	2.4	Leibnitz,s theorem (statement and simple problems only) Derivatives of trigonometric functions (results and simple problems only)	3	2
3	**Successive differentiation and partial differentiation (10 hours)**			
	3.1	Successive differentiation, Standard results on n^{th} derivative	2	2
	3.2	Partial differentiation, continuity of functions of two variables, partial derivatives of higher order, meaning of higher order partial derivatives and the importance of signs with special reference to economic applications. Total differential and total derivative	4	2
	3.3	Homogeneous functions, Euler's theorem on homogeneous function (without proof), properties of homogeneous functions, verification of Euler's theorem for given functions	10	4

4	**Optimization of Functions (12 Hours)**			
	4.1	Increasing, decreasing and stationary functions, convexity and concavity of functions, point of inflexion	2	3
	4.2	Maxima and minima of functions of one independent variable, conditions for maxima and minima, properties of maxima and minima	3	3
	4.3	Maxima, Minima and saddle points of a function of two variables. Necessary and sufficient condition for optimum of a function of two variables.	3	3
	4.4	Simple applications of Maxima and Minima for economic analysis	3	3
5	**Practicum (30 hours)**			
	5.1	Problem solving – calculation of limits and examination of continuity of functions	4	1
	5.2	Problem solving – calculation of derivatives of mathematical and economic functions	6	2
	5.3	Problem solving – Evaluation of maxima and minima of mathematical functions	8	3
	5.4	Problem solving – optimization of economic functions and interpreting the results	12	4
	Teacher specific course components			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:**

	Observation of practical skills, , Laboratory record, *Any other method as may be required for specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report**.** **Practical:** Practical based assessment, Record, *Any other method as may be required for specific course by the course faculty*.

References

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Semester: 3

24UEMSDSC203: Integral Calculus and applications.

Constituent Discipline - 2	Mathematics					
Semester	3					
Type of Course	DSC					
Course Code	24UEMSDSC203					
Course Title	**Integral Calculus and applications**					
Course Level	200 -299					
Course Summary	The objective of this course is to transmit the body of Integral calculus that enables the study of economic theory at the undergraduate level, specifically the courses on microeconomic theory, statistics and econometrics set out in this Syllabus. In this course, particular economic problems such as estimation of total functions, consumer and producer surplus, are solved using the methods of integral calculus.					
Lecture/Tutorial/Practical Hours	60/0/0					
Credits	Total	4	Theory	4	Practical	NIL
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand the process of integration and apply the rules of integration	A	1 2
2	Remember the integral of standard functions useful in economic analysis	R	1 2
3	Understand and apply the different methods of integration	A	1 2
4	Evaluate definite integral and use it to estimate consumer and producer surplus	E	1 2
5	Evaluate the total functions using integration when marginal functions are known	E	1 2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Integration (20 Hours)**			
	1.1	Introduction to integration as reverse process of differentiation. Integral of standard functions in simple form.	4	1
	1.2	Integral of standard functions in linear form	4	1
	1.3	Integral of trigonometric functions	4	1
	1.4	Rules of integration	4	2
	1.5	Integral of power functions, exponential functions, logarithmic functions	4	2
2	**Methods of Integration (15 hours)**			
	2.1	Integration by substitution	5	3
	2.2	Integration by parts	5	3
	2.3	Integration by partial fractions	5	3
3	**Definite integral (15 hours)**			
	3.1	Indefinite integral and definite integral, working rule to find definite integral, definite integral as area under curve	5	4
	3.2	Properties of definite integrals	5	4
	3.3	Application of integration in economics – Determination of total function when marginal function is given, Relation between profit, Marginal cost and revenue	5	4
4	**Consumer and producer surplus, learning curve, present value (10 Hours)**			
	4.1	Consumer surplus and producer surplus – definition, formula for calculating consumer surplus and producer surplus	3	5
	4.2	Learning curve, rate of sales, compound interest and annuity, Pareto's law of distribution of income	3	5
	4.3	Estimation of the following - demand function from price elasticity, consumption function from MPC, saving function from MPS, capital formation from investment function, rate of sales, depreciation,	4	5

Teacher specific course components

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** Observation of practical skills, , Laboratory record, *Any other method as may be required for specific course by the course faculty*.

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Semester: 4

24UEMSDSC207 : Intermediate course on Matrices and determinants

Constituent Discipline - 2	Mathematics					
Semester	4					
Type of Course	DSC					
Course Code	24UEMSDSC207					
Course Title	**Intermediate Matrix Algebra and Applications**					
Course Level	200 -299					
Course Summary	The objective of this course is to introduce the theory of Matrices and determinants that enables the study of economic theory at the undergraduate level, specifically the courses on microeconomic theory, macroeconomics and econometrics set out in this Syllabus. In this course, applications of matrices and determinants is used to solve problems of Input output analysis.					
Lecture/Tutorial/Practical Hours	45/0/30					
Credits	Total	4	Theory	3	Practical	1
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand the concept of matrices, types of matrices and basic operations on matrices and its properties	U	1 2
2	Evaluate determinants, inverse and apply transformations to find inverse and rank	E	1 2
3	Apply matrix inversion method and Cramer's rule to solve system of equations	A	1 2
4	Apply matrix inversion method to solve problems input-output analysis	A	1 2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Matrices (10 Hours)**			
	1.1	Matrices, order of matrix, Types of matrices-Raw Matrix, column matrix, Null matrix, Square matrix, diagonal matrix, scalar matrix, unit matrix	2	1
	1.2	Transpose of matrix, symmetric matrix, skew-symmetric matrix, Triangular (upper and lower) matrix, Equality of matrices	2	1
	1.3	Trace of a matrix and its properties, Idempotent matrix, nilpotent matrix, complex conjugate of a matrix, sub-matrix, principal sub-matrix, leading sub-matrix	2	1
	1.4	Basic operations on matrices –scalar multiplication, addition of matrices, subtraction of matrices, properties of matrix addition, matrix multiplication, properties of matrix multiplication, transpose of matrix and its properties	4	1
2	**Determinants and Inverse (15 hours)**			
	2.1	Determinant of a square matrix of order 2, minors and cofactors, determinant of higher order matrices	3	2
	2.2	Properties of determinants	3	2
	2.3	Cofactor matrix, adjoint of a matrix, properties of adjoint, singular and non-singular matrix, inverse of a square matrix	3	2
	2.4	Elementary raw transformations, Inverse of a matrix by Gauss reduction method	3	2
	2.5	Elementary transformations, equivalent matrices, Rank of matrix, properties of rank of matrix	3	2
3	**Solution of a system of linear equations (10 Hours)**			
	3.1	System of n linear (non-homogeneous and homogeneous) equations in n unknowns, consistent and inconsistent system of equations, criterion for consistency	1	3
	3.2	Solution of non-homogeneous linear equations using matrix inversion method	3	3
	3.3	Solution of non-homogeneous linear equations using Gauss Elimination method	3	3

	3.4	Solution of non-homogeneous linear equations using Cramer's rule.	3	3
4	**Input Output Analysis (10 Hours)**			
	4.1	Introduction to input-output analysis, Assumptions of I-O analysis, Transaction matrix, Coefficient matrix, interpretation of elements in the coefficient matrix	3	4
	4.2	Types of input-output models – open and closed models, static and dynamic models, importance of input-output analysis in development and planning	3	4
	4.3	Estimation of gross output vector using matrix inversion method	4	4
5	**Practicum (30 hours)**			
	5.1	Problem solving – Basic operations on matrices	4	1
	5.2	Problem solving – Evaluation of determinants, use of properties of determinants, adjoint of matrix, inverse	6	2
	5.3	Problem solving – Evaluation of inverse of matrix by row transformations	5	3
	5.4	Problem solving – evaluation of solution of equations by various methods	10	4
	5.5	Problem solving – Input-output analysis	5	4
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group

	discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** Observation of practical skills, , Laboratory record, *Any other method as may be required for specific course by the course faculty*.
	A. End Semester Examination (ESE) **Theory:** Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report**.** **Practical:** Practical based assessment, Record, *Any other method as may be required for specific course by the course faculty*.

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5. Hands, D. W.: Introductory Mathematical Economics, Second Edition, 2004.

6. J. Hall & P. Knight, Higher Algebra Arihant Publications.

7. R. Bronsons, Matrix Operations, McGraw-Hill Education.

8. I. N. Heirstein, Topics in Algebra, Wiley. 9

Semester: 5

24UEMSDSC303: Advanced Matrix Algebra and Applications

Constituent Discipline - 2	Mathematics					
Semester	5					
Type of Course	DSC					
Course Code	24UEMSDSC303					
Course Title	**Advanced Matrix Algebra and Applications**					
Course Level	300 - 399					
Course Summary	The objective of this course is to introduce the advanced concepts matrix theory that enables the study of economic theory at the undergraduate level, specifically the courses on microeconomic theory, macroeconomics and econometrics set out in this Syllabus. Emphasis is given for topics necessary for solving problems in Microeconomics, and Econometrics.					
Lecture/Tutorial/Practical Hours	60/0/0					
Credits	Total	4	Theory	4	Practical	NIL
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand the concept of vectors and operations on vectors and their properties	U	1 2
2	Apply the concept of characteristic equation and characteristic roots, Apply the above with reference to Cayley Hamilton theorem for evaluation of inverse of matrix	E	1 2
3	Understand the concept of Quadratic forms and apply the same in multiple regression models	A	1 2
4	Understand the concept of matrix differentiation and evaluate the optimality using Hessian determinant	E	1 2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Vectors (15 Hours)**			
	1.1	Vector, equality of vectors, null vector, addition of vectors and its properties, multiplication of a vector by a scalar and its properties	5	1
	1.2	Vector space, Linearly independent and dependent set of vectors, linear combination of vectors	5	1
	1.3	Scalar product of vectors and its properties, orthogonal vectors, magnitude of a vector	5	1
2	**Characteristic roots and characteristic roots (15 hours)**			
	2.1	Characteristic value problem, Characteristic root, Characteristic matrix, properties of Characteristic roots and Characteristic vectors.	5	2
	2.2	Determination of characteristic vectors, diagonalization of matrix, Rank of a product, rank of symmetric matrix, rank of a matrix, Determinant in terms of Characteristic roots	5	2
	2.3	Characteristic function, Characteristic equation, Eigen vectors, The Cayley Hamilton theorem and its applications.	5	2
3	**Quadratic forms (15 Hours)**			
	3.1	Linear, bilinear and quadratic forms, types of quadratic forms, Linear form as a matrix product, Bilinear form as a matrix product, Quadratic form as a matrix product.	5	3
	3.2	Linear transformations, Orthogonal transformations, Successive linear transformation, diagonal reduction of a symmetric matrix, reduction of quadratic form into sum of squares form.	5	3
	3.3	Index and signature of the form, canonical form, Sylvesters law of inertia, Lagrange's reduction, Kroneckers reduction. Non-negative, positive definite, negative definite, Positive semi-definite, negative semi-definite, indefinite	5	3

4	**Matrix differentiation and Hessian determinant (15 Hours)**			
	4.1	Vector/Matrix differentiation, differentiation of the quadratic form $X^{/}AX$ with respect to X	5	4
	4.2	Hessian determinant- Hessian determinant of order , General hessian determinant of order n	5	4
	4.3	Conditions for maximum and minimum of economic functions in terms of hessian determinant	5	4
Teacher specific course components				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** Observation of practical skills, , Laboratory record, *Any other method as may be required for specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report**.** **Practical:** Practical based assessment, Record, *Any other method as may be required for specific course by the course faculty*.

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7. R. Bronsons, Matrix Operations, McGraw-Hill Education.

8. I. N. Heirstein, Topics in Algebra, Wiley. 9

Semester: 5

24UEMSDSC304: Intermediate Optimization Methods

Constituent Discipline - 2	Mathematics					
Semester	5					
Type of Course	DSC					
Course Code	24UEMSDSC304					
Course Title	**Intermediate Optimization Methods**					
Course Level	300 -399					
Course Summary	The objective of this course is to introduce the operations research methods that enables the study of economic theory at the undergraduate level, specifically the courses on microeconomic theory, macroeconomics and econometrics set out in this Syllabus. In this course, particular economic problems are solved using the operations research tools.					
Lecture/Tutorial/Practical Hours	45/0/30					
Credits	Total	4	Theory	3	Practical	1
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	To understand the tools and techniques of Optimization techniques	Understand Apply	1 2
2	To formulate a linear programming problem in standard form	Understand Apply	1 2
3	To solve a linear programming problem using graphical and simplex methods	Understand Apply	1 2
4	To solve transportation problem using northwest corner rule, Vogels approximation method and Least cost method	Understand Apply	1 2
5	To solve assignment problem using Hungarian method, To find solution to game with or without saddle point	Understand Apply	1
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Introduction to OR(8 Hours)**			
	1.1	Definition of O.R, Scope, phases and Limitations of O.R.	2	1
	1.2	Linear Programming Problem, Formulation of LPP	2	1
	1.3	Solution of LPP - Feasible solution – Basic feasible solution.	2	2
	1.4	Standard form of LPP	2	2
2	**Solution of LPP (12 hours)**			
	2.1	Definitions of bounded, unbounded and optimal solutions, Graphical method of solving LPP	2	3
	2.2	Simplex technique - Definitions of Basic, non-basic variables - basic solutions - slack variables and optimal solutions.	3	3
	2.3	Simplex procedure of solving LPP	3	3
	2.4	Duality and its applications in economics, shadow prices	4	3
3	**Transportation and Assignment problems (15 Hours)**			
	3.1	Transportation problem, Statement of transportation problem in the standard format. Mathematical formulation	3	4
	3.2	Balanced and unbalanced T.P, Feasible solution- Basic feasible solution - Optimum solution - degeneracy in a T.P.	3	4
	3.3	Methods of solving Transportation problem**,** North West Corner rule, Vogel's approximation method, Least cost Method)- Optimality test (Modi Method) 2- Problems.	3	4
	3.4	Definition of Assignment problem, balanced and unbalanced assignment problem -restrictions on assignment problem -	3	5
	3.5	Mathematical formulation - formulation and solution of an assignment problem (Hungarian method)	3	5

4	**Game theory and Information Economics (10 Hours)**			
	4.1	Theory of games: Two-person zero-sum game, pure and mixed strategy.	2	5
	4.2	Game with and without saddle point, solution of games using Minimax and Maximin law.	3	5
	4.3	Finitely repeated games and backward induction; infinitely repeated games; history dependent strategies; onestep deviation property; the repeated Prisoners' dilemma; idea of folk theorem.	2	5
	4.4	Simultaneous move games with incomplete information (Bayesian games) Strategies; Bayesian Nash equilibrium; auctions; other applications.	3	5
5	**Practicum (30 hours)**			
	5.1	Formulation of LPP in standard form using case studies	5	1
	5.2	Solving LPP by graphical and simplex method and application of duality	15	2
	5.3	Problem solving in Transportation and Assignment	5	3
	5.4	Problems on Game theory and its application and cae study in economics	5	4
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **Theory:** Quiz, Oral Presentation, Self and Peer assessments, Written test, Open book test, Problem based assignment, Field study report/Group

	discussion. *Any other method as may be required for specific course by the course faculty*. **Practical:** Observation of practical skills, , Laboratory record, *Any other method as may be required for specific course by the course faculty*.
	B. End Semester Examination (ESE) **Theory:** Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report**.** **Practical:** Practical based assessment, Record, *Any other method as may be required for specific course by the course faculty*.

References

1. Hamdy Taha, Operations Research: An Introduction, 9th Edition, Pearson
2. Operation research, theory and applications, J.K.Sharma, Macmillan India ltd.
3. Operations Research: Principles and Practice, Ravindran.
4. Operation Research, VK.Kapoor, Sultan Chand Co.
5. Operation Research, Sharma & Anand, Himalaya Publishing House.
6. Operation Research, Kanthi Swarup, Sultan Chand Co.
7. Operation Research, SD. Sharma, Kedarnath Co.
8. Operation Research-problem and solutions, J.K.Sharma, Macmillain India limited.

Semester: 6

24UEMSDSC308: Advanced Optimization Methods

Constituent Discipline - 2	Mathematics					
Semester	6					
Type of Course	DSC					
Course Code	24UEMSDSC308					
Course Title	**Advanced Optimization Methods**					
Course Level	300 -399					
Course Summary	The objective of this course is to introduce the operations research methods that enables the study of economic theory at the undergraduate level, specifically the courses on microeconomic theory, macroeconomics and econometrics set out in this Syllabus. In this course, particular economic problems are solved using the operations research tools.					
Lecture/Tutorial/Practical Hours	45/0/30					
Credits	Total	4	Theory	3	Practical	1
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand and apply the tools of dynamic and geometric programming	A	1 2
2	Understand and apply the tools of Inventory control to attain optimum level of inventory	A	1 2
3	Understand and apply the concept of PERT and CPM in project scheduling	A	1 2
4	Understand and apply the various methods for Unconstrained and constrained optimization	A	1 2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Dynamic Programming and Geometric Programming (10 Houirs)**			
	1.1	Dynamic programming, Principle of optimality, recursive equation approach, Characteristics of dynamic programming, algorithm	2	1
	1.2	Solution of discrete dynamic problem – Case study on optimum allocation, marketing, reliability	3	1
	1.3	Geometric programming, posynomial, Geometric-Arithmetic mean inequality, unconstrained geometric programming problem	2	1
	1.4	Constrained geometric programming problem, Complementary geometric programming problem, algorithm	3	1
2	**Predictive Analytics for Inventory control (10 hours)**			
	2.1	Problem of inventory, Concept of EOQ, Deterministic and stochastic inventory problems, Deterministic model with and without shortages.	2	2
	2.2	EOQ problem with one or more than one price break, EOQ problem with constraint on space and level	3	2
	2.3	SIC techniques, ABC analysis, VED, SDE, HML, FSND, XYZ analysis	2	2
	2.4	Inventory with uncertain demand – use of normal distribution to find the stock level	3	2
3	**Network Routing problems and PERT/CPM (12 Hours)**			
	3.1	Network notations and definitions, Minimal spanning tree problem and algorithm, shortest route problem, Dijkstra's shortest path algorithm	3	3
	3.2	Maximal flow problems and augmenting path method and algorithm. CO3	3	3

	3.3	Basic components of network, logic of network construction, Critical path analysis, Forward and backward pass calculation	3	3
	3.4	Use of Probability and probability distributions in PERT analysis,	3	3
4	**Constrained and unconstrained Optimization (13 Hours)**			
	4.1	Concept of constrained optimization, applications of constrained optimization in economics, methods of constrained optimization	2	4
	4.2	Method of elimination for constrained optimization when there are only two variables and one linear constraint, maximization of utility subject to budget constraint	3	4
	4.3	Lagrange's method of undetermined multipliers	4	4
	4.4	Kuhn-Tuker theory and conditions for optimum	4	4
5	**Practicum (30 hours)**			
	5.1	Solving dynamic and geometric programming problems	7	1
	5.2	Solving problems to evaluate EOQ under given conditions	7	2
	5.3	Project planning using PERT and CPM	8	3
	5.4	Optimization under constraints and unconstrained conditions	8	4
5	**Teacher specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.

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Semester: 7

24UEMSDSC404: Differential equations and Difference equations

Constituent Discipline - 2	Mathematics					
Semester	7					
Type of Course	DSC					
Course Code	24UEMSDSC404					
Course Title	**Differential equations and Difference equations**					
Course Level	400 - 499					
Course Summary	The objective of this course is to introduce differential equations and difference equations that enables the study of economic theory at the undergraduate level, specifically the courses on microeconomic theory, macroeconomics and econometrics set out in this Syllabus. Differential equations and difference equations are used a tool for economic modelling, especially the growth models.					
Lecture/Tutorial/Practical Hours	60/0/0					
Credits	Total	4	Theory	4	Practical	Nil
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
Understand	Understand the concept of Differential Equations and apply the skill to solve differential equation of different order.	A	1 2
2	Analyse economic models using differential equations.	An	1 2
3	Understand the concept of difference Equations and apply the skill to solve differential equation of different order.	A	1 2
4	Analyse economic models using difference equations.	A	1 2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Differential Equations (20 Hours)**			
	1.1	Differential equations – meaning and definition, Kinds of differential equations, Order of differential equations, Degree of a differential equation, solution of differential equations, Formation of differential equations.	4	1
	1.2	Solution of first order and first degree differential equations, solution of differential equations with separated and separable variables,	6	1
	1.3	Homogeneous differential equations, Solution of linear homogeneous differential equations, Solution of differential equations reducible to homogeneous form,	5	1
	1.4	Exact differential equations, solution of an exact differential equation, transformation of inexact differential equation to exact differential equations	5	1
2	**Applications of differential equations (15 hours)**			
	2.1	Applications of differential equations in Micro economics- Cost function, Utility and demand analysis, Market equilibrium.	7	2
	2.2	Applications of differential equations in Macro/Growth models, Dynamic multiplier, Harrod-Domar model, Solow model.	8	2
3	**Difference equations (15 Hours)**			
	3.1	Introduction to difference equation, solution of difference equation, solution of first order difference equation, Dynamics of the equilibrium.	8	3
	3.2	Second order difference equations, solution of second order difference equations, real different roots, equal or repeated roots, complex roots. Solution of third order difference equations	7	3

4	**Applications of difference equations (10 Hours)**			
	4.1	Applications of difference equations in economics, Cobbweb model, Market model with inventory, dynamic multiplier with constant autonomous investment and dynamic multiplier with change in autonomous investment.	6	4
	4.2	Multiplier accelerator model, Multiplier accelerator-interaction model,	4	4
Teacher specific course components				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
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References

1. A. C. Chiang and K. Wainwright (2005): Fundamental Methods of Mathematical Economics, McGraw Hill International Edition.

2. A. C. Chiang (1984): Fundamental Methods of Mathematical Economics, McGraw Hill International Edition.

3. K. Sydsaeter and P. J. Hammond (2002): Mathematics for Economic Analysis. Pearson Educational Asia

4. Mukherji and S. Guha: Mathematical Methods and Economic Theory, Oxford University Press, 2011.

5. Hands, D. W.: Introductory Mathematical Economics, Second Edition, 2004.

6. J. Sinha Roy and S Padhy: A course of Ordinary and Partial differential equation Kalyani Publishers, New Delhi.

8. Simmons G F, Differential equation, Tata Mc GrawHill, 1991. 2. Martin Braun, Differential Equations and their Applications, Springer International, Student

9. Ross, S. L. Differential Equations. Wiley, 3rd edition, 2007.

10. Coddington, E. A. An Introduction to Ordinary Differential Equations. Dover Publications, 1989.

11. Farlow, S. J. An Introduction to Differential Equations and Their Applications. Dover Publications, 2006.

CONSTITUENT DISCIPLINE 3 – STATISTICS

24UEMSDSE103: FUNDAMENTALS OF STATISTICS AND DATA VISUALISATION

Constituent Discipline - 3	Statistics					
Semester	I					
Type of Course	DSC					
Course Code	**24UEMSDSC103**					
Course Title	FUNDAMENTALS OF STATISTICS AND DATA VISUALISATION					
Course Level	100-199					
Course Summary	This course helps to acquire foundational knowledge of various types of data, Descriptive Statistics, probability theory, correlation and regression and their real world applications. Additionally, R programming built-in functions/Excel is used to address numerical challenges associated with the topics discussed					
Lecture/Tutorial/Practical Hours	-45----/------/-30-----					
Credits	Total	4	Theory	3	Practical	1
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Explain and understand the concepts of different type of data, sampling and sampling techniques.	U	1
2	Summarise data using various measure of central tendency, dispersion, skewness and Kurtosis.	A	1,2
3	Analyse relationship between variables using scatter diagrams, correlation coefficients and regression analysis	An	1,2

4	Develop skills in solving real world problems through the applications of regression techniques, particularly in predicting outcomes and understanding the limitations of prediction.	An	1,2
5	Understand basic Probability concepts, including random experiments sample space and elementary ideas of probability. Apply Bayes' theorem to update probabilities based on new information and evidence.	A	1,2
6	Apply using R or Excel to illustrate and analyse statistical concepts, enhancing practical skills.	An	1,2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Data and Variables (…17.. hours)**			
	1.1	Types of data and variables: concepts of primary data and secondary data, Examples of univariate and bivariate data type	3	1
	1.2	Diagrams and Graphs	4	1
	1.3	Scales of measurements- Ordinal, Nominal, Ratio, Interval.	2	1
	1.4	Population and sample, Types of sampling. Non-probability and probability Sampling. Simple random sampling, systematic sampling, stratified sampling and cluster sampling with real life examples	4	1
	1.5	Measures of central tendency- mean, median, mode (Examples using raw data).	4	2
2	**Measures of Dispersion and Moments (…12.. hours)**			
	2.1	Measures of dispersion-Range, QD, MD, SD. Box Plot.	5	2
	2.2	Relative measure of Dispersion- Coefficient of variation	1	2
	2.3	Moments - Raw and central moments	3	2
	2.4	Skewness and Kurtosis with examples	3	2

3	**Correlation and Regression (…8.. hours)**			
	3.1	Correlation, Scatter diagram, Karl Pearson's correlation coefficient, Rank Correlation	4	3
	3.2	Regression- Two types of regression lines, Problems on prediction	4	4
4	**Elementary Probability Theory (8 hours)**			
	4.1	Random experiment-Sample space- Event, Examples	2	5
	4.2	Elementary ideas of probability – Classical and Axiomatic definitions with examples. Addition theorem of probability with proof for 2 and n events	3	5
	4.3	Conditional probability, Independence of events, Bayes' theorem with proof, Examples	3	5

5	**Practicum (30 Hours)**			
	5.1	Using MS Excel, plot diagrams and graphs. solve numerical problems in measures of central tendency using Excel/R software	8	6
	5.2	Numerical problems in measures of dispersion and obtain different measures of skewness and kurtosis.	8	6
	5.3	Draw regression lines using Excel, Numerical examples on correlation and regression	6	4
	5.4	Numerical examples of theory of probability	8	5

References:

1. Gupta, S. C. and Kapoor, V. K. Fundamentals of Mathematical Statistics, Sultan Chand and Sons.

2. Gupta, S.P., Statistical Methods. Sultan Chandand Sons: NewDelhi.

3. Medhi, J. Statistical Methods, 2nd Edition, New Age International Pulbishers,

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24UEMSDSE106: THEORY OF RANDOM VARIABLES AND STATISTICAL DISTRIBUTIONS

Constituent Discipline - 3	Statistics					
Semester	II					
Type of Course	DSC					
Course Code	**24UEMSDSC106**					
Course Title	**THEORY OF RANDOM VARIABLES AND STATISTICAL DISTRIBUTIONS**					
Course Level	100-199					
Course Summary	To acquire the basic knowledge of random variable theory and various distribution functions and its applications. To acquire the basic knowledge of statistical distributions and their applications.					
Lecture/Tutorial/Practical Hours	-45----/------/-30-----					
Credits	Total	4	Theory	3	Practical	1
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Examine major components of random variable theory and distribution theory.	Understand	1
2	Explain bivariate random variable, joint probability distribution functions and their properties	Understand and Apply	1,2
3	Explain the concept of expectation and its properties. Explain the concept of Moment generating functions and Characteristic function	Apply and Analize	1,2
4	Develop skills required to effective understanding of various distributions.	Apply a nd Analize	1,2
5	Analyse several applications and advantages of distributions	Understand and Apply	1,2

6	R programming for Statistical Computing.	Apply and Analyse	1,2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Random Variable theory (…15.. hours)**			
	1.1	Describe univariate random variables in discrete and continuous cases.	3	1
	1.2	Demonstrate probability mass function, probability density function and their properties, Describe distribution function of a random variable and its properties	3	1
	1.3	Demonstrate functions of random variable, transformation of random variable (univariate)	3	1
	1.4	Describe bivariate random variable, demonstrate joint probability mass function and joint probability density function and their properties,	3	2
	1.5	Demonstrate marginal and conditional distributions (bivariate case), Demonstrate independence of random variables (bivariate case).	3	2
2	**Mathematical Expectation (…8.. hours)**			
	2.1	Demonstrate mathematical expectation, its properties and simple problems.	4	3
	2.2	Describe Central Tendency and Dispersion measures in terms of expectation	2	3
	2.3	Describe generating functions – moment generating function, characteristic function, their properties	2	3
3	**Discrete Probability Distributions (…12.. hours)**			
	3.1	Discrete uniform distribution and Bernoulli distribution	3	4
	3.2	Explain Binomial distribution and derive its characteristics. Fitting of binomial distribution.	3	4,5

	3.3	Explain Poisson distribution and derive its characteristics, Fitting of Poisson distribution	3	4,5
	3.4	Explain Geometric distribution , its characteristics and lack of memory property	3	4,5
4	**Continuous Probability Distributions (…10.. hours)**			
	4.1	Explain continuous uniform distribution and its characteristics	1	4
	4.2	Explain exponential distribution, gamma distribution and their characteristics. Derive lack of memory property of exponential distribution.	4	4,5
	4.3	Explain normal distribution and derive its properties.	3	4,5
	4.4	Discuss standard normal distribution and use of standard normal tables. Fitting of normal distribution.	2	4,5

5	**Practical**			
	5.1	Numerical examples of Random Variable(Univariate, Bivariate), Marginal distributions, and problems on independence.	8	6
	5.2	Numerical examples of mathematical expectation, M.G.F, and characteristic function	6	6
	5.3	Numerical examples of uniform Bernoulli Binomial, Poisson and Geometric distribution	8	4
	5.4	Numerical examples of Exponential, Gamma, Normal and Standard Normal.	8	5

References

1. Gupta, S. C. and Kapoor, V. K. Fundamentals of Mathematical Statistics, Sultan Chand and Sons.

2. Gupta, S.P., Statistical Methods. Sultan Chandand Sons: NewDelhi.

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Semester: 3

24UEMSDSE204: DATA ANALYSIS IN INFERENTIAL STATISTICS USING R/PYTHON

Constituent Discipline - 3	Statistics					
Semester	III					
Type of Course	DSC					
Course Code	**24UEMSDSE204**					
Course Title	**DATA ANALYSIS IN INFERENTIAL STATISTICS USING R/PYTHON**					
Course Level	200-299					
Course Summary	This course covers key concepts in Statistics including sampling distribution, Estimation of parameters, Testing of hypothesis Emphasis is placed on practical applications using R or Python.					
Lecture/Tutorial/Practical Hours	-45----/------/-30-----					
Credits	Total	4	Theory	3	Practical	1
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Sampling Distributions	Learning Domains *	PO
1	Understand different Sampling Distributions.	Understand	1
2	Describe estimation. Examine properties of a good estimator.	Understand and Apply	1
3	Construct confidence intervals for parameters.	Apply and Analize	1,2
4	Understand basic concepts of statistical hypotheses and their applications.	Understand and Apply	1
5	Evaluate two types of errors, power of a test and obtain power function.	Evaluate	1,2

6	Explain various parametric test procedure and performing various parametric tests	Apply and Analyse	1,2
7	Conduct data analysis using R/ Python	Evaluate	1,2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Sampling Distributions (…12.. hours)**			
	1.1	Derivation of the sampling distribution of sample mean for a normal population, standard errors of sample mean and sample variance.	3	1
	1.2	$\chi 2$ distribution- p.d.f. with n degrees of freedom, properties, assumptions and applications	3	1
	1.3	Student's t- distribution - p.d.f., properties	3	1
	1.4	Snedecor's F- distribution: p.d.f., Distribution of 1/F .properties. Relationship between t, F and $\chi 2$ distributions	3	2
2	**Estimation of Parameters -I (…10.. hours)**			
	2.1	Types of Estimation - Point Estimation and interval estimation.	3	3
	2.2	Desirable properties of Point Estimator.	2	3
	2.3	Interval estimation- Confidence interval for the mean, difference of means, variance ratio of variances and proportion	5	3
3	**Statistical Inference -I (…14.. hours)**			
	3.1	Testing of hypothesis- Statistical test. Null and Alternative hypothesis, Types of errors	2	4
	3.2	Significance level, power. Critical Region, P value.	2	4,5

	3.3	Small sample tests – Z-test,, t- test.	4	4,5
	3.4	Chi-square test for testing variance and F test for testing equality of variances.	4	4,5
	3.5	Paired t test.	2	4,5
4	**Statistical Inference -II (…10.. hours)**			
	4.1	Large Sample test- Z test for testing population means, equality of population means.	1	4
	4.2	Testing population proportion, equality of two population proportions;	4	4,5
	4.3	Chi-Square test - goodness of fit, test of independence;	4	4,5

5	**Practical**			
	5.1	Numerical problems on sampling distribution.	8	6
	5.2	Numerical examples of Desirable Properties of point estimation	6	6
	5.3	Problem solving- Calculation of significance level, Power, Testing of hypothesis using small samples test using R/python	8	4
	5.4	Problem solving – Testing of hypothesis using large sample test using R/Python	8	5

References

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Semester: 4

24UEMSDSE208: STATISTICAL TOOLS FOR QUALITATIVE RESEARCH

Constituent Discipline - 3	Statistics					
Semester	IV					
Type of Course	DSC					
Course Code	**24UEMSDSE208**					
Course Title	**STATISTICAL TOOLS FOR QUALITATIVE RESEARCH**					
Course Level	200-299					
Course Summary	This course covers different types of scales for measurement, Analyse and interpret qualitative data non parametric tests and practical applications using Excel/ R.					
Lecture/Tutorial/Practical Hours	60/0/0/					
Credits	Total	4	Theory	4	Practical	Nil
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Iidentify and use the proper the scales of measurement for data collection	Apply	1 2
2	Analyse and interpret qualitative data	Analyse	1,2
3	Conduct non parametric test and report the results	Analyse, Apply	1,2
4	Perform non parametric tests using Excel/R	Apply	1,2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Measurement - Scaling, Reliability and Validity (15 Hours)**			
	1.1	Scales of measurement, scale characteristics and levels of measurement, Primary scales of measurement, Nominal, ordinal, interval and ratio scales.	3	1
	1.2	Rating Scales - Dichotomous scale, Category scale, Likert scale, Semantic differential scale, Numerical scale, Itemised rating scale, Fixed or constant sum scale, Stapel scale, Graphic rating scale.	6	1
	1.3	Ranking Scales -Paired comparison scale, Forced choice scale, comparative scale	3	1
	1.4	Goodness of measurement - validity and reliability, content validity, face validity, criterion related validity, concurrent validity, predictive validity, test retest reliability, split half reliability	3	1
2	**Qualitative research (15 hours)**			
	2.1	Qualitative data – sources of qualitative data, Collection of qualitative data	3	2
	2.2	Analysis of Qualitative data- Principle of fitness for purpose, thick description and reflexivity	3	2
	2.3	Ethics in qualitative data Analysis	3	2
	2.4	Data reduction, data display, Drawing conclusions	3	2
	2.5	Computer assisted qualitative data analysis	3	2
3	**Introduction to Non Parametric Tests and Chi Square tests (12 Hours)**			
	3.1	Classification of statistical tests – Parametric and non parametric tests.	3	3
	3.2	Criteria regarding scale, population parameter and assumption about population distribution for parametric and non parametric tests.	3	3
	3.3	Advantages and limitations of non parametric tests	3	3

	3.4	Chi square test goodness of fit, Chi square test of independence, Chi square test of homogenity	3	3
4	**Other non parametric tests (18 Hours)**			
	4.1	One sample runs test, Sign test	3	3
	4.2	Two independent samples non parametric tests - Mann Whitney U Test, Steps for conducting Mann Whitney U test	3	3
	4.3	Two related samples non parametric tests - Sign Test for matched pairs, Steps for conducting Sign Test	4	3
	4.4	k related samples non parametric tests – Friedman Two way ANOVA Test, Steps for conducting Friedman Two way ANOVA Test	4	3
	4.5	k independent samples non parametric tests – Kruskal Wallis Test, Steps for conducting Kruskal Wallis Test	4	3
Teacher specific course components				

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, Discussion-based Learning, Inquiry-Based Learning, Field based collection and interactions, Online Learning, Blended Learning, and other innovative learning approaches.
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	B. End Semester Examination (ESE) **Theory:** Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report**.** **Practical:** Practical based assessment, Record, *Any other method as may be required for specific course by the course faculty*.

Semester: 5

UEMSDSE305: SAMPLE SURVEY ANALYSIS AND DESIGN OF EXPERIMENTS

Constituent Discipline - 3	Statistics					
Semester	V					
Type of Course	DSC					
Course Code	**24UEMSDSE305**					
Course Title	**SAMPLE SURVEY ANALYSIS AND DESIGN OF EXPERIMENTS**					
Course Level	300-399					
Course Summary	The course explores in detail the basic concepts of sampling techniques. This course provides a thorough exploration of statistical modelling and analysis. ANOVA (Analysis of Variance) and Experimental Design. This course provides a basis to introduce real-life applications.					
Lecture/Tutorial/Practical Hours	-45----/------/-30-----					
Credits	Total	4	Theory	3	Practical	1
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	To Explain the basic concept of sample survey.	U	1
2	To Apply various sampling schemes like SRS, Stratified sampling and Systematic sampling	A	2
3	To Compare the efficiencies of estimates obtained using different sampling techniques and discuss the merits and demerits and demerits	An	2
4	To Explain the principles of experimentation	U	1
5	To prepare one-way and two-way analysis of variances	An	1
6	To Design and analyse CRD, RBD, LSD	An	2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Basic Concepts and Simple Random Sampling (…15.. hours)**			
	1.1	Explain the basic concepts of sampling.	2	1
	1.2	Discuss the advantages and disadvantages of sampling over census.	2	1
	1.3	Distinguish between Probability and non-probability sampling- Judgment, Mixed Sampling, Quota sampling, Sampling and Non sampling errors	3	1
	1.4	Distinguish between simple random sampling with and without replacement and explain the procedures of selecting a sample.	3	2
	1.5	Evaluation of the estimates of population mean and total for variables, variance of the estimates, and the confidence interval containing population mean	3	2
	1.6	Determination of the estimates for population proportion of SRS for attributes	2	2
2	**Stratified Random Sampling (…10.. hours)**			
	2.1	Definition of a stratified sample. Stratified random sampling: Estimation of the population mean and population total-their variances and estimates of the variances	4	3
	2.2	Explain allocation of sample size in different strata, using proportional allocation and optimum allocation with and without varying cost	4	3
	2.3	Comparison of Stratified Sampling with Simple Random Sampling	2	3
3	**Design of Experiments (…12.. hours)**			
	3.1	Explain the concept of design of experiments	2	4
	3.2	Explain Fundamental principles of experimentation and need for design of experiments	3	4,5

	3.3	Define ANOVA, State uses of ANOVA and assumptions	2	4,5
	3.4	State the model for one way, two way and three way classification. Perform one way two way analysis of variance	5	4,5
4	**Experimental Designs (…8.. hours)**			
	4.1	Define CRD and state its advantages	1	6
	4.2	Design and analyze CRD .	2	6
	4.3	Define RBD and state its advantages.	1	6
	4.4	Design and analyse RBD	2	6
	4.5	Define LSD and state its advantages	1	6
	4.6	Design and analyse LSD	1	6

5	**Practical**			
	5.1	Numerical examples to select an SRS with and without replacement from finite populations.	8	6
	5.2	Numerical examples for SRSWOR, estimate the mean, standard error and the sample size	6	6
	5.3	Numerical examples of one way two way and three way classified data	8	4
	5.4	Numerical examples of CRD,RBD and LSD	8	5

References

1.Cochran, W.G. (2007).Sampling Techniques, (3rd Edn.), John Wiley and Sons.

2. Singh,D. and Choudhary,F.S.(2020)Theory and Analysis of Sample Survey Designs, (2nd Edn.) ,New Age International Publishers.

3. Mukhopadhyay, P. (2013). Theory and Methods of Survey Sampling, (2nd Edn.) Prentice-Hall of India.

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9. Hinkelmann, K.and Kempthrone, O. (2014).Design and Analysis of Experiments, Vol.I, John Wiley and Sons

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Semester: 6

24UEMSDSE309: TIME SERIES ANALYSIS AND STOCHASTIC PROCESSES

Constituent Discipline - 3	Statistics					
Semester	VI					
Type of Course	DSC					
Course Code	**24UEMSDSE309**					
Course Title	**TIME SERIES ANALYSIS AND STOCHASTIC PROCESSES**					
Course Level	300-399					
Course Summary	This course aims to introduce the concept of time series and its statistical analyses. Explores in detail the concepts stochastic processes, and their properties.					
Lecture/Tutorial/Practical Hours	60/0/0					
Credits	Total	4	Theory	4	Practical	Nil
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Understand the importance of time series analysis in real life problems.	A	1,2
2	Apply the concept of additive and multiplicative models in decomposing the components of a time series data	A	1,2
3	Estimate the trend component, present in a time series.	An	1,2
4	Synthesize various concepts of Stochastic process and apply	A	1,2
5	Explore various properties of Markov process	E	2
6	Analyse Random walk	An	2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Introduction to time series data (12 hours)**			
	1.1	Time series, components of time series, additive and multiplicative models.	4	1
	1.2	Determination of trend, analysis of seasonal fluctuations, test for trend and seasonality.	5	1
	1.3	Exponential and moving average smoothing, holt-winter smoothing, forecasting based on smoothing.	3	3
2	**Study of stationarity (18 hours)**			
	2.1	Time series as a discrete parameter stochastic process	4	3
	2.2	Auto covariance and auto correlation functions and their properties, stationary processes.	5	3
	2.3	Test for stationarity. Unit root test.	4	3
	2.4	Stationary processes in the frequency domain, spectral analysis of lime series.	5	3
3	**Introduction to stochastic processes**: **(20 hours)**			
	3.1	Classification of stochastic processes according to state space and time space, wide sense and strict sense stationary processes, processes with stationary independent increments	4	4
	3.2	Markov process, Markov chains-transition probability matrices, Chapman-Kolmogorov equation	4	4,5
	3.3	First passage probabilities, generating functions, classification of states, criteria for recurrent and transient states.	4	4,5
	3.4	Mean recurrence time, mean ergodic theorem, the basic limit theorem of Markov chains (statement only).	4	4,5
	3.5	Reducible and irreducible Markov chains, stationary distributions, limiting probabilities and absorption probabilities	4	4,5
	Random Walk (10 hours)			

4	4.1	Random walk, gambler's ruin problem	3	6
	4.2	Galton-Watson branching process, generating function relations	3	6
	4.3	Mean and variance functions, extinction probabilities, criteria for extinction	4	6

References

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5. Kendall, M.G. (1978) Time Series, (2nd Edn.), Charles Griffin and Co Ltd.

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7. Ross S.M. (2007) Stochastic Processes. Second Edition, Wiley Eastern, New Delhi

8. Ross S.M. (2014) Introduction to Probability Models. Eleventh Edition, Elsevier.

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	B. End Semester Examination (ESE) **Theory:** Written test/Standardized Test (MCQ)/Open book/ Problem based assignments/Individual project report/Team project report**.** **Practical:** Practical based assessment, Record, *Any other method as may be required for specific course by the course faculty*.

Semester: 7

24UEMSDSE405: MULTIVARIATE DATA ANALYSIS

Constituent Discipline - 3	Statistics					
Semester	**VII**					
Type of Course	DSC					
Course Code	**24UEMSDSE405**					
Course Title	**MULTIVARIATE DATA ANALYSIS**					
Course Level	400-499					
Course Summary	This course aims to introduce the concept of analyse data using multiple response and multiple dichotomy analysis. Analyse the trend in data, perform discriminant analysis, conjoint analysis for product design and factor analysis for data reduction.					
Lecture/Tutorial/Practical Hours	--45---/------/---30---					
Credits	Total	4	Theory	3	Practical	1
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Analyze data using multiple response and multiple dichotomy analysis	Analyse	1 2
2	Perform brand positioning using multidimensional scaling	Apply	1 2
3	Analyze the trend in data, Use logistic regression for classification and prediction.	Analyse Apply	1 2
4	Perform discriminant analysis for classification and prediction and cluster analysis for segmentation	Analyse Evaluate	1 2
5	Perform Conjoint analysis for product design and factor analysis for data reduction	Apply	1 2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Multiple response and multiple dichotomy analysis (08 Hours)**			
	1.1	Multiple response Analysis – Purpose and application areas, Uses, data entry in SPSS, interpretation of output	2	1
	1.2	Multiple response Analysis- Case study with secondary data, Analysis of secondary data, reporting the results and interpretation of results, decision making	2	1
	1.3	Dichotomy Analysis – Purpose and application areas, Uses, data entry in SPSS, interpretation of output	2	1
	1.4	Dichotomy Analysis - Case study with secondary data, Analysis of secondary data, reporting the results and interpretation of results, decision making	2	1
2	**Multidimensional scaling (8 hours)**			
	2.1	Multidimensional scaling, perceptual mapping technique, application area, uses	2	2
	2.2	Basic Methods of Multidimensional scaling, Attribute based approach, Similarity/dissimilarity based approach	2	2
	2.3	Multidimensional scaling, Case study with secondary data, Analysis of secondary data. Data entry in SPSS editor	2	2
	2.4	Multidimensional scaling, reporting the results and the interpretation of results, decision making, Euclidean distance model, Scatterplot of linear fit, scatterplot of non linear fit, Transformation scatter plot.	2	2
3	**Trend Analysis, Classification and prediction using logistic regression (8 Hours**			
	3.1	Trend Analysis, linear, quadratic and cubic	2	3
	4.2	Data entry for tend analysis, Case study with secondary data, Analysis of secondary data. Interpretation of SPSS output	2	3
	3.3	Logistic regression, application areas, uses. Interpretation of individual coefficients, Case study using secondary data	2	3
	3.4	Logistic regression versus Linear discriminant analysis, Pros and cons of usage of logistic regression in real life situation	2	3
4	**Discriminant analysis for classification and prediction and cluster analysis for3segmentation (10 Hours)**			

	4.1	Discriminant analysis, areas of application, applications in selection, classification and prediction	2	4
	4.2	Classification matrix, Group centroids, decision rule for classifying objects, relative strength of explanatory variables	2	4
	4.3	Predicting group membership, Accuracy of classification, stepwise/fixed model, Apriori probability of classification into groups, case study	2	4
	4.4	Cluster analysis, hierarchical and non hierarchical clustering methods, k means clustering method.	2	4
	4.5	Interpretation of final cluster centers to name the clusters.	2	4
5	**Conjoint analysis for product design and factor analysis for data reduction (11 Hours)**			
	5.1	Conjoint analysis, application, uses, benefits, trade off between various attribute values in decision making process	2	5
	5.2	Conversion of rank order data into interval scaled measures, case study, recoding the input data ad dummy variables through effects coding and running regression model	2	5
	5.3	Factor analysis, applications in data reduction, a tool for combining variables, factors and original variables	2	5
	5.4	Data entry for factor analysis, two stages in factor analysis, Factor extraction and factor rotation	2	5
	5.5	Use of Eigen values for determining the number factors to be extracted, Factor loadings, interpretation of factors.	3	5
6	**Practical (30 hours)**			
	6.1	Case study based on the primary data for analysis using multiple response and multiple dichotomy analysis	8	1
	6.2	Case study based on the primary data for analysis using multidimensional scaling method	7	2
	6.3	Case study based on the primary data for analysis of trend in data, Use logistic regression for classification and prediction.	15	3

Semester: 7

24UEMSDSC406: ANALYTICAL TOOLS FOR MULTIVARIATE ANALYSIS AND MULTIVARIATE DISTRIBUTIONS

Discipline/Programme	Statistics					
Semester	VII					
Type of Course	DSC					
Course Code	**24UEMSDSC406**					
Course Title	**ANALYTICAL TOOLS FOR MULTIVARIATE ANALYSIS AND MULTIVARIATE DISTRIBUTIONS**					
Course Level	400-499					
Course Summary	Students will comprehend real vectors, orthogonality and Gram-Schmidt orthogonalization process understanding bivariate and multivariate distributions, interpreting results from the distribution of quadratic forms, and applying these skills in practical scenarios using R software.					
Lecture/Tutorial/Practical Hours	60/------/0-----					
Credits	Total	4	Theory	4	Practical	Nil
Pre-requisite, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO
1	Interpret vector space, linear dependence and independence of vectors, spanning vector space, projection of vector.	U	1,2
2	Solve theory of equations, generalized inverse of matrix, quadratic forms, linear transformations	A	1,2
3	Explain random vectors, mean vector and dispersion matrix	An	1,2
4	Apply multivariate normal distribution in real-life situations.	A	1,2
5	Build characterizations of multivariate distribution.	C	1,2
6	Obtain the distribution of quadratic forms.	C	2
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)			

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Real vectors (15 hours)**			
	1.1	Real vectors (generalization of co-ordinates), Angle and Norm of vectors, Orthogonality and Gram-Schmidt orthogonalization process. Axiomatic approach and examples.	5	1
	1.2	Subspaces, intersection and sum of subspaces. Span of a set, Linear dependence and independence, dimension and basis, dimension theorem.	5	1
	1.3	Direct Sum and Complement subspace, Orthogonal Projection of a vector	5	1
2	**G-inverse and Quadratic Form (15 hours)**			
	2.1	System of homogeneous and non-homogeneous linear equations.	3	2
	2.2	Projection matrix and application to least square method.	4	2
	2.3	Generalized inverse, Moore-Penrose inverse.	4	2
	2.4	Quadratic forms: Classification & canonical reduction, Linear transformations.	4	3
3	**Multivariate Distributions (20 hours)**			
	3.1	Random vectors, mean vector, dispersion matrix	5	4
	3.2	Bivariate normal distribution, pdf, marginal distributions, conditional distributions and independence.	5	4
	3.3	Multivariate normal distribution, characteristic function, marginal distributions, and conditional distributions, properties, characterizations, orthogonal transformation	5	5
	3.4	Multinomial distribution and its basic properties.	5	5
4	**Distribution of Quadratic Forms (10 hours)**			
	4.1	Distribution of quadratic forms, Scalar quadratic forms, Cochran's theorem	10	6

References

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