

**MAR ATHANASIUS COLLEGE (AUTONOMOUS)  
KOTHAMANGALAM, KERALA - 686666**

**NAAC Accredited 'A+' Grade Institution**

**Email: [mac@macollege.in](mailto:mac@macollege.in)**

**[www.macollege.in](http://www.macollege.in)**



**SCHEME AND SYLLABUS  
FOR  
POST GRADUATE PROGRAMME  
UNDER CREDIT SEMESTER SYSTEM  
MAC-PG-CSS 2020  
IN  
M.Sc. ACTUARIAL SCIENCE**

**EFFECTIVE FROM THE ACADEMIC YEAR 2020-2021  
BOARD OF STUDIES IN ACTUARIAL SCIENCE (PG)**

# MAR ATHANASIVS COLLEGE (AUTONOMOUS) KOTHAMANGALAM

## Academic Council

### COMPOSITION – With Effect From 01-06-2020

**Chairperson** : **Dr. Shanti.A.Avirah**  
Principal  
Mar Athanasius College (Autonomous), Kothamangalam

**Experts/Academicians are from outside the college representing such areas as Industry, Commerce, Law, Education, Medicine, Engineering, Sciences etc.**

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Mar Athanasius College Association  
Kothamangalam
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University Grants Commission,  
New Delhi.
3. **Dr. R.K. Chauhan**  
Former Vice-Chancellor, Lingaya's University,  
Faridabad, Haryana -121002
4. **Dr. Sheela Ramachandran**  
Pro-Chancellor,  
Atmiya University  
Rajkot.
5. **Prof. Kuruvilla Joseph**  
Senior Professor and Dean,  
Indian Institute of Space Science and Technology (IIST),  
Department of Space, Govt. of India, Valiyamala, Thiruvananthapuram
6. **Dr. M.C. Dileep Kumar**  
Former Vice Chancellor  
SreeSankaracharya Sanskrit University  
Kalady, Kerala, India

7. **Dr. Mathew. K.**  
Principal  
Mar Athanasius College of Engineering,  
Kothamangalam, Kerala - 686 666
  
8. **Adv. George Jacob**  
Senior Advocate  
High Court of Kerala  
Ernakulam

**Nominees of the university not less than Professors**

9. **Dr. Biju Pushpan**  
SAS SNDP Yogam College  
Konni
  
10. **Dr. Suma Mary Scharia**  
UC College  
Aluva
  
11. **Dr. V.B. Nishi**  
Associate Professor  
Sree Shankara College, Kalady.

**Member Secretary**

12. **Dr. M.S.Vijayakumary**  
Dean – Academics  
Mar Athanasius College (Autonomous)  
Kothamangalam

**Four teachers of the college representing different categories of teaching staff by rotation on the basis of seniority of service in the college**

13. **Dr. Bino Sebastian. V** (Controller of Examinations)
  
14. **Dr. Manju Kurian**, Asst. Professor, Department of Chemistry
  
15. **Dr. Smitha Thankachan**, Asst. Professor, Department of Physics
  
16. **Dr. Asha Mathai**, Asst. Professor, Department of Malayalam

## **Heads of the Departments**

17. Dr. Jayamma Francis, Head, Department of Chemistry
18. Dr. Mini Varghese, Head, Department of Hindi
19. Ms. Shiny John, Head, Department of Computer Science
20. Dr. Igy George, Head, Department of Economics
21. Dr. Rajesh.K. Thumbakara, Head, Department of Mathematics
22. Dr. Aji Abraham, Head, Department of Botany
23. Dr. Selven S., Head, Department of Zoology
24. Dr. Deepa. S, Head, Department of Physics
25. Dr. Aswathy Balachandran, Head, Department of English
26. Dr. Diana Ann Issac, Head, Department of Commerce
27. Ms. Seena John, Head, Department of Malayalam
28. Ms. Diana Mathews, Head, Department of Sociology
29. Ms. Sudha. V, Head, Department of Statistics
30. Dr. Jani Chungath, Head, Department of History
31. Sri. Haary Benny Chettiamkudiyil, Head, Department of Physical Education
32. Ms. Shari Sadasivan, Head, Department of Marketing and International Business
33. Dr. Julie Jacob, Head, Department of Biochemistry
34. Ms. Nivya Mariyam Paul, Head, Department of Microbiology
35. Ms. Jaya Vinny Eappen, Head, Department of Biotechnology
36. Ms. Shalini Binu, Head, Department of Actuarial Science
37. Ms. Simi. C.V, Head, Post Graduate Department of History
38. Ms. Sari Thomas, Head, Post Graduate Department of Statistics
39. Ms. Sheeba Stephen, Head, Department of B.Com Model III - Tax Procedure and Practice
40. Ms. Dilmol Varghese , Head, Post Graduate Department of Zoology
41. Ms. Bibin Paul, Head, Post Graduate Department of Sociology

**BOARD OF STUDIES IN ACTUARIAL SCIENCE (PG) - 2020**

**CHAIRMAN**

1.	Dr. E.S. JEEVANAND	Associate Professor Research Department of Mathematics Union Christian College, Aluva
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**ACADEMIC EXPERTS**

1.	Dr. G. GOPAL	Former Professor and Head Department of Statistics University of Madras Chepauk Campus, Chennai
2.	R.SATHYANARAYANAN	LIC-Divisional Manager Coimbatore

**MGU NOMINATED MEMBER**

1.	Dr. P. MOHANCHANDRAN NAIR	Professor and Head Department of Demography Kerala University, Thiruvananthapuram.
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**INDUSTRIAL EXPERT**

1.	Mr. S. MANIKANDAN	Head of Core Modeling Team, AXA Business Services Pvt. Ltd, Pune
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**MERITORIOUS ALUMNUS**

1.	Ms. ARYA THAMPI	Actuarial Specialist AON Specialist Services Pvt. Ltd, Bangalore
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**SPECIAL INVITEES**

1.	Ms.SHALINI BINU	Assistant Professor and Head Department of Actuarial science Mar Athanasius College Kothamangalam
2.	Ms.SILLA MATHEW	Assistant Professor Department of Actuarial science Mar Athanasius College Kothamangalam
3.	Ms.ASHA VARGHESE	Assistant Professor Department of Actuarial science Mar Athanasius College Kothamangalam

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## PREFACE

Post graduate programme in Actuarial Science is a two-year full-time programme, comprising of four semesters. The curriculum and syllabus of any academic programme has to be symmetrically subjected to thorough revision so as to make it more relevant and meaningful. The psychological profile, learning style and outlook towards higher education have undergone a change due to the explosion of information. New and innovative methods of evaluation and application are the need of the hour. The restructured and revised curriculum is developed considering the current industry needs in terms of the skill sets demanded by the industry. It also endeavors to align the programme structure and course curriculum with student aspirations and corporate expectations.

The Board of Studies proceeded with the task of restructuring the PG programme in Actuarial Science as per the terms of reference and guidelines given by the university in line with the proposals put forward by the University Grant Commission. The revisions were effected based on the recommendations made at the workshops conducted for this purpose, besides several sittings of the Board of Studies. The diversity available within the overall framework helps flexible specialization.

We acknowledge the assistance and guidance received from the management and the university and all those who have contributed in different ways in this venture.

It is recommended that the content of the syllabus be reviewed and revised periodically in consultation with the members of the Board of Studies.

I hope this restructured syllabus and curriculum would enrich and equip the students to meet future challenges.

**Dr. E.S. Jeevanand**  
**Associate Professor**  
**Department of Mathematics**  
**UC College Aluva**  
**Chairman, Board of Studies**

**LIST OF PG PROGRAMMES**  
**IN MAR ATHANASIOUS COLLEGE (AUTONOMOUS), KOTHAMANGALAM**

SL. NO.	PROGRAMME	DEGREE	FACULTY
1	ENGLISH	MA	LANGUAGE AND LITERATURE
2	ECONOMICS	MA	SOCIAL SCIENCES
3	SOCIOLOGY	MA	SOCIAL SCIENCES
4	HISTORY	MA	SOCIAL SCIENCES
5	MATHEMATICS	M.Sc.	SCIENCE
6	CHEMISTRY	M.Sc.	SCIENCE
7	PHYSICS	M.Sc.	SCIENCE
8	BOTANY	M.Sc.	SCIENCE
9	STATISTICS	M.Sc.	SCIENCE
10	ZOOLOGY	M.Sc.	SCIENCE
11	BIOCHEMISTRY	M.Sc.	SCIENCE
12	BIOTECHNOLOGY	M.Sc.	SCIENCE
13	MICROBIOLOGY	M.Sc.	SCIENCE
14	ACTUARIAL SCIENCE	M.Sc.	SCIENCE
15	COMMERCE (Specialization-FINANCE AND TAXATION)	M.Com	COMMERCE
16	COMMERCE (Specialization-MARKETING AND INTERNATIONAL BUSINESS)	M.Com	COMMERCE



**REGULATIONS OF THE POST GRADUATE PROGRAMMES**  
**UNDER CREDIT SEMESTER SYSTEM**  
**MAC-PG-CSS2020**  
**(2020 Admission onwards)**

**1. SHORT TITLE**

- 1.1 These Regulations shall be called “Mar Athanasius College (Autonomous) Regulations (2020) governing Post graduate Programmes under the Credit Semester System (MAC-PG-CSS2020)”.
- 1.2 These Regulations shall come into force from the Academic Year 2020-2021.

**2. SCOPE**

- 2.1 The regulations provided herein shall apply to all Regular Post graduate (PG) Programmes, M.A. /M.Sc. /M.Com. conducted by Mar Athanasius College (Autonomous) with effect from the academic year 2020-2021 admission onwards.

**3. DEFINITIONS**

- 3.1 ‘**Academic Committee**’ means the Committee constituted by the Principal under this regulation to monitor the running of the Post-Graduate programmes under the Credit Semester System (MAC-PG-CSS2020).
- 3.2 ‘**Academic Week**’ is a unit of five working days in which distribution of work is organized from day one to day five, with five contact hours of one hour duration on each day. A sequence of 18 such academic weeks constitutes a semester.
- 3.3 ‘**Audit Course**’ is a course for which no credits are awarded.
- 3.4 ‘**CE**’ means **Continuous Evaluation (Internal Evaluation)**
- 3.5 ‘**College Co-ordinator**’ means a teacher from the college nominated by the Principal to look into the matters relating to MAC-PG-CSS2020 for programmes conducted in the College.

- 3.6 **‘Comprehensive Viva-Voce’** means the oral examinations conducted by the appointed examiners and shall cover all courses of study undergone by a student for the programme.
- 3.7 **‘Common Course’** is a core course which is included in more than one programme with the same course code.
- 3.8 **‘Core Course’** means a course that the student admitted to a particular programme must successfully complete to receive the Degree and which cannot be substituted by any other course.
- 3.9 **‘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 / seminar / project /practical training / assignments/evaluation etc., to meet effective teaching and learning needs.
- 3.10 **‘Course Code’** means a unique alpha numeric code assigned to each course of a programme.
- 3.11 **‘Course Credit’** One credit of the course is defined as a minimum of one hour lecture /minimum of 2 hours lab/field work per week for 18 weeks in a Semester. The course will be considered as completed only by conducting the final examination.
- 3.12 **‘Course Teacher’** means the teacher of the institution in charge of the course offered in the programme.
- 3.13 **‘Credit (Cr)’** of a course is a numerical value which depicts the measure of the weekly unit of work assigned for that course in a semester.
- 3.14 **‘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 x Cr.**
- 3.15 **‘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. CGPA determines the overall performance of a student at the end of a programme.  
**(CGPA = Total CP obtained/ Total credits of the programme)**

- 3.16 'Department'** means any teaching Department offering a programme of study in the institution.
- 3.17 'Department Council'** means the body of all teachers of a Department in a College.
- 3.18 'Dissertation'** means a long document on a particular subject in connection with the project /research/ field work etc.
- 3.19 'Duration of Programme'** means the period of time required for the conduct of the programme. The duration of post-graduate programme shall be 4 semesters spread over two academic years.
- 3.20 'Elective Course'** means a course, which can be substituted, by equivalent course from the same subject.
- 3.21 'Elective Group'** means a group consisting of elective courses for the programme.
- 3.22 'ESE' means End Semester Evaluation (External Evaluation).**
- 3.23 'Evaluation'** is the process by which the knowledge acquired by the student is quantified as per the criteria detailed in these regulations.
- 3.24 External Examiner** is the teacher appointed from other colleges for the valuation of courses of study undergone by the student in a college. The external examiner shall be appointed by the college.
- 3.25 'Faculty Advisor'** is a teacher nominated by a Department Council to coordinate the continuous evaluation and other academic activities undertaken in the Department.
- 3.26 'Grace Grade Points'** means grade points awarded to course(s), recognition of the students' meritorious achievements in NSS/ Sports/ Arts and cultural activities etc.
- 3.27 'Grade Point' (GP)** 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.
- 3.28 'Grade Point Average (GPA)'** is an index of the performance of a student in a course. It is obtained by dividing the sum of the weighted grade point obtained in the course by the sum of the weights of Course.  $(GPA = \frac{\sum WGP}{\sum W})$

- 3.29** ‘**Improvement Course**’ is a course registered by a student for improving his performance in that particular course.
- 3.30** ‘**Internal Examiner**’ is a teacher nominated by the department concerned to conduct internal evaluation.
- 3.31** ‘**Letter Grade**’ or ‘**Grade**’ for a course is a letter symbol (A+, A, B+, B, C+, C, D) which indicates the broad level of performance of a student for a course.
- 3.32** **MAC-PG-CSS2020** means **Mar Athanasius College Regulations Governing Post Graduate programmes under Credit Semester System, 2020.**
- 3.33** ‘**Parent Department**’ means the Department which offers a particular post graduate programme.
- 3.34** ‘**Plagiarism**’ is the unreferenced use of other authors’ material in dissertations and is a serious academic offence.
- 3.35** ‘**Programme**’ means the entire course of study and Examinations.
- 3.36** ‘**Project**’ is a core course in a programme. It means a regular project work with stated credits on which the student undergo a project under the supervision of a teacher in the parent department/ any appropriate research centre in order to submit a dissertation on the project work as specified. It allows students to work more autonomously to construct their own learning and culminates in realistic, student-generated products or findings.
- 3.37** ‘**Repeat Course**’ is a course to complete the programme in an earlier registration.
- 3.38** ‘**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.
- 3.39** ‘**Seminar**’ means a lecture given by the student on a selected topic and expected to train the student in self-study, collection of relevant matter from various resources, editing, document writing and presentation.
- 3.40** ‘**Semester Grade Point Average(SGPA)**’ is the value obtained by dividing the sum of credit points (CP) obtained by the student in the various courses taken in a semester by the total number of credits for the course in that semester. The SGPA shall be rounded off to two decimal places. SGPA determines the overall performance of a student at the end

of a semester ( $SGPA = \text{Total CP obtained in the semester} / \text{Total Credits for the semester}$ ).

- 3.41** ‘**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.
- 3.42** ‘**Weight**’ is a numeric measure assigned to the assessment units of various components of a course of study.
- 3.43** **University** means Mahatma Gandhi University Kottayam to which the college is affiliated.
- 3.44** ‘**Weighted Grade Point (WGP)**’ is grade points multiplied by weight. ( $WGP=GP \times W$ )
- 3.45** ‘**Weighted Grade Point Average (WGPA)**’ is an index of the performance of a student in a course. It is obtained by dividing the sum of the weighted grade points by the sum of the weights. WGPA shall be obtained for CE (Continuous Evaluation) and ESE (End Semester Evaluation) separately and then the combined WGPA shall be obtained for each course.

#### 4. ACADEMIC COMMITTEE

- 4.1.** There shall be an Academic Committee constituted by the Principal to Manage and monitor the working of MAC-PG-CSS2020.
- 4.2.** The Committee consists of:
1. Principal
  2. Dean, Administration
  3. Dean, Academics
  4. IQAC Coordinator
  5. Controller of Examinations
  6. One Faculty each representing Arts, Science, Commerce, Languages, and Self Financing Programmes

## 5. PROGRAMME STRUCTURE

**5.1** Students shall be admitted to post graduate programme under the various Faculties. The programme shall include three types of courses, Core Courses, Elective Courses and Common core courses. There shall be a project with dissertation and comprehensive viva-voce as core courses for all programmes. The programme shall also include assignments / seminars/ practical's etc.

**5.2** No regular student shall register for more than 25 credits and less than 16 credits per semester unless otherwise specified. The total minimum credits, required for completing a PG programme is 80.

### **5.3. Elective Courses and Groups**

**5.3.1** There shall be various groups of Programme Elective courses for a Programme such as Group A, Group B etc. for the choice of students subject to the availability of facility and infrastructure in the institution and the selected group shall be the subject of specialization of the programme.

**5.3.2** The elective courses shall be either in fourth semester or distributed among third and fourth semesters. There may be various groups of Elective courses (three elective courses in each group) for a programme such as Group A, Group B etc. for the choice of students, subject to the availability of facility and infrastructure in the institution.

**5.3.3** The selection of courses from different elective groups is not permitted.

**5.3.4** The elective groups selected for the various Programmes shall be intimated to the Controller of Examinations within two weeks of commencement of the semester in which the elective courses are offered. The elective group selected for the students who are admitted in a particular academic year for various programmes shall not be changed.

#### **5.4. Project Work**

- 5.4.1.** Project work shall be completed in accordance with the guidelines given in the curriculum.
- 5.4.2** Project work shall be carried out under the supervision of a teacher of the department concerned.
- 5.4.3.** A candidate may, however, in certain cases be permitted to work on the project in an Industrial/Research Organization on the recommendation of the supervising teacher.
- 5.4.4** There shall be an internal assessment and external assessment for the project work.
- 5.4.5.** The Project work shall be evaluated based on the presentation of the project work done by the student, the dissertation submitted and the viva-voce on the project.
- 5.4.6** The external evaluation of project work shall be conducted by two external examiners from different colleges and an internal examiner from the college concerned.
- 5.4.7** The final Grade of the project (External) shall be calculated by taking the average of the Weighted Grade Points given by the two external examiners and the internal examiner.
- 5.5** **Assignments:** Every student shall submit at least one assignment as an internal component for each course.
- 5.6** **Seminar Lecture:** Every PG student shall deliver one seminar lecture as an internal component for every course with a weightage of two. The seminar lecture is expected to train the student in self-study, collection of relevant matter from the various resources, editing, document writing and presentation.
- 5.7** **Test Papers (Internal):**Every PG student shall undergo at least two class tests as an internal component for every course with a weight one each. The best two shall be taken for awarding the grade for class tests.
- 5.8.** **No courses shall have more than 5 credits unless otherwise specified.**

**5.9. Comprehensive Viva-Voce** -Comprehensive Viva-Voce shall be conducted at the end of fourth semester of the programme and its evaluation shall be conducted by the examiners of the project evaluation.

**5.9.1.** Comprehensive Viva-Voce shall cover questions from all courses in the Programme.

**5.9.2.** There shall be an internal assessment and an external assessment for the Comprehensive Viva-Voce.

## **6. ATTENDANCE**

**6.1.** The minimum requirement of aggregate attendance during a semester for appearing at the end-semester examination shall be 75%. Condonation of shortage of attendance to a maximum of 15 days in a semester subject to a maximum of two times during the whole period of the programme may be granted by the University.

**6.2** If a student represents his/her institution, University, State or Nation in Sports, NCC, or Cultural or any other officially sponsored activities such as college union/ university union etc., he/she shall be eligible to claim the attendance for the actual number of days participated subject to a maximum 15 days in a Semester based on the specific recommendations of the Head of the Department or teacher concerned.

**6.3** Those who could not register for the examination of a particular semester due to shortage of attendance may repeat the semester along with junior batches, without considering sanctioned strength, subject to the existing University Rules and Clause 7.2.

**6.4.** A Regular student who has undergone a programme of study under earlier regulation/ Scheme and could not complete the Programme due to shortage of attendance may repeat the semester along with the regular batch subject to the condition that he has to undergo all the examinations of the previous semesters as per the MAC-PG-CSS2020 regulations and conditions specified in 6.3.

**6.5** A student who had sufficient attendance and could not register for fourth semester examination can appear for the end semester examination in the subsequent years with the attendance and progress report from the principal.



**7. REGISTRATION/ DURATION**

- 7.1** A student shall be permitted to register for the programme at the time of admission.
- 7.2** A student who registered for the Programme shall complete the Programme within a period of four years from the date of commencement of the programme.
- 7.3** Students are eligible to pursue studies for additional post graduate degree. They shall be eligible for award of degree only after successful completion of two years (four semesters of study) of college going.

**8. ADMISSION**

- 8.1** The admission to all PG programmes shall be done through the Centralised Allotment Process of Mar Athanasius College (Autonomous), Kothamangalam(MAC-PG CAP) as per the rules and regulations prescribed by the affiliating university and the Government of Kerala from time to time.
- 8.2** The eligibility criteria for admission shall be as announced by the Parent University from time to time.

**9. ADMISSION REQUIREMENTS**

- 9.1** Candidates for admission to the first semester of the PG programme through CSS shall be required to have passed an appropriate Degree Examination of Mahatma Gandhi University as specified or any other examination of any recognized University or authority accepted by the Academic council of Mahatma Gandhi University as eligible thereto.
- 9.2** Students admitted under this programme are governed by the Regulations in force.

**10. PROMOTION:**

- 10.1** A student who registers for the end semester examination shall be promoted to the next semester
- 10.2** A student having 75% attendance and who fails to register for examination of a particular semester will be allowed to register notionally and is promoted to the next semester, provided application for notional registration shall be submitted within 15 days from the commencement of the next semester.

**10.3** The medium of Instruction shall be English except programmes under faculty of Language and Literature.

## **11. EXAMINATIONS**

**11.1 End-Semester Examinations:** The examinations shall be at the end of each semester of three hour duration for each centralised and practical course.

**11.2** Practical examinations shall be conducted at the end of each semester or at the end of even semesters as prescribed in the syllabus of the particular programme. The number of examiners for the practical examinations shall be prescribed by the Board of Studies of the programmes.

**11.3** A question paper may contain short answer type/annotation, short essay type questions/problems and long essay type questions. Different types of questions shall have different weightage.

## **12. EVALUATION AND GRADING**

**12.1 Evaluation:** The evaluation scheme for each course shall contain two parts; (a) End Semester Evaluation (ESE) (External Evaluation) and (b) Continuous Evaluation (CE)(Internal Evaluation). 25% weightage shall be given to internal evaluation and the remaining 75% to external evaluation and the ratio and weightage between internal and external is 1:3. Both End Semester Evaluation (ESE) and Continuous Evaluation (CE) shall be carried out using direct grading system.

**12.2 Direct Grading: The direct grading for CE (Internal) and ESE(External Evaluation) shall be based on 6 letter grades (A+, A, B, C, D and E) with numerical values of 5, 4, 3, 2, 1 and 0 respectively.**

**12.3 Grade Point Average (GPA): Internal and External components are separately graded and the combined grade point with weightage 1 for internal and 3 for external shall be applied to calculate the Grade Point Average (GPA) of each course. Letter grade shall be assigned to each course based on the categorization provided in 12.16.**

12.4 **Internal evaluation:** The internal evaluation shall be based on predetermined transparent system periodic written tests, assignments, seminars, lab skills, records, viva-voce etc.

12.5 Components of internal (CE) and External Evaluation (ESE): Grades shall be given to the evaluation of theory / practical / project / comprehensive viva-voce and all internal evaluations are based on the Direct Grading System.

Proper guidelines shall be prepared by the BOS for evaluating the assignment, seminar, practical, project and comprehensive viva-voce within the framework of the regulation.

12.6 There shall be no separate minimum grade point for internal evaluation.

12.7 **The model of the components and its weightages for Continuous Evaluation (CE) and End Semester Evaluation (ESE) are shown in below:**

**a) For Theory (CE) (Internal)**

	Components	Weightage
i.	Assignment	1
ii.	Seminar	2
iii.	Best Two Test papers	2(1 each)
<b>Total</b>		<b>5</b>

**(Average grade of the best two papers can be considered. For test paper all the Questions shall be set in such a way that the answers can be awarded A+, A, B, C, D, E grades)**

**b) For Theory (ESE) (External)**

Evaluation is based on the pattern of Question specified in 12.15.5

**c) For Project (CE) (Internal)**

Components	Weightage
Relevance of the topic and analysis	2
Project content and presentation	2
Project viva	1
<b>Total</b>	<b>5</b>

(The components and the weightage of the components of the Project (Internal) can be modified by the concerned BOS without changing the total weightage 5)

**d) For Project (ESE) (External)**

Components	Weightage
Relevance of the topic and analysis	3
Project content and presentation	7
Project viva	5
<b>Total</b>	<b>15</b>

(The components and the weightage of the components of the Project (External) can be modified by the concerned BOS without changing the total weightage 15)

**e) Comprehensive viva-voce (CE) (Internal)**

Components	Weightage
Comprehensive viva-voce(all courses from first semester to fourth semester)	5
<b>Total</b>	<b>5</b>

(Weightage of the components of the Comprehensive viva-voce (Internal) shall not be modified.)

**f) Comprehensive viva-voce (ESE) (External)**

Components	Weightage
Comprehensive viva-voce(all courses from first semester to fourth semester)	15
<b>Total</b>	<b>15</b>

(Weightage of the components of the Comprehensive viva-voce (External) shall not be modified)

12.8 **All grade point averages shall be rounded to two digits.**

12.9 To ensure transparency of the evaluation process, the internal assessment grade awarded to the students in each course in a semester shall be published on the notice board at least one week before the commencement of external examination.

12.10 **There shall not be any chance for improvement for Internal Grade.**

12.11 The course teacher and the faculty advisor shall maintain the academic record of each student registered for the course and a copy should be kept in the college for verification for at least two years after the student completes the programme.

12.12 **External Evaluation.** The external examination in theory courses is to be conducted by the College at the end of the semester. The answers may be written in English or Malayalam except those for the Faculty of Languages. The evaluation of the answer scripts shall be done by examiners based on a well-defined scheme of valuation. The external evaluation shall be done immediately after the examination.

12.13 Photocopies of the answer scripts of the external examination shall be made available to the students on request as per the rules prevailing in the University.

12.14 The question paper should be strictly on the basis of model question paper set and directions prescribed by the BOS.

12.15. **Pattern of Questions**

12.15.1 **Questions shall be set to assess knowledge acquired, standard, and application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. Due weightage shall be given to each module based on content/teaching hours allotted to each module.**

12.15.2 The question setter shall ensure that questions covering all skills are set.

12.15.3 A question paper shall be a judicious mix of short answer type, short essay type /problem solving type and long essay type questions.

12.15.4 The question shall be prepared in such a way that the answers can be awarded A+, A, B, C, D, E grades.

12.15.5Weight: Different types of questions shall be given different weights to quantify their range as follows:

Sl.No.	Type of Questions	Weight	Number of questions to be answered
1	Short Answer type questions	1	8 out of 10
2	Short essay / problem solving type questions	2	6 out of 8
3	Long Essay Type questions	5	2 out of 4

### 12.16 Direct Grading System

Direct Grading System based on a 6- point scale is used to evaluate the Internal and External examinations taken by the students for various courses of study.

Grade	Grade point(G)	Grade Range
A+	5	4.50 to 5.00
A	4	4.00 to 4.49
B	3	3.00 to 3.99
C	2	2.00 to 2.99
D	1	0.01 to 1.99
E	0	0.00

### 12.17 Performance Grading

Students are graded based on their performance (GPA/SGPA/CGPA) at the examination on a 7-point scale as detailed below.

Range	Grade	Indicator
4.50 to 5.00	A+	Outstanding
4.00 to 4.49	A	Excellent
3.50 to 3.99	B+	Very good
3.00 to 3.49	B	Good(Average)
2.50 to 2.99	C+	Fair
2.00 to 2.49	C	Marginal
up to 1.99	D	Deficient(Fail)

**12.18 No separate minimum is required for Internal Evaluation for a pass, but a minimum grade is required for a pass in an External Evaluation. However, a minimum C grade is required for pass in a Course**

- 12.19 A student who fails to secure a minimum grade for a pass in a course will be permitted to write the examination along with the next batch.
- 12.20 **Improvement of Course-** The candidate who wish to improve the grade/grade point of the external examination of the of a course/ courses he/ she has passed can do the same by appearing in the external examination of the semester concerned along with the immediate junior batch. This facility is restricted to first and second semester of the programme.
- 12.21 **One Time Betterment Programme-** A candidate will be permitted to improve the **CGPA** of the programme within a continuous period of four semesters immediately following the completion of the programme allowing only once for a particular semester. The **CGPA** for the betterment appearance will be computed based on the **SGPA** secured in the original or betterment appearance of each semester whichever is higher. If a candidate opts for the betterment of **CGPA** of a programme, he/she has to appear for the external examination of the entire semester(s) excluding practical /project/comprehensive viva-voce. One time betterment programme is restricted to students who have passed in all courses of the programme at the regular (First appearance)
- 12.22 **Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) calculations.** The SGPA is the ratio of sum of the credit point of all courses taken by a student in a semester to the total credit for that semester. 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.
- Semester Grade Point Average -SGPA ( $S_j$ ) =  $\sum(C_i \times G_i) / \sum C_i$**
- (SGPA= Total credit Points awarded in a semester / Total credits of the semester)
- Where ‘ $S_j$ ’ is the  $j^{\text{th}}$  semester, ‘ $G_i$ ’ is the grade point scored by the student in the  $i^{\text{th}}$  course ‘ $C_i$ ’ is the credit of the  $i^{\text{th}}$  course.

**12.23 Cumulative Grade Point Average (CGPA)** of a programme is calculated using the formula:-

$$\text{Cumulative Grade Point Average (CGPA)} = \frac{\sum(C_i \times S_i)}{\sum C_i}$$

(CGPA= Total credit Points awarded in all semester / Total credits of the programme)

Where 'C<sub>i</sub>' is the credit for the i<sup>th</sup> semester, 'S<sub>i</sub>' is the SGPA for the i<sup>th</sup>

semester. The **SGPA** and **CGPA** shall be rounded off to 2 decimal points.

For the successful completion of semester, a student shall pass all courses and score a minimum **SGPA** of 2.0. However a student is permitted to move to the next semester irrespective of her/his **SGPA**

### 13. GRADE CARD

13.1 The Institution under its seal shall issue to the students, a consolidated grade card on completion of the programme, which shall contain the following information.

- a) Name of the University.
- b) Name of college
- c) Title of the PG Programme.
- d) Name of Semesters
- e) Name and Register Number of students
- f) Code, Title, Credits and Max GPA(Internal, External & Total) of each course (theory & practical), project, viva etc in each semester.
- g) Internal, external and Total grade, Grade Point (G), Letter grade and Credit point (P) in each course opted in the semester.
- h) The total credits and total credit points in each semester.
- i) Semester Grade Point Average (SGPA) and corresponding Grade in each semester
- j) Cumulative Grade Point Average (CGPA), Grade for the entire programme.
- k) Separate Grade card will be issued.
- l) Details of description of evaluation process- Grade and Grade Point as well as indicators, calculation methodology of SGPA and CGPA as well as conversion scale shall be shown on the reverse side of the grade card.



**14. AWARD OF DEGREE** - The successful completion of all the courses with 'C' grade within the stipulated period shall be the minimum requirement for the award of the degree.

**15. MONITORING COMMITTEE**

There shall be a Monitoring Committee constituted by the Principal to monitor the internal evaluations conducted.

**16. RANK CERTIFICATE**

Rank certificate shall be issued to candidates who secure positions 1<sup>st</sup> and 2<sup>nd</sup> . Candidates shall be ranked in the order of merit based on the CGPA secured by them. Grace grade points awarded to the students shall not be counted for fixing the rank. Rank certificate shall be signed by the Principal and the Controller of Examinations.

**17. GRIEVANCE REDRESSAL COMMITTEE**

17.1 Department level: The College shall form a Grievance Redressal Committee in each Department comprising of the course teacher and one senior teacher as members and the Head of the Department as Chairperson. The Committee shall address all grievances relating to the internal assessment grades of the students.

17.2. College level: There shall be a college level Grievance Redressal Committee comprising of faculty advisor, college co-ordinator, one senior teacher and one staff council member and the Principal as Chairperson.

**18. FACTORY VISIT / FIELD WORK/VISIT TO A REPUTED RESEARCH INSTITUTE/ STUDENT INTERACTION WITH RENOWNED ACADEMICIANS** may be conducted for all Programmes before the commencement of Semester III.

19. Each student may undertake Internship/on the job training for a period of not less than 15 days. The time, duration and structure of **INTERNSHIP/ON THE JOB TRAINING** can be modified by the concerned Board of Studies.

**20. TRANSITORY PROVISION**

Notwithstanding anything contained in these regulations, the Principal shall, for a period of three year from the date of coming into force of these regulations, have the power to

provide by order that these regulations shall be applied to any programme with such modifications as may be necessary.

21. **REPEAL**

The Regulations now in force in so far as they are applicable to programmes offered by the college and to the extent they are inconsistent with these regulations are hereby repealed. In the case of any inconsistency between the existing regulations and these regulations relating to the Credit Semester System in their application to any course offered in a College, the latter shall prevail.

22. **Credits allotted for Programmes and Courses**

22.1 Total credit for each programme shall be **80**.

22.2 Semester-wise total credit can vary from 16to25

22.3 The minimum credit of a course is 2 and maximum credit is 5

23. **Common Course:** If a course is included as a common course in more than one programme, its credit shall be same for all programmes.

24. **Course Codes:** The course codes assigned for all courses (Core Courses, Elective Courses, Common Courses etc.) shall be unique.

25. Models of distribution of courses, course codes, type of the course, credits, teaching hours for a programme are given in the following tables

**Programmes without practical -Total Credits 80- Scheme of the syllabus**

Semester	Course-Code	Course Name	Type of the Course	Teaching Hours per week	Credit	Total Credits
I	Course.code1	Name 1	core	5	4	20
	Course.code2	Name 2	core	5	5	
	Course.code3	Name 3	core	5	4	
	Course.code4	Name 4	core	5	4	
	Course.code5	Name 5	core	5	3	
II	Course.code6	Name 6	core	5	5	20
	Course.code7	Name 7	core	5	4	
	Course.code8	Name 8	core	5	4	
	Course.code9	Name 9	core	5	4	
	Course.code10	Name 10	core	5	3	
III	Course.code11	Name 11	core	5	4	18
	Course.code12	Name 12	core	5	4	
	Course.code13	Name 13	core	5	4	
	Course.code14	Name 14	core	5	3	
	Course.code15	Name 15	Elective	5	3	
IV	Course.code16	Name 16	core	5	4	22
	Course.code17	Name 17	core	5	4	
	Course.code18	Name18	core	5	3	
	Course.code19	Name19	Elective	5	3	
	Course code 20	Name 20	Elective	5	3	
	Project-Course.code20	Name21	core		3	
	Comprehensive viva-voce Course.code21	Name 22	core		2	
	<b>Total</b>					<b>80</b>

**Appendix****1. Evaluation first stage – Both internal and external to be done by the teacher)**

<b>Grade</b>	<b>Grade Points</b>	<b>Range</b>
<b>A+</b>	<b>5</b>	<b>4.50 to 5.00</b>
<b>A</b>	<b>4</b>	<b>4.00 to 4.49</b>
<b>B</b>	<b>3</b>	<b>3.00 to 3.99</b>
<b>C</b>	<b>2</b>	<b>2.00 to 2.99</b>
<b>D</b>	<b>1</b>	<b>0.01 to 1.99</b>
<b>E</b>	<b>0</b>	<b>0.00</b>

**The final Grade range for courses, SGPA and CGPA**

<b>Range</b>	<b>Grade</b>	<b>Indicator</b>
<b>4.50 to 5.00</b>	<b>A+</b>	<b>Outstanding</b>
<b>4.00 to 4.49</b>	<b>A</b>	<b>Excellent</b>
<b>3.50 to 3.99</b>	<b>B+</b>	<b>Very good</b>
<b>3.00 to 3.49</b>	<b>B</b>	<b>Good</b>
<b>2.50 to 2.99</b>	<b>C+</b>	<b>Fair</b>
<b>2.00 to 2.49</b>	<b>C</b>	<b>Marginal</b>
<b>Upto1.99</b>	<b>D</b>	<b>Deficient(Fail)</b>

**Theory-External-ESE**

Maximum weight for external evaluation is 30. Therefore Maximum Weighted Grade Point (WGP) is 150

Type of Question	Qn. No.'s	Grade Awarded	Grade Point	Weights	Weighted Grade Point
Short Answer	1	A+	5	1	5
	2	-	-	-	-
	3	A	4	1	4
	4	C	2	1	2
	5	A	4	1	4
	6	A	4	1	4
	7	B	3	1	3
	8	A	4	1	4
	9	B	3	1	3
	10	-	-	-	-
Short Essay	11	B	3	2	6
	12	A+	5	2	10
	13	A	4	2	8
	14	A+	5	2	10
	15	-	-	-	-
	16	-	-	-	-
	17	A	4	2	8
	18	B	3	2	6
Long Essay	19	A+	5	5	25
	20	-	-	-	-
	21	-	-	-	-
	22	B	3	5	15
			<b>TOTAL</b>	<b>30</b>	<b>117</b>
<b>Calculation :</b> <b>Overall Grade of the theory paper = Sum of Weighted Grade Points /Total Weight = 117/30 = 3.90 = Grade B</b>					

**Theory-Internal-CE**

Maximum weight for internal evaluation is 5. Therefore Maximum Weighted Grade Point (WGP) is 25.

Components	Weight (W)	Grade Awarded	Grade Point(GP)	WGP=W *GP	Overall Grade of the Course
Assignment	1	A	4	4	<b>WGP/Total Weight= 24/5 =4.8</b>
Seminar	2	A+	5	10	
Test Paper 1	1	A+	5	5	
Test Paper 2	1	A+	5	5	
<b>Total</b>	<b>5</b>			<b>24</b>	<b>A+</b>

**Comprehensive viva-voce-External-ESE**

Maximum weight for external evaluation is 15. Therefore Maximum Weighted Grade Point (WGP) is 75

Components	Weight (W)	Grade Awarded	Grade Point(GP)	WGP=W*GP	Overall Grade of the Course
Comprehensive viva-voce	15	A	4	60	<b>WGP/Total Weight = 60 / 15 = 4</b>
<b>Total</b>	<b>15</b>			<b>60</b>	<b>A</b>

**Comprehensive viva-voce-Internal-CE**

Maximum weight for internal evaluation is 5. Therefore Maximum Weighted Grade Point (WGP) is 25

Components	Weight (W)	Grade Awarded	Grade Point(GP)	WGP=W*GP	Overall Grade of the Course
Comprehensive viva-voce	5	A+	5	25	WGP/Total Weight = 25/ 5 = 5
Total	5			25	

**Project-External-ESE**

Maximum weight for external evaluation is 15. Therefore Maximum Weighted Grade Point (WGP) is 75

Components	Weight (W)	Grade Awarded	Grade Point(GP)	WGP=W*GP	Overall Grade of the Course
Relevance of the topic & Analysis	3	C	3	9	WGP/Total Weight = 59/15= 3.93
Project Content & Presentation	7	A+	5	35	
Project Viva- Voce	5	B	3	15	
Total	15			59	B+

**Project-Internal-CE**

Maximum weight for internal evaluation is 5. Therefore Maximum Weighted Grade Point (WGP) is 25

Components	Weight (W)	Grade Awarded	Grade Point(GP)	WGP=W*GP	Overall Grade of the Course
Relevance of the topic & Analysis	2	B	3	6	WGP/Total Weight= 21/5 = 4.2
Project Content & Presentation	2	A+	5	10	
Project Viva-Voce	1	A+	5	5	
Total	5			21	A

**2. Evaluation Second stage-(to be done by the College)****Consolidation of the Grade(GPA) of a Course PC-1**

The End Semester Evaluation (ESE) (External evaluation) grade awarded for the course PC-1 is A and its Continuous Evaluation (CE) (Internal Evaluation) grade is A. The consolidated grade for the course PC-1 is as follows:

<b>Evaluation</b>	<b>Weight</b>	<b>Grade awarded</b>	<b>Grade Points awarded</b>	<b>Weighted Grade Point</b>
External	3	A	4.20	12.6
Internal	1	A	4.40	4.40
Total	<b>4</b>			<b>17</b>
Grade of a course	GPA of the course =Total weighted Grade Points/Total weight= $17/4 = 4.25 = \text{Grade A}$			

**1. Evaluation Third stage-(to be done by the College)****Semester Grade Point Average (SGPA)**

<b>Course code</b>	<b>Title of the course</b>	<b>Credits (C)</b>	<b>Grade Awarded</b>	<b>Grade Points(G)</b>	<b>Credit Points (CP=C X G)</b>
<b>01</b>	<b>PC-1</b>	<b>5</b>	<b>A</b>	<b>4.25</b>	<b>21.25</b>
<b>02</b>	<b>-----</b>	<b>5</b>	<b>A</b>	<b>4.00</b>	<b>20.00</b>
<b>03</b>	<b>-----</b>	<b>5</b>	<b>B+</b>	<b>3.80</b>	<b>19.00</b>
<b>04</b>	<b>-----</b>	<b>2</b>	<b>A</b>	<b>4.40</b>	<b>8.80</b>
<b>05</b>	<b>-----</b>	<b>3</b>	<b>A</b>	<b>4.00</b>	<b>12.00</b>
<b>TOTAL</b>		<b>20</b>			<b>81.05</b>
<b>SGPA</b>	<b>Total credit points / Total credits = <math>81.05/20 = 4.05</math> Grade- A</b>				



**1. Evaluation Third stage-(to be done by the College)****Cumulative Grade Point Average (CGPA)**

If a candidate is awarded three **A+** grades in semester 1(SGPA of semester 1), semester 2 (SGPA of semester 2) and semester 4 (SGPA of semester 4), and **B** grade in semester 3(SGPA of semester 3), then CGPA is calculated as follows:

Semester	Credit of the Semesters	Grade Awarded	Grade point (SGPA)	Credit points
I	20	A+	4.50	90
II	20	A+	4.60	92
III	20	B	3.00	60
IV	20	A+	4.50	90
<b>TOTAL</b>	<b>80</b>			<b>332</b>
<b>CGPA= Total credit points awarded / Total credit of all semesters = 332 / 80= 4.15</b> <b>( Which is in between 4.00 and 4.49 in 7-point scale)</b> <b>Therefore the overall Grade awarded in the programme is A</b>				

## ELIGIBILITY FOR ADMISSION

Academic eligibility should be satisfied as on the last date of submission of academic data. No candidate shall be admitted to the PG programme unless he/she possess the qualifications and minimum requirements thereof, as prescribed by Mahatma Gandhi University from time to time.

**If an applicant for admission is found to have indulged in ragging in the past or if it is noticed later that he/she had indulged in ragging, admissions shall be denied or he/she will be expelled from Mar Athanasius College (Autonomous), Kothamangalam.**

Candidates should have passed the corresponding Degree Examination under the 10 + 2 + 3 pattern with one core/main subject and two complementary/subsidiary subjects from any of the Universities in Kerala or of any other University recognized by Mahatma Gandhi University as equivalent thereto for admission, subject to the stipulation regarding marks.

OR

Candidates who have passed Degree examination with Double or Triple main subject and candidates who have passed the Degree Examination in Vocational or Specialized Programmes are also eligible for admission. However, they have to submit copy of the Equivalency/Eligibility Certificate from Mahatma Gandhi University, stating that, their Qualifying Examination is recognized for seeking admission to the relevant P.G. Degree Programme(s) as applicable, at the time of admission. This provision is not applicable in the case of those applicants who have passed their qualifying examination from MG University.

### The minimum requirements for admission to M.Sc. Actuarial Science (SF) programme:

Graduates who have passed qualifying examination in CBCS (2017)/CBCSS (2013) pattern	Graduates who have passed qualifying examination in CBCSS (2009) pattern	Graduates who have passed qualifying examination in other patterns
Graduation in any degree with Mathematics/Statistics as one of the subject of study with not less than CGPA/CCPA of 5.00 out of 10.00 in the Core Group (Core + Open + Complementary). Graduation in Commerce with not less than CGPA/CCPA of 5.00 out of 10.00 in the Core	Graduation in any degree with Mathematics/Statistics as one of the subject of study with not less than CGPA of 2.00 out of 4 in the Core Group (Core + Open + Complementary). Graduation in Commerce with	Graduation in any degree with Mathematics/Statistics as one of the subject of study with not less than 50% marks in the Part III subjects (Main/Core+ Subsidiaries/Complementaries). Graduation in Commerce with not less than 50% marks in the Part III subjects (Main/Core+Subsidiaries/ Complementaries) provided they

Group (Core + Open + Complementary) provided they have studied Mathematics at Plus Two level	not less than CGPA of 2.00 out of 4 in the Core Group (Core + Open + Complementary) provided they have studied Mathematics at Plus Two level	have studied Mathematics at Plus Two level
<b>A weightage of 10 marks shall be given to the candidate who has studied Mathematics as Main/Core Subject.</b>		

**The Open course under core group is taken only for reckoning the eligibility for applying for the PG programmes concerned. But a candidate cannot apply for the respective PG programmes solely on the basis of the open course selected under core group.**

**Relaxation in Marks in the qualifying examination:**

- (i) **Kerala Scheduled Caste/Scheduled Tribe Category:** The minimum grade in the qualifying examination for admission to the PG Degree programme is 'C' in the seven point scale for CBCSS and a pass for pre CBCSS applicants.
- (ii) **SEBC Category:** A relaxation of 3% marks in the qualifying examination from the prescribed minimum is allowed i.e. CGPA of 4.7 for CBCS (2017), CCPA of 4.7 for CBCSS (2013), CGPA of 1.88 for CBCSS (2009) applicants and 47% marks for pre-CBCSS applicants for admission to M Sc. programmes and CGPA of 4.2 for CBCS (2017), CCPA of 4.2 for CBCSS (2013), CGPA of 1.68 for CBCSS (2009) applicants and 42% marks for pre-CBCSS applicants for admission to M.A/M.Com programmes
- (iii) **OEC Category:** A relaxation of 5% marks in the qualifying examination from the prescribed minimum is allowed i.e. CGPA of 4.5 for CBCS (2017), CCPA of 4.5 for CBCSS (2013), CGPA of 1.80 for CBCSS (2009) applicants and 45% marks for pre - CBCSS applicants for admission to M Sc. programmes and CGPA of 4.0 for CBCS (2017), CCPA of 4.0 CBCSS (2013), CGPA of 1.60 for CBCSS (2009) applicants and 40% marks for pre CBCSS applicants for admission to MA/M Com programmes.
- (iv) **Persons with Disability category:** A relaxation of 5% marks in the qualifying examination from the prescribed minimum is allowed i.e. CGPA of 4.5 for CBCS (2017), CCPA of 4.5 for CBCSS (2013), CGPA of 1.80 for CBCSS (2009) applicants and 45% marks for pre – CBCSS applicants for admission to M Sc. Programmes and CGPA of 4.0 for CBCS (2017), CCPA of 4.0 for CBCSS (2013), CGPA of 1.60 for CBCSS (2009) applicants and 40% marks for pre CBCSS applicants for admission to for admission to MA/M Com programme.

## **ABOUT THE PROGRAMME**

Actuarial Science deals with identifying, assessing, analyzing and managing financial risks in the insurance and finance sectors. Actuarial Science graduates use mathematical and statistical methods in assessing risk and probability analysis principles in minimizing the financial implications of uncertain events. The Actuarial Science programme curriculum is a combination of multiple disciplines such as Mathematics, Statistics, Economics, Accounting, Finance and Computer Science. The interrelatedness and synergies of these disciplines help graduates to synthesize the ideas, theories and principles of these disciplines in developing solutions for actuarial problems. A comprehensive curriculum like this opens career opportunities for actuarial science graduates in insurance, reinsurance, pension fund, healthcare, investment companies, banking and academics. The restructured post graduate programme includes newly developed course content in Actuarial Mathematics, Financial engineering and loss reserving, Actuarial Statistics and Business.

## **AIM OF THE PROGRAMME**

The main aim of the programme is to provide fundamental grounding in actuarial theories and methods and its application in statistical and probabilistic modelling. The programme aims to achieve its goals through the specific learning objectives given below.

1. Equip students with the knowledge and understanding of mathematical, statistical and financial tools and techniques and the application of these techniques in solving actuarial issues.
2. Provide a grounding in principles of actuarial modelling, mathematical techniques and theories of interest rate which can be used to model cashflows with known values and those dependent on death, survival, or other uncertain risks
3. Enable students to apply statistical techniques to actuarial applications in insurance, pensions and emerging areas of actuarial practice.
4. Proficiency in using software programming languages like R and Excel for statistical computations
5. Provide basic understanding and knowledge of the instruments used by the corporates to raise finance, analyze and interpret the financial account statements and manage financial risks.
6. Introduce students with underlying core micro and macroeconomic principles that guide decision making in organizations and explains the functioning of the economic system.

7. Enable students to understand the insurance and financial environment, key products and principles that govern insurance, superannuation and other areas of actuarial practices.
8. Identify the business problems and apply appropriate analytical tools to evaluate and manage constantly changing business environment
9. Help develop problem-solving, critical thinking and business skills like communication, networking and working in teams, which are the key abilities that the actuarial graduates are expected to possess.
10. Assist and prepare students for actuarial examinations administered by the Institute of Actuaries of India (IAI) and the Institute and Faculty of Actuaries(IFoA), UK

**POST GRADUATE PROGRAMME OUTCOMES**

<b>PO No.</b>	<b>Upon completion of post graduate programme, the students will be able to:</b>
PO-1	Create, apply and disseminate knowledge through research leading to innovation
PO-2	Think critically, explore possibilities and exploit opportunities positively
PO-3	Work in teams facilitating effective interaction in work place
PO-4	Lead a sustainable life
PO-5	Embrace lifelong learning

**PROGRAMME SPECIFIC OUTCOMES**

<b>PSO No.</b>	<b>Upon completion of M.Sc. Actuarial Science Programme, the student will be able to:</b>	<b>PO No.</b>
<b>PSO-1</b>	Describe , analyze and synthesize mathematical, statistical, financial and economic theories and models in solving actuarial issues	<b>1,2</b>
<b>PSO-2</b>	Perform calculations of simple assurance and annuity contracts with the help of standard actuarial functions using mortality table	<b>1,2</b>
<b>PSO-3</b>	Analyze the financial cost of risk and uncertainty using actuarial models and develop insurance policies that minimize the cost of risk	<b>1,2</b>
<b>PSO-4</b>	Demonstrate proficiency in collecting, organizing and drawing inferences from data using relevant software packages and communicating the results and solutions to peer and wider community in a lucid and effective manner	<b>1,2,3,5</b>
<b>PSO-6</b>	Demonstrate leadership skills and the ability to work cooperatively and effectively in a team	<b>3,5</b>
<b>PSO-7</b>	Attempt actuarial examination administered by Institute of Actuaries of India(IAI) and The Institute and Faculty of Actuaries (IFoA) enhancing employability	<b>1,2,5</b>
<b>PSO-8</b>	Relate to and apply actuarial professional standards, code of conduct and ethics in every aspect of life	<b>1,2,4</b>

## PROGRAMME STRUCTURE

COURSE CODE	TITLE	COURSE TYPE	HOURS/ WEEK	CREDITS
<b>SEMESTER I (20 Credits)</b>				
PG20AS101	Actuarial Statistics – I	Core	5	4
PG20AS102	Financial Mathematics – I	Core	5	5
PG20AS103	Business Economics – I	Core	5	4
PG20AS104	Models – I	Core	5	4
PG20AS105	Business Communication	Core	5	3
<b>SEMESTER II (20 Credits)</b>				
PG20AS206	Actuarial Statistics – II	Core	5	5
PG20AS207	Financial Mathematics – II	Core	5	4
PG20AS208	Business Economics – II	Core	5	4
PG20AS209	Models – II	Core	5	4
PG20AS210	Actuarial Computing – I	Core	5	3
<b>SEMESTER III (18 Credits)</b>				
PG20AS311	Contingencies – I	Core	5	4
PG20AS312	Risk modeling – I	Core	5	4
PG20AS313	Corporate Finance	Core	5	4
PG20AS314	Financial Accounting	Core	5	3
PG20AS315	Elective I -Business Management	Elective	5	3
<b>SEMESTER IV (22 Credits)</b>				
PG20AS416	Contingencies – II	Core	5	4
PG20AS417	Risk modeling – II	Core	5	4
PG20AS418	Actuarial Computing – II	Core	5	3
PG20AS419	Elective II- Financial Engineering	Elective	5	3
PG20AS420	Elective III - Insurance and Retirement Benefits	Elective	5	3
PG20AS421	Project Work And Report			3
PG20AS422	Viva – Voce			2

# SEMESTER I



Semester	Code	Subject	Total Hrs:90	Credits
I	PG20AS101	ACTUARIAL STATISTICS I	Hrs. / Week:5	4

### Course Objectives

- To equip students with basic knowledge of statistics for synthesizing the ideas and data to develop solutions to problems.
- Application of mathematical and statistical theories to analyze the future financial events that are of particular relevance to actuarial work.

### Syllabus

#### MODULE I (13 Hours)

##### UNIT 1 (6 Hours)

Summarizing data - Grouped Frequency Distribution – Stem and Leaf Diagrams - Line Plots - Cumulative Frequency tables Measures of Location- The Mean - The Median - The Mode - Measures of Spread – The Standard Deviation- Moments – The Range – The Inter-quartile Range - Symmetry and Skewness ( Bowley’s Pearson’s& moments ) - Box Plots.

##### UNIT 2 (4 Hours)

Probability - definition- Basic Properties – addition rule for probability – conditional probability definition - Random Variables- Discrete Random Variables- Random Variables – Probabilities – Probability Functions – Cumulative Distribution Functions – Continuous

##### UNIT 3 (3 Hours)

Random Variables- Definition- Probability Density Function – Cumulative Distribution Function. Expect Values – Mean - Variance and Standard Deviation –Linear Functions of X- Moments

#### MODULE II (25 Hours)

##### UNIT I (18 Hours)

Statistical Distributions - Important Discrete Distributions – Uniform Distribution – Bernoulli Distribution- Binominal Distribution - Geometric Distribution – Negative Binomial Distribution – Hyper Geometric Distribution – Poisson Distribution – Examples .Important Continuous Distributions – Uniform Distribution- Exponential Distribution – Gamma Distribution – Beta Distribution- Normal Distribution – Examples -- Poisson Process

Deriving Poisson Process formulae .Monte Carlo Simulation – Inverse transform method for discrete and continues distributions.

**UNIT II (7 Hours)**

The Central Limit Theorem and its applications – Definitions – Practical Uses – Normal Approximation for Binomial Distribution, Poisson distribution and Gamma Distribution - The Continuity Correction – Examples

**MODULE III (27 Hours)**

**UNIT I (7 Hours)**

Generating Functions - Moment Generating Functions - General Formula – Finding Moments - Uses of Moment Generating Functions – Important Examples. Cumulative Generating Functions - General Formula – Finding Moments - Uses of Moment Generating Functions – Linear functions - Important Examples.

**UNIT II (10 Hours)**

Joint Distributions- Joint Probability (Density) Functions – Discrete Case – Continuous Case- Marginal Probability (Density) Functions – Discrete Case – Continuous Case- Conditional Probability (Density) Functions - Continuous Case – Independence of Random Variables – Discrete Case- Continuous Case.

**UNIT III (10 Hours)**

Expectations of Functions of Two Variables- Expectations - Expectation of a Sum- Expectation of a Product – Covariance and Correlation Coefficient –Useful Results on Handling Covariance – Variance of a Sum – Convolutions – Moments of Linear Combinations of Independent Random Variables - Using Generating Functions to Derive Distributions of Linear Combinations of Independent Random Variables

**MODULE IV (25 Hours)**

**UNIT I (15 Hours)**

Conditional Expectation - The Conditional Expectations  $E[Y/X]$ - The Random Variables  $E[Y/X]$  - The Random Variables  $V[Y/X]$  and the “ $E[V]+V[E]$ ” result - Examples. Sampling and statistical inferences - Sample inference – Population inference – Statistical inference – Moments of sample mean and variance - sampling distribution for the normal – Independence of sample mean and variance. Use of  $t$  – statistic for random samples from a normal distribution - Using F distribution for the ratio of two sample variances from normal

distributions (definitions and applications only without derivations for F and t distribution) – Examples.

**UNIT 2**

**(10 Hours)**

Introduction of Point estimation - Constructing estimators of population parameters using method of moments – examples Constructing estimators of population parameters using Method of Maximum likelihood Estimator – examples. Un-biasedness- means square error of an estimator - Asymptotic distribution of maximum likelihood estimator – comparing method of moments and MLE.

**Recommended References**

1. Miller, I., Miller, M., & Freund, J. E. (2014). John E. Freund's mathematical statistics with applications. Boston: Pearson.
2. Yuly Koshevnik (2017). Fundamentals of Statistical Thinking Tools and Applications
3. Klugman, S. A., Beckley, J. A., Scahill, P. L., Varitek, M. C., & White, T. A. (2012). Understanding actuarial practice. Society of Actuaries.
4. Perna, C., & Sibillo, M. (Eds.). (2012). Mathematical and statistical methods for actuarial sciences and finance. Springer.
5. Frees, E. W. (2009). Regression modeling with actuarial and financial applications. Cambridge University Press.

**Course Outcomes**

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Describe the essential features of statistical distributions	K2
2	Summarize data using appropriate statistical analysis, descriptive statistics and graphical presentation	K4
3	Solve problems including probabilistic events and theories.	K3
4	Define and apply the principles of statistical inference	K3
5	To synthesis actuarial data using statistical techniques.	K5
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

**Learning Pedagogy**

Lecturing supplemented with technology-enabled learning, Group assignments.

**Assessment Tools**

Assignment, Seminar, Test papers and End semester examination

Semester	Code	Subject	Total Hrs. : 90	Credits
I	PG20AS102	FINANCIAL MATHEMATICS I	Hrs. / Week : 5	5

### Course Objectives

- Express financial problems in a mathematical framework by evaluating various financial instruments.
- Provide a fundamental knowledge in the principals of modelling as applied to actuarial works focusing particularly on deterministic models.

### Syllabus

#### MODULE I (15 Hours)

##### UNIT 1 (4 Hours)

Cash Flow Models: Cash flow process -- Examples of cash flow scenarios -- Zero coupon bond , Fixed interest securities, Index linked securities, Cash on deposit, Equity, Annuity, An Interest only Loan and Repayment Loan.

##### UNIT 2 (2 Hours)

Insurance contracts: Pure endowment -- An endowment assurance -- Term assurance -- Contingent annuity -- Car insurance policy -- Health cash plans.

##### UNIT 3 (9 Hours)

Time value of money: Interest-simple interest, Compound interest, Accumulation factors -- The principle of consistency -- Present Values -- Discount rates -- Simple discount -- Compound discount -- Effective rates of interest and discount -- Equivalent rates.

#### MODULE II (20 Hours)

##### UNIT 1 (5 Hours)

Interest Rates: Nominal Rates -- Nominal rates of Interest and discount --Accumulating and discounting using nominal interest and discount rates.

##### UNIT 2 (8 Hours)

The Force of Interest: Accumulating and discounting using force of interest -- Derivation -- Relationships between effective, nominal and force of interest -- Force of interest as a function of time -- Present Values.

**UNIT 3 (7 Hours)**

Real and Money Rates of Interest: Definition of real and money interest rates - Deflationary conditions - Usefulness of real and money interest rates.

**MODULE III (25 Hours)**

**UNIT 1 (5 Hours)**

Discounting and Accumulating: Present values of cash flows -- Discrete cash flows, Continuous cash flows -- Valuing cash flows -- Constant interest rates and sudden changes in interest rates -Interest income.

**UNIT 2 (7 Hours)**

Level Annuities -- Present Values – Payments made in arrear -- Payment made in advance -- Accumulations – Perpetuities – Continuously payable annuities

**UNIT 3 (8 Hours)**

Annuities payable pthly: Present values, Accumulations and Perpetuities -- Annuities payable pthly where  $p$  is less than 1 – Non integer value of  $n$ .

**UNIT 4 (5 Hours)**

Deferred annuities -- Annual payments -- Continuously payable annuities – Annuities payable pthly- Non-integer values of  $n$ .

**MODULE IV (30 Hours)**

**UNIT 1 (9 Hours)**

Increasing annuities --Varying annuities -- Annual payments -- Continuously payable annuities

**UNIT 2 (9 Hours)**

Decreasing Annuities – Special Cases --Irregular payments and Compound increasing annuities.

**UNIT 3 (7 Hours)**

Equations of Value: The equation of value and the yield on a transaction –The theory – Solving for an unknown quantity.

**UNIT 4 (5 Hours)**

Uncertain payment or receipt – Probability of Cash flows -- Higher Discount rate

**Recommended References**

1. Bower, N. L., Gerber, H. U., Hickman, J. C., Jones, D. A., & Nesbitt, C. J. (1997). Actuarial Mathematics.
2. Promislow, S. D. (2014). Fundamentals of Actuarial Mathematics. John Wiley & Sons.
3. Booth, P., Haberman, S., Chadburn, R., James, D., Khorasane, Z., Plumb, R. H., & Rickayzen, B. (2004). Modern actuarial theory and practice. Chapman and Hall/CRC.
4. Harrison, F., & Lock, D. (2017). Advanced project management: a structured approach. Routledge.
5. Ingersoll, J. E. (1987). Theory of Financial decision making (Vol. 3). Rowman & Littlefield.
6. Lessard, D. R., & Paddock, J. L. (1983). Evaluating international projects: weighted-average cost of capital versus valuation by components.

**Course Outcomes**

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Use a generalized cash flow model to describe financial transaction	K2
2	Apply different kinds of interest rates expressed in different time periods	K3
3	Define and derive compound interest functions	K5
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

**Learning Pedagogy**

Lecturing supplemented with technology-enabled learning, Group assignments

**Assessment Tools**

Assignment, Seminar, Test papers and End Semester Examination

Semester	Code	Subject	Total Hrs:90	Credits
I	PG20AS103	BUSINESS ECONOMICS - I	Hrs./Week: 5	4

### Course Objectives

Develop the ability to apply core microeconomic concepts, tools and techniques in analyzing and interpreting business decisions.

### Syllabus

#### MODULE I (16 Hours)

##### UNIT 1 (8 Hours)

Economics and Economies: What economists study – Problem of scarcity – Microeconomic choices – Opportunity cost – Rational choices – Marginal costs and benefits – Microeconomic objectives – Production possibility curve – Circular flow of goods and income

Classification of economic systems: The command economy – Free-market economy – Mixed economy – Assessment of different economies

##### UNIT 2 (8 Hours)

Main strands of economic thinking: The classical approach – Marxist socialism – Keynesian schools of thought: Neo-Keynesians, Post-Keynesians and New-Keynesians – The monetarist approach- The new classical approach – The Austrian School

#### MODULE II (20 Hours)

##### UNIT 1 (12 Hours)

Demand: Relationship between demand and price – The demand curve - Determinants of demand – Movements along and shifts in the demand curve

Supply: Supply and price – Supply curve - Determinants of supply – Movements along and shifts in the supply curve

Price and output determination: Equilibrium price and output – Movement to a new equilibrium – Incentives in markets

##### UNIT 2 (8 Hours)

Elasticity and Uncertainty - Price elasticity of demand (PED): Measuring price elasticity of demand – Calculating PED using original and point method -- Determinates of price elasticity of



demand – Price elasticity of supply – Other elasticity: Income elasticity of demand – Cross-price elasticity of demand

The time dimension: Short- run and long-run adjustment – Price expectations and speculation -- Dealing with uncertainty and risk – Control of prices – Indirect taxes and subsidies: Effect of imposing taxes – Effect of subsidizing goods

**MODULE III (32 Hours)**

**UNIT 1 (10 Hours)**

Marginal utility theory: Total and marginal utility – One-commodity model – Multi-commodity model -- Marginal utility and the demand curve -- Utility and insurance - Behavioural economics.

Indifference analysis: Limitation of marginal utility approach – Indifference curve – Budget lines – Usefulness of indifference analysis

**UNIT 2 (22 Hours)**

Production and Cost: Short–run and long-run changes in production – The law of diminishing returns – Total, average and marginal physical products - Long-run theory of production – The scale of production – Location – The size of the whole industry – Costs in long-run: Meaning and types of costs -- Relationship between short-run and long-run average cost curves.

Revenue: Total, average and marginal revenue – Revenue curve when price is not affected by the firm’s output -- Revenue curves when price varies with output – Shifts in revenue curve

Profit maximization: Short-run profit maximization using total curves – Short-run profit maximization using average and marginal curves.

**MODULE IV (22 Hours)**

**UNIT 1 (16 Hours)**

Alternative market structures - Perfect competition: Assumptions of perfect competition – Short run and long-run equilibrium of the firm -- Perfect competition and public interest.

Monopoly: Definition – Barriers to entry – Equilibrium price and output – Monopoly and the public interest – The theory of contestable markets.

Imperfect competition - Monopolistic competition: Assumptions - Equilibrium of firm – Limitation of the model – Non-price competition - Comparing monopolistic competition with other market structures

Oligopoly: Features of oligopoly – Competition and collisions - Collusive oligopoly – Non-collusive oligopoly - Game theory.

**UNIT 2**

**(6 Hours)**

Product marketing and advertising: Product differentiation – Marketing – Advertising

Pricing strategies: Cost based pricing – Variations in mark-up – Limit pricing - Price discrimination: Three different types of price discrimination - Multiple products pricing: Interrelated demand – Interrelated production – Pricing and the product life cycle.

**Recommended References**

1. Slomon J, Wride A, Garratt D, 2018-Economics –10<sup>th</sup> edition, Pearson.
2. Sloman J, Garratt D, Guest J, Jones E, 2016- Economics for Business –7<sup>th</sup> edition, Pearson
3. Parkin, M., & Bade, R. (2007). Foundations of economics. Pearson Addison Wesley.
4. Perman, R. J., & Scouller, J. (2010). Economics of corporate and competitive strategy Oxford University Press Australia and New Zealand.
5. Chrystal, K. A., & Lipsey, R. G. (1997). Economics for business and management. OUP Catalogue.
6. David Begg, Stanley Fisher and Rudiger Dorn Busch. Economics, McGraw Hill
7. Wonnacott, P., & Wonnacott, R. J. (1982). An introduction to microeconomics. New York; Montreal: McGraw-Hill.

**Course Outcomes**

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Explain basic economic concepts of opportunity cost, scarcity, production possibility curve and economic choices regarding key allocation decisions made by businesses	K2
2	Assess the main strands of economic thinking	K5
3	Describe the factors that determine demand and supply and analyze effect of these factors on market dynamics	K4
4	Calculate price, income and cross elasticity of demand and explain the effect of elasticity on revenue	K3
5	Explain the short-run and long-run cost functions and establish the linkage between production function and cost function	K2
6	Compare and contrast between the different market structures and explain profit maximization in short-run and long-run with the help of diagrams	K4
7	Assess pricing strategies adopted by firms	K5
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

**Learning Pedagogy**

Lecture using ICT tools, Debates, Group assignments, Discussions on newspaper articles related to topics covered in the syllabus and Case study.

**Assessment Tools**

Assignment, Seminar, Test papers, Quiz, Class participation and End semester examination

Semester	Code	Subject	Total Hrs:90	Credits
I	PG20AS104	MODELS - I	Hrs. / Week: 5	4

### Course Objectives

Develop knowledge of and the ability to apply statistical methods for stochastic processes (especially Markov chains and Markov jump processes) and survival analysis.

### Syllabus

#### MODULE I (15 Hours)

##### UNIT 1 (7 Hours)

Stochastic process: Types of stochastic process - discrete state space with discrete time changes - discrete state space with continuous time changes - continuous state space - displaying observed data - processes of mixed type - counting processes

##### UNIT 2 (5 Hours)

Defining a stochastic process - sample paths - stationarity - increments - the Markov property - filtrations

##### UNIT 3 (3 Hours)

Examples - White noise - general random walk - Poisson process - compound Poisson process - time series.

#### MODULE II (35 Hours)

##### UNIT 1 (4 Hours)

Markov chains: An example of a Markov chain - The Chapman-Kolmogorov equations - Time-homogeneous Markov chains - Time-inhomogeneous Markov chains

##### UNIT 2 (8 Hours)

Models - a simple model of a No Claims Discount (NCD) policy - another model of an NCD policy - simple random walk on  $S = \{\dots - 2, -1, 0, 1, 2, \dots\}$  - simple random walk on  $\{0, 1, 2, \dots, b\}$  - a model of accident proneness

##### UNIT 3 (8 Hours)

The long-term distribution of a Markov chain - the stationary probability distribution - the long-term behaviour of Markov chains - Modelling using Markov chains - estimating transition probabilities - assessing the fit - simulation.

**UNIT 4** (10 Hours)

The two-state Markov model and the Poisson model: The two-state Markov model - assumptions underlying the model - comparison with other models - Survival probabilities- Statistics - definitions - joint density function - The maximum likelihood estimator - maximising the likelihood function - Properties of the maximum likelihood estimator - asymptotic distribution of  $\mu$  - Alternative method of obtaining the asymptotic distribution

**UNIT 5** (5 Hours)

The Poisson model - the Poisson distribution - the Poisson model of mortality - estimating the underlying force of mortality - links to the two-state Markov model - estimating death probabilities - Comment on application - Appendix - solving first-order differential equations.

**MODULE III** (25 Hours)

**UNIT 1** (10 Hours)

Survival models: A simple model of survival - future lifetime - probabilities of death and survival - force of mortality - Survival probabilities - The probability density function of  $T_x$  - Life table functions - Initial and central rates of mortality

**UNIT 2** (10 Hours)

Expected future lifetime - complete expectation of life - curtate expectation of life - The relationship between the complete and curtate expectation of life - Future lifetimes-variance - Uses of the expectation of life - some important formulae - Simple parametric survival models

**UNIT 3** (5 Hours)

The Gompertz and Makeham laws of mortality - Calculating the parameter values - Survival probabilities.

**MODULE IV** (15 Hours)

**UNIT 1** (4 Hours)

Estimating the lifetime distribution function: Questions of inference - estimating the lifetime distribution - Censoring mechanisms

**UNIT 2** (6 Hours)

The Kaplan-Meier (product-limit) model - Introduction - Assumptions and notation - extending the force of mortality to discrete distributions - Calculating the Kaplan-Meier estimate of the survival function - A graphical approach - Comparing lifetime distributions

**UNIT 3**

**(5 Hours)**

The Nelson-Aalen model - The integrated hazard function - Calculating Nelson-Aalen estimates - Relationship between the Kaplan-Meier and Nelson-Aalen estimates - Parametric estimation of the survival function - Maximum likelihood estimation - Using the estimates for different age ranges.

**Recommended References**

1. Marubini, E.; Valsecchi, M. G. - John Wiley, 2004. Analysing survival data from clinical trials and observational studies
2. Benjamin, B.; Pollard, J. H. The analysis of mortality and other actuarial statistics : (3rd ed). - Institute and Faculty of Actuaries, (1993)
3. Hinde, A. - Routledge, (1998).- Demographic methods.
4. Hickman, J. C. North American Actuarial Journal (1997) - Introduction to actuarial modeling.
5. Macdonald, A.S., Richards, S.J. and Currie, I.D.- Modelling mortality with actuarial applications. - Cambridge University Press, 2018.
6. Scott, W. F. -Mortality studies. - University of Aberdeen, Department of Mathematical Sciences, 2000.
7. Daykin, C. D.; Pentikainen, T.; Pesonen, M. - Chapman & Hall, (1994). - Practical risk theory for actuaries.
8. Elandt-Johnson, R. C.; Johnson, N. L. - John Wiley, (1999). -Survival models and data analysis.
9. Shailaja R Deshmukh.-Actuarial Statistics - An Introduction using R. 3rd ed

**Course Outcomes**

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Describe and classify stochastic processes.	K2
2	Define and apply Markov chain.	K6
3	Explain the concept of survival models and derive maximum likelihood estimators for transition intensities.	K3
4	Describe and apply techniques of survival models.	K4
5	Describe estimation procedures for lifetime distributions.	K5
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

**Learning Pedagogy**

Lecturing supplemented with technology-enabled learning, Group assignments

**Assessment Tools**

Assignment, Seminar, Test papers and End semester examination

Semester	Code	Subject	Total Hrs:90	Credits
I	PG20AS105	BUSINESS COMMUNICATION	Hrs. / Week: 5	3

### Course Objectives

- To provide students with the nuances of the business environment.
- Equip students with the understanding of communication theory and its application to effective business writing, verbal and non-verbal communication.
- Develop skills in resume writing and strategies and techniques needed for success in interviews.

### Syllabus

#### MODULE I (24 Hours)

##### UNIT 1 (8 Hours)

Nature and process of communication: Role of communication – Classification – Purpose --  
Barriers to communication – 7 c's of communication – Universal elements in communication –  
Effective listening

##### UNIT 2 (8 Hours)

Corporate communication: Importance of communication in management - Formal and informal  
communication - Communication structure in organization

##### UNIT 3 (8 Hours)

Non-verbal communication: Characteristics of non-verbal communication – Classification of  
non-verbal communication: Meta- communication – Kinesics communication – Developing non-  
verbal communication skills

#### MODULE II (22 Hours)

##### UNIT I (12 Hours)

Writing letters, memos and instant messages: Writing Business Letters: Introduction - Principles  
of writing business Letter - Types of business letters - Format and layout of business Letters –  
Drafting notices – Memos – Agenda – Minutes of the meeting – News release – Advertising –  
Business etiquettes



**UNIT 2** (10 Hours)

Writing reports and proposals: What is a report? – Difference between report and other writing – Purpose of report: Defining a problem, Preparing work plan, Gathering information and organizing information -- Kinds of reports – Objective of reports -- Using technology for preparing

**MODULE III** (22 Hours)

**UNIT 1** (12 Hours)

Presentation skills: Introduction – Elements of presentation – Designing a presentation - Oral presentation: Organizing - Composing and preparing for oral presentations - Visual support for business presentation: Types of visual aid – Appearance – Posture - Practicing delivery of presentation.

Negotiation skills: Introduction – Nature – Need to negotiate – Factors affecting negotiation – Negotiation strategies

**UNIT 2** (10 Hours)

Understanding the case method of learning – Different types of cases – Overcoming the difficulties of the case method – Right way of reading a case – Case analysis approaches– Analyzing the case – Case preparation

**MODULE IV** (22 Hours)

**UNIT 1** (12 Hours)

Resumes and Cover Letters: Introduction - Writing a Resume - Writing job application letters - Employment communication: Group discussions - Interviewing for jobs preparing other types of employment messages – Understanding interviewing process – Preparing for job interviews – Follow up after the interview

**UNIT 2** (10 Hours)

Group Communication: Planning meetings: Objectives – Participants – Timing - Venue of meetings - Leading meetings. - Media management - The press release - Press conference - Media interviews - Seminars – Workshops – Conferences

## Recommended References

1. Bovée, C. L., Thill, J. V., & Raina, R. L. (2016). Business communication today. Pearson Education India.
2. Chaturvedi, P. D., & Chaturvedi, M. (2011). Business Communication: Concepts, Cases, and Applications, Dorling Kindersley: Pearson Education
3. Pal, R., & Korlahalli, J. S. (2011). Essentials of business communication. Sultan Chand & Sons.
4. Guffey, M. E., & Loewy, D. (2012). Essentials of business communication. Cengage Learning.
5. Ellet, W. (2007). The case study handbook: How to read, discuss, and write persuasively about cases. Harvard Business Press.
6. Bisen, V. Priya. 2009. Business Communication. New Age International Pvt. Ltd.
7. Mohan, R. S. K. (2002). Business Correspondence and Report Writing, 3e. Tata McGraw-Hill Education

**Course Outcomes**

<b>CO. No</b>	<b>On completion of this course, the students will be able to:</b>	<b>Knowledge Level</b>
1	Demonstrate effective oral and written communication skills	K3
2	Compose professional documents, prepare and deliver presentations using modern technology	K6
3	Distinguish and select appropriate organizational formats and channels in developing and presenting business messages	K3
4	Identify and respect differences in the perspectives and culture of the team members and effectively work in collaboration with others	K1
5	Demonstrate effective communication skills in group discussions and interviews	K3
6	Analyze case, examine solution alternatives and propose the most effective solution supported by evidence	K4
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

**Learning Pedagogy**

Lecturing using ICT tools, Case study, Group assignments and Role-play

**Assessment Tools**

Test papers, Seminar, Oral and written assignments and presentations, Class participation and End semester examination.

# SEMESTER II

Semester	Code	Subject	Total Hrs:90	Credits
II	PG20AS206	ACTUARIAL STATISTICS II	Hrs. / Week:5	5

### Course Objectives

- Explain and apply the advanced theories of statistics to interpret and evaluate actuarial models.
- To develop the capacity to work independently on statistical analysis with personal accountability.

### Syllabus

#### MODULE I (30 Hours)

##### UNIT 1 (15 Hours)

Introduction of Confidence Interval – Derivation of confidence interval – confidence intervals for Population mean and Population variance – confidence interval for binomial and Poisson parameters with normal approximation.

##### UNIT 2 (15 Hours)

Confidence intervals for difference between population means - Confidence intervals for ratio of population variances – confidence interval for binomial and Poisson distribution parameters with normal approximation. Confidence interval for a difference between two means from paired data.

#### MODULE II (20 Hours)

##### UNIT 1 (5 Hours)

Hypothesis Testing: null and alternative hypothesis – simple and composite hypothesis - type I error type II error – likelihood ratio- level of significance – Probability value and power of test.

##### UNIT 2 (5 Hours)

Basic tests for one sample – Population mean variance and standard deviation. Testing binomial and Poisson parameter

##### UNIT 3 (10 Hours)

Basic tests for two sample – Difference between two Population means and Ratio of Population variances - Testing difference between binomial and Poisson parameter. Chi-squared test - contingency table – example problems

**MODULE III (15 Hours)**

**UNIT 1 (5 Hours)**

Introduction of Data Analysis - scatter plots for bi-variate data– correlation analysis – sample correlation coefficient – spearman’s rank correlation coefficient – Inference (only result 1 and result 2 – Multivariate correlation analysis - sample correlation coefficient matrix.

**UNIT 2 (7 Hours)**

Introduction of Linear regression – The simple bivariate linear model – Partitioning the variability of the response – The full normal model and inference – Inferences on the slope parameter. Analysis of variance (One way ANOVA methods and Problems) – Estimating a mean response and predicting an individual response – checking the model –

**UNIT 3 (3 Hours)**

Multiple linear regression model (Basics)

**MODULE IV (25 Hours)**

**UNIT 1 (9 Hours)**

Introduction of Generalized linear models – Exponential families: Normal distribution – Poisson distribution – Binomial distribution – gamma distribution - liner predictor – Interaction between variables – Factors and interaction between factors – Predictors with variable and factors and interaction - Link functions – Model fitting and comparison – Residuals analysis and assessment of model fit.

**UNIT 2 (6 Hours)**

Introduction of Bayesian Statistics – Bayes’ theorem - Prior and Posterior distribution: Notation determination the posterior density – Discrete and Continuous prior distribution – conjugate priors –improper prior distribution The loss function: quadratic loss - absolute error loss- all- or- nothing loss - Examples.

**UNIT III (5 Hours)**

Credibility Theory-The credibility premium formula- The credibility factor- Bayesian credibility- The Poisson/Gamma model- The Normal/Normal model.

**UNIT IV (5 Hours)**

Empirical Bayes Credibility Theory- Empirical Bayes Credibility Theory: Model 1- Model 1: Parameter estimation- Empirical Bayes Credibility Theory: Model-2

**Recommended References**

1. Miller, I., Miller, M., & Freund, J. E. (2014). John E. Freund's mathematical statistics with applications. Boston: Pearson.
2. Yuly Koshevnik (2017). Fundamentals of Statistical Thinking Tools and Applications
3. Klugman, S. A., Beckley, J. A., Scahill, P. L., Varitek, M. C., & White, T. A. (2012). Understanding actuarial practice. Society of Actuaries.
4. Perna, C., & Sibillo, M. (Eds.). (2012). Mathematical and statistical methods for actuarial sciences and finance. Springer.
5. Frees, E. W. (2009). Regression modeling with actuarial and financial applications. Cambridge University Press.

**Course Outcomes**

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Explain and apply the basic principles of exploratory data analysis	K2
2	Understand the Statistical applications of Maximum likelihood inference, Interval estimation and Hypothesis Testing.	K4
3	Describe and apply appropriate software to fit linear and multiple regression models to a data set and interpret the output.	K6
4	Fit generalized linear model to data set and describe how a suitable model can be chosen by using analysis of deviance.	K4
5	Explain the fundamental concepts of Bayesian statistics and use them to compute Bayesian estimators	K2
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

**Learning Pedagogy**

Lecturing supplemented with technology-enabled learning, Group assignments

**Assessment Tools**

Assignment, Seminar, Test papers and End semester examination

Semester	Code	Subject	Total Hrs:90	Credits
II	PG20AS207	FINANCIAL MATHEMATICS - II	Hrs. / Week :5	4

### Course Objectives

- Express financial problems in a mathematical framework by evaluating various financial instruments
- Describe and interpret the theories of interest rates.

### Syllabus

#### MODULE I (15 Hours)

##### UNIT 1 (10 Hours)

Loan Schedule: Calculating the capital outstanding – Introduction --The theory prospective and retrospective loan calculations

##### UNIT 2 (5 Hours)

Calculating the Interest and Capital Elements -- The loan schedule -- Installments payable more frequently than annually -- Consumer Credit: Flat Rates and APRs

#### MODULE II (25 Hours)

##### UNIT 1 (13 Hours)

Project Appraisal- Introduction – Estimating cash flows – Fixed interest rates -- Accumulated value, Net present value and internal rate of return -- Discounted payback period.

##### UNIT 2 (12 Hours)

The comparison of two investment projects – Different interest rates for lending and borrowing – Payback period - Other considerations.

#### MODULE III (30 Hours)

##### UNIT 1 (5 Hours)

Taxation: Introduction – Personal taxation – Considerations – Taxable income – Tax rates – Corporation of- accounting profits & taxable profits – Rates of tax – Uses of corporation tax system - Capital gain of - Chargeable gains – Indexation allowance – Capital losses – Rates of tax- other taxes – Stamp duty – Inheritance taxes – Property taxes – Sales tax – Custom and excise duties – Double taxation relief.



**UNIT 2** (10 Hours)

Bonds Equity And Property -- Fixed interest securities – Calculating the price-without tax-allowing for income tax-capital gains tax-capital gains test -- Calculating yields-deferred income tax.

**UNIT 3** (15 Hours)

Uncertain income securities – Equities – Property -- Real rate of interest -- Inflation adjusted cash flows – Calculating real yield using an inflation index – Calculating real yields given constant inflation assumption – Payments related to the rate of inflation – The effects of inflation – Index linked bonds.

**MODULE IV** (20 Hours)

**UNIT 1** (3 Hours)

Term Structure of interest rates: Discrete time – Discrete time spot rates - Discrete time forward rates.

**UNIT 2** (5 Hours)

Continuous time rates – Continuous time spot rates – Continuing time forward rates – Instantaneous forward rates.

**UNIT 3** (2 Hours)

Theories of term structure of interest rates – Expectation theory -- liquidity preferences -- Market segmentation -- Why interest rates vary over time -- Theories -- Yields to maturity – Par yields.

**UNIT 4** (10 Hours)

Duration, convexity and immunization -- Interest rate risk-- Effective duration – Duration – Convexity – Immunization

### Recommended References

1. Bower, N. L., Gerber, H. U., Hickman, J. C., Jones, D. A., & Nesbitt, C. J. (1997). Actuarial Mathematics.
2. Promislow, S. D. (2014). Fundamentals of Actuarial Mathematics. John Wiley & Sons.
3. Booth, P., Haberman, S., Chadburn, R., James, D., Khorasanee, Z., Plumb, R. H., & Rickayzen, B. (2004). Modern actuarial theory and practice. Chapman and Hall/CRC.
4. Harrison, F., & Lock, D. (2017). Advanced project management: a structured approach. Routledge.
5. Ingersoll, J. E. (1987). Theory of Financial decision making (Vol. 3). Rowman & Littlefield.

### Course Outcomes

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Apply the concept of equation of value to create loan schedule.	K6
2	Use discounted cash flows and equation of value techniques in project appraisal.	K3
3	Apply Duration and Convexity to immunize the interest rate risk of a portfolio of liabilities.	K3
4	Evaluate Bond, Equity and Property according to the tax liability.	K5
5	Show how financial techniques can be used in the assessment of capital investment projects	K4
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

### Learning Pedagogy

Lecturing supplemented with technology-enabled learning, Group assignments

### Assessment Tools

Assignment, Seminar, Test papers and End semester examination

Semester	Code	Subject	Total Hrs:90	Credits
II	PG20AS208	BUSINESS ECONOMICS - II	Hrs. / Week: 5	4

### Course Objectives

To provide general understanding of macroeconomic principles, operations of economic system and how decisions by economic agents impact the economic system

### Syllabus

#### MODULE I (26 Hours)

##### UNIT 1 (8 Hours)

Government interventions in market: Efficiency under perfect competition - Objectives of government interventions - Types of market failure – Types of government intervention - The case for less Government intervention

##### UNIT 2 (6 Hours)

Competition policy: Restrictive - Monopoly –Merger policy – Policies towards research and development – Intervention of government in encouraging technological advancement

##### UNIT 3 (12 Hours)

Macroeconomic environment: The circular flow of income: Withdrawals and injections – Equilibrium in circular flow – The measurement of national income and output - Macroeconomic objectives - Unemployment: Meaning and measurement of unemployment – Costs of unemployment – Causes of unemployment – Types of unemployment – Unemployment and labour market -- Inflation: Inflation rate measure – Causes of inflation – Costs and types of inflation – Inflation and AD-AS Model.

#### MODULE II (28 Hours)

##### UNIT 1 (6 Hours)

International trade and payments: Globalization – Trading patterns – Advantages of trade – Arguments for restricting trade – Problems with protection – Role of World Trade Organization (WTO) in international trade.

**UNIT 2**

**(8 Hours)**

Analysis of business cycle: Actual and potential growth – Factors that determine economic growth - Factors that determine the length and magnitude of business cycle - Relationship between economic growth and environmental sustainability

Balance of Payment and exchange rate: The balance of payment account – Exchange rate – Fixed versus floating exchange rates - Relationship between exchange rate and balance of payment – Exchange rates in practice

**UNIT 3**

**(8 Hours)**

Financial system: Definition, role and evolution – Banking system: Types of banks – Functions of banks – Liquidity and profitability – The central bank—The money market - Money and interest rates: Money market model –Supply of money -- Credit creation – Relationship between money supply and interest rate – Demand for money – Equilibrium in money market – Effect of change in the money supply

**UNIT 4**

**(6 Hours)**

Monetary policy: Policy setting – Control of money supply over medium and long term –Control of money supply over short term - Techniques to control the money supply – Techniques to control interest rates -- Difficulties in controlling money supply and interest rates

**MODULE III**

**(22 Hours)**

**UNIT I**

**(8 Hours)**

Classical and Keynesian theory: Classical theory: Classical analysis of output and employment – Classical analysis of prices and inflation – The Keynesian revolution: Keynes rejection of classical macroeconomics – Keynesian analysis of employment and inflation - The determination of national income – Keynesian model of unemployment and inflation

**UNIT 2**

**(8 Hours)**

Monetarist and New classical schools and Keynesian responses: Monetarist school – The new classical school – The expectations-augmented Phillips curve – The monetarist perspective on inflation and unemployment – The Keynesian response.

**UNIT 3** (6 Hours)

Relationship between the goods and money market: The effect of monetary changes on national income – Monetary effects of changes in the goods market – The IS-LM model – The IS-MP model.

**MODULE IV** (14 Hours)

**UNIT 1** (8 Hours)

Supply side policy: Approaches to supply side policy: New classical – Keynesian – Third way supply side policies – Supply side policies in practice : Market oriented policies –Interventionist policies – Regional and urban policy.

**UNIT 2** (6 Hours)

Demand side policy: Fiscal policy and public finances: Definition and types of fiscal policy – Use of fiscal policy – The policy making environment.

**Recommended References**

1. Slomon J, Wride A, Garratt D, 2018,-Economics –10<sup>th</sup> edition, Pearson.
2. Sloman J, Garratt D, Guest J, Jones E, 2016-Economics for Business –7<sup>th</sup> edition, Pearson
3. Stonecash, R., Gans, J., King, S., &Mankiw, N. G. (2011). Principles of Macroeconomics. Cengage Learning.
4. Parkin, M., & Bade, R. (2007). Foundations of economics. Pearson Addison Wesley.
5. Perman, R. J., &Scouller, J. (2010). Economics of corporate and competitive strategy. Oxford University Press Australia and New Zealand.
6. Chrystal, K. A., &Lipsey, R. G. (1997). Economics for business and management. OUP Catalogue.
7. David Begg, Stanley Fisher and Rudiger Dorn Busch. Economics, McGraw Hill

**Course Outcomes**

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Describe market failures and types of government intervention towards correcting these failures	K2
2	Describe and explain the Balance of payment, the different constituents of balance of payment and allocate transactions to the appropriate constituent	K3
3	Distinguish between fixed and floating exchange rates, explain how exchange rates are determined, explain the possible causes for depreciation and appreciation of the currency and be able to explain the supply and demand curves for a currency with the help of sketch	K4
4	Describe the macroeconomic variables and how the government seeks to control them by implementing fiscal, monetary and competition policies	K2
5	Discuss the structure, role and stability of financial systems and the efficiency of different financial systems	K2
6	Assess the impact of macroeconomic and supply-side policies on businesses	K5
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

**Learning Pedagogy**

Lecture, Use of ICT tools, Debate, Discussions on newspaper articles related to topics covered in the syllabus, Group assignments and Case study

**Assessment Tools**

Assignment, Seminar, Test papers, Class participation, Quiz and End semester examination

Semester	Code	Subject	Total Hrs:90	Credits
II	PG20AS209	MODELS - II	Hrs. / Week: 5	4

### Course Objectives

Develop knowledge of and the ability to apply statistical methods for proportional hazards models and graduation methods.

### Syllabus

#### MODULE I (20 Hours)

##### UNIT 1 (3 Hours)

Proportional hazards models: Covariates and proportional hazards models – Covariates - proportional hazards models

##### UNIT 2 (5 Hours)

Fully parametric models - Parametric models for the hazard function - Other applications of these models - Use of parametric models

##### UNIT 3 (3 Hours)

The Cox proportional hazards model - Introduction - The utility of the Cox model - Summary

##### UNIT 4 (7 Hours)

Estimating the regression parameters - The partial likelihood - Maximizing the partial likelihood - Properties of the partial likelihood

##### UNIT 5 (2 Hours)

Model fitting - Assessing the effect of the covariates - building models - using the results.

#### MODULE II (20 Hours)

##### UNIT 1 (4 Hours)

Exposed to risk: Calculating the exposed to risk – Homogeneity – The problem of heterogeneity – The solution - The principle of correspondence

##### UNIT 2 (7 Hours)

Exact calculation of the central exposed risk - Working with complete data - Working with incomplete data

##### UNIT 3 (5 Hours)

Census approximation to the central exposed risk with the available data - The census approximation to  $E_x^c$

**UNIT 4**

**(4 Hours)**

Deaths classified using different definition of age - Consistency between census data and death data.

**MODULE III**

**(35 Hours)**

**UNIT 1**

**(7 Hours)**

Graduation and statistical tests: Comparison with another experience - Standard tables - Comparison with standard tables - Graduation - Reasons for graduation - The theoretical argument - The practical argument - Limitations - Summary

**UNIT 2**

**(7 Hours)**

Desirable features of graduation - Smoothness versus adherence to data - Testing smoothness and adherence to data - Suitability for the purpose in hand - Two examples of graduation - Testing the smoothness of a graduation - What is a smooth graduation? - Smoothness test

**UNIT 3**

**(5 Hours)**

Statistics refresher - Statistical tests - Continuity correction - Chi-squared tests

**UNIT 4**

**(16 Hours)**

Statistical tests of a mortality experience - Chi-Squared test - Standardized deviation test - Sings tests - Cumulative deviations - Grouping of signs test - Serial correlations test - Testing actual versus expected rates.

**MODULE IV**

**(15 Hours)**

**UNIT 1**

**(9 Hours)**

Methods of graduation: Graduation by parametric formula - Overview - Choosing and fitting parametric formulae - A practical example - Other considerations - The graduation process - Graduation by reference to a standard table - Overview - The graduation process - Graduation using spline functions - Overview - The graduation process - Examples of graduations using spline functions

**UNIT 2**

**(6 Hours)**

Comparison of different methods - Graduation by parametric formula - Graduation by reference to a standard table - Graduation using spline functions - Statistical tests of a graduation - Comparing one experience with another - Testing a graduation - The effect of duplicate policies



**Recommended References**

1. Marubini, E.; Valsecchi, M. G. - John Wiley, 2004. Analysing survival data from clinical trials and observational studies
2. Benjamin, B.; Pollard, J. H. The analysis of mortality and other actuarial statistics : (3rd ed). - Institute and Faculty of Actuaries, (1993)
3. Hinde, A. - Routledge, (1998).- Demographic methods.
4. Hickman, J. C. North American Actuarial Journal (1997) - Introduction to actuarial modeling.
5. Macdonald, A.S., Richards, S.J. and Currie, I.D.- Modelling mortality with actuarial applications. - Cambridge University Press, 2018.
6. Scott, W. F. -Mortality studies. - University of Aberdeen, Department of Mathematical Sciences, 2000.
7. Daykin, C. D.; Pentikainen, T.; Pesonen, M. - Chapman & Hall, (1994). - Practical risk theory for actuaries.
8. Elandt-Johnson, R. C.; Johnson, N. L. - John Wiley, (1999). -Survival models and data analysis.
9. Shailaja R Deshmukh.-Actuarial Statistics - An Introduction using R. 3rd ed.

**Course Outcomes**

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Describe and apply models for proportional hazards.	K3
2	Describe and calculate central exposed to risk for the given data.	K5
3	Describe the concepts of graduation of crude estimates. Describe and apply statistical tests of the comparison of crude estimates with a standard mortality table/a set of graduated estimates. Describe a test for smoothness of a set of graduated estimates.	K4
4	Describe the process of graduation by the different methods, and state the advantages and disadvantages of each method.	K2
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

**Learning Pedagogy**

Lecturing supplemented with technology-enabled learning, Group assignments

**Assessment Tools**

Assignment, Seminar, Test paper and End semester examination

Semester	Code	Subject	Total Hrs:90	Credits
II	PG20AS210	ACTUARIAL COMPUTING - I	Hrs. / Week :5	3

### Course Objectives

- Application of Statistical software techniques to predict future financial events that are of particular relevance to actuarial work.
- Demonstrate a capacity to work independently with Excel and R programming to analyze actuarial problems.

### Syllabus

#### MODULE I (23 Hours)

Summarize the main features of a data set (exploratory data analysis) - Summarize a set of data using a table or frequency distribution and display it -- Graphically using a line plot, a box plot, a bar chart, histogram, stem and leaf plot, or other appropriate elementary device -- Describe the level/location of a set of data using the mean, median, mode, as appropriate -- Describe the spread/variability of a set of data using the standard deviation, range, interquartile range, as appropriate -- Explain what is meant by symmetry and skewness for the distribution of a set of data -- Generate discrete and continuous random variables using statistical software -- Calculate Pearson's, Spearman's and Kendall's measures of correlation for bivariate data explain their interpretation and perform statistical inference as appropriate.

#### MODULE II (23 Hours)

Constructing estimators of population parameter -- Calculate confidence intervals for mean, variance and standard deviation and difference between two means, ratio of variance from normal data and paired data -- Testing mean, variance and standard deviation and difference between two means, ratio of variance from normal data and paired data -- Fit a simple linear regression model and multiple linear regression model to a data set and interpret the output.

#### MODULE III (22 Hours)

Calculation of simple and compound interest rate -- Calculation of Present Value and Accumulated value -- Level annuities -- Deferred and Increasing Annuities -- Compound increasing and decreasing annuities -- Payments made in arrear, Payment made in advance -- Continuously payable annuities -- Loan schedules: Preparation of loan amortization table -- Calculation of capital outstanding -- Calculation of the Interest and capital elements.

**MODULE IV**

**(22 Hours)**

Methods for project Evaluation: Net Present Value method – Discounted Payback Period method - -Accumulated profit method -- Weighted average cost of capital – Duration -- Discounted mean term – Convexity – Immunization – Asset-Liability management -- Calculating real yield using an inflation index

**Evaluation:** 5 numerical questions each with a weightage of 10 (50 Marks) are to be asked. 3 questions are from Actuarial Statistics I & II and 2 questions are from Financial Mathematics I & II .The questions from Actuarial statistics should be calculated using R programming and the questions from Financial Mathematics should be calculated using Excel. Examination of 3 hour duration must be conducted in the computer lab under the supervision of an examiner appointed by the college.

**Recommended References**

1. Guojun Gan, Emiliano Valdez (2018). Actuarial Statistics with R : Theory and Case Studies
2. Field, A. P., Miles, J., & Field, Z. (2012). Discovering statistics using R/Andy Field, Jeremy Miles, and Zoë Field.
3. Walkenbach, J. (2007). MICROSOFT EXCEL 2007 BIBLE (With CD). John Wiley & Sons.

**Course Outcomes**

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Summarize statistical data using R programming.	K2
2	Apply statistical distributions in modelling using R.	K3
3	Fit a simple linear regression model and multiple linear regression model to a data set and interpret the output	K4
4	Demonstrate actuarial models using excel	K6
5	Analyze the concept and apply methods of project evaluation using excel.	K4
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

**Learning Pedagogy**

Lecturing, Group Assignments, Lab

**Assessment Tools**

Assignment, Seminar, Test papers and End semester examination

# SEMESTER III

Semester	Code	Subject	Total Hrs:90	Credits
III	PG20AS311	CONTINGENCIES - I	Hrs. / Week: 5	4

### Course Objectives

Provide students with essential knowledge in pricing of different life insurance products.

### Syllabus

#### MODULE I (20 Hours)

##### UNIT 1 (2 Hours)

The life table: Present values of payments under life insurance and annuity contracts -  
Equations of value - Allowances for investment income - Other assumptions

##### UNIT 2 (6 Hours)

The life table - Constructing a life table - the force of mortality - Interpretation - Using the  
life table - Life random variables - More notation

##### UNIT 3 (6 Hours)

Life table function at non-integer ages - Method 1 uniform distribution of deaths(UDD) -  
Method 2 constant force of mortality - Evaluating probabilities without use of the life table -

##### UNIT 4 (6 Hours)

Select mortality - Mortality rates that depend on both age and duration - Displaying select  
rates - Constructing select and ultimate life tables - Using tabulated select life table functions.

#### MODULE II (30 Hours)

##### UNIT 1 (9 Hours)

Life assurance contracts: Type of contracts - Whole life assurance contracts - Present value  
random variable - Expected present value - Variance of present value random variable -  
Term assurance contracts - Present value random variable - Expected present value -  
Variance of present value random variable - Pure endowment contracts - Present value  
random variable - Expected present value Variance of the present value variable -  
Endowment assurance contracts - Present value random variable - Expected present value -  
Variance of the present value random variable - Deferred assurance benefits - Present value  
random variable - Expected present value - Variance of the present value random variable

**UNIT 2** (6 Hours)

Benefits payable immediately on death - Whole life assurance - Term assurance - Endowment assurance - Other relationships - Claims acceleration approximation - Further approximation - Evaluating means and variances using select mortality.

**UNIT 3** (12 Hours)

Life annuity contracts: Whole life annuities payable annually in arrears - Present value random variable - Expected present value - Variance of the present value random variable - Whole life annuities payable annually in advance - Present value random variable - Variance of the present value random variable - Temporary annuities payable annually in arrears - Present value random variable - Expected present value - Variance of the present value random variable - Temporary annuities payable annually in advance - Present value random variable - Expected present value - Variance of the present value random variable - Deferred annuities - Present value random variable - Expected present value - Deferred annuities-due - Guaranteed annuities payable annually in advance - Present value random variable - Expected present value - Variance of the present value random variable

**UNIT 4** (3 Hours)

Guaranteed annuities payable annually in arrears - Present value random variable - Expected present value - Variance of the present value random variable - Continuous annuities - Other annuities - Approximations - Continuous annuities - Evaluating means and variance using select mortality.

**MODULE III** (30 Hours)

**UNIT 1** (12 Hours)

Evaluation of assurances and annuities: Evaluating assurance benefits - Evaluating annuity benefits - Premium conversion formulae - Discrete version - Continuous version - Variance of benefits

**UNIT 2** (8 Hours)

Expected present values of annuity payable ' $m$ ' times each year - Expected present values under a constant force of mortality.

**UNIT 3** (7 Hours)

Variable benefits and conventional with-profits policies: Variable payments - Payments varying at a constant compound rate - Payment varying by a constant monetary amount - Whole life assurance - Term assurance - Endowment assurance - Decreasing term assurance - Increasing assurances payable immediately on death - Whole life annuity payable in arrears -



Whole life annuity payable annually in advance - Temporary annuities - Annuities payable continuously

**UNIT 4** (3 Hours)

Conventional with- profit contracts - Types of bonuses.

**MODULE IV** (20 Hours)

**UNIT 1** (9 Hours)

Gross premiums: The gross premiums - Gross future loss random variable - Calculating premiums that satisfy probabilities, using gross future loss random variable

**UNIT 2** (9 Hours)

Principle of equivalence - Definition - Determining gross premiums using the equivalence principle - The basis - Premium payment structures - Annual premium contracts - Conventional with-profits contracts - Premiums payable ' $m$ ' times per year

**UNIT 3** (2 Hours)

Calculating gross premiums using simple criteria other than the equivalence principle.

### Recommended References

1. Bowers, N. L.; Gerber, H. U.; Hickman, J. C - Actuarial mathematics: 2nd ed. et al. Society of Actuaries,
2. Dickson, D.C.M.; Hardy, M.R.; Waters, H.R.- Actuarial mathematics for life contingent risks: 2nd ed. Cambridge University Press,( 2013)
3. Haberman, S.; Pitacco, E. Chapman & Hall, (1999). - Actuarial models for disability insurance.
4. Benjamin, B.; Pollard, J. H. Institute and Faculty of Actuaries, (1993.) - The analysis of mortality and other actuarial statistics. 3rd ed.
5. Promislow, D. John Wiley, (2015).-Fundamentals of actuarial mathematics. 3rd ed.
6. Scott, W. F. Heriot - Life assurance mathematics. -Watt University, (1999).
7. Neill, A. Heinemann, (1977)-Life contingencies.

**Course Outcomes**

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Understand and use mortality table to calculate the probabilities of death/survival using both ultimate and select mortality.	K3
2	Recognize simple assurance and annuity contracts, and develop formulae for the present value of the payments under these contracts and the associated means and variances of these present values.	K5
3	Perform calculations of the mean and variance of simple assurance and annuity contracts with standard actuarial functions, using specified mortality table.	K5
4	Describe the operation and develop formulae for the means and variances of the payments under conventional with-profits contracts.	K6
5	Calculate gross premiums of assurance and annuity contracts, using gross future loss random variable or using principle of equivalence.	K5
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

**Learning Pedagogy**

Lecturing supplemented with ICT tools, Group Assignments

**Assessment Tools**

Assignment, Seminar, Test Papers, End Semester Examination

Semester	Code	Subject	Total Hrs:90	Credits
III	PG20AS312	RISK MODELING - I	Hrs. / Week :4	4

### Course Objectives

- Application of mathematical and statistical modelling techniques to analyze and create solutions to problems that are of particular relevance to actuarial work.
- To collaborate risk modeling theory to a variety of financial and insurance issues.

### Syllabus

#### MODULE I (15 Hours)

##### UNIT 1 (10 Hours)

Loss distributions: Introduction – Simple loss distributions – The exponential distribution – The gamma distribution – The normal distribution – Pareto and Generalized Pareto distribution – lognormal distribution – Wei-bull distribution the burr distribution.

##### UNIT 2 (5 Hours)

Estimation – The method of moment –MLE for gamma and exponential distribution – Method of Percentiles. Goodness of fit tests – Examples.

#### MODULE II (30 Hours)

##### UNIT 1 (15 Hours)

Reinsurance: Introduction – Proportional Reinsurance arrangements – Non Proportional Reinsurance arrangements – Concepts -- Excess of loss reinsurance for insurer - Excess of loss reinsurance for reinsurer - Examples- Proportional Reinsurance Examples.

##### UNIT 2 (15 Hours)

Proportional Reinsurance Lognormal distribution and examples –Normal distribution and Examples Inflation – Estimation of Parameters from Censored Data– Policy Excess – Examples

#### MODULE III (20 Hours)

##### UNIT 1 (5 Hours)

Risk model 1: The Basic model – Discussion of the simplification in the basic model – Notation and Assumption.

**UNIT 2 (15 Hours)**

The collective risk model: the collective risk model distribution function and convolution- Moments of compound distribution– the compound Poisson distribution – the compound binomial distribution – the compound negative binomial distribution – examples

**MODULE IV (25 Hours)**

**UNIT 1 (10 Hours)**

Risk model 2: Introduction - Aggregate claim distribution under proportional and individual excess of loss reinsurance: proportional reinsurance – individual excess of loss reinsurance– Examples – Aggregate excess of loss reinsurance.

**UNIT 2 (15 Hours)**

The Individual risk model - Parameter variability /uncertainty:- Introduction – variability in a heterogeneous portfolio – Examples - variability in a homogeneous portfolio – Examples - variability in claim Numbers and claim amounts and parameter uncertainty - Examples.

**Recommended References**

1. Denuit, M., Maréchal, X., Pitrebois, S., & Walhin, J. F. (2007). Actuarial modelling of claim counts: Risk classification, credibility and bonus-malus systems. John Wiley & Sons.
2. Edward W Frees -Regression Modeling with Actuarial and Financial Applications (International Series on Actuarial Science)
3. Blacker & Yang Actuaries in Micro insurance: Managing Risk for the Underserved ACTEX
4. Miller & Lawton | Stone House-An introduction to statistical modeling – Dobson, Annette J- Chapman & Hall, 1983 viii, 125 pages – ISBN : 0 412 24860 3
5. Hossack,Ian B; Pollard, John H; Zehnwirth, Benjamin -Introductory statistics with applications in general insurance- – 2<sup>nd</sup> ed. – Cambridge University Press , 1999.
6. Klugman, Stuart A; Panjer, Harry H; Willmot, Gordon E; Venter, Gary G.- John Wiley & Sons -Loss models: from data to decisions. 1998

**Course Outcomes**

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Describe and use statistical distributions for risk modelling.	K2
2	Fit a statistical distribution to a dataset and calculate goodness of fit measures	K3
3	Apply compound distributions in risk modelling	K3
4	Develop risk modeling techniques in claim forecasting	K6
5	Analyze the concept and methods of re-insurance to hedge against risk.	K4
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

**Learning Pedagogy**

Lecturing supported with ICT tool, Group Assignments.

**Assessment Tools**

Assignment, Seminar, Test Papers, End Semester Examination

Semester	Code	Subject	Total Hrs:90	Credits
III	PG20AS313	CORPORATE FINANCE	Hrs. / Week : 5	4

### Course Objectives

- Acquire knowledge of corporate finance including a knowledge of the instruments used by companies to raise finance and manage financial risk
- Construct management information and evaluate working capital.

### Syllabus

#### MODULE I (22 Hours)

##### UNIT 1 (9 Hours)

Key principles of finance and corporate governance: Introduction to finance – Finance and real resources of organization - Finance and the organization: Objectives - Responsibilities for financial decisions – The importance of capital budgeting – Financial analysis.

##### UNIT 2 (8 Hours)

Business objectives – The stakeholders – Conflicting objective provides of finance- Contractual theory – Ways of managing conflicts - Business objectives – Agency theory-- The role of agreements --The value of a company -- A re- statement - The maximization of shareholders wealth – The goal of the financial managers -- The opportunity cost of capital – The capital markets - Corporate governance and organization – Accountability.

##### UNIT 3 (5 Hours)

Business Ownership: Types of business entity – Sole trader – Partnership limited companies – Limited liability partnerships – Private & public limited companies – Pros & cons of limited companies.

#### MODULE II (24 Hours)

##### UNIT 1 (4 Hours)

Long term finance: loan capital – Introduction – Debenture stock – Unsecured loan stock - Subordinate debt- Eurobond loan capital – Floating rate notes.

##### UNIT 2 (4 Hours)

Share capital – Ordinary shares – Preference shares -- Convertibles – Warrants – Options issued by companies – Winding up of a company

**UNIT 3 (4 Hours)**

Issue of shares: Obtaining stock exchange quotation – Reasons for quotation.--Methods to obtain quotation – Offer for sale at fixed price – Offer for sale by tender – Concessionary methods –Offer for subscription – Placing

**UNIT 4 (3 Hours)**

Role of underwriting: Issue made by companies already quoted rights issue – Purpose – Impact – Theoretical price – Scrip issue – Purpose – Impact – Scrip dividend.

**UNIT 5 (5 Hours)**

Short and Medium Term Finance: Medium term company finance – Hire purchase – Credit sale – Leasing – Bank loans -- Short term finance – Bank overdrafts – Trade credit – Factoring -- Bills of exchange – Commercial paper

**UNIT 6 (4 Hours)**

Alternative sources of finance: Shadow banking-project finance-crowd funding-microfinance.

**MODULE III (24 Hours)**

**UNIT 1 (8 Hours)**

Use of derivatives: introduction – Financial futures – Bond futures- Short interest rate future - Work index futures -- Options – Meaning – Margins & premium – Types – Put option - Call option – Uses of option – Interests & currency swaps – Pricing – Risk – Uses of swaps.

**UNIT 2 (8 Hours)**

Evaluation of working capital: working capital – Management -- Sources of short term finance -- Managing cash flow-cash, dividends and dividend sustainability -- Constructing management information -- The purpose of forecast and budgets-examples of forecast and budgets.

**UNIT 3 (8 Hours)**

Growth and restructuring of companies: Motives for growth -- The relationship between profit and growth-the constraints on growth -- Methods of achieving growth-mergers and acquisitions.

**MODULE IV (20 Hours)**

**UNIT 1 (10 Hours)**

Capital structure and dividend policy: Introduction – Capital structure – Components of capital structure -- The aims of financial manager – Asset and their financing needs --

Changing the capital structure -- Theoretical background of gearing decision -- Factors affecting gearing decision in practice.

**UNIT 2** **(5 Hours)**

The market and capital structure – High growth company that is highly geared – Cyclical industry – An industry facing decline -- “ people ” businesses – Company in high growth but high risk industries – Taxation and capital structure.

**UNIT 3** **(5 Hours)**

Dividends-shareholder’s reward – Fundamentals of dividend policy – Factors influencing dividend policy – Other methods of reward – Scrip and stock dividends – Effects on companies and shareholders – Share buyback – The market and dividend

**Recommended References**

1. Ross, S. A., Westerfield, R., & Jordan, B. D. (2008). Fundamentals of corporate finance. Tata McGraw-Hill Education
2. Brealey, R. A., Myers, S. C., Allen, F., & Mohanty, P. (2012). Principles of corporate finance. Tata McGraw-Hill Education.
3. Damodaran, A. (1996). Corporate finance. Wiley.
4. Brigham, E. F., & Houston, J. F. (2012). Fundamentals of financial management. Cengage Learning.
5. Davidson, A. (2008). How to Understand the Financial Pages: A Guide to Money and the Jargon. Kogan Page Publishers.
6. Johnson, T. Palgrave Macmillan, 2017. Ethics in quantitative finance.
7. Lessard, D. R., & Paddock, J. L. (1983). Evaluating international projects: weighted-average cost of capital versus valuation by components



**Course Outcomes**

<b>CO. No</b>	<b>On completion of this course, the students will be able to:</b>	<b>Knowledge Level</b>
1	Understand how companies are governed and structured	K2
2	Suggest appropriate ways to finance a company	K3
3	Assess and analyze the financial environment and draw appropriate conclusions for financial outcomes	K3
4	Evaluate investment Projects	K5
5	Understand How the financial instruments are issued	K2
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

**Learning Pedagogy**

Interactive lecturing supported with ICT tools, Group assignments, Group discussions and Presentations

**Assessment Tools**

Assignment, Seminar, Test paper and End semester examination

Semester	Code	Subject	Total Hrs:90	Credits
III	PG20AS314	FINANCIAL ACCOUNTING	Hrs. / Week : 5	3

### Course Objectives

- Construct company accounts
- Interpret the accounts and financial statements of companies and financial institutions

### Syllabus

#### MODULE I (24 Hours)

##### UNIT 1 (6 Hours)

Introduction to accounts: The accounting framework-Users -- Sources of regulation statutory requirements – Directors report – Accounting standards – Contents of annual report – Auditor’s report.

##### UNIT 2 (6 Hours)

Accounting concepts – Cost concepts – Money measurements concepts – Business entity concept – Realization concept – Accrual concept – Dual aspect concept – Materiality – Prudence – Going on concept- Consistency – Bringing the concepts together.

##### UNIT 3 (6 Hours)

The main accounts: The balance sheet – Format – Fixed assets – Tangible assets and Intangible assets – Revaluation – Current assets – Liabilities – Long term liabilities – Current liabilities – Provisions and charges –Provisions for taxation and dividends – Pensions – Contingent liability –Capital.

##### UNIT 4 (6 Hours)

Profit and loss account – Format – Cost of sales – Expenses – Categories of profit – Taxation – Dividends and retained profits – Earnings per share cash flow statement – Format – Purpose of cash flow statement – Notes to accounts

#### MODULE II (22 Hours)

##### UNIT 1 (11 Hours)

Depreciation and reserves –Introduction – Purpose – Methods – Straight-line methods - Reducing balance method -- Capital and reserves – Share capital and share premium – revaluation reserve –Profit and loss account.

**UNIT 2**

**(11 Hours)**

Constructing Accounts: The trial balance – Construction and preparation of financial statement – Profit and loss account and balance sheet – Awkward items in the trial balance – Depreciation – Profit and loss reserve – Stock -- Adjustment in the accrual concept -- Using the trial balance - Preparation of income statement-balance sheet

**MODULE III**

**(20 Hours)**

**UNIT 1**

**(12 Hours)**

Group accounts and insurance company accounts: Introduction – Consolidated financial statements -- Subsidiary companies – Consolidated balance sheet -- Goodwill on consolidation – Minority interest in associated companies –Minority interest associated companies.

**UNIT 2**

**(8 Hours)**

Insurance companies -- Introduction – Estimation of liabilities and timing of profit – profit and loss account – Technical accounts -Non- technical accounts – Balance sheet –Assets – Liabilities – Shareholders fund.

**MODULE IV**

**(24 Hours)**

**UNIT 1**

**(8 Hours)**

Interpretations of accounts: Introduction –Measuring risk associated with loan capital – Income cover and Income priority percentages – Asset cover and Asset priority percentages – Asset gearing – Income gearing -- Ratios involving share information - Earnings per share - basic and diluted Price earnings ratio-uses -- Dividend yield – Dividend cover -- EBITDA-net asset value per share – Variations.

**UNIT 2**

**(8 Hours)**

Other accounting ratios – Introduction -- Profitability ratios – Return on capital employed – Profit margin -- Asset utilization ratio -- Liquidity ratios – Current ratio- Quick ratio -- Efficiency ratios – Stock turnover period – Debtor's turnover period – Creditors turnover period.

**UNIT 2**

**(8 Hours)**

Weighted Average Cost Of Capital - Introduction – The importance of the discount rate -- Defining the weighted average cost of capital -- Modigliani and miller- - Their view -- CAPM – Cost of equity – CAPM and risk – Systematic risk – Beta as a measure of systematic risk – Measuring beta – Market derived real discount rate -- Cost of debt - Marginal or average cost- determinants – Calculation of WACC.

### Recommended References

1. Scott, W. R. (2003). Financial accounting theory.
2. Beaver, W. H. (1998). Financial reporting: an accounting revolution (Vol. 1). Upper Saddle River, NJ: Prentice Hall.
3. Sloman, J., Garratt, D., Guest, J., & Jones, E. (2016). Economics for business. Pearson Education.
4. Brigham, E. F., & Houston, J. F. (2012). Fundamentals of financial management. CengageLearning.
5. Davidson, A -How to understand the financial pages. 2nd ed. Kogan Page, 2008.
6. Bushman, R. M., & Smith, A. J. (2001). Financial accounting information and corporate governance.

### Course Outcomes

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Describe accounts of different types and the principle features of accounts of a company	K2
2	Construct main accounts of an institution.	K6
3	Interpret the accounts of a company or a group of companies and discuss the limitations of such interpretation.	K5
4	Understand main accounts of insurance company and holding company	K2
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

### Learning Pedagogy

Interactive lecturing supported with ICT tools, Group assignments, Group discussions and Presentations

### Assessment Tools

Assignment, Seminar, Test papers and End semester examination

Semester	Code	Subject	Total Hrs:90	Credits
III	PG20AS31 5	ELECTIVE I: BUSINESS MANAGEMENT	Hrs. / Week: 5	3

### Course Objectives

- Familiarize students with the impact of internal and external environment on organizations operations and strategies
- Enable students to identify the business problems and apply an appropriate analytical tool to evaluate the constantly changing business environment
- Develop strategic thinking, leadership skills, working in teams and decision-making abilities of students

### Syllabus

#### MODULE I (30 Hours)

##### UNIT 1 (15 Hours)

External Business Environment: Nature and Types of competitive environments – Impact and influence of external environment on organizations – Corporate social responsibility – Organizational development – Organizational culture.

##### UNIT 2 (15 Hours)

Organizational Behaviour: Features of organizational behavior – Changing nature of work – Organization and management – Impact of globalization on organizations – Impact and influence of internal environment on the organization's strategy

#### MODULE II (30 Hours)

##### UNIT 1 (15 Hours)

Strategic Management: Concepts in strategic management – Different levels of strategies in organization - Organizational goals, objectives and policies – Organization structure – Value chain analysis.

##### UNIT 2 (15 Hours)

Impact of internal and external environment on organizations: PESTEL analysis - SWOT analysis - Porter's five force model - Porter's diamond - Stakeholder mapping –Qualitative and quantitative tools of competitor's analysis – Scorecards – Internal and external growth strategies.

**MODULE III (20 Hours)**

**UNIT 1 (12 Hours)**

Managing Change: Nature of organizational change – Reasons for resistance to change – Human and social factors of change – Tools and methods for implementation of change – Risk associated with managing change

**UNIT 2 (8 Hours)**

Leadership: Importance in organizations – Styles and forms of leadership – Values and behavior of leaders- exercising leadership power – Effective leadership variables

**MODULE IV (10 Hours)**

**UNIT 1**

Team work: understanding teams – Process of teamwork – Type of teams - Team composition and behavior - Types of member team roles – Frameworks and models - Team decision--making processes and methods - Nature of group dynamics – Project management: tools and techniques - - Nature and causes of conflicts – Management of conflict – Importance of building effective teams.

**Recommended References**

1. Parikh, M., & Gupta, R. (2010). Organizational Behaviour Tata McGraw Hill. Education Private Limited: New Delhi
2. Aswathappa, K., & Reddy, G. S. (2009). Organizational behaviour (Vol. 20). Himalaya Publishing House.
3. Sherlekar, S. A., & Sherlekar, V. S. (2007). Himalaya Publishing House. Modern Business Organisation and Management: Systems-based Contingency Approach to the Organisation and Management of Business.
4. Robbins, S. P. (2001). Organizational Behaviour: Concepts, Controversies and Applications Australia and New Zealand. Prentice Hall.
5. Kotter, J. P. (2012). Leading change. Harvard business press.
6. Chance, P.L., & Chance, E.W. (2002). Introduction to educational leadership and organizational behavior: Theory into practice. Larchmont, NY: Eye on Education.

7. Larcker, D., & Tayan, B. (2015). Corporate governance matters: A closer look at organizational choices and their consequences. Pearson Education
8. Rothwell, W. J., Stavros, J. M., Sullivan, R. L., & Sullivan, A. (Eds.). (2009). practicing organization development: A guide for leading change (Vol. 34). John Wiley & Sons.

### Course Outcomes

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Analyze key drivers of the internal and external business environment and evaluate the impact of internal and external environment on the organization and its strategy	K4
2	Apply strategic tools and framework to assess competitiveness and develop strategies	K3
3	Explain the nature of organizational change and apply tools and methods for successful implementation of change	K3
4	Compare between the main approaches to leadership, styles and forms of leadership	K2
5	Demonstrate the ability to lead and participate effectively in group settings	K2
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

### Learning Pedagogy

Lectures, Debate, Group assignments and Case study

### Assessment Tools

Assignment, Seminar, Test papers, Class participation and End semester examination

# SEMESTER IV



Semester	Code	Subject	Total Hrs:90	Credits
IV	PG20AS416	CONTINGENCIES - II	Hrs. / Week: 5	4

### Course Objectives

Provide students essential knowledge on areas such as reserving and profit testing of different life insurance products.

### Syllabus

#### MODULE I (20 Hours)

##### UNIT 1 (7 Hours)

Gross premium reserves: Why hold reserves - Prospective reserves - Calculating gross premium reserves - Calculating prospective reserves that satisfy probabilities - Gross premium prospective reserves for conventional with-profits policies - Reserve conventions

##### UNIT 2 (6 Hours)

Retrospective reserves - Retrospective accumulations - Gross premium retrospective reserve

##### UNIT 3 (5 Hours)

Equality of prospective and retrospective reserves - Conditions for equality - Demonstrating the equality of prospective and retrospective reserves - Recursive relationship between reserves for annual premium contracts

##### UNIT 4 (2 Hours)

Net premium reserves for conventional without profit contracts - Difference from gross premium reserve - A special result for the net premium reserve for some endowment and whole life assurance contracts.

#### MODULE II (15 Hours)

##### UNIT 1 (5 Hours)

Mortality profit : Mortality profit on single policy - Death strain at risk (DSAR) - Expected death strain (EDS) - Actual death strain (ADS) - Mortality profit - Mortality profit on a portfolio of policies

##### UNIT 2 (5 Hours)

Allowing for death benefits payable immediately - Allowing for survival benefits - Annuities - Allowing for different premium or annuity payment frequencies.

##### UNIT 3 (5 Hours)

Unit-linked and accumulating with-profits contracts: Unit-linked contracts - Unit funds and non-unit funds - Accumulating with-profits contracts - Definition - Unitised (accumulating)

with-profits contracts - Charges and benefits under UWP - Comparison between UWP and the simple AWP designs.

**MODULE III (25 Hours)**

**UNIT 1 (9 Hours)**

Competing risks: Health insurance contract - Multiple state models - Notation - Valuing continuous cash flows using multiple state models - Designing the multiple state model

**UNIT 2 (6 Hours)**

Multiple decrement models - A simple example - Multiple decrement probabilities - Deriving probabilities from transition intensities

**UNIT 3 (7 Hours)**

Multiple decrement tables - Associated single decrement tables - Relationships between single and multiple decrement tables - Constructing a multiple decrement table - Obtaining dependent probabilities - Integral formulae for multiple decrement probabilities

**UNIT 4 (3 Hours)**

Using multiple decrement tables to evaluate expected present values of cash flows

**MODULE IV (30 Hours)**

**UNIT 1 (8 Hours)**

Profit testing: Evaluating expected cash flows for various contract types - Example 1: Conventional whole life assurance - Example 2: Conventional endowment assurance - Example 3: Unit-linked endowment assurance - Example 4: Single premium unitized with-profits contract

**UNIT 2 (7 Hours)**

Profit test for annual premium contracts - Summary measures of profit - Profit testing using the present value random variable - Pricing using profit test - Profit criterion.

**UNIT 3 (10 Hours)**

Reserving aspects of profit testing: Pricing and reserving bases - Calculating reserves for Unit-linked contracts - Reserves revisited - Calculating reserves for unit-linked contracts

**UNIT 4 (5 Hour)**

Calculating reserves for conventional contracts using the profit test - Effect of pricing and reserving bases on a profit test - Setting out the calculations.

**Recommended References**

1. Bowers, N. L.; Gerber, H. U.; Hickman, J. C - Actuarial mathematics: 2nd ed. et al. Society of Actuaries,
2. Dickson, D.C.M.; Hardy, M.R.; Waters, H.R.- Actuarial mathematics for life contingent risks: 2nd ed. Cambridge University Press,( 2013)
3. Haberman, S.; Pitacco, E. Chapman & Hall, (1999). - Actuarial models for disability insurance.
4. Benjamin, B.; Pollard, J. H. Institute and Faculty of Actuaries, (1993.)-The analysis of mortality and other actuarial statistics. 3rd ed.
5. Promislow, D. John Wiley, (2015).-Fundamentals of actuarial mathematics. 3rd ed.
6. Scott, W. F. Heriot - Life assurance mathematics. -Watt University, (1999).
7. Neill, A. Heinemann, (1977)-Life contingencies. .
8. Gerber, H. U. Springer -Life insurance mathematics. 3rd ed.; Swiss Association of Actuaries, (1997).
9. Booth, P. M.; Chadburn, R. G.; Haberman, S. et al. Chapman & Hall, (2005). - Modern actuarial theory and practice. 2nd ed.

**Course Outcomes**

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Describe and calculate reserves under assurance and annuity contracts using prospective and retrospective method of valuation.	K3
2	Define and calculate death strain at risk, expected death strain, actual death strain and mortality profit, for a single policy or a portfolio of policies.	K3
3	Describe the construction and use of multiple decrement tables. Define a multiple decrement model as a special case of a multiple state Markov model.	K6
4	Describe the operation of conventional, unit-linked and accumulating with-profits contracts.	K2
5	Profit test of whole life, endowment and term assurances, annuities, unit-linked contracts, and conventional/unitized with-profits contracts. Show how a profit test can be used to price a product.	K4
6	Project expected future cash flows for the above listed contracts, and hence to show it can be used to calculate gross premium reserves.	K3
7	Show how, for unit-linked contracts, non-unit reserves can be established to eliminate ('zeroise') future negative cash flows, using a profit test model.	K2
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

**Learning Pedagogy**

Lecturing supplemented with technology-enabled learning, Group assignments

**Assessment Tools**

Assignment, Seminar, Test papers and End semester examination

Semester	Code	Subject	Total Hrs:90	Credits
IV	PG20AS417	RISK MODELING - II	Hrs. / Week :5	4

### Course Objectives

- Application of Actuarial risk modelling techniques to predict future financial events that are of particular relevance to actuarial work.
- Demonstrate a capacity to work independently with risk modeling techniques to actuarial problems.

### Syllabus

#### MODULE I (30 Hours)

##### UNIT 1 (10 Hours)

Time series: Introduction – Properties of a uni-variate time series – Auto Covariance function – Auto Correlation function – correlograms - Partial Auto Covariance function – Partial Auto Correlation function. Stationary random series

##### UNIT 2 (20 Hours)

Main linear model of time series: introduction- Backwards shift operator ‘B’ and Difference operator ‘ $\Delta$ ’ – Examples. Main linear models of time series - the first order autoregressive model AR (1) – the autoregressive model AR (P) – the first – order moving average. Model MA (1) the moving average MA (q) the autoregressive moving average process ARMA (p, q) - Modeling non stationary processes: the ARIMA model – Examples – Basics of Markov Property

#### MODULE II (17 Hours)

##### UNIT 1 (10 Hours)

Ruin Theory: Introduction - Basis concepts and notation - The surplus process – Equations. The probability of ruin in discrete and continues time –The Poisson and compound Poisson Processes

##### UNIT 2 (7 Hours)

Probability of ruin in the short term - premium security loadings. Reinsurance and ruin – Introduction – Proportional reinsurance – Excess of loss reinsurance – Examples.

**MODULE III (25 Hours)**

**UNIT 1 (5 Hours)**

Run – off triangles: Introduction – The origins of run-off triangles – Types of reserves – Presentations of claims data – Estimating future claims –Other ways of recording data. Projections using development factors: Run-off Patterns – The statistical model for run-off triangles

**UNIT 2 (10 Hours)**

The chain ladder method – model checking – other methods of deriving development factors - Assumptions underlying the method. Adjusting for inflation: The inflation adjusted chain ladder method – Dealing with Past and Future Inflation -Assumptions underlying the method

**UNIT 3 (10 Hours)**

The average cost per claim method - Description and Application of the method – Assumptions underlying the method Loss ratios - The Bornhuetter-Ferguson method: concept of Bornhuetter-Ferguson method – Description of the method – Application of the method – Assumptions underlying the method – Grossing up factors versus development factors.

**MODULE IV (18 Hours)**

**UNIT 1 (8 Hours)**

Machine Learning - An overview of machine learning – Concepts in machine learning – The loss function – Model evaluation – Examples. Generalization error and model validation – Train validation test – Validation and over-fitting – Regularization –

**UNIT 2 (10 Hours)**

Branches of machine learning – Supervised Learning - Unsupervised Learning – Semi - Supervised Learning - Reinforcement Learning. Stages of analysis in machine learning – Collecting data – Types of data - Exploring and Preparing Data – Splitting the table into the training and validation sets.

**Recommended References**

1. Denuit, M., Maréchal, X., Pitrebois, S., & Walhin, J. F. (2007). Actuarial modelling of claim counts: Risk classification, credibility and bonus-malus systems. John Wiley & Sons.
2. Edward W Frees -Regression Modeling with Actuarial and Financial Applications (International Series on Actuarial Science)

3. Blacker & Yang Actuarial Science in Micro insurance: Managing Risk for the Underserved  
ACTEX
4. Miller & Lawton | Stone House-An introduction to statistical modeling – Dobson, Annette J- Chapman & Hall, 1983 viii, 125 pages – ISBN : 0 412 24860 3
5. Hossack, Ian B; Pollard, John H; Zehnwirth, Benjamin -Introductory statistics with applications in general insurance- – 2<sup>nd</sup> ed. – Cambridge University Press , 1999.
6. Klugman, Stuart A; Panjer, Harry H; Willmot, Gordon E; Venter, Gary G.- John Wiley & Sons -Loss models: from data to decisions. 1998

### Course Outcomes

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Analyze basic concepts of time series models.	K4
2	Develop deterministic forecast from time series data using actuarial risk modelling techniques	K6
3	Explain concepts of ruin theory for a risk model and to evaluate probability of ruin for an insurance company.	K4
4	Estimate the ultimate cost of claims in general insurance by application of Run –off triangles.	K3
5	Explain and apply elementary principles of Machine learning.	K3
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

### Learning Pedagogy

Lecturing using ICT tool, Group assignments

### Assessment Tools

Assignment, Seminar, Test papers and End semester examination

Semester	Code	Subject	Total Hrs:90	Credits
IV	PG20AS418	ACTUARIAL COMPUTING - II	Hrs. / Week: 5	3

### Course Objectives

Provide students with technical knowledge in areas such as pricing, reserving and profit testing of different life insurance products using Microsoft Excel.

### Syllabus

#### MODULE I (22 Hours)

##### UNIT 1 (6 Hours)

The Life Table: constructing a life table - Calculating the values of life table functions - Constructing select and ultimate life table.

##### UNIT 2 (8 Hours)

Life Assurance Contracts and Life Annuity Contracts: Estimating expected present value of outgo and income and under various life insurance contracts - Whole life - Endowment - Term - Pure endowment

##### UNIT 3 (8 Hours)

Evaluation of Assurances and Annuities: Evaluating assurance and annuity benefits - Expected present value of annuity payable 'm' times

#### MODULE II (22 Hours)

##### UNIT 1 (8 Hours)

Gross Premiums and Reserves: Calculating required life table functions, Probabilities and commutation functions - Calculating gross premium using equation of value

##### UNIT 2 (8 Hours)

Calculating Gross Premium Reserve - Prospective reserve - Retrospective reserve - Net premium reserves for conventional without profit contracts.

##### UNIT 3 (6 Hours)

Mortality Profit: Expected present value of single life assurances and annuities - Calculating mortality profit using EDS and ADS



**MODULE III** (23 Hours)

**UNIT 1** (12 Hours)

Competing risk: Multiple decrement probabilities - Constructing multiple decrement tables - Evaluate expected present value of cash flows.

**UNIT 2** (11 Hours)

Unit linked and accumulating with profit contracts: Accumulating with profits contract

**MODULE IV** (23 Hours)

**UNIT 1** (12 Hours)

Profit Testing: Calculating expected cash flows for various contract types - Profit test for annual premium contracts - Pricing using profit test.

**UNIT 2** (11 Hours)

Reserving aspects of profit testing: Pricing and reserving - Calculating reserves for unit-Linked contracts - Calculating reserves for conventional contracts using profit test.

### Recommended References

1. Walkenbach, J. (2007). MICROSOFT EXCEL 2007 BIBLE (With CD). John Wiley & Sons.
2. Shailaja R Deshmukh.-Actuarial Statistics - An Introduction using R. 3rd ed.

### Course Outcomes

CO. No	On completion of this course, The students will be able to:	Knowledge Level
1	Handle real data sets as an application of ideas in the subject contingency using Microsoft Excel.	K3
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

### Learning Pedagogy

Lecture, Group assignments, Lab

### Assessment Tools

Assignment, Seminar, Test papers and End semester examination

Semester	Code	Subject	Total Hrs:90	Credits
IV	PG20AS419	ELECTIVE II FINANCIAL ENGINEERING	Hrs. / Week : 5	3

### Course Objectives

- Provide grounding in the principles of modelling applied to actuarial works
- Analyze and reduce the risks in investments

### Syllabus

#### MODULE I (21 Hours)

##### UNIT 1 (10 Hours)

The efficient market hypothesis: The three forms of market hypothesis-active v/s passive investment management -- The evidence for or against each form of the efficient market hypothesis -- Informational efficiency -- Volatility test.

##### UNIT 2 (10 Hours)

Utility theory: The expected utility theorem -- Utility functions -- State dependent utility functions -- Construction of utility functions -- Maximum premium -- Minimum premium -- Limitations of utility theory

#### MODULE II (22 Hours)

##### UNIT 1 (10 Hours)

Stochastic dominance of behavioural finance: stochastic dominance -- Behavioural finance -- Prospect theory critique of expected utility theory -- Heuristics behavioural biases -- A behavioural approach to the equity premium puzzle.

##### UNIT 2 (12 Hours)

Measures of investment risk: Variance of return-semi variance of return-shortfall probabilities -- Value at risk-tail value risk and expected short fall -- Relationship between risk measures and utility functions -- Risk and insurance companies-pooling resources -- Policyholder behaviour

**MODULE III (24 Hours)**

**UNIT 1 (10 Hours)**

Stochastic models of investment returns: Simple models -- Fixed rate model -- Varying rate model -- Moments-the log normal distribution.

**UNIT 2 (14 Hours)**

Portfolio theory: Assumption underlying mean variance portfolio theory – Definitions -- Derivation of efficient frontier-derivation of efficient frontier – The case of N securities -- Benefits of diversification

**MODULE IV (23 Hours)**

**UNIT 1 (13 Hours)**

Models of asset returns: definition-Macroeconomics factor models-Fundamental factor model-statistical factor models-construction of models-the single index models-Data requirements.

**UNIT 1 (10 Hours)**

Asset pricing models: assumptions-consequences of the extra assumptions-The separation theorem-the capital market line-the security market line-derivation of security market line-limitations of CAPM-extensions of basic CAPM-uses-estimating parameters for asset pricing model

**Recommended References**

1. Baxter, M., Rennie, A., & Rennie, A. J. (1996). Financial calculus: an introduction to derivative pricing. Cambridge university press.
2. Cairns, A. J. (2018). Interest rate models: an introduction. Princeton University Press.
3. Joshi, M. S., & Paterson, J. M. (2013). Introduction to mathematical portfolio theory. Cambridge University Press.
4. Davis, M., & Etheridge, A. (2006). Louis Bachelier's theory of speculation. URL: <https://f-origin.Hypotheses>.

**Course Outcomes**

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Describe and interpret the theories on the behavior of financial markets.	K2
2	Describe advantages and disadvantages of different measures of investment risk.	K2
3	Apply stochastic interest rate models to the calculation of probability of cash flows to a given amount at a specific future time.	K5
4	Evaluate the liability using different methods.	K5
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

**Learning Pedagogy**

Interactive lecturing sessions, Use of ICT tools, Group assignments, Group discussions and Presentations

**Assessment Tools**

Assignments, Seminar, Test papers and End semester examination

Semester	Code	Subject	Total Hrs:90	Credits
IV	PG20AS420	<b>ELECTIVE III: INSURANCE AND RETIREMENT BENEFITS</b>	<b>Hrs. / Week: 5</b>	<b>3</b>

### Course Objectives

- Equip students with the understanding of principles of insurance and superannuation
- Introduce different employee and retirement benefit schemes.
- Provide an understanding of the tax aspects of group and retirement benefit schemes
- Familiarize students with the International accounting standards and the use of Accounting standards AS-15 in actuarial valuation

### Syllabus

#### MODULE I (25 Hours)

##### UNIT 1

Concept of Insurance and its origin: History – Principles and concept in insurance -- Liberalization of Indian insurance -- Underwriting in insurance –Types of insurance products: Life, General and Health -- Micro insurance -- Social security schemes: Objective -- Schemes in India -- Changes in the field of insurance industry - Challenges facing insurance industry-Issues in insurance industry -- IRDA – Regulations.

#### MODULE II (15 Hours)

##### UNIT 1 (15 Hours)

Superannuation Schemes: Objectives -- Development of scheme pension as retirement benefit- defined benefit and defined contribution -- Optional pensions -- Commutation of pension -- Pension in other contingencies -- Methods of costing pension -- Costing of past service pension - - Definite, Indefinite and Controlled funding -- National pension scheme.

**MODULE III (35 Hours)**

**UNIT 1 (20 Hours)**

Group Insurance: Objective and Development of scheme -- Comparison between individual and group insurance -- Conditions of eligibility -- Eligible groups-contributory and Non- contributory schemes -- Group selection -- Rate making in group insurance -- Group insurance in lieu of EDLI – Group creditor insurance -- Weaker section scheme and rural scheme -- Group saving linked insurance scheme

**UNIT 2 (15 Hours)**

Provident fund and employee's family pension and deposit linked insurance scheme --Gratuity scheme: Payment of gratuity act 1972-- Objective of gratuity scheme -- Ways of meeting gratuity liability -- Group gratuity scheme.

**MODULE IV (15 Hours)**

**UNIT 1**

Accounting standards – Indian AS- 15, US GAAP and International Accounting Standards – Actuarial valuation of retirement benefits -- Taxation aspects

**Recommended References**

1. Rosenbloom, J. S., & Hallman, G. V. (1991). Employee benefits planning. Prentice Hall.
2. Baranoff, E. Z., & Baranoff, E. Z. (2004). Risk management and insurance (pp. 48-52). Danvers: Wiley.
3. Baker, T., & Simon, J. (Eds.). (2010). Embracing risk: The changing culture of insurance and responsibility. University of Chicago Press.
4. Jones, H. E., & Long, D. L. (2005). Principles of Insurance: Life, Health, and Annuities. LOMA.
5. Dreze, J., Hills, J., & Sen, A. (1991). Social security in developing countries. E. Ahmad (Ed.). Oxford: Clarendon.

**Course Outcomes**

CO. No	On completion of this course, the students will be able to:	Knowledge Level
1	Demonstrate knowledge of life, property and health insurance contracts and provisions	K2
2	Compare between individual and group insurance and describe the conditions for eligibility under group insurance	K2
3	Demonstrate knowledge of superannuation schemes: pension, provident fund and gratuity	K2
4	Compare and contrast between different methods of pension costing	K4
5	Explain the features of accounting standards and its application in actuarial valuation	K3
6	Explain the tax treatment of group and retirement benefit schemes	K2
<b>K1-Remembering K2-Understanding K3-Applying K4-Analysing K5-Evaluating K6-Creating</b>		

**Learning Pedagogy**

Lectures using ICT tools, Debates, Discussions on topics in news covered in the syllabus and  
Group assignments

**Assessment Tools**

Test papers, Class participation, Seminar, Assignments and End semester examinations

# MODEL QUESTION PAPERS



# **SEMESTER 1**

Model Question Paper: **QPCODE: -----**

**M.Sc. DEGREE (C.S.S) EXAMINATION.....**

M.Sc. Actuarial Science

**PG19AS101– ACTUARIAL STATISTICS I**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

**Section A**

(Answer any **Eight** questions. Each question carries a weight of 1)

1. Give the types of data.
2. Define Probability.
3. Define Random variable.
4. List out any five continuous distribution.
5. Define Probability Generating Function.
6. Obtain the probability function for the marginal distribution of M from 0;where

$$P(M = m, N = n) = \frac{m}{35 \times 2^{n-2}}, \text{ where } m = 1, 2, 3, 4 \text{ and } n = 1, 2, 3$$

7. Define Compound Distribution.
8. Briefly give the equation and definition of Central Limit Theorem.
9. Calculate three commonly used statistics that provide a measure of spread, and are expressed in terms of the original unit of measure, for the following set of ten observations : 5.1, 2.6, 7.3, 4.4, 4.6, 2.9, 3.4, 3.2, 4.4, 5.0
10. Define a simple random sample? **(8x1=8)**

**Section B**

(Answer any **Six** questions. Each question carries a weight of 2)

11. Draw Stem and Leaf diagram of following Data :

243 306 271 396 287 399 466 269 295 330

425 324 228 113 226 176 320 230 404 487

127 74 523 164 366 343 330 436 141 388

12. A box of chocolates contains 8 milk chocolates and 4 plain chocolates. A chocoholic eats three chocolates. Calculate the probability that:
- all three are milk chocolates
  - exactly one is a plain chocolate.
13. A continuous random variable has the probability density function  
 $f_X(x) = ke^{-2x}$  for  $x > 0$ . Find  $k$  and  $P(X < 5.27)$ .
14. If  $X \sim N(25, 36)$ , find:
- $P(X < 28)$
  - $P(X > 30)$
  - $P(X < 20)$
  - $P(|X - 25| < 4)$
15. Find the CGF of  $X$  where  $X \sim \text{Gamma}(\alpha, \lambda)$ , and hence find its mean and variance.
16. If the number of minutes it takes for a mechanic to check a tyre is a random variable having an exponential distribution with mean 5, what is the probability that the mechanic will take:
- more than eight minutes to check two tyres ?
  - at least fifteen minutes to check three tyres?
17. Let  $X$  and  $Y$  have joint density function given by:  $f(x, y) = \frac{3}{5} x(x+y)$ ,  $0 < x < 1$ ,  $0 < y < 2$ , Determine the conditional expectation  $E[Y|X = x]$ .
18. The number of claims arising in a month under a home insurance policy, follows a Poisson distribution with mean 0.075. Calculate the approximate probability that at least 50 claims in total arise in a month under a group of 500 independent such policies.

**(6x2=12)**

**Section C**

(Answer any **Two** questions. Each question carries a weight of 5)

19. (i) State and Prove Bayes theorem
- (ii) The punctuality of trains has been investigated by considering a number of train journeys. In the sample, 60% of trains had a destination of Manchester, 20% Birmingham and 20% Edinburgh. The probabilities of a train arriving late in Manchester, Edinburgh or Birmingham are 30%, 20% and 25% respectively. If a late train is picked at random from the group under consideration, what is the Probability that it terminated in Manchester?
20. U and V have the joint distribution given by  $f(u, v) = (2u+v)/3000$ ,  
Where  $10 < u < 20, -5 < v < 5$  Find  $E(U)$  and  $E(V)$  :
- (i) using  $f(u, v)$
- (ii) using marginal distribution  $f(u)$  and  $f(v)$
21. Calculate  $P(X < 8)$  if:
- (i) X is the number of claims reported in a year by 20 policyholders. Each policyholder makes claims at the rate of 0.2 per year independently of the other policyholders.
- (ii) X is the number of claims examined up to and including the fourth claim that exceeds £20,000. The probability that any claim received exceeds £20,000 is 0.3 independently of any other claim.
- (iii) X is the number of deaths amongst a group of 500 policyholders. Each policyholder has a 0.01 probability of dying independently of any other policyholder.
- (iv) X is the number of phone calls made before an agent makes the first sale. The probability that any phone call leads to a sale is 0.01 independently of any other call.
22. Find  $P(X < 8)$  if:
- (i)  $X \sim U(5, 10)$                       (ii)  $X \sim N(10, 5)$                       (iii)  $X \sim \text{Exp}(0.5)$
- (iv)  $X \sim \text{Chi-Square}$  with degrees of freedom 5                      (v)  $X \sim \text{Gamma}(8, 2)$
- (vi)  $X \sim \log N(2, 5)$
- (2x5=10)

Model Question Paper: **QPCODE:** .....

**M.Sc. DEGREE (C.S.S) EXAMINATION.....**

M.Sc. Actuarial Science

**SEMESTER I**

**PG19AS102– FINANCIAL MATHEMATICS - I**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

**Section A**

(Answer any **Eight** questions. Each question carries a weight of 1)

1. Express  $i$  in terms of  $d$
2. Define Nominal rate of return and Force of interest.
3. Find the effective annual interest rate that is equivalent to a simple interest rate of 3%pa over 4 years.
4. Explain principle of consistency
5. Define Deferred Annuity.
6. State the Linear Interpolation formula which is used to find yield in Equation of Value.
7. Explain present value
8. Calculate the accumulated value of 6.34 ,assuming a force of interest of 9%after  
1)3months 2)3 years and 3)7 years and 5 days
9. Define mortgage
10. Find  $i^{(4)}$  if  $i=4\%$  (8x1=8)

**Section B**

(Answer any **Six** questions. Each question carries a weight of 2)

11. The force of interest is given by:

$$\delta(t) = \begin{cases} 0.04 + 0.002t & 0 \leq t < 10 \\ 0.015t - 0.08 & 10 \leq t < 12 \\ 0.07 & t \geq 12 \end{cases}$$

Find an expression for the accumulation factor from time 0 to  $t$ .

12. Explain Call Deposit and Equity with examples.
13. Find  $n$ , if  $P=78.92, I=5, R=125$  and  $i=10\%$
14. Find the present value as at 1 June 2004 of payments of £1,000 payable on the first day of each month from July 2004 to December 2004 inclusive, assuming a rate of interest of 8% per annum convertible quarterly.
15. Rent on a property is payable continuously for 5 years. The rent in the first year is £3,000, thereafter the annual rent increases by £500 pa. Calculate the present value of the rent at the start of the 5 years, using an annual effective rate of interest of 6%.
16. A company has just bought an office block for £5m, which it will rent out to a number of small businesses. The total rent for the first year will be £100,000, increasing by 4% pa compound in each future year. It will be sold after 20 years for £7.5m. Assuming that rent is paid in the middle of each year, calculate the yield the company will obtain on this investment. Ignore tax.
17. \$50,000 is repayable by equal annual payments at the end of each of the next 5 years. Interest is 8% pa for the first three years and 12% pa thereafter. Calculate the accumulated value at the end of the sixth year
18. Explain any five different types of annuity type financial products with time line

(6x2=12)

### Section C

(Answer any **Two** questions. Each question carries a weight of 5)

19. The force of interest is given by:

$$\delta(t) = \begin{cases} 0.08 - 0.001t & 0 \leq t < 3 \\ 0.025t - 0.04 & 3 \leq t < 5 \\ 0.03 & t \geq 5 \end{cases}$$

Calculate the present value at time 2 of a payment of £1,000 at time 10.

20. The force of interest at any time  $t$  (measured in years) is given by:

$$\delta(t) = \begin{cases} 0.04 & 0 < t \leq 1 \\ 0.05t - 0.01 & 1 < t \leq 5 \\ 0.24 & t > 5 \end{cases}$$

What is the total accumulated value at any time  $t$  ( $>0$ ) of investments of 1 at times 0, 4 & 6?

21. A man makes payments into an investment account of \$200 at time 5, \$190 at time 6, \$180 at time 7, and so on until a payment of \$100 at time 15. Assuming an annual effective rate of interest of 3.5%, calculate:
- the present value of the payments at time 4
  - the present value of the payments at time 0
  - the accumulated value of the payments at time 15
22. Explain any seven cash flow scenarios

(2x5=10)

Model Question Paper: **QPCODE:** .....

**M.Sc. DEGREE (C.S.S) EXAMINATION.....**

**SEMESTER I**

M.Sc. Actuarial Science

**PG19AS103 BUSINESS ECONOMICS- I**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

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**Section A**

(Answer any **Eight** questions. Each question carries a weight of 1)

1. Define opportunity cost with example
2. Differentiate micro economics and macroeconomics
3. What is mean by mixed economy?
4. State the law of demand
5. Define Income elasticity of demand for a good
6. Define marginal utility
7. What is sunk cost?
8. Define product differentiation
9. What is a cartel?
10. Describe Marx's labour theory of value

(8 × 1 =8)

**Section B**

(Answer any **Six** questions. Each question carries a weight of 2)

11. What is natural level of unemployment? What are its causes? What policies do you suggest to deal with this problem?
12. Distinguish between a dominant equilibrium and a Nash equilibrium
13. Explain the Austrian school's view of government intervention in the form of providing a legal framework and regulation
14. The demand equation for a good is  $Q_d=25-4P$  and its supply equation is  $Q_s=1+2P$ , where P is the price. Find the range of values of P at which there will be surplus of supply over demand.



15. A risk averse magician is planning to organise his first ever foreign show. On successful completion of show he will earn \$40,000. He would earn nothing if the show is disrupted. The probability of disruption is 0.2%. His utility function is  $U(w)=10+w^{0.5}$ .  
Calculate the maximum premium the magician will be prepared to pay to insure against the risk of disruption of his show.
16. Describe with the aid of a diagram the intended effect of advertising on a product's demand curve and explain how advertising achieves this effect.
17. What are the four stages of lifecycle of a product? How will the consumer demand, competition and the other factors affecting the pricing decision generally vary between these stages?
18. With help of a diagram, explain how a monopolist firm can employ perfect price discrimination to increase its profits.

(6 × 2 =12)

### Section C

(Answer any **Two** questions. Each question carries a weight of 5)

19. Discuss the determinants of supply and demand
20. Compare and contrast oligopoly, monopolistic competition and perfect competition in terms of:
- a) The product that they offer
  - b) Their ability to affect the prices that they charge
  - c) The level of profits that they make
21. Explain why and how the problems of adverse selection and moral hazard affect insurance companies and how these problems can be dealt with.
22. Explain the different pricing strategies adopted by organisations

(2 × 5 =10)

Model Question Paper: **QPCODE: .....**  
**M.Sc. DEGREE (C.S.S) EXAMINATION.....**  
**First Semester**  
 Branch: M.Sc. Actuarial Science  
**PG19AS104: MODELS - I**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

**Section A**

(Answer any **Eight** questions. Each question carries a weight of 1)

1. Explain what  $S_{29}(36)$  and  $F_{30}(20)$  represents.
2. Consider a Markov chain with state space  $S=\{0,1,2\}$  and transition matrix:

$$P = \begin{matrix} & p & q & 0 \\ \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} & \begin{matrix} 1/2 \\ p - 1/2 \end{matrix} & \begin{matrix} 0 \\ 7/10 \end{matrix} & \begin{matrix} 1/2 \\ 1/5 \end{matrix} \end{matrix}$$

Calculate the transition probability  $P_{ij}^{(3)}$ .

3. Consider a time homogeneous Markov chain with state space  $S=\{0,1,2\}$  and transition matrix:

$$P = \begin{matrix} & p + 1/10 & 1/10 & q \\ \begin{matrix} 0 \\ 1 \\ 2 \end{matrix} & \begin{matrix} 1/5 \\ 1/5 \end{matrix} & \begin{matrix} 3/10 \\ p + 3/10 \end{matrix} & \begin{matrix} 1/2 \\ 3/10 \end{matrix} \end{matrix}$$

- i) What are the values of  $p$  and  $q$ ?
- ii) Draw a transition graph for this process.

3. Derive  $f_x(t)$ .
4. Show that  $e_x = P_x[1 + e_{x+1}]$
5. A chef specializing in the manufacture of fluffy meringues uses a *Whiskmatic* disposable electric kitchen implement. The *Whiskmatic* is rather unreliable and often breaks down, so the chef is in the habit of replacing the implement in use at a given time, shortly before an important social function or after making the 1,000th fluffy meringue with that implement.

The following times until mechanical failure (no asterisk) or replacement whilst in working order (asterisk) were observed (measured in days of use):

17, 13, 15\*, 7\*, 21, 18\*, 5, 18, 6\*, 22, 19\*, 15, 4, 11, 14\*, 18, 10, 10, 8\*, 17

Define  $N$ ,  $m$ ,  $k$ ,  $t_j$ ,  $d_j$ ,  $c_j$ ,  $t_j c_j$ ,  $n_j$  for these data, assuming that censoring occurs just after the failures were observed.

6. Explain a Poisson model of mortality.
7. State the assumptions underlying the two state Markov model.
8. Butterflies of a certain species have short lives. After hatching, each butterfly experiences a lifetime defined by the following probability distribution:

Lifetime (days)	Probability
1	0.10
2	0.30
3	0.25
4	0.20
5	0.15

Calculate  $\lambda_j$  for  $j = 1, 2, \dots, 5$  (to 3 decimal places) and sketch a graph of the discrete hazard function.

9. For a discrete time stochastic process  $X_n$  define the terms
  - Stationary
  - Weak stationarity
  - Increment
  - Markov Property
10. Show that
 
$$\text{Cov}(aX+b, cW+d) = ac \text{cov}(W, X) + cb \text{Cov}(W, Y)$$

### Section B

(Answer any Six questions. Each question carries a weight of 2)

11. A motor insurance company grants its customers either no discount (state 0) or 25% discount (state 1) or 50% discount (state 2). A claim-free year results in a transition to the next higher state the following year (or in the retention of the maximum discount) similarly, a year with one claim or more causes a transition to the next lower state (or the retention of the zero discount status).

Under these rules, the discount status of a policyholder forms a Markov chain with state space  $S = \{0, 1, 2\}$ ; if the probability of a claim-free year is  $3/4$ .

- i) Find the transition graph and transition matrix
- ii) Calculate the probability of holding the maximum discount in year  $n+3$  given that you do not qualify for any discount in year  $n$
- iii) Calculate the probability in the above model of starting with a discount level of 25% and ending up 4 years later at the same level.

12. Consider a Markov chain with only two states,  $S = \{0,1\}$ , and transition matrix

$$P = \begin{pmatrix} 1/2 & 1/2 \\ 1/3 & 2/3 \end{pmatrix}$$

Determine the stationary distribution(s) of this chain.

13. Show that, if mortality experience conforms to Gompertz' Law, then:

$$-\log(-\log p_x) = \log \left[ \frac{\log c}{B(c-1)} \right] - x \log c$$

Suggest how this property could be used.

14. (i) Define and derive  $e_x^0$  and  $e_x$ . Find the relation between  $e_x^0$  and  $e_x$ .

(ii) Calculate the complete and curtate expectation of life for an animal subject to a constant

force of mortality of 0.05 per annum.

15. A clinical trial is being carried out to test the effectiveness of a new drug. Sixty patients were involved in the trial, which followed them for 2 years from the start of their treatment. The following data show the period in complete months from the start of treatment to the end of observation for those patients who died or withdrew from the trial before the end of the 2 year period.

Deaths: 8, 10, 10, 16, 20  
 Withdrawals: 2, 6, 9, 16, 18, 22, 22

(i) Calculate the Kaplan-Meier estimate of the survival function.

(ii) Construct an approximate 95% confidence interval for the probability that a patient survives for at least 18 months after the start of the drug treatment.

16. State the relationship between Product Limit and Nelson Aalen method.

17. A large computer company always maintains a workforce of exactly 5,000 young workers, immediately replacing any worker who leaves. Use the Poisson model to calculate the probability that there will be fewer than 3 deaths during any 6-month period, assuming that all workers experience a constant force of mortality of 0.0008 per annum.

18. Show that  $\hat{\mu} = \frac{d}{v}$ .

### Section C

(Answer any **Two** questions. Each question carries a weight of 5)

19. A simple NCD system has four levels of discount . 0%, 20%, 40% and 60%. A new policyholder starts on 0% discount. At the end of each policy year, policyholders will change levels according to the following rules:

- At the end of a claim free year, a policyholder moves up one level, or remains on the maximum discount.
- At the end of a year in which exactly one claim was made, a policyholder drops back one level, or remains at 0%.
- At the end of a year in which more than one claim was made, a policyholder drops back to zero discount.

For a particular policyholder in any year, the probability of a claim free year is  $7/10$ , the probability of exactly one claim is  $1/5$  and the probability of more than one claim is  $1/10$ .

- Write down the transition matrix for this time homogeneous Markov chain.
- Calculate  $P_{ij}^{(2)}$  the 2-step transition probabilities from state  $i$  to state  $j$ .
- If the policyholder starts with no discount, what is the probability that this policyholder is at the maximum discount level 5 years later?
- If a large number of people having the same claim probabilities take out policies at the same time, what proportion would you expect to be in each discount category after a long time?

20. (i)  $T_x$  denotes the future lifetime of a life currently aged  $x$ .

Write down the probability density function of  $T_x$ .

- Using your answer to (i), show that:

$$\frac{\partial}{\partial s} \log {}_s p_x = -\mu_{x+s}, \text{ and}$$

$${}_t p_x = \exp\left\{-\int_0^t \mu_{x+s} ds\right\}.$$

- In a certain population, the force of mortality is given by:

	$\mu_x$
$60 < x \leq 70$	0.01
$70 < x \leq 80$	0.015
$x > 80$	0.025

Calculate the probability that a life aged exactly 65 will die between exact ages 80 and 93.

- A mortality table which obeys Gompertz law for older age has  $\mu_{70} = 0.025330$  and  $\mu_{90} = 0.126255$ . Find the probability of life aged 60 will survive for next 20 years.
  - The mortality tables which obeys Gompertz law for older ages has  $l_{50}=90000$ ,  $l_{70}=70000$  and  $l_{90}=20000$ . Estimate the probability that the life aged 60 will survive for 20 years.

22. The following data relate to 12 patients who had an operation that was intended to correct a life-threatening condition, where time 0 is the start of the period of the investigation:

1	0	120	Censored
2	0	68	Death
3	4	120	Censored
5	5	35	Censored
6	10	40	Death
7	20	120	Censored
8	44	115	Death
9	50	90	Death
10	63	98	Death
11	70	120	Death
12	80	110	Death

You can assume that censoring was non-informative with regard to the survival of any individual patient.

- i) Compute the Nelson-Aalen estimate of the cumulative hazard function,  $\Delta(t)$ , where  $t$  is the time since having the operation.
- ii) Using the results of part (i), deduce an estimate of the survival function for patients who have had this operation.
- iii) Estimate the probability of a patient surviving for at least 70 weeks after undergoing the operation.

Model Question Paper: **QPCODE:** .....

**M.Sc. DEGREE (C.S.S) EXAMINATION.....**

M.Sc. Actuarial Science

**SEMESTER I**

**PG19AS105– BUSINESS COMMUNICATION**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

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**Section A**

(Answer any **eight** questions. Each question carries a weight of 1)

1. What do you mean by communication?
2. List the seven c's of communication
3. What are the requirements of an effective feedback?
4. What do you mean by corporate image?
5. Give four importance of business letter
6. Define the term enclosures.
7. What is a circular?
8. What is group communication?
9. What is statutory report?
10. What is a resume? (8x1=8)

**Section B**

(Answer any **six** questions. Each question carries a weight of 2)

11. List the characteristics of communication and discuss the seven barriers to effective communication.
12. Non-verbal communication can have a greater impact than verbal communication comment. Explain the various types of non-verbal communication in brief.
13. Explain the difference between formal and informal communication.
14. Write short notes on (a) upward communication and (b) downward communication
15. What is the memo? When you write a memo, what language and writing style will you follow? Explain.

16. Advertisements are used by organizations to communicate with prospective customers. What is the meaning and objectives of corporate advertising? Discuss with examples.
17. Explain the different delivery styles that speakers can select for their presentation
18. What are different types of business reports? (6x2=12)

**Section C**

(Answer any **two** questions. Each question carries a weight of 5)

19. As a speaker, you are addressing a group of people. What could be the possible barriers in this communication?
20. Explain the purpose of keeping minutes of a meeting. What goes into the contents of the minutes of a meeting?
21. What are the steps in making an oral business presentation?
22. Discuss the significance of effective business letter. Explain the various kinds of layout of business letter (2x5=10)



# **SEMESTER 2**

Model Question Paper: **QPCODE:.....**  
**M.Sc. DEGREE (C.S.S) EXAMINATION.....**  
**SEMESTER II**  
M.Sc. Actuarial Science  
**PG19AS206 –ACTUARIAL STATISTICS- II**  
(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

**Section A**(Answer any **Eight** questions. Each question carries a weight of 1)

1. Distinguish between the terms ‘estimate’ and ‘estimator’?
2. Explain confidence interval estimation?
3. Explain Type-I & Type-II errors in hypothesis testing?
4. Distinguish between correlation and regression?
5. Explain the principle of maximum likelihood estimation.
6. What is ANOVA? What are the assumptions made?
7. Define degrees of freedom?
8. Define Hypothesis and its types?
9. What is the general formula for calculating the treatment effect?
10. Write down the key components of Generalised Linear Model

**(8x1=8)****Section B**(Answer any **Six** questions. Each question carries a weight of 2)

11. In the context of generalized linear models, explain what you understand by the following terms: Covariate, Linear predictor and Link function
12. Find the MLEs of  $\mu$  and  $\sigma$  for a sample of  $n$  IID observations from  $N(\mu, \sigma^2)$  distribution.
13. In a one year mortality investigation, 45 of the 250 ninety year olds present at the start of the investigation died before the end of the year. Assuming that the number of deaths has a binomial distribution with parameters  $n=250$  and  $q$ , find a symmetrical 90% confidence interval for the unknown mortality rate  $q$ .

14. The annual rainfall in cm at a certain weather station over the last ten years has been as follows:

17.2, 28.1, 25.3, 26.2, 30.7, 19.2, 23.4, 27.5, 29.5, 31.6

Scientists at the weather station wish to test whether the average annual rainfall has increased from its former long term value of 22 cm. Test this hypothesis at the 5% level, stating any assumptions that you make.

15. A new computerized ultrasound scanning technique has enabled doctors to monitor the weights of unborn babies. The table below shows the estimated weights for one particular foetal at fortnightly intervals during the pregnancy.

Calculate  $S_{xx}$ ,  $S_{yy}$ ,  $S_{xy}$  and find correlation.

Gestation period (weeks)	30	32	34	36	38	40
Estimated foetal weight (kg)	1.6	1.7	2.5	2.8	3.2	3.5

16. A schoolteacher is investigating the claim that class size does not affect GCSE results. His observations of nine GCSE classes are as follows:

Class	$X_1$	$X_2$	$X_3$	$X_4$	$Y_1$	$Y_2$	$Y_3$	$Y_4$	$Y_5$
Students in class ( $c$ )	35	32	27	21	34	30	28	24	17
Average GCSE point score for class ( $p$ )	5.9	4.1	2.4	1.7	6.3	5.3	3.5	2.6	1.6

Obtain the fitted regression line of  $p$  on  $c$ .

17. Consider the following data on sales, accounts and administration in a company.

Sales	72	81	96	75	69	88	74	102
Accounts	65	73	78	66				
Admin	61	79	67	74	65			

- (i) Find the overall mean  $\mu$ .
- (ii) Find the treatment means,  $\mu_i$ .
- (iii) Hence, find the treatment effects.

18. A random sample  $(X_1, \dots, X_n)$  is taken. Derive from first principles the maximum likelihood estimators for:

- (i)  $\lambda$  from an Exp ( $\lambda$ ) distribution
- (ii)  $p$  from a Bin( $m, p$ ) distribution.

(6x2=12)

### Section C

(Answer any **Two** questions. Each question carries a weight of 5)

19. A university wishes to analyze the performance of its students on a particular degree course. It records the scores obtained by a sample of 12 students at entry to the course, and the scores obtained in their final examinations by the same students. The results are as follows:

Student	A	B	C	D	E	F	G	H	I	J	K	L
Entrance exam score $x$ (%)	86	53	71	60	62	79	66	84	90	55	58	72
Finals paper score $y$ (%)	75	60	74	68	70	75	78	90	85	60	62	70

- (i) Obtain the linear regression equation of  $y$  on  $x$ .
  - (ii) Assuming the full normal model, calculate an estimate of the error variance  $\sigma^2$  and obtain a 90% confidence interval for  $\sigma^2$ .
20. Find a 95% confidence interval for the average height of 10 year old children, assuming that heights have a  $N(\mu, \sigma^2)$  distribution (where  $\mu$  and  $\sigma^2$  are unknown), based on a random sample of 5 children whose heights are:  
124cm, 122cm, 130cm, 125cm and 132cm.
21. In a one year investigation of claim frequencies for a particular category of motorists, the total number of claims made under 5,000 policies was 800. Assuming that the number of claims made by individual motorists has a *Poi* ( $\lambda$ ) distribution, find a symmetrical 90% confidence interval for the unknown average claim frequency  $\lambda$ .
22. An analysis using the simple linear regression model based on 19 data points gave the following sum of squares and products:  $S_{xx}= 12.2, S_{yy}= 10.6, S_{xy}= 8.1$
- (i) Calculate  $\hat{\beta}$  and test whether  $\beta$  is significantly different from zero.
  - (ii) Calculate the correlation coefficient  $r$  and test whether it is significant.

(2x5=10)

Model Question Paper: **QPCODE:.....**

**M.Sc. DEGREE (C.S.S) EXAMINATION.....**

**SEMESTER II**

M.Sc. Actuarial Science

**PG19AS207 – FINANCIAL MATHEMATICS - II**

(2019 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

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**Section A**

(Answer any **Eight** questions. Each question carries a weight of 1)

1. Write a note on project appraisal methods
2. Define Capital gain tax.
3. Distinguish between time spot and forward rates
4. Describe yield to maturity
5. Define NPV
6. Explain retrospective loan calculation.
7. Define DPP
8. An investor purchases a 100 zero coupon bond for 90. calculate the yield obtained if the bond is redeemed after a) 5 years and b) 10 years.
9. Explain with examples the terms convexity.
10. Which are the random factors that affect interest rates **(8x1=8)**

**Section B**

(Answer any **Six** questions. Each question carries a weight of 2)

11. A speculator borrows £50,000 at an effective interest rate of 8% per annum to finance a project that is expected to generate £7,500 at the end of each year for the next 15 years. Find the discounted payback period for this investment.
12. A loan of 1,000 bears interest of 6% per annum payable yearly and will be redeemed at par after ten years. An investor, liable to income tax and capital gains tax at the

- rates of 40% and 30% respectively, buys the loan for 800. what is his net effective annual yield?
13. An investor liable to income tax at 25% and capital gain tax at 20% purchases 10,000 nominal of a newly issued 5 year fixed interest bond which is redeemable at par and pays coupons of 8% pa half yearly in arrears calculate the price the investor should pay to obtain a yield of 10% pa.
- 14.
15. A French investor who is taxed at 35% on income has just purchased 500 shares in a small education company ex-dividend. Dividends are paid annually and the next dividend is due in one month's time. the last dividend was 8 per share and dividends are expected to rise by 4% pa. calculate the price paid by the investor if the expected yield 12% pa effective.
- 16.

The cashflows  $C_t$  (where the time  $t$  is measured in years and the amounts are in £000) for two business ventures are as follows:

$$\text{Venture 1: } C_0 = -100, C_1 = -40, C_2 = +50, C_3 = +120$$

$$\text{Venture 2: } C_1 = -45, C_3 = +25, C_4 = +25, C_5 = +25$$

Calculate the accumulated profit at time 5 and the net present value for each of these ventures using a risk discount rate of 15% per annum.

17.

The 3, 5 and 7-year spot rates are 6%, 5.7% and 5% *pa* respectively. The 3-year forward rate from time 4 is 5.2% *pa*. Calculate:

- (i)  $f_3$
- (ii)  $f_{5,2}$
- (iii)  $y_4$
- (iv)  $f_{3,4}$

18

A fund must make payments of £50,000 at the end of the sixth and eighth years. Show that, if interest rates are currently 7% *pa* at all durations, immunisation to small changes in interest rates can be achieved by holding an appropriately chosen combination of a 5-year zero-coupon bond and a 10-year zero-coupon bond.

(6x2=12)

### Section C

(Answer any **Two** questions. Each question carries a weight of 5)

19. An investor is planning to make an investment in one or both of two projects. The cash flows associated with the projects are as follows. The unit of time is years.
- Project A: Initial payments of £2 million at time zero and £4 million at time 2 are made. In return a sum of £900,000 per annum is paid continuously from time 5 to time 25.
- Project B: Regular payments of £100,000 are made at the start of each year for 10 years. In return, amounts of  $X$ ,  $2X$ ,  $3X$  and so on are made annually for 10 years, the first payment being made at time 11.
- (i) Find the net present value of Project A at an effective annual interest rate of 10%.
  - (ii) Find the value of  $X$  if the internal rate of return for Project B is the same as that for Project A.
  - (iii) Find the value of  $X$  if both projects are to have the same net present value at 10% *pa*.
20. An investor purchases a bond 3 months after issue. The bond will be redeemed at par 10 years after issue and pays coupons of 6% *pa* annually in arrears. The investor pays tax of 25% on both income and capital gains (with no relief for indexation).
- (i) Calculate the purchase price of the bond per £100 nominal to provide the investor with a rate of return 8% *pa* effective.
  - (ii) The real rate of return expected by the investor from the bond is 3% *pa* effective. Calculate the annual rate of inflation expected by the investor.

21. An index takes the following values:

1/1/05	121.2	1/1/06	123.9	1/1/07	125.2
1/4/05	122.8	1/4/06	124.2	1/4/07	126.0
1/7/05	123.1	1/7/06	124.4		
1/10/05	123.6	1/10/06	124.9		

An index-linked bond is purchased on 1/4/05 (when the remaining term is two years) for a price of £101 per £100 nominal. The bond is due to be redeemed at par. All coupon and redemption payments are linked to the inflation index three months prior to the payment date. The coupons on the bond are of nominal amount of 4% pa payable half-yearly in arrears on 1<sup>st</sup> April and October every year. Calculate the real yield obtained by the investor. You may ignore tax.

22. A loan of 16,000 is repayable by ten level payments, made annually in arrears. The annual effective rate of interest is 4%. Calculate:

- The interest element of the 4th payment
- The capital element of the 7th payment
- The capital repaid in the last five years of the loan
- The total interest paid over the whole loan.

**(2x5=10)**



Model Question Paper: **QPCODE:.....**

**M.Sc. DEGREE (C.S.S) EXAMINATION.....**

M.Sc. Actuarial Science

**SEMESTER II**

**PG19AS208- BUSINESS ECONOMICS- II**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

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**Section A**

(Answer any **Eight** questions. Each question carries a weight of 1)

1. Define consumer surplus.
2. Explain Frictional Unemployment.
3. What are public goods?
4. What is a patent?
5. Define terms of trade
6. What is meant by absolute advantage
7. Explain multiplier effect
8. Define disposable income
9. What do you mean by privatization?
10. Define international liquidity

**(8 × 1=8)**

**Section B**

(Answer any **Six** questions. Each question carries a weight of 2)

11. What is meant by “Economic Growth”? What are the key factors that may lead to Economic Growth
12. What are the three categories of withdrawals from and injections into the circular flow of income? Describe briefly

13. Explain briefly the reasons when international trade may occur even though there is no comparative advantage?
14. Consider the following data of an economy of a given year. All data are in rupees. GDP = 1000, GNP = 1200, personal disposable income = 1000, personal saving = 200, investment = 80, undistributed profit of corporations = 0, net foreign transfers = 0 and government expenditure = 20.  
Find out the values of net factor income from abroad, aggregate consumption expenditure, total taxes net of transfers and trade balance.
15. Discuss who gains and who loses as markets become continually more globalised.
16. Explain why Government tries to avoid fluctuations in price of its domestic currency. How the Government can maintain its value in short and long term?
17. What is the difference between cost-push inflation and demand-pull inflation?
18. What are the possible motives for growth via vertical integration? What are the problems associated with vertical integration?

(6×2=12)

### Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. Discuss the effectiveness of monetary and fiscal policy with fixed and floating exchange rates.
- 20.
- Explain why Governments may wish to avoid fluctuations in the value of a country's currency and how they can maintain its value in the short and long term.
  - Explain the problems associated with restriction on foreign exchange trading and other methods of restricting the outflow of money.
21. An economy is characterized by following equations:
- $$C = 100 + cY_d = 100 + 0.75Y_d,$$
- $$I = 45,$$
- $$G = 80,$$
- $$T = 20 + 0.20Y,$$
- $$R = 40,$$
- $$X = 40,$$

$$M = 30 + 0.10Y,$$

where C is consumption function, c is marginal propensity to consume, Yd is Disposable income ( $Y - T + R$ ), I is autonomous investment, G is autonomous government purchases, T is tax function, Y is level of income, R is autonomous transfer payments by the government, X is autonomous exports, M is import function.

- a) Find out equilibrium national income.
  - b) What will be the size of Government Purchases multiplier?
  - c) Other things remaining same, by what amount the government purchases should increase in order to raise the equilibrium national income by 20% ?
22. Government of a country ABC is worried about very high inflation and wants to control it through reducing money supply. List out and explain the ways by which the money supply can be reduced. Explain how each method help reducing money supply.

**(2×5=10)**

Model Question Paper: QPCODE:.....

**M.Sc. DEGREE (C.S.S) EXAMINATION.....**  
**SECOND SEMESTER**

Branch: M.Sc. Actuarial Science

**PG19AS209: MODELS - II**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

**Section A**

(Answer any **Eight** questions. Each question carries a weight of 1)

1. The covariates for the  $i$  th observed life are (56, 183, 40) representing (age last birthday at the start of the study, height in  $cm$ , daily dose of drug A in  $mg$ ). Using the regression parameters  $\beta = (0.0172, 0.0028, -0.0306)$ , Calculate  $\lambda(t; z_i)$  in terms of  $\lambda_0(t)$ .
2. A graduation covers 20 age groups and has resulted in 6 positive and 14 negative deviations. Carry out a signs test on these data values.
3. State uniform distribution of deaths assumption.
4. Explain why it is necessary to graduate crude rates of mortality for practical use.
5. For a force of mortality  $\mu_x$  that is known to follow Gompertz' Law, calculate the parameters B and c if  $\mu_{50} = 0.017609$  and  $\mu_{55} = 0.028359$ .
6. State the major limitations of graduation.
7. Write down an equation for serial correlation coefficient at lag 1.
8. State principle of correspondence
9. A mortality investigation covered the period 1 January 2017 to 1 January 2018. Time is measured in years from 1 January 2017 and  $P_x(t)$  denotes the number of lives at time  $t$  aged  $x$  last birthday. The following data were recorded for each  $x$  :

$dx$  = number of deaths aged  $x$  next birthday  
 $P_x(0)$  and  $P_x(1)$

- (i) Obtain an expression for the central exposed to risk in terms of the available census data that may be used to estimate the force of mortality  $\mu_{x+f}$ , stating your assumptions.
  - (ii) Determine the value of  $f$ .
10. Explain why it is necessary to graduate crude rates of mortality for practical use

**(8x1=8)**

**Section B**

(Answer any **Six** questions. Each question carries a weight of 2)

11. You are investigating the survival times of patients who have just undergone heart surgery at one of 3 city hospitals A, B or C. You have recorded the following data for each patient:

$$Z_1 = \begin{cases} 0 & \text{for females} \\ 1 & \text{for males} \end{cases}$$

$$Z_2 = \begin{cases} 1 & \text{if patient attended Hospital B} \\ 0 & \text{otherwise} \end{cases}$$

$$Z_3 = \begin{cases} 1 & \text{if patient attended Hospital C} \\ 0 & \text{otherwise} \end{cases}$$

You have decided to model the force of mortality at time  $t$  (measured in days since the operation was performed) by an equation of the form  $\lambda(t) = \lambda_0(t)e^{\beta Z^T}$ , and you have estimated the parameter values to be:

$$\hat{\beta}_1 = 0.031 \quad \hat{\beta}_2 = -0.025 \quad \hat{\beta}_3 = 0.011$$

Compare the force of mortality for a female patient who attended Hospital A with that of:

- (i) a female patient who attended Hospital B
  - (ii) a male patient who attended Hospital C.
12. An investigation was carried out into the survival times (measured in months) of patients in hospital following liver transplants. The covariates are  $z_{1i} = 0$  for placebo, 1 for treatment X, and  $z_{2i} =$  weight of patient (measured in kg).

The observed lifetimes (with weights in brackets) were as follows and observations with an asterisk represent censored observations.

<i>Placebo</i>	<i>Treatment X</i>
3 (83)	6*(58)
9 (68)	11(73)
14 (75)	14(68)
16 (86)	14* (49)

What contribution to the partial likelihood is made by the deaths at time 14 using Breslow's assumption?

13. Explain graduation by parametric formula.
14. Calculate the exact values of the complete and curtate expectation of life for a newborn animal subject to a constant force of mortality of 0.05 per annum.
15. Explain the method of signs test.
16. Describe desirable features of graduation.
17. Differentiate between initial and central exposed to risks.
18. A mortality investigation covers the period 1 January 2001 to 31 December 2003. In this investigation, the age label used is "age last birthday".

Give the range of dates for which the lives in the following table contribute to  ${}_c E_x$  at each age where they make a contribution. Assume that the day of entry counts in the exposed to risk but the day of exit does not.

	Date of birth	Date of joining	Date of exit	Reason for exit
A	25.04.69	07.08.99	30.10.02	Death
B	01.07.69	12.09.02	–	–
C	04.09.68	22.07.03	4.12.03	Withdrawal

(6x2=12)

### Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. A study has been undertaken into the effect of a new treatment on the survival times of patients suffering from a tropical disease. The following model has been fitted:

$$h_i(t) = h_0(t) \exp(\beta^T z)$$

where  $h_i(t)$  is the hazard at time  $t$ , where  $t$  is the time since treatment

$h_0(t)$  is the baseline hazard at time  $t$

$z$  is a vector of covariates, where

$z_1$  = period from diagnosis to treatment in years

$z_2$  = 0 if existing treatment given, 1 if new treatment given

$z_3$  = 0 if female, 1 if male

$\beta$  is a vector of parameters, where

$\beta_1 = 0.5$

$$\beta_2 = 0.01$$

$$\beta_3 = -0.05$$

- a. State the group of lives to which the baseline hazard applies.
- b. For a male who was given the new treatment 6 months after diagnosis:
  - (a) Write down the hazard function, in terms of  $h_0(t)$  only.
  - (b) Express the survival function, in terms of  $h_0(t)$  only.

(iii) For a female given the new treatment at the time of diagnosis, the probability of survival for 5 years is 0.75. Calculate the probability that the male in (ii) will survive 5 years.

20. The mortality experience of some whole of life assurance policyholders has been compared with a standard mortality table for assured lives. The following is an extract from the data.

Age, $x$	Actual deaths, $\theta_x$	Expected deaths, $E_x q_x^s$	$\theta_x - E_x q_x^s$
60	37	42.88	-5.88
61	40	61.73	-21.73
62	28	38.06	-10.06
63	41	47.23	-6.23
64	34	40.36	-6.36
65	40	49.98	-9.98
66	27	25.13	1.87
67	15	22.25	-7.25
68	16	26.23	-10.23
69	30	27.61	2.39
70	23	25.11	-2.11
Total	331	406.56	-75.57

- a. Carry out a comparison between the actual and expected mortality experience, using the following statistical tests:

- (a) Chi-squared test
- (b) Serial correlations test.

You should state the appropriate null hypothesis and, for each test, and give the conclusion reached with regard to this hypothesis.

(ii) You have now decided to produce graduated rates of mortality by fitting the following function to these data using weighted least squares techniques:  $g(x) = a \cdot qx^s$

- (a) Determine the value of the parameter  $a$  that minimizes the weighted least squares criterion for these data.
- (b) The graduated rates are to be tested using the same tests as in part (i). Without performing any further calculations, state how you would expect the results to differ, if at all, from the results of the tests you carried out in part (i).

21. You have been given the following census counts for a population (covering all ages):

$P_{2016}$  = Number in population on 1 January 2016 = 20,000

$P_{2017}$  = Number in population on 1 January 2017 = 40,000

$P_{2018}$  = Number in population on 1 January 2018 = 30,000

Estimate the central exposed to risk (all ages) for this population over each of the following periods, given only the census counts  $P_{2016}$ ,  $P_{2017}$  and  $P_{2018}$ . In each case, state any assumptions you have made.

(i) Period: 1 January 2016 to 31 December 2017

(ii) Period: 1 July 2016 to 30 June 2017

(iii) Period: 1 January 2018 to 31 December 2018

(iv) Period: 1 April 2017 to 31 March 2018

22. The mortality rates for a population for the age range 30-34 were estimated by fitting a straight line  $\alpha + \beta x$  to the crude values of  $\log_e (q_x / p_x)$ . Test whether this model (with estimated parameter values of  $\alpha = -10.9446$  and  $\beta = 0.110404$ ) can be considered to give a good fit to the data shown in the table below for 2003.

Age $x$	30	31	32	33	34
Number of deaths in 2003	335	391	428	436	458

The initial exposed to risk in 2003 was approximately 700,000 at each age.



Model Question Paper: **QPCODE:.....**

**M.Sc. DEGREE (C.S.S) EXAMINATION.....**

M.Sc. Actuarial Science

SEMESTER II

**PG19AS210 – ACTUARIAL COMPUTING - I**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

(Answer any **Three** questions. Each question carries a weight of 10)

1. Write R code for following questions,
  - a) Simulating a random sample from the discrete uniform distribution, Generate a vector for sample space  $S = \{1, 2, 3, \dots, 20\}$
  - b) Simulating a random sample of 100 values from the binomial distribution with  $n = 20$  and  $p = 0.3$
  - c) Calculate  $P(X \leq 5) = 0.9432683$  for  $\lambda = 2.7$ , consider  $x$  following poisson distribution.
  - d) Simulating 100 values from a  $U(0,3)$  distribution and calculate  $P(X \leq 1.8) = 0.6$
  - e) Simulating a random sample of 100 values from the gamma distribution with  $\alpha = 2$  and  $\lambda = 0.25$
2. Sample of 100 claims for damage due to water leakage on an insurance company's household contents policies might be as follows:

243 306 271 396 287 399 466 269 295 330

425 324 228 113 226 176 320 230 404 487

127 74 523 164 366 343 330 436 141 388

293 464 200 392 265 403 372 259 426 262

221 355 324 374 347 261 278 113 135 291

176 342 443 239 302 483 231 292 373 346

293 236 223 371 287 400 314 468 337 308

359 352 273 267 277 184 286 214 351 270

330 238 248 419 330 319 440 427 343 414

291 299 265 318 415 372 238 323 411 494

- Summaries these data using frequency with any graphical method
- Plot the value and give explanation
- Draw stem and leaf diagram
- Calculate mean, median and mode

3. A life insurance company examines the ages of the last 100 policyholders to take out endowment assurance with them. The results are shown below:

Age (years)	0 – 14	15 – 19	20 – 24	25 – 34	35 – 54	55 – 79
Frequency	9	28	21	16	14	12

- Draw a histogram for these data and use it to comment on the shape of the distribution
  - Estimate the mean age for these policyholders.
  - Estimate the median age for these policyholders.
  - How do the result of parts (ii) and (iii) confirm your observations in part (i)?
4. A bank lends a company £250000 at a fixed rate of interest of 10% *pa*. The loan is to be repaid by level monthly payments in arrears for 5 years. Construct a Loan schedule for the above transaction and Calculate
- The capital and interest element in the 49<sup>th</sup> instalment
  - The capital outstanding immediately after the 14<sup>th</sup> instalment
  - The capital repaid in the last 5 instalments
  - The total interest paid over the whole loan
  - The interest paid in the 3<sup>rd</sup> year

At the end of the fourth year the company decides to make further improvements in their operations and wants to borrow another £4, 00000 at that stage. If the total balance is to be repaid over 3 years by level monthly payments and there is no alteration to the interest rate, calculate

- The monthly instalment
- The total interest paid over this 3 years

5.

a. An investor wishes to find the present value of a stream of property income payments.

She proposes to make the following assumptions.

- The level of current payments is £20,000 per annum, paid quarterly in advance.
- Payments will remain fixed for 5-year periods. At the end of each 5-year period the payments will rise in line with total inflationary growth over the previous five years.
- Inflation is assumed to be constant at 3% per annum.
- The interest rate for the calculation is 12% per annum effective.

Find the present value of the income stream assuming that the payments continue for 50 years.

b. A man makes payments into an investment account of \$200 at time 5, \$190 at time 6, \$180 at time 7, and so on until a payment of \$100 at time 15. Assuming an annual effective rate of interest of 3.5%, calculate:

- i. The present value of the payments at time 4
- ii. The present value of the payments at time 0
- iii. The accumulated value of the payments at time 15

# **SEMESTER 3**

Model Question Paper: **QPCODE:.....**  
**M.Sc. DEGREE (C.S.S) EXAMINATION.....**  
**THIRD SEMESTER**  
 Branch: M.Sc. Actuarial Science  
**PG19AS311: CONTINGENCIES - I**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

**PART A**

(Answer any **Eight** questions. Each question carries a weight of 1)

1. Explain UDD assumption and derive  ${}_{t-s}q_{x+s} = \frac{(t-s)q_x}{1-s.q_x}$ .
2. Define gross premium.
3. Find (i)  $\ddot{a}_{30:10|}$  (AM92 at 4%)  
(ii)  $\ddot{a}_{75}$  (PMA92 C20 at 4%)
4. Calculate the expected present value of a payment of £2,000 made 6 months after the death of a life now aged exactly 60, assuming AM92 Select mortality and 6% *pa* interest.
5. Explain concept of select mortality and ultimate mortality.
6. A population is subject to a constant force of mortality of 0.015 *pa*. Calculate:
  - (i) The probability that a life aged exactly 20 dies before age 21.25.
  - (ii) The probability that a life aged exactly 22.5 dies between the ages of 25 and 27
  - (iii) The complete expectation of life for a life aged exactly 28.
7. Verify that  $A_{65} = 1 - d\ddot{a}_{65}$  using AM92 mortality and 4% *pa* interest.
8. Calculate the value of  $(Ia)_{50}$  assuming AM92 mortality and 4% *pa* interest.
9. Explain types of LAC
10. If  $T_x$  and  $K_x$  are random variables measuring the complete and curtate future lifetimes, respectively, of a life aged  $x$ , write down an expression for each of the following symbols as the expectation of a random variable:

- (i)  $A_x$   
(ii)  $A_{x:n}^1$   
(iii)  $A_{x:n}^{\overline{1}}$

(8x1=8)

**PART B****(Answer any six questions. Each Question has weight 2)**

11. Calculate  ${}_3p_{62.5}$  based on PFA92C20 mortality using:

- (i) The CFM assumption  
(ii) The UDD assumption

12. A life is subject to a constant force of mortality of 0.008 *pa* at all ages above 50. The constant force of interest of 4% *pa*. Calculate the exact values of:

- (i)  $\bar{A}_{50}$   
(ii)  $A_{50}$

13. Derive EPV and variance of endowment assurance contract.

14. A 50-year-old woman purchases a deferred annuity to provide herself with an income of £15,000 *pa*, paid annually in advance from age 70 until death.

Calculate the expected present value of the benefits from this deferred annuity, using PFA92C2 Mortality, and an interest rate of 4% *pa* effective.

15. (i) Explain types of bonuses

(ii) For the three alternative bonus allocation methods specified above, and given an initial guaranteed sum assured of £10,000 in each case, calculate the sum assured (including bonuses) as at the end of Years 1, 2 and 3.

16. Prove that  $\ddot{a}_{x:\overline{n}|} = \ddot{a}_{\overline{n}|} + n|\ddot{a}_x$

17. Hubert, aged 60, is applying to buy a whole life immediate annuity from an insurance company, with his life savings of £200,000. Calculate the largest amount of level annuity, payable annually in arrear, that the insurer could pay if it requires a probability of loss from the contract of no more than 10%.

Assume PMA92C20 mortality, interest of 5% *pa*, and expenses of 1% of each annuity payment.

18. Using AM92 mortality and 4% *pa* interest, calculate:

(i)  $\ddot{a}_{60}^{(2)}$

(ii)  $a_{60}^{(12)}$

(iii)  $\ddot{a}_{50:\overline{15}|}^{(4)}$

(6x2=12)

### PART C

(Answer any Two questions. Each Question has weight 5)

19. An annuity of £8,500 *pa* is to be paid monthly in advance for the remaining lifetime of Mrs S, who is currently aged exactly 60. Calculate the single premium that should be paid for this annuity, allowing for initial expenses of 1.5% of the premium and administration expenses payable at the start of each year, including the first. Administration expenses are £120 at the start of Year 1 and increase at the rate of 1.9231% *pa*. Assume AM92 Select mortality and 6% *pa* interest.

20. Given the following select and ultimate  $q_x$  values, calculate the values of  $l_x$  and  $l_{x+1}$  for  $x = 45$  and  $x = 46$ , assuming that  $l_7 = 1,000$ .

Age	Duration 0	Duration 1	Duration 2+ (ie Ultimate)
45	0.000838		
46	0.000924	0.001158	
47	0.001018	0.001284	0.001415
48		0.001423	0.001564
49			0.001729

21. A whole life assurance policy pays 20,000 on death in Year 1, 20,100 on death in Year 2, and so on increasing by 100 each year. The payment is made immediately on death of a life currently aged 35 exact.

- Write down an expression for the present value random variable of this payment, in terms of the curtate future lifetime  $K_x$ , and/or the complete future lifetime  $T_x$ .
- Calculate the expected present value of these benefits, assuming:
  - AM92 Select mortality and 6% *pa* interest
  - a constant force of mortality of 0.015 *pa* and force of interest 0.03 *pa*.

22. Prove that  $\bar{A}_x = \frac{i}{\delta} A_x$

(2x5=10)

Model Question Paper: QPCODE:.....

M.Sc. DEGREE (C.S.S) EXAMINATION.....

M.Sc. Actuarial Science

PG19AS311 – RISK MODELING - I

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

**Section A**

(Answer any **Eight** questions. Each question carries a weight of 1)

1. Show that if  $\gamma = \frac{1}{2}$ , the Weibull distribution will always have a standard deviation that exceeds the mean, whereas if  $\gamma = 2$  the opposite will be true.
2. If  $X$  has a Pareto distribution with parameters  $\lambda = 400$  and  $\alpha = 3$ , and  $N$  has a Poisson (50) distribution, find the expected value of  $S$ .
3. What is the variance of  $S$ , the aggregate claim amount before reinsurance? Why is it not true that  $\text{var}(S_I) + \text{var}(S_R) = \text{var}(S)$ ?
4. Define risk model?
5. If claims from a portfolio have a  $N(500, 400)$  distribution, and there is a retention limit of  $M = 550$ , find the mean amount paid by the reinsurer on all claims.
6. Define Reinsurance and its types?
7. Losses arising from a portfolio follow a Pareto distribution with parameters  $\alpha = 3$  and  $\lambda = 2,000$ . Calculate the probability that a randomly chosen loss amount exceeds the mean loss amount.
8. Suppose that  $N \sim \text{Poisson}(\lambda)$ ,  $M \sim \text{Poisson}(\mu)$ , and  $N$  and  $M$  are independent. Use a convolution approach to derive the probability function of  $N + M$ .
9. Determine an expression for the MGF of the aggregate claim amount random variable if the number of claims has a  $\text{Bin}(100, 0.01)$  distribution and individual claim sizes have a  $\text{Gamma}(10, 0.2)$  distribution.
10. State the two conditions that must hold for a risk to be insurable. (8 × 1 = 8)

**Section B**

(Answer any **six** questions. Each question carries a weight of 2)

11. The probability of a claim arising on any given policy in a portfolio of 1,000 one year term assurance policies are 0.004. Claim amounts have a  $\text{Gamma}(5, 0.002)$  distribution. Find the mean and variance of the aggregate claim amount.



12. The aggregate claims from a risk have a compound Poisson distribution with parameter  $\mu$ . Individual claim amounts (in pounds) have a Pareto distribution with parameters  $\alpha = 3$  and  $\lambda = 1,000$ . The insurer of this risk calculates the premium using a premium loading factor of 0.2 (ie it charges 20% in excess of the risk premium). The insurer is considering effecting excess of loss reinsurance with retention limit £1,000. The reinsurance premium would be calculated using a premium loading factor of 0.3. The insurer's profit is defined to be the premium charged by the insurer less the reinsurance premium and less the claims paid by the insurer, net of reinsurance.
- Show that the insurer's expected profit before reinsurance is  $100\mu$ .
  - Calculate the insurer's expected profit after effecting the reinsurance, and hence find the percentage reduction in the insurer's expected profit.
13. Suppose that the Poisson parameters of policies in a portfolio are not known but are equally likely to be 0.1 or 0.3.
- Find the mean and variance (in terms of  $m_1$  and  $m_2$ ) of the aggregate claims from a policy chosen at random from the portfolio.
  - Find the mean and variance (in terms of  $m_1$ ,  $m_2$  and  $n$ ) of the aggregate claims from the whole portfolio.
14. Consists of the following values, in units of thousands of pounds:  
4.6, 6.8, 22.9, 1.4, 3.8, 10.2, 19.4, 32.1
- If the original claim amounts are modelled using a *Gamma* ( $\alpha, \lambda$ ) distribution, and the retained proportion is 80%, find the distribution of the reinsurer's claims and hence estimate the parameters  $\alpha$  and  $\lambda$  using a method of moments approach.
15. Derive a formula for the average claim amount. If individual claim amounts  $X$  follow a lognormal distribution with PDF:

$$f_X(x) = \frac{1}{x\sigma\sqrt{2\pi}} \exp\left[-\frac{1}{2}\left(\frac{\log x - \mu}{\sigma}\right)^2\right], \quad x > 0$$

16. The annual aggregate claims from a risk have a compound Poisson distribution with parameter 250. Individual claim amounts have a Pareto distribution with parameters  $\alpha = 4$  and  $\lambda = 900$ . The insurer effects proportional reinsurance with a retained proportion of 75%. Calculate the variances of the total amounts paid by the insurer and by the reinsurer.

17. The random variable  $S$  has a compound Poisson distribution with Poisson parameter 4. The individual claim amounts are either 1, with probability 0.3, or 3, with probability 0.7. Calculate the probability that  $S = 4$ .
18. An insurer arranges excess of loss reinsurance with retention limit of Rs. 10,000. The reinsurer suspects that the original claims (including the claims settled entirely by the direct insurer) are independent and have a Pareto distribution. Recent claim amounts paid by the reinsurer in respect of this risk happen to be Rs. 4,253, Rs. 22,320, Rs. 9,724, Rs. 3,692 and Rs. 85,035. The reinsurer wants to estimate the proportion of claims that are settled directly by the insurer. Use the method of moments to obtain an estimate of this proportion.

(6 × 2 = 12)

### Section C

(Answer any **Two** questions. Each question carries a weight of 5)

19. Let  $N$  be the number of claims on a risk in one year. Suppose claims  $[X_1, X_2, \dots]$  are independent, identically distributed random variables, independent of  $N$ . Let  $S$  be the total amount claimed in one year.
- Derive  $E(S)$  and  $\text{var}(S)$  in terms of the mean and variance of  $N$  and  $X_1$ .
  - Derive an expression for the moment generating function  $M_S(t)$  of  $S$  in terms of the moment generating functions  $M_X(t)$  and  $M_N(t)$  of  $X_1$  and  $N$  respectively.
  - If  $N$  has a Poisson distribution with mean  $\lambda$  show that:  

$$M_S(t) = \exp(\lambda (M_X(t) - 1))$$
  - If  $N$  has a binomial distribution with parameters  $m$  and  $q$ , determine the moment generating function of  $S$  in terms of  $m$ ,  $q$  and  $M_X(t)$ .
20. Claims from a portfolio are believed to have a *Pareto*  $(\alpha, \lambda)$  distribution. In Year 0,  $\alpha=6$  and  $\lambda=1000$ . An excess of loss reinsurance arrangement is in force, with a retention limit of 500. Inflation is a constant 10% *pa*.
- Find the distribution of the insurer's claim payments in Years 1 and 2 before reinsurance.
  - Find the percentage increase in the insurer's mean net claims payout in each year.

21. The annual aggregate claim amount from a risk has a compound Poisson distribution with Poisson parameter 10. Individual claim amounts are uniformly distributed on (0, 2000). The insurer of this risk has affected excess of loss reinsurance with retention level 1600. Calculate the mean, variance of both the insurer's and reinsurer's aggregate claims under this reinsurance arrangement.

22. Claim amounts from a portfolio have the distribution with PDF  $f(x) = 2cx \exp(-cx^2)$ ,  $x \geq 0$ . An individual excess of loss reinsurance arrangement with retention limit  $M = 3$  is in force. A sample of the reinsurer's payment amounts gives the following values:

$$n = 10 \quad \Sigma y_i = 8.7 \quad \Sigma y_i^2 = 92.3$$

where the units are millions of pounds. Find the maximum likelihood estimate of  $c$ .

(2 × 5 = 10)

Model Question Paper: **QPCODE:.....**

**M.Sc. DEGREE (C.S.S) EXAMINATION.....**

M.Sc. Actuarial Science

**SEMESTER III**

**PG19AS313- CORPORATE FINANCE**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

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**Section A**

(Answer any **Eight** questions. Each question carries a weight of 1)

1. Define Agency Theory
2. What is meaning of Credit Sale and Leasing
3. What are the main methods by which a company can obtain a listing on the Stock Exchange
4. What is the meaning of Eurobonds and Conversion Premium
5. Define Double taxation relief
6. What are the categories of Future contract
7. Briefly explain Mergers and Acquisitions.
8. Sources of Short term finance
9. Types of Factoring
10. What is Subordinate debt ( 1x8=8)

**Section B**

(Answer any **Six** questions. Each question carries a weight of 2)

11. What are the objectives of shareholders and give an example
12. Explain the different type of Short Term Company finance
13. Explain Role of underwriting
14. Define Preference Shares and list of possible varieties of Preference Shares
15. What are the principles of Personal taxation
16. Define Options and explain the types of Options
17. Write a note on purpose and examples of forecast budgets

18. Pros and cons of limited companies

(2x6=12)

**Section C**

(Answer any **Two** questions. Each question carries a weight of 5)

19. Explain the different type of Business entity

20.

- a. Ordinary Shares are the most risky from of investment so a prudent investor should avoid investing in them – Discuss
- b. List of Possible varieties of Ordinary Shares

21. What is meaning of Swap and explain its Types & Uses of Swap

22.

- a. How is taxable Income calculated?
- b. Assume that the personal allowance is 5000, and that the marginal tax rates are 20% for the first40, 000 and 40% for taxable income above this. Assuming there are no adjustments to total income, how much tax will a single person earning 50,000 pay? What proportion of total income is paid in tax?

(2x5=10)

Model Question Paper: **QPCODE:.....**

**M.Sc. DEGREE (C.S.S) EXAMINATION.....**

**SEMESTER III**

M.Sc. Actuarial Science

**PG19AS314 – FINANCIAL ACCOUNTING**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

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**Section A**

(Answer any **Eight** questions. Each question carries a weight of 1)

1. Write main users of accounting information?
2. Write formula for cost of sales in income statement?
3. Define Revaluation reserve?
4. Define share capital and share premium?
5. Give a definition of Good will?
6. Write two special features of insurance company accounts?
7. What is the use of gross dividend yield?
8. A UK company made £5m pre-tax profit last year. It paid a dividend for the year of £0.02 per share. It has 100m shares in issue currently priced at £1. assuming corporation tax is charged at 30%, calculate  
i) earnings per share    ii) dividend cover    iii) gross dividend yield    iv) PE ratio
9. Define dividend policy
10. Give the statement of cash flow (8x1=8)

**Section B**

(Answer any **Six** questions. Each question carries a weight of 2)

11. Write – Contents of an auditor's Report?

12. The following data was taken from the records of ABC plc and relates to the values of the company's assets, liabilities and capital at 31st December 2007. Organize the items to form the company's balance sheet as at 31st December 2007.

	<i>£000s</i>
Inventories	135
Trade payables	65
Machinery (cost)	347
Machinery (accumulated depreciation)	132
Cash	56
Long-term loans	289
Ordinary share capital	200
Trade receivables	195
Tax provision	67
Dividend provision	45
Retained earnings	185
Land	350
Other reserves	100

13. Explain awkward items in the trial balance?

14. Consider the following non-current assets:

- factory, initial cost £250,000, estimated useful life 25 years, no residual value
- two vans, initial cost £15,000 each, estimated useful life 6 years, no residual value
- machinery, initial cost £122,000, estimated useful life 11 years, estimate residual value £13,750.

The factory was bought 7 years ago. The vans and the machinery were all bought at the beginning of 2007.

The factory and the vans are depreciated using the straight line method. Depreciation on the machinery is worked out using the reducing balance method.

Calculate the company's total depreciation charge for 2007?

15. Define the following items:

- i) Holding company                      ii) subsidiary company  
iii) Associated undertaking      iv) minority interest

16. What are the difference between subsidiary companies and associated companies?

17. Explain income cover and income priority percentages?

18. Explain - i) EPS      ii) EBITDA per share

- iii) PE ratio (using net earnings)      iv) gross dividend yield                      (6x2=12)

**Section C**(Answer any **Two** questions. Each question carries a weight of 5)

19. Explain the types of accounting concepts?
20. You are examining a company's balance sheets for two years in order to understand what has happened to the non-current assets over the period. Given the selected items from the balance sheets and additional data, calculate the amount received from the sale of non-current assets.

Non-Current Asset	31.07.07 in (000's)	31.07.06 in (000's)
Cost	3976	3465
Depreciation	1245	1033
	2731	2432

Additional information:

- During the year, the company paid £900,000 for new equipment.
  - The depreciation allowance for the year is £432,000.
  - The company made a loss on the disposal of non-current assets of £50,000.
21. Balance sheets (in £s) for Company A and Company B are shown below. Shares in Company A have a par value of 50p, and those in Company B a par value of 25p.

	A	B
Non Current assets	200	100
Current assets	600	440
Share Capital	300	160
Reserves	400	80
Current Liabilities	100	300

Calculate the goodwill cost of control assuming that Company A's shares are priced at par, and that B's shareholders are offered 1 share in A for every 1 share in B when A acquires:(i) 100% of Company B and (ii) 75% of Company B.

22. Explain Gearing & Asset gearing and income gearing? (2x5=10)



Model Question Paper: **QPCODE:.....**

**M.Sc. DEGREE (C.S.S) EXAMINATION.....**

M.Sc. Actuarial Science

**SEMESTER III**

**PG19AS315-ELECTIVE I- BUSINESS MANAGEMENT**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

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**Section A**

(Answer any **Eight** questions. Each question carries a weight of 1)

1. Define Organizational behavior.
2. Define Organizational Diagnosis
3. What is leadership?
4. What is BCG matrix?
5. What is group cohesion?
6. What is reactive change?
7. What do you mean by contingency leader?
8. What is emotional intelligence?
9. What do you understand by resistance to change?
10. Differentiate organizational culture and climate (8 × 1=8)

**SECTION –B**

(Answer any **six** questions. Each question carries a weight of 2)

11. Distinguish between the Functional and Product organization and Line & Staff organization.  
List the merits and demerits with examples.
12. Analyze the major methods applied in conflict management and how they help to address conflicts cycles. Give examples
13. Explain transactional theory of leadership with help of illustrations

14. Why is 'Business Ethics' assuming greater importance in today's business world? Identify and briefly discuss in various functions of management.
  15. Discuss the key roles for managing change in organizations and their limitations.
  16. Discuss the importance of differentiation strategy in the present competitive environment. Explain the advantages and disadvantages
  17. Define strategic management. Explain its characteristics
  18. What is a mission statement? Explain the elements in developing mission statement
- (6 × 2=12)

### SECTION-C

(Answer any **Two** questions. Each question carries a weight of 5)

19. Explain the importance of social and organizational culture in bringing about change. Discuss what creates a proactive approach in bringing about change in organizational culture.
  20. What are the different leadership styles? What is the most effective leadership style? Justify your explanation with examples.
  21. What do you understand by group dynamics? What are the different stages of group dynamics? Identify the reasons which play an influential role in the formation of a group and why. Explain with suitable examples.
  22. Write short notes on any three of the following:
    - a) Socio-Technical approach to work design
    - b) Mechanistic vs. Organic systems
    - c) Role Analysis Technique
    - d) Sensitivity training
- (2 × 5= 10)

# **SEMESTER 4**

Model Question Paper QP CODE:  
**M.Sc. DEGREE (C.S.S) EXAMINATION.....**  
**Fourth Semester**  
 Branch: M.Sc. Actuarial Science  
**PG19AS416: CONTINGENCIES - II**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

**PART A**

**(Answer any eight questions. Each Question has weight 1)**

1. Define profit signature
2. List the main features of a unit linked contract.
3. Explain prospective and retrospective methods of calculating reserves.
4. Define the term DSAR.
5. Why hold reserves?
6. Using the multiple decrement table in the preceding question, calculate  ${}_1/(aq)_{50}^d$ , and state what this probability means in words.
7. Explain when mortality profit arises?
8. Explain direct and overhead expenses.
9. What is selection ? Explain various types
10. Calculate the probability that an active scheme member who is currently aged exactly 39, will retire in the normal health over the year of age ending on his 62<sup>nd</sup> birthday. use the service table defined in the pension scheme table in the examination table booklet for your calculations

**(1x8=8)**

**PART B**

**(Answer any six questions. Each Question has weight 2)**

11. In a certain population, forces of decrement are assumed to be constant over individual years of age. The following independent forces of decrement will be assumed for this population between the exact ages of 50 and 52: Force of decrement for year of age commencing from exact age  $x$

Age $x$	due to mortality	due to sickness
50	0.011	0.075
51	0.012	0.081

Construct a double decrement table including the two decrements of mortality a sickness, for this population between exact ages 50 and 52, assuming a radix of  $(al)_{50} = 100,000$ .

12. Under a five-year unit-linked policy, and assuming no non-unit reserves are held, the expected non-unit cashflows emerging at the end of each year, per policy in force at the start of that year, are:

(-10, -20, 5, -15, 40)

Calculate the non-unit reserves that should be set up to zeroise the negative cashflows, and give the profit vector. Assume 6% *pa* interest, and ignore mortality.

13. The company's expenses in respect of this policy in the first month were 55% of the annual premium plus £178, and on average the mortality experience of all such policyholders was 58% of AM92 Ultimate. Death claim payments are made at the end of the month, after all charges have been deducted. Calculate the profit or loss to the company for the first month (ignoring any interest in the non-unit fund and assuming that the proportion of policyholders dying during the first month is one-twelfth of the annual proportion).

14. Calculate the gross premium retrospective reserve at the end of the second policy year for a 5-year single premium endowment assurance with sum assured £30,000 payable on maturity or at the end of the year of earlier death, issued to a 48-year old. Assume AM92 Select mortality, interest of 4% *pa* effective, initial expenses of £360 and renewal expenses of £45 at the start of each year excluding the first.

15. Show the equality of prospective and retrospective gross premium reserves for a whole life assurance contract.

16. A temporary annuity of £3,000 *pa* payable annually in arrears for a term of 10 years was purchased one year ago by a life then aged exactly 60 by the payment of a single premium. Show algebraically that the current retrospective and prospective gross premium reserves are equal, assuming that the pricing and reserving bases are the same. The company assumes that each policy incurs initial expenses of £200 and annual expenses of 1.5% of each annuity payment.

17. Under a 10-year 'double endowment' assurance policy issued to a group of lives aged 50, a sum assured of £10,000 is payable at the end of the year of death and £20,000 is paid if the life survives to the maturity date. Premiums are payable annually in advance.

You are given the following information: reserve at the start of the 8th year (per policy in force): £12,951

number of policies in force at the start of the 8th year: 200

number of deaths during the 8th year: 3

annual premium (per policy) £1,591

- (i) Assuming that reserves are calculated according to the basis specified below, calculate the profit or loss arising from mortality in the 8th year.
- (ii) (ii) Comment on your results.

Basis: Mortality: ELT15 (Males)

Interest: 4% *pa* effective

Expenses: None

18. We wish to construct a double decrement table for mortality and sickness only. The independent force of sickness for the year of age from 50 to 51 is 0.075 and the independent force of mortality for the same year of age is 80% of the force of mortality according to the ELT15 (Males) mortality table. Assuming that all forces of decrement are constant over individual years of age, calculate the first line of this double decrement table, using a radix of  $(al)_{50} = 100,000$ .

(2x6=12)

### PART C

(Answer any two questions. Each Question has weight 5)

19. Suppose a life insurance company sells a 5-year regular-premium endowment assurance policy to a 55-year old male. The sum insured is £10,000 payable at the end of year of death. Initial expenses are 50% of annual premium, renewal expenses are 5% of subsequent premiums. Premiums are payable annually in advance. There is a surrender benefit payable equal to a return of premiums paid, with no interest. This is paid at the end of the year of withdrawal. The company is required to hold net premium reserves, calculated ignoring surrenders. We shall now calculate the projected yearly cashflows per policy in force at the start of each year, using the following bases.

For pricing: AM92 Ultimate mortality, 4% *pa* interest, expenses as above and ignoring surrenders, using the equivalence principle

For reserving: Interest and mortality as per pricing

For future cashflow projection: Interest and expenses as per pricing, dependent surrender and mortality probabilities as in the table below.

(5x2 = 10)

Age $x$	$(aq)_x^d$	$(aq)_x^w$
55	0.005	0.1
56	0.006	0.05
57	0.007	0.05
58	0.008	0.01
59	0.009	0

20. A conventional with-profits whole life assurance policy with an initial sum assured of £100,000 was taken out 5 years ago by a man who was then aged exactly 45, for an annual premium of £2,500. The insurance company has declared compound reversionary bonuses of 3% *pa* each year during this period. All benefits are paid at the end of the year of death.

Calculate the prospective gross premium reserve at the present time using the following assumptions:

Mortality: AM92 Ultimate

Interest: 6% *pa*

Future bonuses: 1.9231% *pa* compound, vesting at the end of each year

Future expenses: £40 *pa* paid at the start of each year, plus £300 payable on a claim

21. William, aged 75, and Laura, aged 80, are the guardians of a child. They take out a life assurance policy that provides a payment of £25,000 immediately when the second of them dies. Level annual premiums are payable in advance whilst the policy is in force.

(i) Calculate the annual gross premium, using the basis given below.

(ii) Calculate the gross premium prospective reserve just before the sixth premium is paid, using the basis given below, assuming that both William and Laura are still alive at that time.

Basis: Mortality: PMA92C20 for William, PFA92C20 for Laura

Interest: 4% *pa* effective

Expenses: Initial: £250

Renewal: 5% of each premium, excluding the first

22. The in-force expected non-unit cashflows for a five-year unit-linked contract taken out by a person aged exactly 50 are (-10, -20, 5, -15, 40). Calculate the non-unit reserves required to zeroise any negative cashflows other than those occurring in the first policy year. Assume AM92Ultimate mortality and 6% *pa* interest.

Model Question Paper: **QPCODE:** .....

**M.Sc. DEGREE (C.S.S) EXAMINATION.....**

**IV SEMESTER**

M.Sc. Actuarial Science

**PG19AS417 – RISK MODELING- II**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

**Section A**

(Answer any **Eight** questions. Each question carries a weight of 1)

1. Give an expression for  $2X_t - 5X_{t-1} + 4X_{t-2} - X_{t-3}$  in terms of second order differences.
2. Define: IBNR claims, Development factor
3. Write surplus process  $U(t)$  equation?
4. List the tests that could be applied to the residuals to test the model for goodness of fit.
5. State the three main stages in the Box-Jenkins approach to fitting an ARIMA time series model.
6. Describe how 'Bornhuetter-Ferguson' method improves the use of loss ratio as compared to basic chain ladder method.
7. Explain what is meant by a 'delay triangle'.
8. Explain the term Cointegrated time series
9. Give two examples of non-linear time series models, while clearly specifying their functional forms.
10. Explain in words the assumptions underlying the Chain Ladder Technique for completing the delay triangle? ( 8 × 1 = 8)

**Section B**

(Answer any **Six** questions. Each question carries a weight of 2)

11. The table below shows the numbers of household insurance claims reported in each development year for accident years from 2005 to 2008. Use the basic chain ladder method to estimate the total ultimate number of claims arising from accidents occurring between 1 January 2005 and 31 December 2008.



Number of claims reported		Development year			
		0	1	2	3
Accident Year	2005	17500	5000	2250	750
	2006	21000	6200	2750	
	2007	18800	5500		
	2008	21300			

12. Show that the moving average process  $X_n = 3 + e_n - e_{n-1} + 0.25 e_{n-2}$  is weakly stationary, where  $e_n$  is a white noise process with mean 0 and variance 1.
13. Explain the following terms relating to machine learning:
  - (a) hyper-parameters
  - (b) CART
  - (c) greedy splitting
  - (d) clustering.
14. Explain the branches of machine learning
15. Let  $Y_t$  be a sequence of independent and identically distributed, standard normal random variables. Which of the following processes are stationary time series, as defined above?
  - (i)  $X_t = \sin(w_t + U)$ , where  $U$  is uniformly distributed on  $[0, 2\pi]$
  - (ii)  $X_t = \sin(w_t + Y_t)$
  - (iii)  $X_t = X_{t-1} + Y_t$
  - (iv)  $X_t = Y_{t-1} + Y_t$
  - (v)  $X_t = 2 + 3t + 0.5X_{t-1} + Y_t + 0.3Y_{t-1}$
16. Estimate the expected outstanding claims reserve for the data in the table below, using the Bornhuetter-Ferguson method. Assume an expected loss ratio of 85%, and that the total claims paid are £1,942,000.

Claims incurred (in1000)	Accident Year	Earned Premium	Development year			
			0	1	2	3
	1997	860	473	620	690	715
	1998	940	512	660	750	
	1999	980	611	700		
	2000	1020	647			

17. A general insurance company is planning to set up a new class of travel insurance. It plans to start the business with £2 million and expects claims to occur according to a Poisson process with parameter 50. Individual claims are thought to have a gamma distribution with parameters  $\alpha = 150$  and  $\lambda = \frac{1}{4}$ . A premium loading factor of 30% is applied.

Explain how each the following change to the company's model will affect the probability of *ultimate* ruin:

- (i) A 28% premium loading factor is applied instead.
- (ii) Individual claims are found to have a gamma distribution with parameters  $\alpha = 150$  and  $\lambda = \frac{1}{2}$
- (iii) The Poisson parameter is now believed to be 60.

18.

- a) The autocorrelation function of a time series shows coefficients significantly different from zero at lags 1 through 4. The partial autocorrelation function shows one spike and monotonically increases to zero as lags length increases. If the time series is model by ARMA (p,q) then state values of p and q.
- b) State the definitions of four non-linear time series models.
- c) If  $X_t$  follows MA(1) and  $Y_t = 0.6 + 0.3t + X_t$  then prove that the standard deviation of first difference of  $Y_t$  will be higher than that of  $X_t$ .

(6 × 2 = 12)

### Section C

(Answer any **two** questions. Each question carries a weight of 5)

19. The aggregate claims arising during each year from a particular type of annual insurance policy are assumed to follow a normal distribution with mean  $0.7P$  and standard deviation  $20P$  where  $P$  is the annual premium. Claims are assumed to arise independently. Insurers are required to assess their solvency position at the end of each year. A small insurer with an initial surplus of £0.1m for this type of insurance expects to sell 100 policies at the beginning of the coming year in respect of identical risks for an annual premium of £5,000. The insurer will incur expenses of  $0.2P$  at the time of writing each policy. Calculate the probability that the insurer will prove to be insolvent for this portfolio at the end of the coming year. Ignore interest.

20. The table below shows the claim payments made by a general insurer in each year for a particular type of insurance.

Claim payments made during year (£000s)		Development Year			
		0	1	2	3
Accident Year	2003	10	50	50	30
	2004	50	70	30	
	2005	40	30		
	2006	90			

- (i) What was the total amount paid during the 2006 calendar year?  
(ii) Find development factors for Development Year 2 for the 2003 and 2004 Accident years.
21. Write down an equation defining the statistical model assumed by each of the following methods of projecting the payments for outstanding claims:
- (i) Basic chain ladder method  
(ii) Inflation adjusted chain ladder method
- Define each symbol and indicate whether the value of each quantity is assumed at the outset or is estimated by the model.
22. Classify the process  $2X_t = 7X_{t-1} - 9X_{t-2} + 5X_{t-3} - X_{t-4} + e_t - e_{t-2}$

(2 × 5 = 10)

QP Code:  
 Model Question Paper  
**M.Sc. DEGREE (C.S.S) EXAMINATION.....**  
**FOURTH SEMESTER**  
 Branch: M.Sc. Actuarial Science  
**PG19AS418 : ACTUARIAL COMPUTING - II**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

**(Answer any THREE questions. Each Question has weight 6)**

1. Use the question spreadsheet to answer the following question. Use the mortality functions on the 'Life Table' tab where appropriate.

An endowment assurance with an 18-year term will pay a sum assured of 75,000 at the end of the term, or at the end of the year of death of a life currently aged exactly 37, if earlier. Level annual premiums are payable at the start of each year while the policy is in force.

The insurance company uses the following basis for the calculation of gross premiums:

Mortality:		AM92 Ultimate
Interest:		3% <i>pa</i> effective
Expenses	Initial:	0.5% of the sum assured
	Renewal:	38 <i>pa</i> payable at the start of each year except the first
	Claim:	350 paid at the time of claim (either on death or maturity)
Commission	Initial:	20% of the first annual premium
	Renewal:	2.5% of each subsequent annual premium ( <i>ie</i> paid at the start of each year except the first)

- (i) Calculate the gross annual premium for the contract.

*Hint: make the interest rate and the premium input variables in your spreadsheet.*

- (ii) Recalculate the premium assuming the effective interest rate is (a) 2% *pa* and (b) 4% *pa*.  
 a. Give a brief explanation of the results obtained.

2. Use the question spreadsheet to answer the following question.

- (i) On the 'Life Table' tab, in the relevant column calculate AM92 Select  $l[x-1]+1$  values for ages  $x = 18, 19, \dots, 91$ , using the given Ultimate  $l_x$  values and the relevant mortality probabilities from the 'Mortality rates' tab.
- (ii) Using the  $l[x-1]+1$  and  $l_x$  values, in the relevant column calculate the associated values of  $d[x-1]+1$ .

- (iii) Calculate AM92 Select  $l[x]$  and  $d[x]$  values in a similar way to parts (i) and (ii), for age  $x = 17, 19, \dots, 90$ .

Use the select life table constructed in part (i) to calculate the probabilities of the following events:

- (a) a select life currently aged exactly 64 is still alive five years later
- (b) a life who was selected one year ago when aged exactly 45, dies within the next 18 years
- (c) a life aged exactly 41, who was selected one year ago, is still alive in 9 years' time but is dead by age 57
- (d) a select life who is currently aged exactly 63 dies in the coming year
- (e) a select life who is currently aged exactly 63 dies between exact ages 64 and 65
- (f) a select life who is currently aged exactly 63 dies between exact ages 65 and 66.

3. Eighteen years ago, a life insurer sold 1,000 identical endowment assurance policies to lives then aged exactly 37. The policy term has just ended. Each policy had a sum assured of £75,000 payable on maturity or immediately on earlier death.

Reserves were calculated using AM92 Ultimate mortality and interest of 3% *pa* effective. These are given in the question spreadsheet, along with an extract from the AM92 life table and the observed number of deaths in each policy year.

Calculate the mortality profit for each policy year assuming that the effective annual rate of interest is 3%.

4. Use the question spreadsheet to answer the following question. Use the mortality functions provided.

The insurance company uses the following basis to calculate retrospective accumulations:

Mortality: PMA92C20  
Interest: 3% *pa* effective

A man aged exactly 65 is considering taking out some kind of life insurance policy.

- i. Under one type of policy, premiums of 1,000 *pa* will be paid for 15 years or until the man's death, if this occurs sooner.

On tab (i) calculate the retrospective accumulation of these premiums at the end of the policy term.

- ii. The man is considering taking out a term assurance policy, under which a benefit of 10,000 will be paid immediately on his death, if this occurs within the next 15 years only.  
Calculate the retrospective accumulation of these benefit payments at the end of the policy term.
- iii. The man is also considering whether to take out a full endowment assurance, which will pay 10,000 at the end of the 15 year term or immediately on earlier death. Calculate the retrospective accumulation of these benefit payments at the end of the policy term.
- iv. Recalculate part (i) assuming an interest rate of 4% *pa*, and explain the answer you obtain.

5. Use the question spreadsheet to answer the following question.

A unit-linked endowment assurance is to be issued to a life aged exactly 50, for a term of 10 years. On survival to the maturity date the bid value of the unit fund is payable. On death before the end of the term, the higher of the unit fund value (calculated as at the end of the policy year of death after all charges have been deducted) or 10,000 is payable at the end of the policy year of death. A premium of 1,000 is paid at the start of each year.

90% of the first and 98% of all subsequent premiums are allocated to units. There is a bid-offer spread of 5% and a fund management charge of 0.75% *pa*, which is deducted from the unit fund at the end of each policy year.

(i) Calculate the net present value of this policy, using the following assumptions

- Mortality: AM92 Select
- Unit growth rate: 6% *pa* effective
- Non-unit interest rate: 3% *pa* effective
- Initial commission: 20% of one annual premium
- Renewal commission: 1 1/2% of each premium except the first
- Initial expenses: 150
- Renewal expenses: 25 *pa* incurred at the start of each year except the first
- Death claim expense: 100
- Maturity expense: 75
- Expense inflation: All non-commission expense amounts are quoted as at outset; they are assumed to inflate at the rate of 2% *pa* from outset to the date of payment
- Risk discount rate: 10% *pa*

- ii. Recalculate the net present value assuming a unit growth rate of 7% *pa* and briefly explain why the net present value has increased.
- iii. Using the original assumptions, calculate the largest first year allocation rate that could be used on the policy that would make the net present value no smaller than 50% of the initial commission.

**Model Question Paper: QPCODE: .....**  
**M.Sc. DEGREE (C.S.S) EXAMINATION.....**  
M.Sc. Actuarial Science  
SEMESTER IV  
**PG19AS419-Elective II- FINANCIAL ENGINEERING**  
**(2020 Admission Onwards)**

**Time: 3 Hours**

**Maximum Weight: 30**

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**Section A**

(Answer any **Eight** questions. Each question carries a weight of 1)

1. What are zero beta models?
2. State Separation theorem?
3. Limitations of utility theory.
4. Which are the three efficient forms of market hypothesis?
5. Distinguish between varying and fixed interest rate models.
6. Distinguish between Systematic and specific risk.
7. What is myopic loss aversion?
8. Why can active management not be justified according to the EMH?
9. State the expected utility theorem
10. What is equity premium puzzle

**Section A**

(Answer any **Six** questions. Each question carries a weight of 2 )

11. a. What is multifactor model?  
b. Explain types of multifactor model.
12. a. Explain CAPM. What are the Limitations of CAPM?
13. The returns from an investment are assumed to conform to the fixed rate model with the distribution of rates as specified below:  
  
0.06 With probability 0.2  
0.08 With probability 0.7  
0.10 With probability 0.1  
  
a. Calculate the expected accumulated value at the end of 5 years of an initial investment of £5,000.  
b. Calculate the accumulated value at the mean rate of return.

14. An investor can invest in only two risky assets A and B. Asset A has an expected rate of return of 10% and a standard deviation of return of 20%. Asset B has an expected rate of return of 15% and a standard deviation of return of 30%. The correlation coefficient between the returns of Asset A and the returns of Asset B is 0.6.
- Calculate the expected rate of return if 20% of an investor's wealth is invested in Asset A and the remainder is invested in Asset B.
  - Calculate the standard deviation of return on the portfolio if 20% of an investor's wealth is invested in Asset A and the remainder is invested in Asset B.
  - Explain why an investor who invests 20% of his wealth in Asset A and the remainder in Asset B is risk-averse.

15. Consider a two-factor model. If:

- The mean specific return is 1.0%
- The expected values of the two factors are 3.0% and 2.2% and
- The sensitivities of investment returns to each of the factors are 0.8 and  $-0.3$  respectively

What is the expected return predicted by the model?

16. Each year, Mr A is offered the opportunity to invest £1,000 in a risk fund. If successful, at the end of the year he will be given back £2,000. If unsuccessful, he will be given back only £500. There is a 50% chance of either outcome. Calculate the expected rate of return per annum on the investment.
17. What are the limitations of utility theory
18. Calculate the mean and variance of the accumulated value at the end of 25 years of an initial investment of £40,000, if the annual rate of return in year  $k$  is independent of that in any other year and  $i_k \sim \text{Gamma}(16, 200)$  for all  $k$ .



**Section C**

(Answer any **Two** questions. Each question carries a weight of 5)

19. An insurer with initial wealth of £2,000 and a utility of  $U(x) = \log(x)$  is designing a policy to cover damages of £500 that occur with probability 0.5. Calculate the minimum premium that the insurer can charge for the policy.

20. Consider two independent assets, Asset A and Asset B, with expected returns of 6% pa and 11% pa and standard deviations of returns of 5% pa and 10% pa, respectively. Let  $x_i$  denote the proportion of the portfolio invested in Asset  $i$ .

- a. If only Assets A and B are available, determine the equation of the efficient frontier in expected return-standard deviation space.

A third Asset, Asset C, is risk-free and has an expected return of 4% pa. A Lagrangian function is to be used to calculate the equation of the new efficient frontier.

- b. Write down, but do not solve, the five simultaneous equations that result from this procedure
- c. Use your simultaneous equations to derive the relationship between  $x_A$  and  $x_B$  on the new efficient frontier.
- d. Hence derive the equation of the new efficient frontier in expected return-standard deviation space.

21. In any year, the rate of return on funds invested with a particular company has mean value  $j$  and standard deviation  $s$ , and is independent of the rates of return in all previous years.

- i) Derive formulae for the mean and the variance of the accumulated value after  $n$  years of a single investment of 1 at time 0.
- ii) Let it be the rate of return earned in the  $t$ th year. Each year the value of  $(1 + it)$  is log normally distributed, with parameters  $\mu = 0.04$  and  $\sigma^2 = 0.09$ .
- a. Show that  $n$ , the number of years that must elapse before the accumulation of a lump sum invested at time 0 has a 75% probability of at least doubling in size, satisfies:
- $$0.04n - 0.2024n - \ln 2 = 0$$
- b. Hence calculate the value of  $n$ .

22. Distinguish between the three main classes of multifactor model

Model Question Paper

**M.Sc. DEGREE (C.S.S) EXAMINATION.....**

M.Sc. Actuarial Science

**IV SEMESTER**

**PG19AS420–Elective III-INSURANCE AND RETIREMENT BENEFITS**

(2020 Admission Onwards)

Time: 3 Hours

Maximum Weight: 30

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**Section A**

(Answer any **Eight** questions. Each question carries a weight of 1)

1. What do you mean by Insurance?
2. Define the term Premium.
3. Define “Non Contributory Scheme”.
4. Distinguish between EDLI and Non- EDLI.
5. Enumerate the main advantages of control funding method.
6. Give a note on any two Optional Pensions.
7. What is Micro Insurance Scheme?
8. Write about Poultry Insurance in rural Scheme.
9. Define the term ‘Beneficiary’.
10. What is Retirement Benefit? (8×1 = 8)

**Section B**

(Answer any **Six** questions. Each question carries a weight of 2)

11. What are the conditions to be fulfilled by Payment of Gratuity Act 1972?
12. Discuss how” Definite funding Method” operates.
13. Describe the fixed cover schemes on lives of employees.
14. Explain tax treatment under superannuation scheme and group insurance scheme.
15. Give a detailed discussion on Weaker Insurance Scheme.

16. Briefly describe about Unit Linked Insurance Scheme.
17. How is International Accounting Standards worked out?
18. State the benefits which are tax free?

(6×2 = 12)

**Section C**

(Answer any **Two** questions. Each question carries a weight of 2)

19. What is insurance? Classify different types of insurance and explain how do insurance companies spread their risk.
20. Explain in detail about the Group Savings Linked Insurance Scheme.
21. Give an account on the rural schemes.
22. Bring out the significance of taxation under Group Insurance Scheme.

(2×5 = 10)