

**SACRED HEART COLLEGE (AUTONOMOUS),
THEVARA KOCHI, KERALA, 682013**



CURRICULUM AND SYLLABUS

CHOICE BASED CREDIT & SEMESTER SYSTEM (CBCSS)

BSc Economics -Mathematics-Statistics (Triple Main)

To be introduced from 2023 Admission

**BOARD OF STUDIES IN
ECONOMICS, MATHEMATICS AND STATISTICS**

**Sacred Heart College,
Thevara, Kochi, Kerala**

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FORWARD

Recent developments in various disciplines indicate a tendency towards the convergence of disciplines as it is more productive in knowledge production and innovation. Recognizing this, many universities in India have already launched multidisciplinary programmes at the UG and PG levels. The proposed programme, BSc Economics-Mathematics-Statistics (triple main), is a much sought-after combination as it equips the students with the foundation of Mathematics and Statistics for the study of Economics.

The syllabus for the proposed programme was prepared by an Expert Committee consisting of members from the Board of Studies of Economics, the Board of Studies of Mathematics and the Board of Studies of Statistics in tune with the curriculum structure of the parent university. In this process, care has been taken to address various aspects such as the creativity of students, knowledge of current developments in the discipline, the impacts due to the development of science and technology, employability and entrepreneurship development. Moreover, adequate credits have been given to each discipline to enable the student to pursue their higher studies in anyone of the disciplines included in the course besides other domains such as Data analytics, Data science, and Content analysis. The scope of diversity is further widened by the introduction of a basket of electives. In tune with the decision of the Mahatma Gandhi University 2017 to incorporate Environmental Studies and Human Rights in UG Programmes, the present syllabus also has incorporated Environmental Studies and Human Rights as core courses.

The eligibility for admission to the programme would be a pass in Grade 12 with Mathematics or Statistics as one of the subjects.

The Academic Council of the college has decided to recommend the above programme which is intended to be introduced from the academic year 2022-23.

(S/d)

Head, Department of
Economics

(S/d)

Head, Department of
Mathematics

(S/d)

Head, Department of
Statistics

Members of the Expert Committee

Sl. No	Name & Address	Designation/Category
1	Dr. Madhusudhanan Nair M S, HoD	Head, Department of Economics, Chairman
2	Prof. Dr. S. Harikumar, Dept. of Applied Economics, CUSAT	Expert in the subject from outside the college.
3	Dr. K V Raju, Faculty of Economics (rtd) Sacred Heart College, Kochi	Expert in the subject from outside the college.
4	Dr. Cyriac Antony, Faculty of Statistics (rtd) Sacred Heart College, Kochi	Expert in the subject from outside the college, Member
5	Dr. Jeenu Kurian, Head, Department of Mathematics, Sacred Heart College	Member
6	Dr. Lakshmipriya, Asst. Professor, Statistics, Sacred Heart College	Member
7	Mr. Jomon Joseph, Data Analyst, Representative from industry, corporate – sector or allied area.	Member
8	Dr. Siby Abraham, Asst. Professor, Department of Economics	Member
9	Dr. Didimos KV, Asst. Professor, Dept. of Mathematics, Sacred Heart College	Member
10	Mr. MC Jose, Asst. Professor, Statistics, Sacred Heart College	Member
11	Mr. Jeet Kurian Mattam, Asst. Professor, Dept. of Mathematics, Sacred Heart College	Member
12	Mr. Sanil Jose, Asst. Professor, Dept. of Mathematics, Sacred Heart College	Member
13	Mr. Vinil KV, Asst. Professor, Dept. of Economics, Sacred Heart College	Member
14	Dr. Aparna S., Asst. Professor, Dept. of Economics	Member

REGULATIONS FOR CHOICE BASED CREDIT AND SEMESTER SYSTEM (CBCSS) FOR UNDER GRADUATE PROGRAMMES -2019

1. Title

These regulations shall be called “**SACRED HEART COLLEGE THEVARA
REGULATIONS FOR CREDIT AND SEMESTER SYSTEM 2019**”

2. Scope

Applicable to all programmes of the college with effect from 2019 admissions, except otherwise approved by the Academic Council of the College

3. Definitions

‘Programme’ means the entire course of study and examinations.

3.1 **‘Duration of Programme’** means the period required for the conduct of the programme. The duration of under graduate programmes shall be 6 semesters, post-graduate programme shall be of 4 semesters and MPhil programmes shall be 2 semesters.

3.2 **‘Semester’** means a term consisting of a minimum of 90 working days, inclusive of examination, distributed over a minimum of 18 weeks of 5 working days, each with 5 contact hours of one hour duration

3.3 **‘Course’** means a segment of subject matter to be covered in a semester. Each Course is to be designed variously under lectures / tutorials / laboratory or fieldwork / study tour /seminar / project / practical training / assignments/evaluation etc., to meet effective teaching and learning needs.

3.4 **‘Common Course I’** means a course that comes under the category of courses for English and **‘Common Course II’** means additional language, a selection of both is compulsory for all students undergoing undergraduate programmes (Model I)

3.5 **‘Core course’** means a course in the subject of specialization within a degree programme.

3.6 **‘Complementary Course’** means a course, which would enrich the study of core courses.

3.7 **‘Open course’** means a course outside the field of his/her specialization, which can be opted by a student.

3.8 '**Additional core course**' means a compulsory course for all under graduate students (as per the UGC directive) to enrich their general awareness.

3.9 The U.G. programmes shall include (a) Common courses (b) Core courses (c) Complementary Courses (d) Open Course (e) Study tour and (f) Internship for selected programmes.

3.10 '**Additional Course**' is a course registered by a student over and above the minimum required courses.

3.11 '**Credit** (Cr) of a course is the numerical value assigned to a course according to the relative importance of the content of the syllabus of the programme.

3.12 '**Extra credits**' are additional credits awarded to a student over and above the minimum credits required for a programme for achievements in co-curricular activities carried out outside the regular class hours OR curricular activities/courses completed for value addition, as directed by the College/ department. It is the numerical value assigned to Club activities, Social service, Internship etc. that is not added with the total academic credits of the students. Additional credit components

- a. Talent & career club activity (optional)
- b. Social service (mandatory)
- c. Internship for Commerce, Communication and Computer applications (mandatory).
- d. Internship (desirable for other programmes).
- e. Add on courses (optional)

3.13 '**Programme Credit**' means the total credits of the UG Programme.

3.14 '**Programme Elective course**' Programme Elective course means a course, which can be chosen from a list of electives and a minimum number of courses is required to complete the programme.

3.15 '**Programme Project**' Programme Project means a regular project work with stated credits on which the student undergoes a project under the supervision of a teacher in the parent department / any appropriate Institute in order to submit a dissertation on the project work as specified.

3.16 '**Internship**' is on-the-job training for professional careers.

3.17 '**Plagiarism**' Plagiarism is the unreferenced use of other authors' material in Dissertations and is a serious academic offence.

3.18 '**Tutorial**' Tutorial means a class to provide an opportunity to interact with students at their individual level to identify the strength and weakness of individual students.

3.19 '**Seminar**' seminar means a lecture by a student expected to train the student in self-study, collection of relevant matter from the books and Internet resources, editing, document writing, typing and presentation.

3.20 '**Evaluation**' means every course shall be evaluated by 25% continuous (internal) assessment and 75% end course/end semester (external) assessment.

3.21 '**Repeat course**' is a course that is repeated by a student for having failed in that course in an earlier registration.

3.22 '**Audit Course**' is a course for which no credits are awarded.

3.23 '**Department**' means any teaching Department offering a course of study approved by the college / Institute as per the Act or Statute of the University.

3.24 '**Parent Department**' means the Department which offers a particular UG/PG programme.

3.25 '**Department Council**' means the body of all teachers of a Department in a College.

3.26 '**Faculty Advisor**' is a teacher nominated by a Department Council to coordinate the continuous evaluation and other academic activities undertaken in the Department.

3.27 '**College Co-ordinator**' means a teacher from the college nominated by the College Council to look into the matters relating to CBCS-PG System.

3.28 '**Letter Grade**' or simply '**Grade**' in a course is a letter symbol (O, A, B, C, D, etc.) which indicates the broad level of performance of a student in a course.

3.29 Each letter grade is assigned a '**Grade point**' (GP) which is an integer indicating the numerical equivalent of the broad level of performance of a student in a course.

3.30 '**Credit point**' (CP) of a course is the value obtained by multiplying the grade point (GP) by the Credit (Cr) of the course $CP = GP \times Cr$.

'**Semester Grade point average**' (SGPA) is the value obtained by dividing the sum of credit points (CP) obtained by a student in the various courses taken in a semester by the total number of credits taken by him/her in that semester. The grade points shall be rounded off to two decimal places. SGPA determines the overall performance of a student at the end of a semester.

3.31 '**Cumulative Grade point average**' (CGPA) is the value obtained by dividing the sum of credit points in all the courses taken by the student for the entire programme by the total number of credits and shall be rounded off to two decimal places.

3.32 '**Grace Marks**' means marks awarded to course/s, as per the orders issued by the college from time to time, in recognition of meritorious achievements in NCC/NSS/Sports/Arts and cultural activities.

4. ATTENDANCE

Being a regular college, physical presence in the regular activities, especially, classes and exams, is mandatory for the students. However, if a student secures 75% of attendance s/he is eligible to appear for the exams, provided there are no other impediments like disciplinary proceedings, malpractice record etc.

- i. A maximum of 5 marks (5%) for a course is given for attendance
- ii. **Absence:** A student found absent for one hour in the forenoon or afternoon session is deprived of the attendance for the entire session as far as eligibility for final exam is concerned.
- iii. The hour related calculation in a course is meant for awarding marks for the course concerned.
- iv. **Late entry:** A student is supposed to be in time in the class. Late arrival related treatment is left to the discretion of the individual teacher. However, as a norm, a late arriving student may be permitted to the class, if it is not inconvenient or distraction to the class as such; though attendance MAY NOT BE GIVEN. Late arrival beyond 5 minutes is treated as ABSENCE; though the teacher may consider permitting the student to sit in the class.
- v. **Leave:** A student has to formally report his/her absence with reasons either in advance, or immediately after the absence for obtaining an approved leave. This applies to all sorts of leave – medical, on duty or other.

The student is supposed to report in prescribed format on the next day of the absence; however, up to a week's time is permitted. Afterwards, the leave applications will not be considered.

The student has to retain a copy/section of the approved leave form and produce the same as proof, in case there is any confusion regarding the leave sanctioning. In the absence of such proof, the claims will not be entertained.

- vi. **Duty Leave:** A student representing the college in sports, arts, social service or academic matters, has to get sanction from the class teacher concerned and submit the leave application form duly endorsed by teacher concerned & the class teacher, and submit it to the faculty Dean (or Vice Principal). The same will be forwarded by the Dean/Vice Principal for attendance entry. **SPORTS:** The approval of the department of Physical Education and the class teacher is required. The time limit for submission mentioned above is applicable in the case of duty leave as well.

vii. **CONDONATION:** a student may have the privilege of condonation of attendance shortage (up to a maximum of 10 days) on the basis of genuineness of the grounds of absence (medical reasons or college duty), duly recommended by the department. This is not a matter of right. It is a matter of privilege based on Principal's discretion and the good conduct of the student on the campus. A student of UG programme may have a maximum of two such opportunities and that of PG programmes only one opportunity.

viii. **RE-ADMISSION** – a student whose attendance is inadequate will have to discontinue the studies. Such students, whose conduct is good, may be re-admitted with the approval of governing council, on the basis of recommendation from the department, and assurance from the student and the guardian regarding good conduct and compliance in academic and discipline matters. For this, the prescribed re-admission fee has to be paid.

As a condition for re-admission, the student should have cleared all academic arrears, or should have appeared for the exams in which he/she is having an arrear (if the results are not out), and should have fulfilled all academic assignments prescribed by the department for compensating for his lack of attendance.

ix. **UNAUTHORISED ABSENCE & REMOVAL FROM ROLLS:** A student absent from the classes continuously for 10 consequent days without intimation or permission shall be removed from the rolls, and the matter intimated to the student concerned. On the basis of recommendation of the department concerned, re-admission process may be permitted by the Principal.

5. PROGRAMME REGISTRATION

- i. A student shall be permitted to register for the programme at the time of admission.
- ii. A UG student who registered for the programme shall complete the same within a period of 12 continuous semesters and a PG student within a period of 8 continuous semesters from the date of commencement of the programme.

6. PROMOTION: A student who registers for the end semester examination shall be promoted to the next semester. However, in extreme circumstances, a student having sufficient attendance who could not register for the end semester examination may be allowed to register notionally by the Principal with the recommendation of the Head of the department concerned and, by paying the prescribed fee.

7. PROGRAMME STRUCTURE FOR MODEL - III

A	Programme Duration	6 Semesters
B	Minimum credits required from common course	8
C	Minimum credits required from three Core courses including Project	109
D	Total Credits required for successful completion of the programme	120
E	Club activity (desirable)	01
F	Social service (mandatory)	01
G	Internship (mandatory)	02
H	Project Work	01
I	Minimum attendance required	75%

8. EXAMINATIONS

All the End Semester Examinations of the college will be conducted by the Controller of Examination. The Principal will be the Chief Controller of Examinations. An Examination committee consists of the Chief Controller of Examinations, Controller of Examinations, Additional Chief Superintendent, Deans, IQAC Coordinator and other faculty members nominated by the Principal will act as an advisory body of the matters relating to the conduct of examinations.

9. EVALUATION AND GRADING

The evaluation scheme for each course shall contain two parts;

- a. Continuous Internal Evaluation (CIA) and
- b. End Semester Examination (ESE).

The internal to external assessment ratio shall be 1:3, for both courses with or without practical. For courses without practical, there shall be a maximum of 75 marks for external evaluation and maximum of 25 marks for internal evaluation. For courses with practical, generally external evaluation shall be for a maximum of 60 marks and internal evaluation for 20 marks. Both internal and external evaluation shall be carried out in the mark system and the marks are to be rounded to the nearest integer.

- a. **Continuous Internal Assessment (CIA)/ Continuous Assessment:** The internal evaluation shall be based on predetermined transparent system involving periodic written tests, assignments, seminars/viva/field survey and attendance in respect of theory courses and based on written tests, lab skill/records/viva and attendance in respect of practical courses. The marks assigned to various components for internal evaluation as follows.

Components of Internal Evaluation (for theory without practical)

	Components	Marks
i.	Assignments	5
ii	Seminar/Quiz/Field survey /Viva etc.	5
iii	Attendance	5
iv	Two Test papers(2x5)	10
	Total	25

- i. **Assignments:** Every student shall submit one assignment as an internal component for every course.

Components	Marks
Punctuality	1
Content	2
Conclusion	1
Reference/Review	1
Total	5

- ii. **Seminar:** The seminar lecture is expected to train the student in self-study, collection of relevant matter from the books and Internet resources, editing, document writing, typing and presentation.

Components	Marks
Content	2
Presentation	2
Reference/Review	1
Total	5

iii. Evaluation of Attendance

2.10 The attendance of students for each course shall be another component of internal assessment.

% of attendance	Mark
Above 90%	5
Between 85 and below 90	4
Between 80 and below 85	3
Between 76 and below 80	2
Between 75 and below 76	1

Components of Internal Evaluation (for theory with practical)

Components of Theory – Internal Evaluation	Marks
Attendance	5
Seminar/ Assignment (Written assignments, preparation of models, charts, posters etc., field survey, field work)	5
Test paper(s)	10
Total	20

Components of Practical- Continuous internal assessment

Components	Marks
Attendance and Lab involvement	2
Record	2
Viva/Model Exam	1
Total	5

iv. **Class Tests:** Every student shall undergo **two class tests** as an internal component for every course.

b. **End Semester Examination (ESE):** The End Semester Examination in theory courses shall be conducted by the college with question papers set by external experts/ question bank. The evaluation of the answer scripts shall be done by the examiners based on a well-defined scheme of evaluation given by the question paper setters/Prepared as per the direction of the Chairman, Board of Examiners. The evaluation of the End Semester Examinations shall be done immediately after the examination preferably through the

centralized valuation.

c. Project

Project work is a part of the syllabus of most of the programmes offered by the college. The guidelines for doing projects are as follows:

- i. Project work shall be completed by working outside the regular teaching hours.
- ii. Project work shall be carried out under the supervision of a teacher in the concerned department or an external supervisor.
- iii. A candidate may, however, in certain cases be permitted to work on the project in an industrial / Research Organization/ Institute on the recommendation of the Supervisor.
- iv. There should be an internal assessment and external assessment for the project work in the ratio 1:3
- v. The external evaluation of the project work consists of valuation of the dissertation (project report) followed by presentation of the work and viva voce.
- vi. The mark and credit with grade awarded for the program project should be entered in the grade card issued by the college.

Components of Internal Evaluation for Projects

Components	Marks
Topic/Area selected	2
Experimentation/Data collection	5
Punctuality-Regularity	3
Compilation	5
Content	5
Presentation	5
Total	25

d. Comprehensive Viva-voce

Comprehensive Viva-voce shall be conducted at the end of the programme, which covers questions from all courses in the programme as per the syllabus.

e. Grade and Grade Points

For all courses (theory & practical), Letter grades and grade point are given on a 10-point scale based on the total percentage of marks, (CIA+ESE) as given below:-

Percentage of Marks	Grade	Grade Point (GP)
95 and above	S Outstanding	10
85 to below 95	A ⁺ Excellent	9
75 to below 85	A Very Good	8
65 to below 75	B ⁺ Good	7
55 to below 65	B Above Average	6
45 to below 55	C Average	5
35 to below 45	D Pass	4
Below 35	F Fail	0
	Ab Absent	0

Grades for the different semesters and overall programme are given based on the corresponding SGPA/CGPA as shown below:

SGPA/CGPA	Grade
Equal to 9.5 and above	<i>S Outstanding</i>
Equal to 8.5 and below 9.5	<i>A+ Excellent</i>
Equal to 7.5 and below 8.5	<i>A Very Good</i>
Equal to 6.5 and below 7.5	<i>B+ Good</i>
Equal to 5.5 and below 6.5	<i>B Above Average</i>
Equal to 4.5 and below 5.5	<i>C Average</i>
Equal to 4.0 and below 4.5	<i>D Pass</i>
Below 4.0	<i>F Failure</i>

A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass for a course. A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the end semester examination for the same semester, subsequently. A student who fails to secure a minimum marks/grade for a pass in a course can be permitted to write the examination along with the next batch.

After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula given below. For the successful completion of semester, a student should pass all courses and score at least the minimum

CGPA grade 'D'. However, a student is permitted to move to the next semester irrespective of her/his SGPA.

Credit Point (CP) of a course is calculated using the formula

CP = Cr x GP, where Cr = Credit; GP = Grade point

Semester Grade Point Average (SGPA) of a Semester is calculated using the formula

SGPA = TCP/TCr, where

TCP = Total Credit Point of that semester = $\sum_1^n CP_i$;

TCr = Total Credit of that semester = $\sum_1^n Cr_i$

Where n is the number of courses in that semester

Cumulative Grade Point Average (CGPA) of a Programme is calculated using the formula

CGPA = $\frac{\sum(SGPA \times TCr)}{\sum TCr}$

SGPA/CGPA shall be round off to two decimal places

To ensure transparency of the evaluation process, the internal assessment marks awarded to the students in each course in a semester shall be published on the notice board/website at least one week before the commencement of external examination. There shall not be any chance for improvement for internal mark.

The course teacher and the faculty advisor shall maintain the academic record of each student registered for the course which shall be forwarded to the controller of examinations through the Head of the Department and a copy should be kept in the department for at least two years for verification

10. Registration for the examination

- a. All students admitted in a programme with remittance of prescribed fee are eligible for the forthcoming semester examinations.
- b. Online application for registration to the various End Semester Examinations shall be forwarded to the CE along with prescribed fee for each course in prescribed format.
- c. The eligible candidates who secure the prescribed minimum attendance of the total duration of the course and possess other minimum qualification prescribed in the regulations for each course shall be issued the hall tickets. The hall ticket shall be downloaded by the students from the college website.
- d. The mode of fee remittance shall be through the prescribed bank.

11. Supplementary Examinations

Candidates who failed in an examination can write the supplementary examination conducted by the College along with regular examinations.

12. Improvement of Examination

A candidate can improve his/her marks once by appearing again for the examination with the subsequent batch with the remittance of prescribed fee. In such cases the better of the two marks shall be taken as the marks awarded to him.

Internal assessment marks shall be carried over to the subsequent semester examination.

There shall not be any provision for improving internal assessment marks.

There will be no improvement examinations for PG programmes

13. Promotion to the Next Higher Semester

A candidate shall be eligible for promotion from one semester to the next higher semester if,

- a. He/she secures a minimum 75 % attendance and registered for the End Semester Examination of the programme for which he/she is studying.
- b. His / her progress of study and conduct are satisfactory during the semester completed, as per the assessments recorded by the course teachers and the Head of the Department concerned.

14. Certificates

1. Diploma and Degree certificates are issued by the Mahatma Gandhi University, Kottayam as per the act and statues of the University on the submission of the consolidated mark / score cards of the students by the College.
2. A consolidated mark / scored card shall be issued to the candidates after the publication of the results of the final semester examination taken by the candidate.
3. A Course Completion Certificate with classification shall be issued to students till the provisional certificate is issued by the university.

15. Award of Degree

The successful completion of all the courses with 'D' grade shall be the minimum requirement for the award of the degree. For M. Phil., minimum grade required is 'C'

16. Monitoring

There shall be a Monitoring Committee constituted by the principal consisting of faculty advisors, HoD, a member from teaching learning evaluation committee (TLE) and the Deans to monitor the internal evaluations conducted by college. The Course teacher, Class teacher and the Deans should keep all the records of the internal evaluation, for at least a period of two years, for verification.

Every Programme conducted under Choice Based Credit System shall be monitored by the College Council under the guidance of IQAC Coordinator, Controller of Exams, academic deans and HoDs.

17. Grievance Redressal Mechanism

In order to address the grievance of students regarding Continuous internal assessment (CIA) a three-level Grievance Redressal mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1: At the level of the concerned course teacher

Level 2: At the level of a department committee consisting of the Head of the Department, a coordinator of internal assessment for each programme nominated by the HoD and the course teacher concerned.

Level 3: A committee with the Principal as Chairman, Dean of the Faculty concerned, HOD of the department concerned and one member of the Academic council nominated by the principal every year as members.

15. Eligibility for Admission:

A candidate who has passed Grade 12 with Mathematics or Statistics as one of the subjects shall be eligible for admission to the programme.

DETAILED DISTRIBUTION OF COURSES

Choice-based Credit and Semester System: BSc Economics (Triple Main) – Model III

SEM	COURSE CODE	TITLE OF THE COURSE	NO.OF HOURS /WEEK	NO.OF CREDITS	WEIGHTAGE	
					INTERNAL	EXTERNAL
1	1	English - I	5	4	25	75
	2	Mathematics - I <i>Calculus</i>	5	4	25	75
	3	Statistics - I <i>Descriptive Statistics</i>	5	3	25	75
	4	Economics – I <i>Microeconomics</i>	5	4	25	75
	5	Economics – II Indian Economic Issues	5	3	25	75
2	6	English – II	5	4	25	75
	7	Mathematics - II <i>Real Analysis I</i>	5	4	25	75
	8	Statistics – II <i>Probability and Statistics</i>	3	3	25	75
	9	Economics – III <i>Macroeconomics</i>	5	4	25	75
	10	Economics – IV <i>Optimization Techniques for Economic Analysis</i>	5	3	25	75
	11	Statistics Practical – I <i>Problem solving using MS Excel</i>	2	2	-	50
3	12	Economics – V <i>Business Economics</i>	5	4	25	75
	13	Mathematics – III <i>Real Analysis II</i>	5	4	25	75
	14	Statistics – III <i>Probability Distributions</i>	5	4	25	75
	15	Economics – VI <i>Theory of Matrices and Mathematical Economics</i>	5	4	25	75
	16	Mathematics – IV <i>Vector Calculus and Laplace Transform & Fourier Series</i>	5	4	25	75
4	17	Mathematics – V <i>Abstract Algebra</i>	5	4	25	75

	18	Statistics – IV <i>Statistical Inference</i>	3	3	25	75
	19	Economics – VII <i>Public Finance and Banking</i>	5	4	25	75
	20	Economics – VIII <i>Indian Financial Systems</i>	5	4	25	75
	21	Mathematics – VI <i>Differential Equations</i>	5	3	25	75
	22	Statistics Practical – II <i>Problem solving using Excel/SPSS</i>	2	2	-	50
5	23	Open Course	4	3	25	75
	24	Mathematics – VII <i>Complex Analysis</i>	4	3	25	75
	25	Mathematics – VIII <i>Numerical Analysis</i>	4	3	25	75
	26	Statistics – V <i>Sampling Theory and Design of Experiments</i>	4	4	25	75
	27	Economics – IX <i>Environmental Economics</i>	.5	4	25	75
	28	Statistics – VI <i>Actuarial Science</i>	4	4	25	75
6	29	Mathematics – IX <i>Linear Algebra and Graph Theory</i>	5	4	25	75
	30	Statistics – VII <i>SQC and Elements of Stochastic process</i>	5	4	25	75
	31	Economics – X <i>Econometrics</i>	5	4	25	75
	32	Choice-based Elective Course	5	4	25	75
	33	Statistics Practical – III <i>Problem solving using R</i>	3	2	25	75
		Project Work	2	2	-	50
		Viva Voce		1	-	50

Choice Based Electives

1. Agricultural Economics
2. International Economics
3. Advanced Econometrics
4. Industrial Economics
5. Game Theory
6. Combinatorics
7. Multivariate Calculus
8. Advanced Optimization Techniques for Economic Analysis
9. Probability and Measure
10. Predictive Analytics for Business Analysis

Total Credits for Core Courses	:	109
Open Course	:	03
Total Credits for Core Course		112
Total Credits for Common Course	:	08
		120

	PROGRAMME OUTCOMES DESCRIPTION
PO1	Critical Thinking & Deep Domain Knowledge
PO2	Effective Communication
PO3	Contribute to Nation Building
PO4	Care for the Environment
PO5	Ethical Values
PO6	Global Perspective

	PROGRAMME SPECIFIC OUTCOMES DESCRIPTION
PSO1	Pursue a successful professional career in the software industry, government, academia, research, or other areas where computer applications are deployed.
PSO2	Demonstrate proficiency in areas of Computer science such as, networking, web development, database queries, cyber security and software engineering.
PSO3	Develop programming skills, networking skills; learn applications, packages, programming languages and modern techniques of IT.
PSO4	Apply theoretical concepts to design and develop programs and develop Industry-focused skills for a successful career.
PSO5	Acquire an understanding in advanced areas of mathematics and statistics.

DETAILS OF COURSES

COURSE 1

COURSE 1: HOMO LOQUENS: EFFECTIVE LISTENING AND SPEAKING

Course Code	19U1CCENG01
Title of the course	Homo Loquens: A Course in Effective Listening and Speaking
Semester in which the course is to be taught	1
No. of credits	4
No. of contact hours	90

COURSE DESCRIPTION

The course is designed as a practical guide to help the students acquire higher levels of listening and speaking skills. The listening part consists of audio recordings of various kinds of speeches which are graded from basic comprehension involving information gathering to advanced listening skills involving deductive comprehension. Each listening unit comprises a series of exercises intended to help the learners improve their vocabulary and sense of grammar. Since the course is designed as a student-centered series of activities, the role of the teacher here is that of a coach. The exercises recommended in the course are intended to be practised in the class.

Aim of the Course

The course is intended to enable the students to acquire higher level of listening comprehension skills and to help them acquire the ability and confidence to use English language in their oral communication.

Course Outcome

On completion of the course, the students should be able to:		PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	Understand the mechanics of English language and comprehend the meaning of simple narrations, announcements and instructions.						
CO 2	Make inferences about the implications of statements from stress and tone recognize the various registers of speech.	*		*			

CO 3	Listen to formal presentations and prepare lecture notes using the appropriate format.						
CO 4	Use English language for a variety of speaking contexts including conversations, presentations, speeches, discussions and negotiations.						
CO 5	Critically evaluate presentations, narrations, speeches and analyze and evaluate their content and respond to them appropriately.						
CO 5	Creatively respond to one's surroundings in the form of dramatic works, poetry, narrations, and songs, and perform them before an audience.						

COURSE OUTLINE

Module 1

[18 Hours]

Listening Comprehension 1: Information Gathering

Skills in focus: Recognising key words and key ideas and extracting specific information from announcements, conversations, presentations and short narrations

Vocabulary in focus: Diction, Collocations, synonyms, antonyms

Grammar in focus: Content words - Nouns, Adjectives, Verbs, Adverbs; Grammatical words – Articles, Pronouns, Prepositions, Conjunctions, Auxiliaries

Module 2

[18 Hours]

Listening Comprehension 2: Forming Inferences

Skills in focus: Drawing inferences related to themes, events, characters, actions etc. from announcements, conversations, presentations and short narrations; Identifying attitudes and emotions of the speaker; Distinguishing between fact and opinion; Identifying the sequence of events, turning points, and the type of discourse; Making predictions based on available information

Vocabulary in focus: Phrasal verbs, Transition words, Idiomatic expressions, Metaphorical use of language

Grammar in focus: Phrases, Clauses, Sentences, Subject verb agreement, Tenses, Active and Passive sentences, Reported speech

Module 3

[18 Hours]

Language in Everyday Use

Skills in focus: Using language to perform various functions in formal and informal contexts:

Appropriate expressions for greeting, agreeing, disagreeing, expressing sympathy, expressing gratitude, giving opinions, making suggestions, asking for information, complimenting, expressing obligation or necessity

Asking questions, making requests, asking for permission, refusing permission, accepting invitation, declining invitation, asking for directions, giving directions, expressions of time, making complaints, offering thanks, apologizing

Module 4

[18 Hours]

Language as Performance

Skills in focus: Developing confidence to respond to various situations through a series of group activities; Engaging in problem solving through short presentations (group); Performing role plays; Participating in group discussions; Responding creatively through various literary forms

Module 5

[18 Hours]

Contextual use of language

Skills in focus: Using language confidently and effectively on formal occasions; Using stress and intonation accurately; Engaging in small talk (chat show); Initiating and participating in telephone conversations; Conducting/Attending interviews; Speaking on ceremonial occasions (welcome speech, presenting someone, felicitations, vote of thanks); Speaking to persuade: Making presentations and participating in debates.

Core Text: *Homo Loquens: A Guide to Effective Listening and Speaking*

COURSE 2
CALCULUS
MATHEMATICS CORE- 1

Course Title	Calculus
Course Code	19U1CRMAT01
Semester	1
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Course Objectives:

The objective of the course is to familiarise the students with the various applications of derivatives and definite integrals especially in economics and business. The course introduces Rolle's Theorem, Lagrange's Mean Value Theorem and their applications.

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs
CO1	Determine whether a given function is increasing or decreasing.	PO1/PSO2	A	PK	6
CO2	Determine limits of functions using limit rules	PO1/PSO2	A	P	6
CO3	Compute higher order derivatives	PO1/PSO2	A	P	6
CO4	Apply the concepts of maxima and minima of a function to real world problems	PO1/PSO2	A	P	6
CO5	Compute derivative for implicit functions	PO1/PSO2	A	P	18
CO6	Apply the concepts of integration to consumer surplus and producer surplus problems	PO1/PSO2	U	C	18

Bridge Course (No questions are to be asked from this section)

Module I

Limits: A Numerical and Graphical Approach, Algebraic Limits and Continuity, Average Rates of Change, Differentiation Using Limits of Difference Quotients, Differentiation

Techniques: The Power and Sum–Difference Rules, Differentiation Techniques: The Product and Quotient Rules, The Chain Rule, Higher-Order Derivatives

(Sections 1.1-1.8 of the Core text)

(20 Hrs)

Module II

Using First Derivatives to Find Maximum and Minimum Values and Sketch Graphs, Using Second Derivatives to Find Maximum and Minimum Values and Sketch Graph, Graph Sketching: Asymptotes and Rational functions, Using Derivatives to Find Absolute Maximum and Minimum Values, Maximum–Minimum Problems, Business and Economics Applications

(Sections 2.1-2.5 of the Core Text)

(20 Hrs)

Module III

Anti-differentiation, Antiderivatives as Areas, Area and Definite Integrals, Properties of Definite Integrals

(Sections 4.1-5.4 of the Core text)

(16 hrs)

Module IV

Integration Techniques: Substitution, Integration Techniques: Integration by Parts, Integration Techniques: Tables, An Economics Application: Consumer Surplus and Producer Surplus

(Sections 4.5-4.7 and 5.1 of the Core text)

(16 hrs)

Text Book: Calculus And Its Applications, by Marvin L. Bittinger, David J. Ellenbogen, Scott A. Sargent (10th Edition), Addison-Wesley.

References

- 1) Thomas Calculus by Maurice Weir, Joel Hass, Frank R Giordano.(11th edition), 2008, Pearson Education
- 2) Calculus: (Vol 1) One Variable Calculus with an introduction to Linear Algebra by Tom M Apostol (2nd Edition), 2016, Wiley Student Edition.
- 3) Advanced Calculus, Schaum’s outlines, by Robert C Wrede and Murray Spiegel. (2nd Edition), 2005, Tata McGraw-Hill.
- 4) Calculus and Its Applications by Larry J Goldstein, David C Lay, David I Schneider and Nakhle H Asmar (12th Edition), 2010, Pearson Education.
- 5) Calculus Early Transcendentals, by James Stewart (5th Edition), 2007, Thomson Learning.

COURSE 3
DESCRIPTIVE STATISTICS
 STATISTICS CORE I

Course Code	
Title of the course	DESCRIPTIVE STATISTICS
Semester in which the course is to be taught	1
No. of credits	4
No. of contact hours	90 (72 Theory + 18 Practical)

Bridge course (7 hours)

(N.B. No questions to be asked for the end semester examination)

Meaning and scope of statistics, Population and sample, Census and Sampling, Advantages of sampling compared to census, Collection of data, Primary and Secondary data, Questionnaire, Types of data – quantitative and qualitative data; Classification and Tabulation, Frequency distributions – discrete, continuous and cumulative frequency distributions; Representation of Statistical data – Bar diagrams, Pie diagrams, Histograms, Frequency polygons and frequency curves, ogives; stem and leaf charts

Module I (25 hours)

Measures of central tendency – Mean, Median, Mode, Geometric Mean, Harmonic Mean - their properties; Quantiles – quartiles, quintiles, deciles, percentiles; Absolute and relative measures of dispersion - Range, Quartile Deviation, Mean Deviation, Standard Deviation- their properties; Coefficient of Variation, Box plots, Lorenz Curve

Module II (10 hours)

Moments – Raw moments, Central moments, Absolute moments- Inter Relations; Skewness, Measures of skewness – Pearson, Bowley and Moment measure; Kurtosis – Moment measure of kurtosis

Module III (10) hours)

Scatter diagram, Curve fitting – Method of least squares, fitting of a straight line, second degree curve, exponential curve, power curve.

Module IV (20 hours)

Index numbers – Simple and Weighted index numbers – Laspeyre’s, Paasche’s,

Bowley's and Fisher's index numbers; Test for index numbers; Cost of living index numbers and their constructions.

Time series- Components of a time series data, Determination of trend- Moving average and curve fitting methods; Computation of and seasonal indices – Method of simple averages.

References

1. S.C. Gupta and V. K. Kapur. (2002) Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and sons New Delhi
2. S.P. Gupta. Statistical Methods ,Sultan Chand & Sons Delhi
3. B.L. Agarwal. Basic Statistics, New Age International (p) Ltd.
4. S.C.Gupta and V.K.Kapoor.(2007) Fundamentals of Applied Statistics,Sultan Chand & Sons Delhi
5. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.
6. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.
7. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes

COURSE 4
MICROECONOMICS

ECONOMICS CORE 1

Course Code	
Title of the course	MICROECONOMICS
Semester in which the course is to be taught	1
No. of credits	4
No. of contact hours	90

Module 1: Exploring the subject matter of Economics

Why study economics? Scope and method of economics; the economic problem: scarcity and choice; the question of what to produce, how to produce and how to distribute output; science of economics; the basic competitive model; prices, property rights and profits; incentives and information; rationing; opportunity sets; economic systems; reading and working with graphs.

Module 2: Supply and Demand: How Markets Work, Markets and Welfare

Markets and competition; determinants of individual demand/supply; demand/supply schedule and demand/supply curve; market versus individual demand/supply; shifts in the demand/supply curve, demand and supply together; how prices allocate resources; elasticity and its application; controls on prices; taxes and the costs of taxation; consumer surplus; producer surplus and the efficiency of the markets.

Module 3: The Households

The consumption decision - budget constraint, consumption and income/price changes, demand for all other goods and price changes; description of preferences (representing preferences with indifference curves); properties of indifference curves; consumer's optimum choice; income and substitution effects; labour supply and savings decision - choice between leisure and consumption.

Module 4: The Firm and Perfect Market Structure and Imperfect Market Structure

Behavior of profit maximizing firms and the production process; short run costs and output decisions; costs and output in the longrun.

Monopoly and anti-trust policy; government policies towards competition; imperfect competition.

Module 5: Input Markets

Labour and land markets - basic concepts (derived demand, productivity of an input, marginal productivity of labour, marginal revenue product); demand for labour; input demand curves; shifts in input demand curves; competitive labour markets; and labour markets and public policy.

Readings

1. Karl E. Case and Ray C. Fair, *Principles of Economics*, Pearson Education Inc., 8th Edition, 2007.
2. N. Gregory Mankiw, *Economics: Principles and Applications*, India edition by South Western, a part of Cengage Learning, Cengage Learning India Private Limited, 4th edition, 2007.
3. Joseph E. Stiglitz and Carl E. Walsh, *Economics*, W.W. Norton & Company, Inc., New York, International Student Edition, 4th Edition, 2007.

COURSE 5
INDIAN ECONOMIC ISSUES AND POLICIES

Course Code	
Title of the course	INDIAN ECONOMIC ISSUES AND POLICIES
Semester in which the course is to be taught	1
No. of credits	3
No. of contact hours	90

Module I: Economic Development Strategy since Independence (25 hrs)

Major features of the economy at independence - Mixed economic framework - Key and strategic role of PSUs – Economic crisis of 1990 – Macro economic reforms implemented since 1991 - Globalization, Liberalization and Privatization – Performance of Indian economy before and after economic reforms - External sector reforms since 1991 - Trade and currency reforms, - foreign capital - FDI, MNCs.

Module II- Demographic Features (20 hrs)

Population–size and structure – characteristics – rural-urban migrations, occupational distribution, problems of over population, population dividend, population policies, gender inequality, women empowerment, education, health, malnutrition.

Module III: Agriculture, Industry and Service Sectors (25 hrs)

Role of agriculture in Indian Economy - Land reforms - New agricultural strategy – Green Revolution - Agricultural Growth and Performance -Agricultural finance and Issues - WTO and Indian Agriculture – food security and PDS in India. Industrial growth during pre-reform and post reform period- Industrial Policy Resolution of 1956 and 1991 – Privatization and disinvestment - Make in India initiatives – Role of Micro, Small and Medium Enterprises (MSMEs) in Indian Economy - Role and performance of service sector in Indian economy – Economic infrastructure in the country: Banking, insurance, transport, telecommunication, energy.

Module IV: Economic Planning and Development Issues (20 hrs)

Basic strategies, objectives and achievements of planning in India - Inclusive growth - NITI Aayog - Trends in India's national income and per capita income – Magnitude of poverty and inequality in India - Unemployment, black money and corruption – rising prices

Readings:

1. Jean Dreze and Amartya Sen, Jean Dreze and Amartya Sen, 2013. *An Uncertain Glory: India and its Contradictions*, Princeton University Press.
2. Rakesh Mohan, 2008, -Growth Record of Indian Economy: 1950-2008. A Story of Sustained Savings and Investment, *Economic and Political Weekly*, May.
3. S.L. Shetty, 2007, -India's Savings Performance since the Advent of Planning, in K.L. Krishna and A. Vaidyanathan, editors, *Institutions and Markets in India's Development*.
4. Himanshu, 2010, Towards New Poverty Lines for India, *Economic and Political Weekly*, January.
5. Himanshu. 2011, -Employment Trends in India: A Re-examination, *Economic and Political Weekly*, September.
6. Rama Baru et al, 2010, -Inequities in Access to Health Services in India: Caste, Class and Region, *Economic and Political Weekly*, September.
7. J.B.G. Tilak, 2007, -Post Elementary Education, Poverty and Development in India, *International Journal of Educational Development*.
8. T. Dyson, 2008, -India's Demographic Transition and its Consequences for Development in Uma Kapila, editor, *Indian Economy Since Independence*, 19th edition, Academic Foundation.
9. K. James, 2008, -Glorifying Malthus: Current Debate on Demographic Dividend in India, *Economic and Political Weekly*, June.
10. Reetika Khera, 2011, -India's Public Distribution System: Utilisation and Impact *Journal of Development Studies*
11. Misra and Puri (recent edition), *Indian Economy*, Himalaya Publishing House, Mumbai.
12. Gaurav Datt & Ashwani Mahajan (recent Edition), *Datt & Sundaram Indian Economy*, S. Chand & Co., New Delhi
13. Y V Reddy (2011) *Global crisis, Recession and Uneven Recovery*, Orient Black Swann.

COURSE 6

TEXT AND CONTEXT: A GUIDE TO EFFECTIVE READING AND WRITING COMMON COURSE – ENGLISH 2

Course Code	19U2CCENG03
Title of the course	Text and Context: A Guide to Effective Reading and Writing
Semester in which the course is to be taught	2
No. of credits	4
No. of contact hours	90

COURSE DESCRIPTION

The course is conceived as a practice-oriented guide to the development of harder language skills namely, reading and writing. The reading exercises are designed in such a way that it helps slow learners as well to acquire adequate skills to go to the higher levels where the students are expected not only to comprehend factual and implied information, but also to discern the mechanics with which authors infuse affective elements into writing. Writing tasks are also graded from simple compositions to attempting sophisticated literary pieces towards the end of the course. Instead of the conventional lecture method, the course is to be delivered as guided sessions involving composition writing and one-to-one mentoring sessions and hence the course material is prepared as a pair of books consisting of a textbook and a workbook.

Aim of the Course

The course is intended to hone the reading and writing skills of the students through a series of exercises and composition work.

Course Outcome:

	COURSE OUTCOMES	PO	PSO
CO 1	Perform different reading strategies such as skimming and scanning.	1,2,5	2,4,5,6
CO 2	Demonstrate an understanding of the implicit and explicit meaning of written materials	1,2,6	1,2,,4
CO 3	Demonstrate an understanding of the different registers of language.	1,2,5	1,3,
CO 4	Analyse the use of various writing strategies adopted by	1,2,5	2,4,6

	writers through close reading.		
CO 5	Synthesize information from various written sources and present them in the form of summaries.	1,2,6	2,3,4,5
CO6	Write original literary creations in different genres as directed, with/without using prompts.	2,3,4,6	1,3,5

Weight Indicators: 0 - No Mapping strength, 1 - Low, 2 - Medium, 3 - High

CO - PO/PSO Mapping												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	0	0	1	0	0	3	0	2	2	2
CO 2	3	3	1	0	2	2	2	3	1	2	0	0
CO 3	3	3	0	0	1	0	3	1	3	1	0	1
CO 4	3	3	0	0	1	0	0	3	0	2	0	2
CO 5	2	3	0	0	0	1	1	3	3	2	2	2
CO 6	1	3	3	1	2	2	1	0	3	0	2	1

Module 1:

[18 Hours]

Reading Strategies 1: Skimming and Scanning

Reading for general and specific information

Skimming the given passages and answer comprehension questions based on the text.

Vocabulary work: words, phrases, phrasal verbs, idioms, plural forms, synonyms, antonyms

Grammar work: cue words, conjunctions, intensity words, compound words, sequence of tense

Module 2

[18 Hours]

Strategies of Reading 2: Reading for Specific Purposes

Skills in focus: Answering factual, inferential, evaluative and extrapolative questions based on the given text. Inferring the meaning of unfamiliar words from context:

Writing précis

Writing integrated summaries

Module 3

[18 Hours]

Dynamics of Writing

Skills in focus: Employing strategies to read literary passages identifying affective components in literary texts; Recognising literary devices (Metaphors, similes, personification, synecdoche, understatement, hyperbole, paradox, imagery, transferred epithet, allusions, and acoustic effects). Writing critical commentaries on literary

passages bringing out the strategies adopted by the author to create the affective content.

Module 4

[18 Hours]

Academic Writing

Skills in focus: Employing writing strategies; writing letters, biodata, brochures, reviews and essays

Module 5

[18 Hours]

Writing Creatively: Directed Writing:

Skills in focus: Writing descriptions, narrations, conversations, plays, poems, advertisements, brochures, dramatic sequences, poems, etc. based on a given text or prompt

Core Text: *Text and Context: A Guide to Effective Reading and Writing*

5. MODEL QUESTION PAPER (*To be incorporated*)

COURSE 7
REAL ANALYSIS 1
 MATHEMATICS CORE 2

Course Title	Real Analysis – I
Course Code	19U5CRMAT05
Semester	2
Credits	4
Contact Hours per week	6
Contact hours per semester.	108

Course Objectives

The objectives of the course include the following:

- 1) To study elementary properties of real numbers.
- 2) To introduce sequences and series and their properties .
- 3) To introduce the limit of a function.

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Find the limit points, interior points and closure of a set	O1/PSO2	U	F	28	0
CO2	Verify the convergence of sequences and series	O1/PSO2	A	F,C	70	0
CO3	Determine the limits of functions	O1/PSO2	AP	F,C	5	0
CO4	Understand theorems on limits	O1/PSO2	U	F,P	5	0

Module -1

(12 Hrs)

Real Numbers

Intervals, bounded and unbounded sets, supremum and infimum of sets, completeness in the set of real numbers, Archimedean property, Dedekind's form of completeness,

Chapter 1:Sections, 2.6, 3,4 ,4.1, 4.2, 4.3 ,4.4

Module - 2

(25 Hrs)

Real Sequences

Sequences, Bounded sequences, convergent sequences, limit point of a sequence, Bolzano - Weierstrass theorem, upper and lower limits of a sequence, limit superior and limit inferior of a sequence, properties (no proof), more properties of convergent sequences, non-convergent sequences, Cauchy's general principle of convergence, Cauchy sequence, Algebra of sequences, some important theorems, Sandwich theorem, Cauchy's first theorem on limits, Cesaro's theorem, Cauchy's second theorem on limits, monotonic sequences, subsequences

Chapter 3 : Sections 1, 1.1, 1.2, 1.3, 1.4, 2, 2.1, 2.2, 2.3, 3, 4, 4.1, 4.2, 5, 6, 6.1, 7, 8, 9, 9.1.

Module -3

(25 Hrs)

Infinite Series

Introduction of an Infinite series, A necessary condition for convergence of an infinite series, Cauchy's general principle of convergence for an infinite series, series of positive terms, Geometric series, comparison series, comparison tests for series of positive terms, Cauchy's root test, D'Alembert's ratio test, Raabe's test, Logarithmic test, Integral test, Cauchy's integral test, Gauss's test,

Chapter 4 : Sections 1, 1.2, 1.3, 1.4, 2, 2.1, 2.2, 2.3, 3, 3.1, 3.2, 3.3, 4, 5, 6, 7, 8, 8.1, 9,

Module -4

(10 Hrs.)

Series of positive and negative terms, Alternating series, Leibnitz test, Absolute convergence and related results.

Chapter 4: Sections 10, 10.1, 10.2 .

Text Book:

Mathematical Analysis, 4th edition, S.C. Malik Savita Arora, New Age International Publishers, 2015.

References

1. Robert .G. Bartle and Donald R Sherbert, Introduction to Real analysis, 3rd edn.
2. Richard.R. Goldberg, Methods of Real Analysis, 3rd Edition, Oxford and IBM publishing co. 1964.
3. Shanti Narayan, A course of Mathematical Analysis S chand and Co ltd, 2004.
4. Elias Zako, Mathematical analysis Vol. 1, Overseas press, New Delhi ,2006.
5. J. M. Howie, Real Analysis, Springer, 2007
6. K.A. Ross, Elementary Real analysis, Springer, Indian reprint

COURSE 8
PROBABILITY AND STATISTICS

STATISTICS CORE 2

Course Code	
Title of the course	PROBABILITY AND STATISTICS
Semester in which the course is to be taught	2
No. of credits	3
No. of contact hours	72 (60 Theory + 12 Practical)

Module I (20 hours)

Random Experiments, Sample Space, Events, Algebra of events, Borel field of events. Approaches to probability- Statistical, Classical and Axiomatic; Addition theorem of probability, Conditional probability, Multiplication theorem, Independence of events, Theorem of total probability, Bayes' theorem.

Module II (15 hours)

Random variables, probability distributions and their properties, Distribution functions, Reliability functions, change of variables (univariate case only)

Module III (10 hours)

Joint distribution of a pair of random variables, marginal and conditional distributions, Independence of random variables

Module IV (15 hours)

Correlation and its properties, Rank correlation, Regression equations and their identification. Probable error, Coefficient of determination, Linear regression(Three variables case), partial and multiple correlations, their expressions and properties (no derivation)

References

1. S.P. Gupta (2011): Statistical Methods 43rd edition, Sultan Chand and Sons Delhi.
2. Gupta S. C. and Kapoor V. K. (2014): Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons
3. B.L. Agarwal (2013): Basic Statistics, 6th edition, New Age International (p) Ltd.

4. Parimal Mukhopadhyaya (1996): Mathematical Statistics, New Central Book Agency (p) Ltd, Calcutta
5. Murray R Spiegel, John Schiller, R. Alu Srinivassan (2008): Theory and problems of PROBABILITY AND STATISTICS, 3rd edition Schaum's Outlines, Tata McGraw-Hill Publishing Company Ltd
6. Rohatgi, V.K. and Saleh, A.K.MD.E.(2015).An Introduction to Probability and Statistics, (3rd ed.),John Wiley & Sons Inc.

COURSE 9
MACROECONOMICS
ECONOMICS CORE 3

Course Code	
Title of the course	MACROECONOMICS
Semester in which the course is to be taught	2
No. of credits	4
No. of contact hours	90

Module I- Introduction to Macroeconomics and National Income Accounting

Basic issues studied in macroeconomics; measurement of gross domestic product; income, expenditure and the circular flow; real versus nominal GDP; price indices; national income accounting for an open economy; balance of payments: current and capital accounts.

Module II- Money and Inflation

Functions of money; quantity theory of money; determination of money supply and demand; credit creation; tools of monetary policy.

Inflation and its social costs; hyperinflation.

Module III - Theoretical foundations of macroeconomics

The classical school – postulates of classical school- classical model with and without savings and dynamics in the model- Says Law- the quantity theory and its restatement by Friedman - The classical dichotomy-Homogeneity postulate-Say’s Identity and Equality (25 hours)

Module IV - The simple Keynesian model

The simple Keynesian model-The principle of effective demand and Keynesian economics- - The Keynesian cross model of income determination up to four sectors- multiplier and its dynamism- Consumption function- its attributes - hypotheses- inter temporal choice (30 hours)

Readings:

1. Dornbusch, Fischer and Startz, *Macroeconomics*, McGraw Hill, 11th edition, 2010.
2. N. Gregory Mankiw. *Macroeconomics*, Worth Publishers, 7th edition, 2010.
3. Olivier Blanchard, *Macroeconomics*, Pearson Education, Inc., 5th edition, 2009.

4. Richard T. Froyen, *Macroeconomics*, Pearson Education Asia, 2nd edition, 2005.
5. Andrew B. Abel and Ben S. Bernanke, *Macroeconomics*, Pearson Education, Inc., 7th edition, 2011.
6. Errol D'Souza, *Macroeconomics*, Pearson Education, 2009.
7. Paul R. Krugman, Maurice Obstfeld and Marc Melitz, *International Economics*, Pearson Education Asia, 9th edition, 2012.

COURSE 10
OPTIMIZATION TECHNIQUES FOR ECONOMIC ANALYSIS
 ECONOMICS CORE

Course Title	Optimization Techniques for Economic Analysis
Course Code	
Semester	2
Credits	3
Contact Hours per week	5
Contact hours per semester.	90

Module I- Introduction - Definition of O.R. - Scope, phases and Limitations of O.R. - Linear Programming Problem - Graphical Method - Definitions of bounded, unbounded and optimal solutions - procedure of solving LPP by graphical method - problems - Simplex technique - Definitions of Basic, non-basic variables - basic solutions - slack variables and optimal solution, simplex procedure of solving LPP - Problems.

Module II – Transportation and Assignment Balanced and unbalanced T.P, Feasible solution- Basic feasible solution - Optimum solution - degeneracy in a T.P. - Mathematical formulation - North West Corner rule - Vogell's approximation method (unit penalty method) Method of Matrix minima (Least cost Method) - problems-algorithm of Optimality test (Modi Method) - Problems. Introduction - Definition of Assignment problem, balanced and unbalanced assignment problem -restrictions on assignment problem - Mathematical formulation - formulation and solution of an assignment problem (Hungarian method) - degeneracy in an assignment problem – Problems.

Module III - Sequencing Definition - Basic assumptions - n jobs to be operated on two machines - problems - n-jobs to be operated on three machines - problems - n-jobs to be operated on m machines - problems . Definition of Inventory models-Type of inventory models: (i) Uniform rate of demand, infinite rate of production with no shortage (ii) Uniform rate of demand, finite rate of replacement with no shortage Book Works - Problems.

Unit - IV PERT CPM- definition of network, event, activity, Three time estimates (optimistic, pessimistic & most likely), critical path, total float and free float - difference between CPM and PERT – Problems.

Reference

P.K. Gupta, Manmohan and KantiSwarup, Operations Research, 9th edition, 2001, Sultan Chand & Sons, Chennai.

C KMustafi, Operations Research, Fourth Edition, New Age International Publishers

P.K.Gupta and D.S. Hira, Operations Research, 2th edition, 1986, S Chand & Co, New Delhi.

S. Kalavathy, Operations Research, 2nd edition -2002, Publishing House Pvt. Limited, New Delhi.

COURSE 11
PROBLEM SOLVING USING MS EXCEL
STATISTICS PRACTICAL

Course Title	Statistics Practical
Course Code	
Semester	2
Credits	2
Contact Hours per week	1
Contact hours per semester.	12

Aim of the course: To give practical training for calculating various statistical measures using Microsoft Excel and SPSS Examination shall be conducted externally to evaluate the students capacity to calculate the various measures mentioned below. Ten questions of 10 marks each shall be given and the student shall attempt any five questions of his her choice. The students shall be able to calculate the following from a given data set.

1. Mean, Median, Mode, Geometric mean and Harmonic mean
2. Quartiles, Quartile deviation, Mean deviation, Standard deviation, Coefficient of Variation
3. Raw Moments and central moments
4. Measures of Skewness and Kurtosis
5. Parameters of curve using principle of least squares and fitting of curves
6. Laspeye's, Paasche's, Bowley's and Fisher's Index numbers
7. Trend values and Seasonal indices
8. Karl Pearson's correlation coefficient and Spearman's rank correlation
9. Regression Equations and estimates
10. Partial and multiple correlations

COURSE 12
BUSINESS ECONOMICS
ECONOMICS CORE 4

Course Code	
Title of the course	BUSINESS ECONOMICS
Semester in which the course is to be taught	3
No. of credits	4
No. of contact hours	90

Module I: Introduction to Business Economics

The scope and methods of Business Economics – role in managerial decision making decision making – approaches to managerial decision making theory and firms – basic concepts in economics – scarcity – choice – resource allocation - fundamental concepts and principles: the incremental concept – the time perspective – the discounting principle – the opportunity cost concept – the equi- marginal principle(concepts only). **(12HRS)**

Module II: Demand Analysis and Forecasting

Demand – types – determinants of demand – Law of demand – changes in demand – elasticity of demand – income – price – cross (with numerical illustration) – Demand determinants of non-durable consumer goods – durable consumer goods – capital goods – demand forecasting – types – methods of demand forecasting – forecasting demand for new products – criteria for a good forecasting method. **(15hrs)**

Module III: Production and Cost Analysis

Production function: Production function with empirical studies – Cobb Douglas production function – Cost concepts and classification – accounting cost and economic cost – actual cost and opportunity cost – explicit cost and implicit or imputed cost – out of pocket cost – book cost – direct and indirect cost – historical cost and replacement cost – short run and long run cost – total cost – average cost – marginal cost – cost estimation – accounting cost method – engineering cost method – objective of the firm: managerial theory of firm- by William J. Baumol. **(15hrs)**

Module IV: Pricing and Profits

Pricing methods – cost oriented pricing – competition oriented pricing – practical methods of pricing – peak-load pricing – pricing of a new product – multi product pricing – Dual pricing – administered pricing – transfer pricing – profit – profit theories – risk bearing theory – market imperfection theory – innovation theory accounting and economic profit – profit planning – Break- even analysis (with numerical illustration). **(15hrs)**

Module V: Long Term Investment Decisions

Capital budgeting – meaning and need demand for capital – methods of investment criteria – payback period method – Average Rate of Return method – Discounted cash flow method – Net Present Value method – Profitability index – Internal Rate of Return method – (with numerical illustration) – cost of capital. **(15hrs)**

References

1. Dominick Salvatore. (2008) *Managerial Economics: Worldwide Applications*. New Delhi.
2. Nellis and Parker (2006). *Principles of Business Economics*. Pearson Education. New Delhi.
3. P.I. Mehta. *Managerial Economics*. Sultan Chand Publications.
4. H.L. Ahuja. *Business Economics*. S.Chand
5. S. Sankaran. (2002). *Managerial Economics*. Margham Publication
6. Mankar and Pillai. (2000). *Business and Managerial Economics*. Himalaya.
7. Mote Paul and Gupta (2000) *Managerial Economics*. Tata Mc Graw Hill.
8. R.L. Varshney and K.L. Maheshwari. *Managerial Economics*. Sultan Chand.
9. Sampat Mukherjee. *Business and Managerial Economics*. New Central Book Agency (p) Ltd.
10. Francis Cherunilam. *Business Economics*

COURSE 13
REAL ANALYSIS 2
 MATHEMATICS CORE

Course Title	REAL ANALYSIS - 2
Course Code	
Semester	3
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Text Books

1. Mathematical Analysis , 4thedition , S.C. Malik Savita arora

Course Objectives

The objectives of the course include the following:

- 1) To introduce continuous functions and to study their properties.
- 2) To introduce derivable functions.
- 3) To introduce Riemann integration for evaluating the integrals of certain bounded functions on finite closed intervals.
- 4) To study improper integrals, Beta and Gamma functions.
- 5) To study uniform convergence of a sequence and a series of functions.

Course Outcomes

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs
CO1	Understand the basic theorems relating limits	PO1/ PSO2	U	F	20
CO2	Understand the basic theorems relating continuity, derivability and integrability of functions.	PO1/ PSO2	U	,C	25
CO3	Understand the concept of Riemann integration	PO1/ PSO2	U	,C	25
CO4	Understand the concepts of convergence of sequence and series of functions	PO4/ PSO4	U	F, P	20

Module 1**(20 Hrs)**

Limits: Limits, Left hand limit and right hand limit, theorems on limits, limit of a function, limit of a function (sequential approach), Cauchy's criterion for finite limits .

Chapter 5: Sections 1 ,1.1 ,1.2 ,1.3 .

Module - II**(25 Hrs)****Continuity and Differentiability:**

Continuous functions, theorems on continuity, continuous functions on a finite closed interval, uniform continuity, derivability at a point, increasing and decreasing functions, Darboux's theorem, Intermediate value theorem for derivatives.

Text 1 :Chapter 5.Sections , 2.1, 2.2, 2.3,2.4, 3, 4, 4.1. **Chapter 6. Sections , 1, 2, 3, 3.1, 4 .**

Module - III**(25 Hrs)****Riemann Integration :**

Definition of Riemann integral , refinement of a partition , Darboux's theorem , conditions of integrability , integrability of sum , difference,product , quotient and modulus of integrable functions , integral as the limit of a sum ,some standard types of integrable functions , integration and differentiation , Fundamental theorem of integral calculus , first mean value theorem , the generalised first mean value theorem, introduction of Riemann- Stieltjes integral

Text 1 :Ch. 9 , Sections , 1 ,1.1 ,1.2 ,2 ,3 ,4 ,5 ,5.1 ,6 ,7 , 8 ,9 ,10.1.,10.2 . Ch. 10, Sections, 1 ,1.1 .

Module IV**(20 Hrs)****Sequences and Series of Functions :**

Point wise convergence of a sequence of functions,uniform convergence of a sequence of functions on an interval, Cauchy's criterion for uniform convergence, tests for uniform convergence of a sequence of functions, Weierstrass's M- test for uniform convergence of a series of functions,Abel's test and Dirichlet's test for the uniform convergence of a series of functions.

Text 1 : Chapter 12 , Sections , 1 ,2 ,2.1 ,2.2 ,2.3 ,3 ,3.1 ,3.2 .

References

- 1 Introduction to Real analysis, by Robert G Bartle and Donald R Sherbert, 3rd Edition, Wiley Student Edition
- 2 Methods of Real Analysis, by Richard R Goldberg, 3rd Edition ,Oxford and IBM publishing co. 1964.
3. Real analysis,by H.L.Royden, 3rd Edition., PHI .
4. A course of Mathematical analysis by Shanti Narayan S Chand and Co Ltd,2004.
5. Mathematical Analysis and its applications by J V Deshpande.

6. Mathematical Analysis Vol. 1, by Elias Zako ,Overseas press , New Delhi ,2006.

7. Real analysis , by Chatterjee, PHI .

8. Real Analysis ,by R A Gordon 2nd Edition. Pearson .

Question Paper Pattern

Module	Part-A (2 marks)	Part – B (5 marks)	Part – C (10 marks)	Total
1	3	3	1	7
2	3	2	1	6
3	4	1	1	6
4	2	2	1	5
Total No. of Questions	2	8	4	24
No. of Questions to be answered	10	5	3	18
Total marks	20	25	30	75

COURSE 14
PROBABILITY DISTRIBUTIONS

STATISTICS CORE 3

Course Code	
Title of the course	PROBABILITY DISTRIBUTIONS
Semester in which the course is to be taught	3
No. of credits	4
No. of contact hours	90

Module I (25 hours)

Mathematical Expectation- Moments, Moment generating functions(m.g.f.) and its properties, Characteristic function and its properties, Conditional expectation, Cauchy Schwartz inequality, Bivariate moments, Correlation between two random variables

Module II (25 hours)

Probability distributions -Uniform, Bernoulli, Geometric, Exponential, Gamma, Beta, Binomial, Poisson,– their properties, mean, variance, m.g.fs; Lack of memory property(LMP). Fitting of binomial and Poisson distributions

Normal, Standard normal and Lognormal distributions – their properties, mean, variance, m.g.fs; Fitting of a normal distribution

Module III (20 hours)

Tchebycheff's inequality, Bernoulli's law of large numbers, Weak law of large numbers, Central limit theorem (Lindberg Levy form with proof), Limiting distributions of binomial and Poisson distributions

Module IV(20hours)

Methods of sampling – Simple random sampling, systematic sampling and stratified sampling, Statistic and Parameter, Sampling distributions, standard error, Sampling distribution of mean and Variance, Chi-square, t and F – their properties and interrelations

References

1. S.C. Gupta and V.K. Kapoor (2014): Fundamentals of Mathematical Statistics, Sultan Chand and Sons
2. Hogg, R.V. and Craig A.T. (1970). Introduction to Mathematical Statistics, Amerind Publishing Co, Pvt. Ltd.

3. V.K. Rohatgi (2015) : An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
4. Mood A.M., Graybill F.A. and Boes D.C.(2017): Introduction to Theory of Statistics, 3rd edition, McGraw Hill.
5. Johnson, N.L, Kotz, S. and Balakrishnan N. (1994). Continuous Univariate Distribution, John Wiley, New York.
6. Johnson, N.L, Kotz, S. and Kemp, A.W. (2005)::Univariate Discrete Distributions, 3rd edition, John Wiley, New York.
7. Daroga Singh, F.S.Chaudhary(1986) :Theory and Analysis of Sample survey Designs New Age International (p) Ltd.
8. Murthy M.N 1969).: Sampling theory and Methods,3rd edition, Statistical Publishing Society, Calcutta.

COURSE 15
THEORY OF MATRICES AND MATHEMATICAL ECONOMICS
 ECONOMICS CORE 5

Course Code	
Title of the course	MATHEMATICAL ECONOMICS
Semester in which the course is to be taught	3
No. of credits	4
No. of contact hours	90

Course Outcome

At the end of the course a student is able to:					
CO1	Demonstrate knowledge about various production functions and cost functions	PO1/P SO 1	U	C	18
CO2	Demonstrate the ability to identify, explain, and use Mathematical concepts, Economic theories and functions in economic analysis.	PO1/P SO 1	Ap	C	18
CO3	Use Quantitative skills to measure and analyze the Consumer and demand functions	PO1/P SO 1	Ap	C	18
CO4	Apply Quantitative Techniques in economic analysis and consumer behavior.	PO1/ PSO 1	U	C	18
CO5	Evaluate the various aspects of market equilibrium.	PO1/P SO 1	U	C	18
TOTAL HOURS OF INSTRUCTION					90

Note: R-remember U-Understand, Ap- Applies An-Analyses, E-Evaluates, Cr- Creates

Unit 1: Theory of Matrices

- 1.1. Types of Matrices, Addition and Multiplication of matrices
- 1.2. Adjoint and inverse of matrices
- 1.3. Elementary transformations, Rank of matrices and calculation of inverse of matrices
- 1.4. Cayley Hamilton theorem and calculation of inverse

Unit- 2: The theory of Consumer Behavior

- 1.1. Utility function-Indifference Curves-commodity substitution-maximization of utility.
- 1.2. Demand function-compensated demand function-demand curves- price, income and cross

elasticities of demand-the Slutsky equation: substitution and income effects.

1.3. Linear expenditure system-separable and additive utility functions-homogeneous and homothetic utility functions- indirect utility function and duality in consumption.

1.4. Theory of revealed preference-strong axiom – substitution effect-composite commodities consumer surplus.

Unit- 3: The theory of the firm

(20 Hours)

2.1. Production function-product curve- Isoquants -elasticity of substitution-optimizing behaviour-constrained output maximisation-constrained cost minimisation-profit maximisation

2.2. Cost function-short run cost function-long run cost function-joint products-constrained revenue maximisation-profit maximisation-

2.3. Homogeneous Function –Definition and properties – Properties of Linearly Homogeneous Function – Cobb – Douglas Production Function – Expansion Path for Cobb-Douglas Function. Elasticity of Substitution -elasticity of linearly Homogenous Functions – C.E.S. and VES production functions—Translog forms-Euler's Theorem—Derivation of cost function from production function- Modern Approach to the Theory of Cost, Shephard's Lemma Adding Up Theorem- Production analysis of multi-product firm.

Unit- 4: Market Equilibrium

(30 Hours)

3.1. Demand function-market demand -producer demand-Supply functions: very short run short run and long run.

3.2. Commodity-market equilibrium: short run equilibrium-long run equilibrium-factor market equilibrium: demand functions, supply functions and market equilibrium- the existence and uniqueness of equilibrium- the stability of equilibrium: static and dynamic-dynamic equilibrium with lagged adjustment: cob-web theorem

3.3. Monopoly-AR and MR- Profit maximisation: cost function, profit maximisation; production function- price discrimination: market and perfect discrimination- the multi-plant monopolist-the multi-product monopolist-revenue maximizing monopolist-monopsony

3.4. Duopoly and oligopoly: homogeneous product: the Cournot and the Stackelberg solutions duopoly and oligopoly: differentiated products-market -shares solution and kinked demand curve solutions.

4.5. Theory of games: Two-person zero-sum game, pure and mixed strategy, game with and without saddle point, Nash equilibrium- Game theory and duopoly problems-solution to games with mixed strategy: the algebraic method and graphical solution to obtain value of the game.

References

1. Henderson, J. M. and R.E. Quandt (1980), Microeconomic Theory: A Mathematical Approach, McGraw Hill, New Delhi.
2. Chiang, A.C. (1986), Fundamental Methods of Mathematical Economics, Mc Graw Hill, New York.
3. R.G.D. Allen, Mathematical Economics, MacMillan, London
4. Lancaster, V. (1965): Mathematical Economics, Rand McNally College Pub
5. Brajesh Kumar (2010): Modern Microeconomics, Global Professional Publishing.
6. Thomas J. Nechyba (2017): Microeconomics: An Intuitive Approach with Calculus
7. Hugh Gravelle and Ray Rees (2010): Microeconomics, 4th Edition, Pearson Education Limited 2nd Edition, Cengage Learning.
8. Dowling. T.E., Introduction to Mathematical Economics, McGraw Hill.
9. Koutsoyiannis, A. (2011), Modern Microeconomics, Macmillan Press, London.
10. Hal R. Varian (2014): Intermediate Microeconomics with Calculus, 1st Edition, W. W. Norton & Company
11. Jeffrey M. Perloff (2014): Microeconomics with Calculus, 3rd Edition, Pearson Education Limited
12. Silberberg, E. (1990): The Structure of Economics – A Mathematical Analysis, McGraw hill

COURSE 16
VECTOR CALCULUS, FOURIER SERIES AND LAPLACE TRANSFORM
 MATHEMATICS CORE

Course Title	Vector Calculus, Fourier Series and Laplace Transform
Course Code	19U3CRMAT03
Semester	3
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Course Objectives:

- 1) To introduce the applications of vector calculus to real world problems.
- 2) To enable the student to find the number, location and roots of real polynomial equations upto fourth order
- 3) To study matrix theory and its application to solution of systems of linear equations.
- 4) To study the applications of Cayley Hamilton theorem.

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs
CO1	Find the gradient of a Scalar Field, the Divergence and Curl of a Vector Point Function, and the directional derivative	PO1/PSO2	A	PK	20
CO2	Understand the applications of vector integration	PO1/PSO2	AP	P	25
CO3	Find the Fourier series expansion of a given periodic function in a specified interval.	PO1/PSO2	AP	P	23
CO4	Find the Laplace transform of a given function.	O1/PSO2	AP	P	23

Module 1

(20 hrs)

Scalar and Vector Fields, Gradient of a Scalar Field, Geometrical Interpretation of Gradient, Directional Derivative, Properties of Gradient, Divergence of a Vector Point Function, Curl of a

Vector Point Function, Physical Interpretation of Divergence, Physical Interpretation of Curl, Properties of Divergence and Curl, Repeated Operations by ∇ .

(Sections 8.10-8.20 of Text 1)

Module 2

(25 hrs)

Integration of Vector Functions, Line Integrals, Circulation, Work Done by a Force, Surface Integrals, Volume Integrals, Divergence Theorem of Gauss (Relation between Surface and Volume Integrals), Green's Theorem in the Plane, Stoke's Theorem (Relation between Line and Surface Integrals).(All theorems without proof).

(Sections 8.21-8.29 of Text 1)

Module 3

(23 hrs)

Fourier Series

Periodic functions, Fourier series, Euler's formulae, Dirichlet's conditions, Change of interval, Half range series

Sections 10.1 to 10.7 of text 1

Module 4

(22 hrs)

Laplace Transforms

Definitions, Properties, Inverse Laplace transforms, Convolution theorem, Application to differential equations.

(Sections 18.1 to 18.12 of text 1)

Text Book: Engineering Mathematics, N.P. Bali, Manish Goyal

References

- 1) Calculus, by Howard Anton, Irl Bivens, Stephen Davis. (10th Edition), Wiley Student Edition.
- 2) Thomas Calculus by Maurice Weir, Joel Hass, Frank R Giordano.(11th edition), 2008, Pearson Education
- 3) Advanced Engineering Mathematics by Erwin Kreyszsig, Ninth Edition, Wiley, India
- 4) Higher Algebra by H.S. Hall and S.R. Knight, Surjit Publications, Delhi.
- 5) Higher Algebra by S. Bernard and J.M. Child, AITBS Publishers, India, 2009
- 6) Basic Linear Algebra, S.Blyth and E.F. Robertson, Springer, Second Edition, 2002
- 7) Matrices, Schaum's Outline Series, Tata McGraw Hill Publications.

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	2	1	6
Total No of Questions	12	8	4	24
No of Questions to be answered	10	5	3	18
Total Marks	20	25	30	75

COURSE 17
ABSTRACT ALGEBRA
 MATHEMATICS CORE

Course Title	Abstract Algebra
Course Code	19U5CRMAT07
Semester	4
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Text Book:

A First Course in Abstract Algebra (7th Edition), John B Fraleigh .

Course Objectives:

The course aims at introducing to the student the concept of groups and related concepts including subgroups, cyclic groups, abelian and non abelian groups, permutation groups, Lagrange's Theorem, Normal subgroups and Factor groups and homomorphisms and simple groups. The concepts of ring, ring with unity, commutative ring, integral domain, division ring and field are also introduced. Ideals, Factor rings and prime and maximal ideals are also discussed.

Course Outcomes:

CO	CO Statement	PO/ PSO	CL	KC	Hrs
CO1	Understand concepts of binary operations and groups	O1/PSO2	U	F	25
CO2	Understand the concepts of subgroups, cyclic group	O1/PSO2	U	F,C	15
CO3	Understand Lagrange's theorem and its applications	O1/PSO2	U	F,C	10
CO4	Understand the concepts of homomorphism and factor groups	O1/PSO2	U	F,P	10
CO5	Compute factor groups	PO1/PSO2	AP	P,C	10
CO6	Understand the concepts of Rings, Fields, Integral Domains	PO1/PSO2	U	C	10
CO7	Understand the concepts of prime and maximal Ideals	PO1/PSO2	U	C	10

Bridge Course

Basic Logic (Negation, Converse, Counter-positive of Statements, Methods of Proof) , Sets and relations, Functions, Types of Functions.

Module 1 (25 hrs)

Binary Operations, Isomorphic Binary Structures, Groups, Subgroups and Cyclic Groups.
(Sections 2-6 of the text)

Module 2 (25 hrs)

Groups of Permutations, Orbits, Cycles, and the Alternating Groups, Cosets and the Theorem of Lagrange, Direct Products
(Sections 8-10 and Section 11.1-11.11 of the Text)

Module 3 (20 hrs)

Homomorphisms, Factor Groups, Factor Group Computations and Simple Groups.
(Sections 13-15 of the Text)

Module 4 (20 hrs)

Rings and Fields, Integral Domains, Fermat's and Euler's Theorems, Homomorphisms and Factor Rings, Prime and Maximal Ideals (Proofs of Theorems 26.3,26.7,26.9 and 26.17 are to be excluded)
(Sections 18-20, 26 and 27.1-27.20).

References

- 1) Topics in Algebra by I.N. Herstein, Wiley Student Edition.
- 2) Contemporary Abstract Algebra by Joseph A Gallian, Narosa Publishing House.
- 3) Algebra by Michael Artin, PHI
- 4) Abstract Algebra by David S Dummit and Richard M Foote

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
1	3	2	1	6
2	3	2	1	6
3	3	2	1	6
4	3	2	1	6
Total No of Questions	12	8	4	24
No.of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

COURSE 18
STATISTICAL INFERENCE
STATISTICS CORE

Course Code	
Title of the course	STATISTICAL INFERENCE
Semester in which the course is to be taught	4
No. of credits	3
No. of contact hours	90 (72 Theory + 18 Practical)

Module I(15 hours)

Concepts of Estimation, Types of Estimation - Point Estimation, Interval Estimation; Properties of Estimation -Unbiasedness, Efficiency, Consistency and Sufficiency

Module II (15hrs)

Methods of Estimation MLE, Methods of Moments, Method of Minimum Variance, Cramer-Rao Inequality (without proof), Interval Estimation for Mean, Variance and Proportion.

Module III (20 hours)

Testing of hypothesis, Statistical hypothesis, Simple and composite hypothesis , Null and Alternate hypotheses, Type I and Type II errors, Critical Region, Size of the test, P value, Power, Neyman-Pearson approach(without proof) , Small sample tests – Z-test,, t- test, Paired t –test, Chi-square test for testing variance and F test for testing equality of variances

Module IV (15 hours)

Large Sample test- Z test for testing population means, equality of population means; Testing population proportion, equality of two population proportions; Chi-Square test - goodness of fit, test of independence; Analysis of Variance (one way classification), Non- parametric tests Wilcoxon signed rank test, Mann Whitney U test

References

1. S.C. Gupta and V.K. Kapoor (2014): Fundamentals of Mathematical Statistics, Sultan Chand and Sons
2. Richard Johnson (2006): Probability and Statistics for Engineers (Miller and Freund). Prentice Hall.

3. Gupta S.P. (2014). Statistical Methods, Sultan Chand & Sons, New Delhi
4. V.K. Rohatgi (2015) : An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
5. Mood A.M., Graybill F.A. and Boes D.C.(2017): Introduction to Theory of Statistics, 3rd edition, McGraw Hill.

COURSE 19

PUBLIC FINANCE AND BANKING

ECONOMICS CORE 6

Course Code	
Title of the course	PUBLIC FINANCE AND BANKING
Semester in which the course is to be taught	4
No. of credits	4
No. of contact hours	90

Module I - INTRODUCTION TO PUBLIC ECONOMICS

Nature and scope of Public Economics – comparison of public and private finance – role of state in economic activities(allocation, distribution &stabilization functions) public goods vs private goods -conditions of efficiency — freed rider problem-Merit goods–principle of maximum social advantage. (18Hrs)

Module II - PUBLIC REVENUE

Public Revenue – Tax and Non-tax revenue – Taxes – canons of taxation –types of taxes – Income tax in India – Goods and Service tax and its impact-principles of taxation– benefit principle and ability to pay theory – impact and incidence of taxation – Effects of taxation –concept of taxable capacity – the Laffer curve – Budget and its role concepts of revenue account, capital account, gender budgeting, fiscal deficit, revenue deficit, primary deficit- zero base budgeting and rotating zero base budgeting-budgetary procedure (18Hrs)

Module III - PUBLIC EXPENDITURE AND PUBLIC DEBT

Meaning – Canons of public expenditure – effects – theories of expenditure growth-Wagner’s hypothesis Peacock- Wiseman hypothesis- development and non-development expenditure public debt – types – debt redemption – burden of public debt–public debt in India. (18Hrs)

MODULE IV - FISCAL FEDERALISM

Meaning and Importance – vertical and horizontal equity in fiscal federalism - fiscal federalism in India – role of Finance commission — report of latest finance commission-grants in aid- State Finance Commission and Panchayati Raj institutions (18Hrs)

Books/Journals for Reference

1. Harvey Rosen, (2008)Public Finance, McGraw Hill, New York.
2. Bernard P. Herber, Modern Public Finance (Richard Irvin Inc)
3. H.L. Bhatia., Public Finance, Vikas Publishing House Pvt Ltd., New Delhi
4. B.P.Tyagi.,PublicFinance,JaiPrakashNath&Co.,Meerut(recentedition)
5. Musgrave and Musgrave (1984), Public Finance in Theory and Practice, McGraw Hill, New Delhi

COURSE 20
INDIAN FINANCIAL SYSTEM
ECONOMICS CORE 7

Course Code	
Title of the course	INDIAN FINANCIAL SYSTEM
Semester in which the course is to be taught	4
No. of credits	4
No. of contact hours	90

Module I - Introduction

Introduction, functions of financial system, Structure of Indian financial system: institutions, markets, instruments and services.

Financial institutions:- Banking institutions. Organized sector - features, functions, types: Commercial banks, co-operative banks, Regional Rural Banks, foreign banks. Unorganized Sector-features, functions, types: indigenous bankers, Money lenders.

Non-Banking Institutions: features, functions, classification: Development Finance Institutions, Investment Institutions, Nonbanking Financial Companies, Hire Purchase Companies, Equipment Leasing Companies, Nidhis, Chit Funds.

Module II - Capital Market and Instruments

New Issue Market - Role - Methods of floating New Issues - Offer to Public Procedure - Intermediaries to the Issue - Trends in the New Issue Market. The Relationship of the New Issue Market and Stock Exchange.

The Secondary Market - Stock Exchanges in India: NSE, BSE, OTCEI. Developments in the Stock Market: Derivatives, Exchange Traded Funds, GDR, ADR, IDR – Indices - Circuit Breakers - Settlement and Clearing.

Bond Market – Corporate bonds, Government bonds – Primary Dealers. Regulation of capital market – Role and functions of RBI and SEBI

Module III - Money Market and Instruments

Functions, structure, features, components: call money market, collateral loan market, acceptance market, bill market. - Characteristics of a developed money market - Instruments: Commercial bills, Treasury bills, call and short notice money market,

Certificate of Deposit, Commercial Paper, Repos. Regulation of money market - LAF.

Module IV - Financial Services

Stock Exchanges, Merchant Banking, Depository and custodial services, Credit rating, Insurance, Leasing, Hire Purchase, Factoring, Mutual Funds: Meaning, Concept, Types.

References

1. Preeti Singh: Dynamics of Indian Financial System Markets, Institutions & Services, Ane Books Pvt Ltd.
2. Bhole, L.M: Financial Institutions and Markets, Tata McGraw Hill Publishing Company Ltd.
3. Gordan and Natarajan, Indian Financial System, Himalaya Publishing House.
4. Khan M.Y., Indian Financial System, Pearson
5. Sriram Khanna, Financial Markets in India & Protection of Investors, New Century Publications, 2004.
6. Clifford Gomez. Financial Markets, Institutions, and Financial Services. Phi Learning Pvt. Ltd.
7. Mishkin, F. and S. Eakins Financial Markets and Institutions. (Addison Wesley)
8. Bayes and Jansen: Money, Banking and Financial Markets, AITBS

COURSE 21
DIFFERENTIAL EQUATIONS

MATHEMATICS CORE

Course Title	Differential Equations
Course Code	19U5CRMAT06
Semester	4
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Course Objectives

The objective of the course is to equip the student with the methods of solution of differential equations, both ordinary and partial.

Course Outcomes

CO	CO Statement	PO/ PSO	CL	KC	Hrs
CO1	Understand the method for solving ordinary differential equations	PO1/ PSO2	U	F	25
CO2	Understand linear differential equations and its solutions	PO1/ PSO2	U	F,C	30
CO3	Compute the solutions of second order linear differential equations using power series method	PO1/ PSO2	AP	F,C	35
CO4	Understand partial differential equations and method of solving the same	PO1/ PSO2	U	F, P	18

Module I

(25 hrs.)

Ordinary differential equations

Exact differential equations and integrating factors (proof of theorem 2.1 excluded) , separable equations and equations reducible to this form,, linear equations and Bernoulli equations, special integrating factors and transformations. Orthogonal and oblique trajectories.

(Sections 2.1, 2.2, 2.3, 2.4, 3.1 of Text 1)

Module II

(30 hrs.)

Basic theory of linear differential equations. The homogeneous linear equation with constant coefficients. The method of undetermined coefficients, Variation of parameters, The Cauchy –

Euler equation.

(Section 4.1 , 4.2 , 4.3, 4.4, 4.5 of Text 1)

Module III

(35hrs.)

Power series solution about an ordinary point, solutions about singular points, the method of Frobenius , Bessel's equation and Bessel Functions, Differential operators and an operator method.

(Section 6.1 , 6.2 , 6.3, 7.1 of Text 1)

Module IV

(18 hrs.)

Partial Differential equations

Surfaces and Curves in three dimensions, solution of equation of the form

$\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$. Origin of first order and second order partial differential equations, Linear equations

of the first order, Lagrange's method

(Chapter 1 , section 1 and 3 & Chapter 2 Section 1, 2 and 4 of text 2)

Text Books:

- 1) Differential Equations, by Shepley L. Ross 3rd Edition, Wiley India .
- 2) Elements of Partial Differential Equation, by Ian Sneddon (Tata McGraw Hill)

References

- 1) A.H.Siddiqi & P. Manchanda – A First Course in Differential Equation with Applications (Macmillian)
- 2) George. F. Simmons – Differential equation with applications and historical notes (Tata McGraw Hill)
- 3) W.E. Boyce & R.C. DiPrima - Elementary Differential Equations and boundary value Problems, (Wiley India)
- 4) S. Balachandra Rao & H. Ranuradha – Differential Equation with Applications and Programs (Universities Press)
- 5) R. K. Ghosh & K. C. Maity - An Introduction to Differential Equations (New Central Books Agency)
- 6) B. K. Dutta – Introduction to Partial Differential Equations (New Central Books) .
- 7) Murray –Differential Equations. Macmillian
- 8) E.A. Coddington - An Introduction to Ordinary Differential Equation, PHI.
- 9) Sankara Rao - Introduction to Partial Differential Equation, 2nd edition, PHI.
- 10) Zafar Ahsan - Differential Equations and their Applications , 2nd edition, PHI

Question Paper Pattern

Module 1	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	2	1	6
Total No of Questions	12	8	4	24
No of Questions to be answered	10	5	3	18
Total Marks	20	25	30	75

COURSE 22
PROBLEM SOLVING USING EXCEL/SPSS

STATISTICS PRACTICAL - II

Course Title	PROBLEM SOLVING USING EXCEL/SPSS
Course Code	
Semester	4
Credits	2
Contact Hours per week	1
Contact hours per semester.	18

Aim of the course: To give practical training for calculating various statistical measures using Microsoft Excel and SPSS

Examination shall be conducted externally to evaluate the students capacity to calculate the various measures mentioned below. Ten questions of 10 marks each shall be given and the student shall attempt any five questions of his her choice. The students shall be able to calculate the following or perform tests from a given data set.

1. Interval estimate for mean, variance and proportion
2. To test the hypothesis concerning mean of a population using small and large samples.
3. To test the hypothesis concerning equality of means of populations using small and large samples.
4. To test the hypothesis concerning proportion of a population
5. To test the hypothesis concerning equality of two population proportions
6. To test equality means using paired t test
7. To test the goodness of fit using Chi square test
8. To test the independence of two attributes using Chi square test
9. To perform One way ANOVA
10. To perform Wilcoxon signed rank test and Mann Whitney U test

COURSE 23
OPEN COURSE

Course Title	
Course Code	
Semester	5
Credits	3
Contact Hours per week	4
Contact hours per semester.	72

COURSE 24
COMPLEX ANALYSIS
 MATHEMATICS CORE -

Course Title	Complex Analysis
Course Code	
Semester	5
Credits	3
Contact Hours per week	5
Contact hours per semester.	90

Text book:

**Complex variables and applications by James Ward Brown & Ruel V. Churchill
 (8 th edition)**

Course Objectives:

The objectives of the course include familiarising the student with the theory of functions of one complex variable, differentiability and analyticity of such functions, complex integration and related topics

Course Outcomes:

CO	CO Statement	PO/ PSO	CL	KC	Hrs
CO1	Understand theorems on limit and continuity of functions of one complex variable	PO1/ PSO2	U	F	32
CO2	Understand the significance of the Cauchy Riemann equations.	PO1/ PSO2	U	F, C	15
CO3	Understand the sufficient conditions for differentiability	PO1/ PSO2	U	F, C	5
CO4	Understand the relationship between analytic and harmonic functions.	PO1/ PSO2	U	F, P	5
CO5	Understand the concepts of convergence of complex sequences and series	PO1/ PSO2	U	F, P	15
CO6	Understand residue calculus and its applications	PO1/ PSO2	U	F, P	18

Bridge Course**(4 hours.)**

A quick review on Complex numbers and its properties, vectors and moduli, complex conjugates, exponential forms, arguments and its properties, roots of complex numbers, and regions in complex plane.

(No questions shall be asked from this section.)

Module I: Analytic functions**(28 hours)**

Functions of a complex variable, limits, theorems on limits, continuity, derivatives, differentiation formulas, Cauchy-Riemann equation, sufficient condition for differentiability, Analytic functions, examples, harmonic functions. Elementary functions, the Exponential function, Logarithmic function, Complex exponents, Trigonometric functions, Hyperbolic functions, Inverse trigonometric and Hyperbolic functions.

Chapter 2 (Sections 12, 15, 16, 18 to 22, 24 to 26); Chapter 3 (Sections 29, 30, 33 to 36)

Module II: Integrals**(25 hours)**

Derivatives of functions, definite integrals of functions, contours, contour integrals, some examples, upper bounds for moduli of contour integrals, antiderivates, Cauchy-Goursat theorem (without proof), simply and multiply connected domains, Cauchy's integral formula, an extension of Cauchy's integral formula, Liouville's theorem and fundamental theorem of algebra, maximum modulus principle.

Chapter 4 (Sections 37 to 41, 43, 44, 46, 48 to 54);

Chapter 5 (Sections 55 to 60 and 62).

Module III: Series**(15 hours)**

Convergence of sequences and series, Taylor's series, proof of Taylor's theorem, examples, Laurent's series (without proof), examples.

Chapter 5 (Sections 55 to 60 and 62)

Module IV: Residues and poles**(18 hours)**

Isolated singular points, residues, Cauchy's residue theorem, three types of isolated singular points, residues at poles, examples. Applications of residues, evaluation of improper integrals, examples.

Chapter 6 (Sections 68 to 70 and 72 to 74); Chapter 7 (Section 78)

References

1) Complex Analysis- An introduction to the theory of Analytic of one Complex Variable by Lars V Ahlfors (4th Edition), Mc Graw Hill

- 2) Complex Analysis by J.M.Howie, Springer
- 3) Complex Analysis with Applications by A David Wunsch, Pearson
- 4) Complex Variables, Theory and Applications, by Kasana, 2nd Edition
- 5) Foundations of Complex Analysis by S Ponnusamy
- 6) Complex Analysis by V Karunakaran
- 7) The Elements of Complex Analysis by B Chaudhary
- 8) Complex Variables – A physical approach with applications and MATLAB by Steven G Krantz, Chapman and Hall/CRC (2007)

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	2	1	6
Total No of Questions	12	8	4	24
No. of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

COURSE 25
NUMERICAL ANALYSIS
 MATHEMATICS CORE

Course Title	Numerical Analysis
Course Code	
Semester	5
Credits	3
Contact Hours per week	4
Contact hours per semester.	90 108

CO	CO Statement	PO/ PSO	CL	KC	Hrs
CO1	Solve algebraic and transcendental equations using numerical methods	PO1/ PSO4	AP	F, P	20
CO2	Understand the concepts of interpolation	PO1/ PSO4	U	F, P	18
CO3	Understand the concepts of DFT and IDFT	PO1/ PSO4	U	F, P	14
CO4	Compute derivatives and antiderivatives using numerical methods	PO1/ PSO4	U	F, C	20

Module I:

(20 hrs)

Solution of Equations

(A quick review mathematical preliminaries, errors, algebraic and transcendental equations) Bisection Method, Method of False Position, Iteration Method, Aitken's Δ process, Newton–Raphson Method, Generalised Newton's Method and Ramanujan's Method

Text 1: Chapter 2 (Sections 2.1, 2.2, 2.3, 2.4, 2.5 and 2.6)

Module II:**(18 hrs)**

Interpolation

Errors in Polynomial Interpolation , Forward Differences, Backward Differences, Central Differences Symbolic Relations, Difference of a Polynomial and Newton's Formulae for Interpolation .

Text 1: Chapter 3 (Sections 3.1, 3.2, 3.3, 3.5 and 3.6)

Module III:**(14 hrs)**

Fourier Approximations

Fourier series, Fourier transform, Discrete Fourier transform (DFT) and inverse Discrete Fourier transform (IDFT).

Text 1: Chapter 4 (Section 4.6 : 4.6.1 and 4.6.2).

Module IV :**(20 Hrs)**

Numerical Differentiation and Integration

Introduction, numerical differentiation and errors in numerical differentiation.

Numerical

Integration, Trapezoidal Rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule, Boole's and Weddle's Rules.

Text 1 : Chapter 6 (Sections 6.1, 6.2 : 6.2.1. Sections 6.4 : 6.4.1, 6.4.2, 6.4.3 and 6.4.4)

Use of Non Programmable Scientific Calculator is Permitted Text Books :

1. S. S. Sastry - Introductory Methods of Numerical Analysis , PHI Learning Private Limited Fifth Edition
2. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition Wiley New Delhi, 2015.

References

1. Scarborough : Numerical Mathematical Analysis
2. Francis Shield (Schaum's Series) : Numerical Analysis
3. Hilderbrand : Introduction to Numerical Analysis

Question Paper Pattern

Module	Part A (2 marks)	Part B (5 marks)	Part C (10 marks)	Total
I	4	2	1	7
II	3	2	1	6
III	2	2	1	5
IV	3	2	1	6
Total No. of Questions	12	8	4	24
No. of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

COURSE 26
SAMPLING THEORY AND DESIGN OF EXPERIMENTS
STATISTICS CORE

Course Code	
Title of the course	SAMPLING THEORY AND DESIGN OF EXPERIMENTS
Semester in which the course is to be taught	5
No. of credits	4
No. of contact hours	90

Module I (20 hours)

Types of sampling – Probability and non probability sampling- Judgment, Mixed Sampling, Quota sampling, Sampling and Non sampling errors

Simple random sampling: Simple random sampling with and without replacement, procedures of selecting a sample, unbiased estimates of the population mean and population total-their variances and estimates of the variances, confidence interval for population mean and total, simple random sampling for attributes, estimation of sample size based on desired accuracy for variables and attributes.

Module II (20 hours)

Stratified random sampling: Estimation of the population mean and population total-their variances and estimates of the variances, proportional allocation and Neyman allocation of sample sizes, cost function, optimum allocation and comparison with simple random sampling.

Module III (15 hours)

Fundamental principles of experimentation, need for design of experiments, analysis of one way, two way and three way classified data.

Module IV (20 hours)

Basic Designs- CRD, RBD, LSD and their analysis.

References

1. Daroga Singh, F.S.Chaudhary(1986) :Theory and Analysis of Sample survey Designs New Age International (p) Ltd..
2. S.C. Gupta and V.K. Kapoor (2014): Fundamentals of Mathematical Statistics,

Sultan Chand and Sons.

3. Cochran, W.G. (2007). Sampling Techniques, (3rd ed.), John Wiley and Sons.
- 4 D.D.Joshi (1987): Linear Estimation And Design of Experiments, New Age International (P) Ltd.
5. Das, M.N. and Giri, N.C. (2008). Design and Analysis of Experiments, New Age International (P) Limited Publishers.

COURSE 27
ENVIRONMENTAL ECONOMICS
ECONOMICS CORE 8

Course Code	
Title of the course	ENVIRONMENTAL ECONOMICS
Semester in which the course is to be taught	5
No. of credits	4
No. of contact hours	90

Module I Unit 1 : Multidisciplinary nature of environmental studies (2 hrs)

Definition, scope and importance- Need for public awareness.

Unit 2 : Natural Resources : (10 hrs)

Renewable and non-renewable resources: Natural resources and associated problems.

Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Case studies.

Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Role of individual in conservation of natural resources. - Equitable use of resources for sustainable lifestyles.

Unit 3: Ecosystems

Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the given ecosystem:-
g. Forest ecosystem

Module -II Unit 1: Biodiversity and its conservation (6 Hrs.)

Introduction

Bio-geographical classification of India - Value of biodiversity: consumptive use, productive use,

social, ethical, aesthetic and option values - India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India (8 Hrs)

Unit 2: Environmental Pollution (8 Hrs.)

Definition

Causes, effects and control measures of: -

Air pollution - Water pollution - Soil pollution - Marine pollution - Noise pollution - Thermal pollution - Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution - Pollution case studies - Disaster management: floods, earthquake, cyclone and landslides.

Unit 3: Social Issues and the Environment (10 Hrs.)

Urban problems related to energy - Water conservation, rain water harvesting, water shed management.

Resettlement and rehabilitation of people: its problems and concerns, Case studies -

Environmental ethics: Issues and possible solutions

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies

Consumerism and waste products - Environment Protection Act

Air (Prevention and Control of Pollution) Act

Water (Prevention and control of Pollution) Act

Wildlife Protection Act - Forest Conservation Act

Issues involved in enforcement of environmental legislation - Public awareness

Module – III Unit I: Economics and Environment (16 Hrs.)

Environmental Economics – Definition – Scope – Meaning – importance – Environment-Economy interaction (linkages) – material balance model – ecosystem – structure and functions – relation between environment and development – Environment as a necessity and luxury-environmental issues and global concern-Stockholm Conference – Helsinki Convention

Montreal Protocol – Kyoto Protocol – Rio Summit – Paris Convention. Population growth and Environment – market failure – tragedy of commons-sustainable development-policy approach to sustainable development (An overview only).

Module IV Unit 1: Framework and Criteria for Environmental Analysis (18hrs)

Evaluation of environmental benefits – Contingent Valuation Method –

Hedonic approach – travel cost method–preventive expenditure method - surrogate market approach – property value approach and wage differential approach - cost benefit analysis – UNIDO analysis – Little- Mirrlees approach

- Environmental Impact Analysis. Pollution control - socially optimum level of

pollution – environmental policies and legislations in India.

Module – V Human Rights (12Hrs)

Unit 1: An Introduction to Human Rights, Meaning, concept and development, Three Generations of Human Rights (Civil and Political Rights; Economic, Social and Cultural Rights).

Unit-2: Human Rights and United Nations–contributions, main human rights related organs - UNESCO, UNICEF, WHO, ILO, Declarations for women and children, Universal Declaration of Human Rights.

Human Rights in India – Fundamental rights and Indian Constitution, Rights for children and women, Scheduled Castes, Scheduled Tribes, Other Backward Castes and Minorities

Unit-3: Human Rights and environmental rights - Right to Clean Environment and Public Safety: Issues of Industrial Pollution, Prevention, Rehabilitation and Safety Aspect of New Technologies such as Chemical and Nuclear Technologies, Issues of Waste Disposal, Protection of Environment Conservation of natural resources and human rights: Reports, Case studies and policy formulation. Conservation issues of western Ghats-mention Gadgil committee report, Kasthurirangan report. Over exploitation of ground water resources, marine Fisheries, sand mining etc.

Reference

1. Agarwal, K.C 2001 Environmental Biology, Nidi Publ. Ltd, Bikaner.
2. Bharucha Erach, Text Book of Environmental Studies for undergraduate Courses. University Press, 2nd Edition 2013 (TB)
3. Brunner, R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
4. Clark, R.S., Marine Pollution, Clarendon Press Oxford (TB)
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001.
6. Environmental Encyclopedia, Jaico Publ. House. Mumbai. 1196p
7. De A.K. Environmental Chemistry, Wiley Eastern Ltd.
8. Down to Earth, Centre for Science and Environment (R)
9. Gleick, P. 1993 Water in crisis, Pacific Institute for Studies in Dev. Environment & Security. Stockholm Environment Institute Oxford University Press 473p
10. Hawkins R.E, Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
11. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University Press 1140p
12. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p
13. McKinney, M.L & Schock R. M. 1996. Environmental Science Systems & Solutions. Web enhanced edition 639p

14. Mhaskar A.K., *Matier Hazardous*, Techno-Science Publications (TB)
Miller T.G. Jr., *Environmental Science*, Wadsworth Publishing Co. (TB)
15. Odum.E.P 1971. *Fundamentals of Ecology*. W.B. Saunders Co. USA574p
16. Rao M. N. & Datta A.K. 1987 *Waste Water treatment* Oxford & IBII
PublicationCo.Pvt.Ltd.345p
17. Sharma B.K., 2001. *Environmental Chemistry*. Geol Publ. House, Meerut
18. *Survey of the Environment*, The Hindu (M)
19. Townsend C., Harper J, and Michael Begon, *Essentials of Ecology*, Blackwell Science (TB)
XI
20. Trivedi R.K., *Handbook of Environmental Laws, Rules Guidelines, Compliances and
Standards*, Vol I and II, EnviroMedia(R)
21. Trivedi R. K. and P.K. Goel, *Introduction to air pollution*, Techno-Science Publication(TB)
22. Wanger K.D., 1998 *Environmental Management*. W.B. Saunders Co. Philadelphia, USA499p
23. (M) Magazine (R) Reference (TB) Textbook
24. Rabindra N. Bhattacharya. (2007). *Environmental Economics an Indian Perspective*. Oxford
University Press.
25. Charls D. Kolstad. (2007). *Environmental Economics*. New Delhi: OUP.
26. Ramaprasad Senguptha. (2009). *Ecology and Economics*. New Delhi: OUP.
27. Janet Thomas.(2009). *Environmental Economics*. New Delhi: Cenage Learning.
28. S.P. Mirsa, S.N. Pandey (2008). *Essential Environmental Studies*. New Delhi: Ane Books.
29. Katar Singh and Shishodia. (2007) *Environmental Economics- Theory and application*. New
Delhi: Sage Publication.
30. Tom Tietenberg. (2004). *Environmental and Natural Resource Economics*. Pearson Education.
31. Karpagam M. (2008). *Environmental Economics*. New Delhi: Sterling Publishers.
32. R.K. Lekhi et al. (2008). *Developmental and Environmental Economics*. Ludhiana: Kalyani
Publishers.
33. Ulaganathan Sankar. (2009) *Environmental Economics*. New Delhi: OUP.
34. N. Das Gupha (1997). *Environmental Accounting*. Wheeler and Co NewDelhi.
35. Thomas and Callan (2007). *Environmental Economics*. Thomas South-Western.
36. Paul Ackin (2000) *Economic Growth and Environmental sustainability*, Routledge, London.
37. Nick Hanley. (2009) *Environmental Economics in Theory and Practice*. Palgrave Macmillan,
New York.
38. Fisher A.C. (1981). *Resource and Environmental Economics*. Cambridge
University Press, Cambridge.
39. Baumol. (1988). *Theory of Environmental Policy* (second edition). Cambridge University
Press, Cambridge
40. Prasanna Chandra: *Projects- Planning, Analysis, Financing, Implementation & Review*.

(5th edition) TataMcGra wHill.

41. PR Trivedi. (2014) Environmental Impact Assessment. APH Publishing Corporation.

40. Erach Baraucha (2014) Test book of Environmental studies, Orient Black Swann.

COURSE 28
ACTUARIAL SCIENCE
 STATISTICS CORE –

Course Code	
Title of the course	ACTUARIAL SCIENCE
Semester in which the course is to be taught	5
No. of credits	4
No. of contact hours	90

Module I: Utility theory, insurance and utility theory, models for individual claims and their sums, survival function, curate future lifetime, force of mortality.

Life table and its relation with survival function examples, assumptions of fractional ages, some analytical laws of mortality select and ultimate tables. Multiple life functions, joint life and last survivor status, insurance and annuity benefits through multiple life functions, evaluation for special mortality laws.

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Module II Multiple decrement models, deterministic and random survivorship groups, associated single decrement tables, central rates of multiple decrement, net single premiums and their numerical evaluations. Distribution of aggregate claims, compound Poisson distribution and its applications.

Module III Elements of compound interest (nominal and effective rate of interest) Life annuities: single payment, continuous life annuities, discrete life annuities, life annuities with monthly payments, communication functions.

Module IV Varying Life annuities, recursions and complete annuities- immediate and apportioable annuities –due. Net premiums: Continuous and discrete premiums, true monthly payment premiums, appportionate premiums, commutation functions, and accumulation type benefits. Net premium reserves: continuous and discrete net premium reserve, reserves on a semi continuous basis, reserves based on true monthly premiums, reserves on an accounted continuous basis reserves at fractional durations.

Reference

1. N.L.Bowers, H.U.Gerber, J.C.Hickman, D.A.Jones and C.J.Nesbitt (1986): Actuarial Mathematics, Society of Actuaries, Ithaca, Illinois,USA .
2. Neill,A.(1977): Life contingencies, Heineman.
3. Spurgeon E.T.(1972): Life contingencies, Cambridge University Press

4. Benjamin,B and Pollard,J.H(1980): Analysis of Mortality and other Actuarial Statistics.
5. Federation of Insurance Institutes study courses: mathematical basis of Life Assurance
(Published by Federation of Insurance Institutes, Bombay).

COURSE 29
LINEAR ALGEBRA AND GRAPH THEORY
 MATHEMATICS CORE

Course Title	LINEAR ALGEBRA AND GRAPH THEORY
Course Code	
Semester	6
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Course Objectives:

The objectives of the course are to introduce the topics of linear algebra and graph theory to the student.

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs
CO1	Understand the concepts of vector space, subspace, linear independence, dimension and row space.	PO1/ PSO2	U	F	25
CO2	Understand the concepts of linear transformation and matrix representation	PO1/ PSO2	U	F,C	25
CO3	Understand the concepts of different types of graphs.	PO1/ PSO2	U	F,C	20
CO4	Understand the concept of matching in a graph, the Marriage problem and various assignment problems	PO1/ PSO2	U	F,P	20

Module I

(25 hrs)

Vector spaces: Vectors, Subspace, Linear Independence, Basis and Dimension, Row Space of a Matrix. (Chapter – 2 Sections 2.1, 2.2, 2.3, 2.4, 2.5 of text 1)

Module II**(25 hrs)**

Linear Transformations: Functions, Linear Transformations, Matrix Representations, Change of Basis, Properties of Linear Transformations.

(Chapter –3 Sections 3.1, 3.2, 3.3, 3.4, 3.5 of text 1)

Module III**(20 hrs)**

An introduction to graph. Definition of a Graph, More definitions, Vertex Degrees, Sub graphs, Paths and cycles, the matrix representation of graphs, Trees. Definitions and Simple properties, Bridges, Spanning trees. Cut vertices and Connectivity.

Text 1: Chapter 1 (Sections 1.1 to 1.7) Text 1: Chapter 2 (Sections 2.1, 2.2 2.3, & 2.6)

Module IV Graph Theory**(20 hrs)**

Euler's Tours, the Chinese postman problem. Hamiltonian graphs & the travelling salesman problem, Matching and augmenting paths, Hall's Marriage theorem (Statement only), Personnel assignment problem, the optimal assignment problem.

Chapter 3 Sections 3.1 (algorithm deleted), 3.2 (algorithm deleted), 3.3, and 3.4 (algorithm deleted). Chapter 4.1, 4.2, 4.3 (Algorithm deleted) 4.4 (Algorithm deleted).

Text Books :

1 Linear Algebra An Introduction (Second Edition), by Richard Bronson, Gabriel B. Costa - Academic Press 2009, an imprint of Elsevier.

2. A first look at graph theory, by John Clark Derek, Allen Holton Allied Publishers

References

1) Linear Algebra Done Right, Sheldon Axler, Springer, 2015.

2) Linear Algebra, A Geometric Approach by S Kumaresan, PHI Learning Pvt.Ltd,

3) Linear Algebra, David C Lay, Pearson Education.

4) Introduction to Graph Theory by Douglas B West, Pearson Education.

5) A Text Book of Graph Theory by R. Balakrishnan and K. Ranganathan, Springer,

6) Graph Theory by Frank Harary

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	2	1	6
Total No of Questions	12	8	4	24
No.of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

COURSE 30
SQC AND ELEMENTS OF STOCHASTIC PROCESS
 STATISTICS CORE –

Course Code	
Title of the course	SQC AND ELEMENTS OF STOCHASTIC PROCESS
Semester in which the course is to be taught	6
No. of credits	4
No. of contact hours	72

Module I (15 hours)

Aims and Objectives of statistical process control and product control, importance of SQC in industry, Control charts, OC curve for control charts, probability limit, tolerance limit, 3 sigma limit and warning limit.

Module II (20 hours)

Control charts for variables – \bar{X} , R chart determining trial control limit and out of control limit and their interpretation.

Control Charts for attributes – p ,np and c chart(Introduction only)

Module III. (20 hours)

Acceptance sampling plans:. Concept of AQL and LTPD. Producers risk and consumer's risk Single and Double sampling plans for attributes and their OC and ASN functions. Design of single and double sampling plans for attributes using Binomial and Poisson distributions. Construction of OC and ASN functions.

Module IV. (20 hours)

Reliability: Introduction. Hazard function, Exponential distribution as life model, its memory- less property. Reliability function and its estimation. System reliability - series, parallel and k out of N systems and their reliabilities with simple examples.

Reference

1. D.C. Montgomery: Introduction to Statistical Quality Control. Wiley
2. V.K. Kapoor and S.C.Gupta L Fundamentals of Applied Statistics. Sultan Chand

3. Parimal Mukhopadhyay : Applied Statistics . New Central Book agency
4. R.C.Gupta: Statistical Quality Control.
5. S.K.Sinha: Reliability and life testing. Wiley Eastern
6. L.S.Srinath: Reliability Engineering. Affiliated East-West Press

COURSE 31
ECONOMETRICS
ECONOMICS CORE 9

Course Code	
Title of the course	ECONOMETRICS
Semester in which the course is to be taught	6
No. of credits	4
No. of contact hours	90

Module I - Introduction and Two Variable Regression Analysis

Econometrics -Meaning, methodology and applications CLRM – PRF – Concept of linearity - Stochastic specification - Significance of stochastic disturbance term Estimation of PRF: SRF
– method of OLS – Deviation form - properties of estimators – CLRM assumptions – Gauss- Markov theorem - Goodness of fit-ANOVA. Hypothesis testing approaches: Confidence interval-Test of Significance-Problem of prediction: Mean and Individual-Reporting and evaluation of regression results.

Module II - Multiple Regression Analysis

Matrix approach: General k variable model-Estimation and assumptions-Variance-Covariance matrix-Gauss-Markov Theorem Proofs- R^2 , R and Adjusted R^2 .
Hypothesis testing: Testing the significance of individual regression co-efficients: t test-Testing the overall significance: F test testing the equality of two-regression co-efficients-Testing linear equality restrictions-Restricted least squares-Prediction.

Module III - Extensions to Two Variable Regression Model

Regression through origin-Scaling and units of measurement-Regression on standardized variables-Functional forms of regression models-Log-linear, semi-log and reciprocal-Choice of functional form-Additive versus multiplicative error term.

Module IV - Relaxing assumptions of CLRM

Multicollinearity, Heteroscedasticity, Autocorrelation, Specification bias: Causes, Consequences, Detection and Remedies

References

1. Gujarathi, D (2003) Basic Econometrics, 4th Edition, New York: McGraw Hill
2. Wooldridge, Jeffrey M, Introductory Econometrics, (2002) Thomson, South Western, USA

Additional Readings

1. Gujarati, Damodar (2011), Econometrics by example, I edition, Palgrave- McMillan.
2. Stock, James and Watson, mark(2012) Introduction to econometrics, II edition, Pearson, Addison Wesley
3. Brooks, Chris (2012), Introductory Econometrics for finance II edition, Cambridge
4. Koutsoyiannis A (1977), Theory of Econometrics, Palgrave, New York.
5. Maddala G S (2002), Introduction to Econometrics, 3rd edition, John Wiley & Sons, New York`
6. Ramanathan, Ramu (2002), Introductory Econometrics with Applications, Thomson Learning Inc, Singapore.
7. Intrilligator, M. D (1980)Econometric Methods, Techniques and Applications Prentice Hall,
8. Engle wood Cliffs, N. J Klein LR (1974) A Text Book of Econometrics 2nd Ed., Prentice Hall, Engle wood Cliffs, N. J
9. Kmenta, Jan (1976), Elements of Econometrics, 2nd ed. Macmillian, New York.
10. Mukherijee, Chandan, Howard white and Marcwuyts (1998) Econometrics and Data Analysis for Developing Countries, Rutledge New York.

COURSE 32
CHOICE-BASED ELECTIVE COURSE

Course Title	CHOICE-BASED ELECTIVE
Course Code	
Semester	6
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

One elective to be selected from the list of electives given

COURSE 33
PROBLEM SOLVING USING MS EXCEL/SPSS/R
PRACTICAL

Course Title	PROBLEM SOLVING USING MS Excel/SPSS
Course Code	
Semester	6
Credits	2
Contact Hours per week	18 2
Contact hours per semester.	90 36

Aim of the course: To give practical training for calculating various statistical measures using Microsoft Excel and SPSS

Examination shall be conducted externally to evaluate the students capacity to calculate the various measures mentioned below. Ten questions of 10 marks each shall be given and the student shall attempt any five questions of his her choice. The students shall be able to do the following from a given data set.

1. Prepare control chart for mean
2. Prepare control chart for range
3. Prepare p Chart
4. Prepare np chart
5. Prepare c chart
6. Draw OC curve
7. Test the significance of regression coefficients
8. Test the equality of two regression coefficients
9. To test the presence of autocorrelation in data
10. To test the presence of multicollinearity and heteroscedasticity in data

PROJECT

All students must do a project. It can be done individually or as a group. However, the viva voce examination on this project will be conducted individually. The projects are to be identified during the V semester of the programme with the help of the supervising teacher. The report of the project is to be submitted to the department for valuation by the examiners appointed by the College.

A project is a scientific and systematic study of real issue or a problem intended to resolve the issue with application of concepts, principles, theories and processes. It should entail scientific collection, analysis and interpretation of data to valid conclusions.

TOPIC SELECTION:

The first step of the project work is to choose a suitable topic for study. This choice will be entirely personal from the area of interest or career prospects of students. The study can deal with any issue of social and economic relevance in an area, organization, related issues of contemporary relevance or a case-study to investigate and describe a phenomenon within its real life context.

PROJECT WORK AND EXPERIENTIAL LEARNING:

Project Work is the best way to practice what you have learnt. It provides an opportunity to investigate a problem by applying concepts in a scientific manner. It enables the application of conceptual knowledge in a practical situation and to learn the art of conducting a study in a systematic way and presenting its findings in a coherent report. The project work helps the students to address and resolve a range of issues an economy faces and become part of valuable learning experience.

PROJECT GUIDELINES:

1. Project work may be done individually or as a team of students not exceeding 5 in number.
2. Team should be, to the extent possible, diverse in composition with different capabilities (weak, strong, creative, analytical etc.) and different orientation (liberal, conservative etc.) to enable cross learning.

3. Divide the project up into a series of smaller steps or parts. Put the parts of the project into a time sequence (literature survey, acquiring a sampling frame, data, analysis etc.)
4. The project topic should be on economic issues / theoretical / case study type bearing on the economic aspects of social life
5. Project topic should be identified in the V semester and the project work should be completed by the end of the VI semester.
6. Project work should be done under the supervision and guidance of teachers.
7. A copy of the project report in English (printed or typed) should be submitted by the student/team on or before 31 March of the year concerned.
8. The valuation of the project will be done at two stages:
 - a. Internal evaluation (supervising teachers will assess the project and award grades)
 - b. External evaluation (The team will comprise of an external examiner appointed by the College and the HOD of the institution concerned or his nominee)
 - c. A Viva voce related to the project work will also be conducted by the external evaluation team. All candidates should undergo the Viva voce test individually.
 - d. ***Grades will be awarded to candidates combining the internal grade, team grade and Viva voce grade.***
9. Length of the project report - 20 to 35 pages. The report may be organized in 3 chapters (minimum). The use of simple statistical tools in data analysis may be encouraged.
10. Project evaluation and the Viva voce should be conducted immediately after the completion of the regular classes / written examination.
- 11. The chairman of the VI semester exam should form and coordinate the evaluation teams and their work.***
12. The project external evaluation should be completed before the commencement of the centralized valuation.
13. External Examiners will be appointed by the Chairperson board from the list of VI semester Board of Examiners.

PROJECT EVALUATION

Internal	
Component	
Topic and area selected	
Experimentations / Data Selected	
Punctuality –Regularity	
Compilation	
Content	
Presentation	
TOTAL	

A MODEL PROJECT DESIGN

The project work can be designed by considering the following elements.

1. Selection of a Topic
2. Pilot Survey—a trial run of questionnaire/interviews
3. Significance / Social relevance of the Study
4. Review of Literature
5. Formulation of Research Questions /Issues
6. Research Objectives (Minimum 2)
7. Coverage (Universe / Sample & period of study)
8. Data source(Primary/Secondary)
9. Methods of Analysis i.e., Tools and Techniques
10. Limitations of the study
11. Chapter outline
12. Result Chapter(s)
13. Conclusion

STRUCTURE OF THE REPORT

The report should be organized in the following sequence:

- i) Title page

- ii) Name of the candidate, Name and designation of the supervising teacher

- iii) Declaration of the student and certificate of the supervising teacher
- iv) Acknowledgements
- v) List of tables, List of figures, table of contents
- vi) Introduction
- vii) Significance of the study
- viii) Related works, if any
- ix) Objectives, methodology and data sources
- x) Chapter scheme
- xi) Main text, summary conclusions and recommendations
- xii) Bibliography

ELECTIVE COURSES

AGRICULTURAL ECONOMICS

ECONOMICS ELECTIVE 1

Course Code	
Title of the course	AGRICULTURAL ECONOMICS
Semester in which the course is to be taught	6
No. of credits	4
No. of contact hours	90

Unit-1:

Economics of Agriculture Nature, scope and its importance in the economy; Role of agriculture in economic development; Mellor's approach and Lewis Model; Linkages between agriculture and industry; Sustainable agricultural development; farm size and productivity; basic features of Indian agriculture. Emerging trends in agricultural technology; Dry land farming and use of bio technology techniques,

Unit-II:

Pricing, Finance and Marketing of Agricultural Product Determination of agricultural price

under perfect and imperfect competition, Price and non-price incentives to agriculture in India, Price policy in India; Terms of trade between agriculture and industry; Agriculture Finance in

India: Importance, types of requirements, sources-institutional and non-institutional;

Agricultural marketing in India: Regulated markets and warehouse; Food security bill-2012.

Unit-III:

Basic features of Indian agriculture, Diversification of Agriculture in India Trends in agriculture growth and agricultural productivity, Pattern of agricultural development-regional variation; Capital formation; Green revolution: Impact on production, Climate change and

agriculture; WTO and Indian development. Agriculture. Recent government policy for agriculture

Readings:

The Economic Structure of Backward Agriculture, Academic Press

Agricultural Problems of India, Vikas Publishing House Pvt. Ltd

Dasgupta, B. The Agricultural Technology in India.

Dutt, R & Sundaram, K.P.M. Indian Economy, S. Chand & Company Ltd. Ellis, Frank. Peasant

Economics, Cambridge University Press

Eicher & Witt: Agriculture in Economic Development, McGraw Hill.

Agricultural Development since Independence, National Book Trust

Indian Economy. Himalaya Publishing House, New Delhi.

INTERNATIONAL ECONOMICS

ECONOMICS ELECTIVE 2

Course Code	
Title of the course	INTERNATIONAL ECONOMICS
Semester in which the course is to be taught	6
No. of credits	4
No. of contact hours	90

Module I - Introduction to the Theory of International Trade

International Economics – Meaning and Significance – Pure theory of international trade – Basic concepts – terms of trade – meaning and types - offer curve – community indifference curve –opportunity cost – Absolute advantage – Comparative advantage- Reciprocal Demand – the Heckscher– Ohlin theory – Factor price equalization theorem- Leontief Paradox – gains from trade – static and dynamic gains.

Module II - Balance of Payments

Meaning and structure of balance of payments – equilibrium and disequilibrium in the balance of payments – measures to correct disequilibrium – Devaluation and Balance of Payments –effects of currency depreciation and capital movements on BOPs Marshall Lerner condition-J-curve effect (20 hours)

Module III - Foreign Exchange Rate

Equilibrium Rate of Exchange – theories of exchange rate determination – purchasing power parity theory – BOP theory – Fixed and flexible exchange rate - forward rate – spot rate – nominal, real, and effective rate of exchange – Foreign exchange risks – hedging and speculation –currency derivatives –future options – currency swaps- international liquidity (25 hrs)

Module IV - Trade Policy and Financial Systems

Commercial policy – free trade vs protection – Tariffs and Quotas - their effects – Gold standard& Mint parity- Bretton Woods System - IMF – IBRD; WTO - Economic integration- trade creation and trade diversion (25 hrs)

Books/Journals for Reference

1. Sodersten, Bo. And Geoffry Reed, International Economics, Palgrave macmillan
2. Dominic Salvatore, (recent edition) International Economics. John Wiley and Sons, Delhi.
3. Francis Cherunilam (2008), International Economics, Tata McGraw Hill, Delhi.

4. Giancarlo Gandolfo (2006) Elements of International Economics, Springer (India) Private Limited.
5. Dominic Salvatore, Schaum's Outlines, Theory and Problems of International Economics. Tata McGraw Hill, Delhi.

ADVANCED ECONOMETRICS

ECONOMICS ELECTIVE 3

Course Code	
Title of the course	ADVANCED ECONOMETRICS
Semester in which the course is to be taught	6
No. of credits	4
No. of contact hours	90

Course Outcome

At the end of the course students are able to:	
1	Demonstrate the skills to build predictive models that help in decision-making.
2	Demonstrate the knowledge of the assumptions upon which different econometric methods are built as well as their implications.
3	Analyze various economic data based on broad knowledge of the linear regression model.
4	Use the various econometric tools that enable them to make valid inferences.
5	Introduce dynamicity to the econometric models and effectively estimate such models.

Module 1 Simultaneous Equation Models

The Nature of Simultaneous Equation Models- Problems of Simultaneous Equation Model- Bias of OLS Estimators (Inconsistency and Simultaneity bias.) –The Identification Problem- Rules of Identification- Order and Rank Conditions – Hausman Specification Test-Methods of Estimating Simultaneous Equation System- Structural, Reduced Form and Recursive Models -Estimation of Simultaneous Equation Model- Single Equation Model; Indirect Least Squares (ILS) – Instrumental Variable (IV); 2SLS.

Module II- Time Series Econometrics

Stationarity, Basic Concepts- Unit Root,- Trend Stationary and Difference Stationary Process- Tests of Stationary- Dickey Fuller Test, Engle- Granger Test, Random Walk Model- Co-integration - Economic Application -Approaches to Economic Forecasting- AR, MR and ARIMA Modeling of Time Series Data- The Box Jenkin's Methodology- Vector Auto Regression- Problems with VAR Modeling- Applications Limited dependent Variable: Logit, Probit and Tobit models for truncated data.

Module III- Panel data Regression Models

Panel Data- Estimation of Panel Data Regression Models Using the Fixed Effect Model, and the Random Effect Approach-Hausman Test

Module IV- Applications of Econometrics and Statistical Packages

Discriminate and Principal Component Analysis, Econometric Applications in India, Computer Software Operating System- Application Software and Packages- Data Entry and Statistical Analysis- using SPSS & STATA

References

1. Intrilligator, M. D (1980) *Econometric Methods, Techniques and Applications* Prentice Hall, Engle wood Cliffs, N. J
2. Dilip M. Nachane (2006), *Econometrics: Theoretical Foundations and empirical Perspective*, Oxford University Press, New Delhi.
3. Gujarati, Damodar (2003), *Basic Econometrics*, 4th edition, McGraw Hill, New York.
4. Koutsoyiannis A (1977), *Theory of Economics*, Palgrave, New York.
5. Maddala G S (2002), *Introduction to Econometrics*, 3rd edition, John Wiley & Sons.
6. Ramanathan, Ramu(2002), *Introductory Econometrics with Applications*, Thomson Learning Inc, Singapore.
7. Johnston J (1984), *Econometric Methods*,3rd edition, McGraw Hill, New York.
8. Klein LR (1974) *A Text Book of Econometrics 2nd Ed.*, Prentice Hall , Engle wood Cliffs,
9. Kmenta, Jan (1976), *Elements of Econometrics*, 2nd ed. Macmillian, New York.
10. Mukherjee, Chandan, Howard white and Marc wuyts (1998) *Econometrics and Data Analysis for Developing Countries*, Rutledge New York.
11. Wooldridge, Jeffrey M (2002), *Introductory Econometrics*, Thomson, South Western, USA
12. Greene, William H (2004), *Econometric Analysis*, 4th ed, Prentice Hall , Engle wood Cliffs, N.
13. K. L. Krishna (Ed.) (1997), *Econometric Applications in India*, Oxford University Press, New Delhi.
14. Pindyck ,Robert S. and Daniel L. Rubinfeld (1997) *Econometric Models and Economic Forecasts*, M cGrawHill, 3-d Edition, Singapore.
15. Baltagi, B.H. (2005): *Econometric analysis of panel data*, John Wiley and Sons Ltd, New York.
16. Patricia E Gaynor and Rickey C Kirk Patrick (1994) : *Introduction to Time Series and Forecasting in Business and Economics*, Magraw Hill, New York
17. Amemiya T. (1985), *Advanced Econometrics*, Harvard University Press, Cambridge, Mass.
18. Tsay, Ruey S (2001), *Analysis of Financial Time Series*, John Wiley and Sons, Macmillan Press.
19. Pindyck, Robert S. and Daniel L. Rubinfeld (1995) – *Econometric Models and Economic Forecasts*, 4th Edition, Irwin McGraw-Hill, New York
20. Chiang, Alpha C., and Kevin Wainwright. 2005. *Fundamental methods of mathematical economics*. Boston, Mass: McGraw-Hill/Irwin.
21. Dowling, Edward T. *Schaum's Outline of Introduction to Mathematical Economics*. McGraw-Hill, 2000.

INDUSTRIAL ECONOMICS

ECONOMICS ELECTIVE 4

Course Code	
Title of the course	INDUSTRIAL ECONOMICS
Semester in which the course is to be taught	6
No. of credits	4
No. of contact hours	90

Module 1

Scope of Industrial economics; Concept, measurement and determinants of efficiency of firms, Productivity Movements in India, National Productivity Council; Forms of organization of industrial firms; Theory of optimum size of the firm, Factors influencing optimum size; Competition Commission of India: Role and Objectives.

Module 2

Market structure, Performance of the firms in different form of the market; Concentration: its meaning and determinants, Measurement of market concentration: Herfindahl Index and Lerner Index; Industrial Location: meaning and determinants, Theories of Industrial Location: Alfred Deductive Analysis and Sargent Florence's Inductive Analysis.

Module 3

Industrial Finance: Concept, need and types, Internal and external sources of industrial finance; Industrial growth in India during plans, Impact of economic reforms on India's industrial growth; India's industrial policy: 1956 & 1991; Role and performance of public sector enterprises, definition, role and performance of MSMEs, Magnitude industrial disputes in India; MSMEs: Make in India and skill India.

Readings:

1. A.M. Hansen : Public Enterprises and Economic Development, Routledge and Kegan Poul
2. Baumol, William J., Economic Theory and Operation Analysis, Prentice Hall of India Pvt. Ltd., New Delhi.
3. Dean, Joel, Managerial Economics, Prentice Hall of Inc.,
4. Dominic Salvatore, Managerial Economics, Mc.Graw Hill Inc, New York
5. Donald A Hay and D.J Morris, Industrial Economics: Theory and Evidence, Oxford

University Press.

6. Francis Cherunilam, Industrial Economics: An Indian Perspective, Himalaya Publishing House, New Delhi.
7. K.V. Sivaya and VBM Das, Indian Industrial Economy, S. Chand Company.
8. R.R. Barthwa, Industrial Economics: An Introductory Text Book, New Age International
9. SSM Desai and Nimal Bhalerao, Industrial Economy of India, Himalaya Publishing House
10. Planning Commission : Final Report on Industrial Planning and Licensing
11. R.K. Haza, The Structure of the Corporate Sector in India, Asia Publishing House

Websites for reference

<http://economics.about.com/od/pricing>

www.studyfinance.com

<http://www.economicswbinstitute.org/glossary/costs.htm>

www.netmba.com

www.nationalanalysts.com

MULTIVARIATE CALCULUS AND INTEGRAL TRANSFORMS

MATHEMATICS ELECTIVE -1

Course Code	
Title of the course	MULTIVARIATE CALCULUS AND INTEGRAL TRANSFORMERS
Semester in which the course is to be taught	6
No. of credits	4
No. of contact hours	90

Text 1: Tom APOSTOL, Mathematical Analysis, Second edition, Narosa Publishing House.

Text 2: WALTER RUDIN, Principles of Mathematical Analysis, Third edition – International Student Edition.

Module 1: (16 hours)

The Weirstrass theorem, other forms of Fourier series, the Fourier integral theorem, the exponential form of the Fourier integral theorem, integral transforms and convolutions, the convolution theorem for Fourier transforms. (Chapter 11 Sections 11.15 to 11.21 of Text 1)

Module 2: (17 hours.)

Multivariable Differential Calculus The directional derivative, directional derivatives and continuity, the total derivative, the total derivative expressed in terms of partial derivatives, An application of complex- valued functions, the matrix of a linear function, the Jacobian matrix, the chain rate matrix form of the chain rule. (Chapter 12 Sections. 12.1 to 12.10 of Text 1)

Module 3: (21 hours.)

Implicit functions and extremum problems, the mean value theorem for differentiable functions, a sufficient condition for differentiability, a sufficient condition for equality of mixed partial derivatives, functions with non-zero Jacobian determinant, the inverse function theorem (without proof), the implicit function theorem (without proof), extrema of real- valued functions of one

variable, extrema of real-valued functions of several variables. Chapter 12 Sections-. 12.11 to 12.13. of Text 1 Chapter 13 Sections-. 13.1 to 13.6 of Text 1

Module 4: (21 hours.)

Integration of Differential Forms Integration, primitive mappings, partitions of unity, change of variables, differential forms, Stokes theorem (without proof)
Chapter 10 Sections. 10.1 to 10.25, 10.33 of Text 2

References:-

1. Limaye Balmohan Vishnu, Multivariate Analysis, Springer.
2. Satish Shirali and Harikrishnan, Multivariable Analysis, Springer

Question Paper Pattern

Module	Part A (1.5 Marks Question) Answer all Questions	Part B (5 Marks Question) Answer any four	Part C (10 Marks Question) Answer one from each module
I	2	2	2
II	2	2	2
III	2	2	2
IV	2	2	2
Total (75 Marks)	10 Marks	25 Marks	40 Marks

PROBABILITY AND MEASURE
MATHEMATICS ELECTIVE -2

Course Code	
Title of the course	PROBABILITY AND MEASURE
Semester in which the course is to be taught	6
No. of credits	4
No. of contact hours	90

Text 1: V.K (2001) An Introduction to Probability and Statistics, 2ndEdn, Wiley India (P) Ltd, New Delhi.

Text 2: Bhat B.R (1999) Modern Probability Theory , 3rdEdn, New Age International (P) Ltd, New Delhi.

Module 1: (18 hours)

Random variables: Algebra of sets, Fields, Sigma fields, Inverse function, Measurable functions, Random variables, Induced sigma fields, Limits of random variables.

(Text 2 : Unit- 1)

Module 2: (20 hours)

Probability Space, Definitions of probability, Properties, Discrete Probability space, general probability space, Induced probability space, Extension of Probability measure, Other measures, Moment inequalities – Markov’s inequality, Chebychev- Bienayme’s inequality, Lyapunov’s inequality.

(Text 2:Unit-3)

(Text 1: Chapters 2& 3 ,Text 2 : Chapter 3)

Module 3: (20 hours)

Multiple random variable, Independence of random variables, Covariance and Correlation and moments, Addition and Multiplication theorems on expectation, Cr inequality, Holder’s inequality, Cauchy- Schwartz’s inequality, Jensen’s inequality, Minkowski’s inequality, Conditional expectation.

Text Book 1: Sections 4.2 to 4.3 (till example 6), 4.5 (till theorem 6 including its Corollary’s

1 and 2, 4.6.

Text Book 2: Section 5.3 (c) and (d).

Module 4: (17 hours)

Convergence of sequence of random variables – Convergence in law, Convergence in probability, Convergence in rth mean, Convergence almost surely. Weak Law of Large Numbers-Kinchine's Weak Law of Large Numbers, Strong Law of Large Numbers-Kolmogrov strong law of large numbers, Central Limit Theorem- Lindberg- Levy form and Liapunov's form of Central Limit Theorem

Text Book 1 : Section 6.2 (till Theorem 12)

References:

1) S.C Gupta and V.K Kapoor (2002) Fundamentals of Mathematical Statistics, 11thEdn, Sultan Chand & Sons, New Delhi.

2) Billingsley, P. (1986) Probability and Measure, Second Edition, John Wiley