SCHOOL OF ADVANCED SCIENCES
DEPARTMENT OF MATHEMATICS

M.Sc. Business Statistics
(MBS)

Curriculum & Syllabi
(2021–2022 Admitted Students)

VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

- ❖ **World class Education**: Excellence in education, grounded in ethics and critical thinking, for improvement of life.
- ❖ **Cutting edge Research**: An innovation ecosystem to extend knowledge and solve critical problems.
- ❖ **Impactful People**: Happy, accountable, caring and effective workforce and students.
- ❖ **Rewarding Co-creations**: Active collaboration with national & international industries & universities for productivity and economic development.
- ❖ **Service to Society**: Service to the region and world through knowledge and compassion.

VISION STATEMENT OF SCHOOL OF ADVANCED SCIENCES

To be an internationally renowned science school in research and innovation by imparting futuristic education relevant to the society.

MISSION STATEMENT OF SCHOOL OF ADVANCED SCIENCES

- ❖ To nurture students from India and abroad by providing quality education and training to become scientists, technologists, entrepreneurs and global leaders with ethical values for a sustainable future.

- ❖ To enrich knowledge through innovative research in niche areas.

- ❖ To ignite passion for science and provide solutions for national and global challenges.

M.Sc. Business Statistics

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be practitioners and leaders in their chosen field.

2. Graduates will function in their profession with social awareness and responsibility.

3. Graduates will interact with their peers in other disciplines in their work place and society and contribute to the economic growth of the country.

4. Graduates will be successful in pursuing higher studies in their chosen field.

5. Graduates will pursue career paths in teaching or research.

M.Sc. Business Statistics

PROGRAMME OUTCOMES (POs)

PO_01: Having a clear understanding of the subject related concepts and of contemporary issues.

PO_02: Having problem solving ability to address social issues.

PO_03: Having a clear understanding of professional and ethical responsibility.

PO_04: Having cross cultural competency exhibited by working in teams.

PO_05: Having a good working knowledge of communicating in English.

M.Sc. Business Statistics

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of M.Sc. Business Statistics programme, graduates will be able to

PSO1: To analyse a business problem in industry, academia, or government, and determine the appropriate statistical tests.

PSO2: To use specialist software tools for data storage, analysis and visualization.

PSO3: Able to independently carry out research/investigation to solve practical problems.

M.Sc. Business Statistics

CREDIT STRUCTURE

Category-wise Credit distribution

Category	Credits
University Core (UC)	29
University Elective (UE)	06
Programme Core (PC)	23
Programme Elective (PE)	22
Total Credits	**80**

M.Sc. Business Statistics

DETAILED CURRICULUM

Course Code	Course Title	Type	L	T	P	J	C
University Core (UC)							
MAT5018	Foundations of Business Mathematics	TH	3	0	0	0	3
ENG5003/	English for Science and Technology	LO	0	0	4	0	2
FRE5001/	Francais fonctionnel	TH	2	0	0	0	
GRE5001	Deutsch fuer Anfaenger	TH	2	0	0	0	
STS4001	Essentials of Business Etiquettes	SS	3	0	0	0	1
STS4002	Preparing for Industry	SS	3	0	0	0	1
SET5001	Science, Engineering and Technology Project - I	PJT	0	0	0	0	2
SET5002	Science, Engineering and Technology Project - II	PJT	0	0	0	0	2
SET5003	Science, Engineering and Technology Project – III	PJT	0	0	0	0	2
RES5001	Research Methodology	ETP	2	0	0	0	2
MBS6099	Master Thesis	PJT	0	0	0	0	14
Total Credits							**29**

M.Sc. Business Statistics

DETAILED CURRICULUM

Programme Core (PC)							
Course Code	**Course Title**	**Type**	**L**	**T**	**P**	**J**	**C**
MAT5019	Business Statistics with R	ETL	2	0	2	0	3
MAT5020	Data Analytics and Decision Making	ETL	2	0	2	0	3
MAT5021	Business Computer applications	ETH	2	0	0	0	2
MAT5022	Modelling and Simulation	ETH	2	0	2	0	3
MAT5023	Machine Learning with Business Applications	ETL	2	0	2	0	3
MAT5024	Decision Support Systems	ETL	2	0	0	4	3
MAT5025	Applied Multivariate Analysis	ETL	2	0	2	0	3
MAT5026	Time Series Analysis and Business Forecasting	ETL	2	0	2	0	3
Total Credits							**23**

M.Sc. Business Statistics

DETAILED CURRICULUM

Course Code	Course Title	Type	L	T	P	J	C
Programme Elective (PE)							
MAT6013	Survey Sampling and Design	ETH	2	0	0	4	3
MAT6014	Production and Operations Management	ETH	2	0	2	0	3
MAT6015	Big Data Analytics and Visualization	ETH	2	0	2	0	3
MAT6016	Network and Project Management	ETH	3	0	0	0	3
MAT6017	Actuarial Statistics	ETH	3	0	0	0	3
MAT6018	Optimization Modelling	ETH	3	0	0	0	3
MAT6019	Inventory Analysis	ETH	3	0	0	0	3
MAT6020	Financial Mathematics	ETH	3	0	0	0	3
MAT6021	Artificial Intelligence in Business	ETL	3	0	2	0	4
MATXXXX	Industrial Statistics	ETH	2	0	2	0	3
MATXXXX	Official Statistics	ETH	2	0	0	0	2
MATXXXX	Statistical Consulting	ETH	2	0	0	0	2
MATXXXX	Econometric Analysis	ETL	2	0	2	0	3
MATXXXX	Mathematical Demography	ETH	3	0	0	0	3
MATXXXX	Economics for Business and Management	ETH	3	0	0	0	3
Total Credits							**44**

University Core

Course Code	Course Title	L	T	P	J	C
MAT5018	**Foundations of Business Mathematics**	**3**	**0**	**0**	**0**	**3**
Pre-Requisite	**NIL**	**Syllabus Version**				
		1.0				

Course Objectives:

- To enhance the analytical capability of the students using Business Mathematical concepts.
- The students will be able to understand the utilities of Ratio, Proportion and Percentage, Progressions and Interest, Set theory and its Business applications, Permutation, Combination. Matrices and calculus in real time Business.
- To familiarize the students with the basic mathematical tools with emphasis on applications to business and economic situations.
- To prepare the students for subsequent work in their business majors and for their future careers in the business community.

Expected Course Outcome (CO):

- Students shall know how to solve the various business problems using Business Mathematics concepts.
- Students shall be able to use and apply a wide variety of Business Mathematics concepts for various manufacturing and service industries.
- Students will be able to understand the mathematical concepts and terminology involved in derivatives, basic arithmetic operations on vectors and matrices, including inversion and determinants.
- Apply Business Mathematics techniques in Business Problem.

Module:1	Ratio, Proportion and Percentage	6 hours	

Ratio - Definition, Continued Ratio, Inverse Ratio, Proportion, Continued Proportion, Direct Proportion, Inverse Proportion, Variation, Inverse Variation, Joint Variation, Percentage-Meaning and Computations of Percentages.

Module:2	Progressions and Interest	6 hours	

Arithmetic, Geometric & Harmonic Progression, Simple Interest & Compound Interest, Equated Monthly Instalments (EMI).

Module:3	Set theory and its Business applications	6 hours	

Notation of Sets, Singleton Set, Finite Set, Infinite Set, Equal Set Null Set, Subset, Proper Subset, Universal Set, Union of Sets, Intersection of Sets.

Module:4	Permutation & Combination	6 hours	

Difference between Permutation and Combination. Calculation of permutation and combination. Emphasis should be on their use in calculation of probability problems.

Module:5	Matrices and Determinants	7 hours	

Definition of Matrix, Types of Matrices, Properties of Determinants, Transpose of a Matrix, Matrix Operation, Addition, Subtraction, Multiplication of Matrices, Determinants of a square Matrix of order two and three, Adjoint of a square Matrix, Inverse of a square Matrix, Business Application, Solution of Linear Simultaneous Equations - by Cramer's Rule, by using inverse of a Matrix Determinants.

Module:6	**Differential , Integral Calculus and Payroll**	**6 hours**	

Differential: Differentiation of sum, Product and Quotient, Applications in Business, Marginal Cost, Marginal Revenue, Maximum Profit. Integral Calculus: Integration by Substitution, Partial fractions and Integration by parts, Definite integrals, Application of Integration. Payroll: Gross pay, Hourly rate and hours worked, Overtime, Salary, Commission, Net Pay.

Module:7	**Depreciation, Annuities and their applications**	**6 hours**	

Depreciation and Salvage value, straight line method, units of products, double declining balance method, sum of the year's digits method, Annuities, Sinking funds, Amortization, Capital Budgeting   .

Module:8	**Contemporary issues:**	**2 hours**	

Lecture by Industry Experts

	Total Lecture hours:	**45 hours**	

Text Books:

- Pillai and Bagawathi, S (2007), *Business Mathematics and Statistics*, Chand Publications.
- M. Raghavachari (2006), *Business Mathematics*, Tata Mcgraw Hill.
- Andre Francis (2004), *Business Mathematics and Statistic,* Thomson Publications.

Reference Books:

- Bradley Teresa and Patton Paul (2013), Essential Mathematics For Economics And Business, 2nd Edition, Wiley India.
- Qasi Zameeruddin, V.K.Khanna and SK Bhambria, (2009), Business Mathematics, Vikas Publishing House Pvt. Ltd.
- P.R. Vittal (2009), Business Mathematics, Margham Publications.
- Padmalochan Hazarika (2010), A Text Book of Business Mathematics, 2nd edition, S. Chand Publishing.

Mode of evaluation:	CAT / Digital Assignment / Quiz / FAT		
Recommended by Board of Studies	24-06-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

Course Code	Course Title	L	T	P	J	C
ENG5003	**English for Science and Technology** **(for MCA & M.Sc., programmes)**	**0**	**0**	**4**	**0**	**2**
Pre-Requisite	**Cleared EPT**	**Syllabus Version**				
		1.1				

Course Objectives:

- To enable students to communicate effectively in social, academic and professional contexts thereby enhancing their interpersonal, managerial, problem-solving, and presentation skills.
- To facilitate students to develop their listening competency and critically evaluate and review documentaries, talks and speeches.
- To Assist students to read and comprehend News Articles and Scientific Texts; effectively interpret tables and graphs; write and proof-read official correspondences.

Expected Course Outcome:

- Make effective presentations and display their interpersonal skills in academic and professional contexts.
- Emerge as good listeners and critically evaluate oral communication.
- Excel in reading, comprehending and interpreting technical reports, texts and data.
- Able to write effectively in English and also display their proof-reading abilities.
- Face real interviews and handle personal and professional conflicts effectively.

Module:1	Career Goals	4hours

Short term and long term career goals
Activity: SWOT Analysis/ Comprehending speeche**s**

Module:2	Interpersonal Skills	4 hours

Interpersonal Communication in/with Groups (Corporate Etiquette: Journey from Campus to corporate)
Activity: Role Plays/Mime/Skit

Module:3	Listening Skills	4 hours

Listening to Documentary
Activity: Critically evaluate/Review a documentary/TED Talk

Module:4	Reading Skills	4hours

Skimming, Scanning, Intensive & Extensive reading
Activity: Reading News Papers/Magazines/Scientific Texts

Module:5	Report Writing	4hours

Language and mechanics of writing report
Activity: Writing a Report/Mini Project

Module:6	Study Skills	4hours

Summarizing the report
Activity: Abstract, Executive Summary, Digital Synopsis

Module:7	**Interpreting skills**	**4hours**

Interpret data in tables and graphs Activity: Transcoding

Module:8	**Editing Skills**	**4hours**

Proof Reading
Sequencing
Activity: Editing any given text

Module:9	**Presentation Skills**	**4 hours**

Oral Presentation using digital tools
Activity: Oral presentation on the given topic using appropriate non-verbal cues

Module:10	**Group Discussion**	**4 hours**

Intragroup interaction (avoid, accommodate, compete, compromise, collaborate)
Activity: Group discussion on a given topic

Module:11	**Professional Skills**	**4 hours**

Résumé Writing
Activity: Prepare an Electronic Résumé

Module:12	**Skill-Gap Analysis**	**4 hours**

Tailor your skills to suit the Job needs
Activity: Write a SoP for higher Studies/Purpose Statement for job

Module:13	**Interview Skills**	**4 hours**

Placement/Job Interview
Activity: Mock Interview

Module:14	**Managerial Skills**	**4 hours**

Official Meeting to organize events
Activity: Writing Agenda, Minutes of Meeting (video conferencing) and Organizing an event

Module:15	**Problem Solving Skills**	**4 hours**

Conflict Management & Decision Making
Activity: Case analysis of a challenging Scenario

	Total Lecture hours:	**60 hours**	

Text Book(s)

•	Kuhnke, E. Communication Essentials For Dummies. (2015). First Edition. John Wiley & Sons.
•	Hewings, M. Advanced Grammar in Use Book with Answers and CD-ROM: A Self-Study Reference and Practice Book for Advanced Learners of English. (2013). Third Edition. Cambridge University Press. UK.

Reference Books

- Churches, R. Effective Classroom Communication Pocketbook. Management Pocketbooks. (2015). First Edition. USA.
- Wallwork, A. English for Writing Research Papers. (2016). Second Edition. Springer.
- Wood, J. T. Communication in Our Lives. (2016). Cengage Learning. Boston. USA.
- Anderson, C. TED Talks: The Official TED Guide to Public Speaking. (2016). First Edition.Boston. Houghton Mifflin. New. York.
- Zinsser, William. On writing well. HarperCollins Publishers. 2016. Thirtieth Edition. New York.
- Tebeaux, Elizabeth, and Sam Dragga. The essentials of Technical Communication. 2015. First Edition Oxford University Press. USA.

Mode of Evaluation: Mini Project, Flipped Class Room, Lecture, PPT's, Role play, Assignments Class/Virtual Presentations, Report and beyond the classroom activities

List of Challenging Experiments (Indicative)

1.	Setting short term and long term goals	**2 hours**
2.	Mime/Skit/ Activities through VIT Community Radio	**6 hours**
3.	Critically evaluate / review a documentary/ Activities through VIT Community Radio	**4 hours**
4.	Mini Project	**10 hours**
5.	Digital Synopsis	**4 hours**
6.	Case analysis of a challenging Scenario	**4 hours**
7.	Intensive & Extensive reading of Scientific Texts	**4 hours**
8.	Editing any given text	**8 hours**
9.	Group discussion on a given topic / Activities through VIT Community Radio	**8 hours**
10.	Prepare a video résumé along with your video introduction and then create a website (in Google Sites/Webly/Wix) showcasing skills and achievements.	**10 hours**
Total Laboratory Hours		**60 hours**

Mode of evaluation: Mini Project, Flipped Class Room, Lecture, PPT's, Role play, Assignments Class/Virtual Presentations, Report and beyond the classroom activities

Recommended by Board of Studies	22-07-2017		
Approved by Academic Council	No. 47	Date	24.08.2017

Course Code	Course Title	L	T	P	J	C
FRE5001	**Francais Fonctionnel**	**2**	**0**	**0**	**0**	**2**
Pre-Requisite	**Nil**	**Syllabus Version**				
		1.0				

Course Objectives:

The course gives students the necessary background to:
- demonstrate competence in reading, writing, and speaking basic French, including knowledge of vocabulary (related to profession, emotions, food, workplace, sports/hobbies, classroom and family).
- achieve proficiency in French culture-oriented viewpoint.

Expected Course Outcome: Students will be able to
- Remember the daily life communicative situations via personal pronouns, emphatic pronouns, salutations, negations, interrogations etc.
- Create communicative skill effectively in the French language via regular/irregular verbs.
- Demonstrate comprehension of the spoken/written language in translating simple sentences.
- Understand and demonstrate the comprehension of some particular new range of unseen written materials.
- Demonstrate a clear understanding of the French culture through the language studied.

Module:1	Saluer, Se présenter, Etablir des contacts	**3 hours**

Les Salutations, Les nombres (1-100), Les jours de la semaine, Les mois de l'année, Les Pronoms Sujets, Les Pronoms Toniques, La conjugaison des verbes réguliers, La conjugaison des verbes irréguliers- avoir / être / aller / venir / faire etc.

Module:2	**Présenter quelqu'un, Chercher un(e) correspondant(e), Demander des nouvelles d'une personne.**	**3 hours**

La conjugaison des verbes Pronominaux, La Négation,
L'interrogation avec *'Est-ce que ou sans Est-ce que'*.

Module:3	**Situer un objet ou un lieu, Poser des questions**	**4 hours**

L'article (défini/ indéfini), Les prépositions (à/en/au/aux/sur/dans/avec etc.), L'article contracté, Les heures en français, La Nationalité du Pays, L'adjectif (La Couleur, l'adjectif possessif, l'adjectif démonstratif/ l'adjectif interrogatif (quel/quelles/quelle/quelles), L'accord des adjectifs avec le nom, L'interrogation avec Comment/ Combien / Où etc.,

Module:4	**Faire des achats, Comprendre un texte court, Demander et indiquer le chemin.**	**6 hours**

La traduction simple :(français-anglais **/** anglais –français)

Module:5	**Trouver les questions, Répondre aux questions générales en français.**	**5 hours**

L'article Partitif, Mettez les phrases aux pluriels, Faites une phrase avec les mots donnés, Exprimez les phrases données au Masculin ou Féminin, Associez les phrases.

Module:6	Comment ecrire un passage	3 hours

Décrivez :

La Famille /La Maison, /L'université /Les Loisirs/ La Vie quotidienne etc.

Module:7	Comment ecrire un dialogue	4 hours

Dialogue:

   a) Réserver un billet de train
   b) Entre deux amis qui se rencontrent au café
   c) Parmi les membres de la famille
   d) Entre le client et le médecin

Module:8	Invited Talk: Native speakers	2 hours

	Total Lecture hours:	30 hours	

Text Book(s)

- Echo-1, Méthode de français, J. Girardet, J. Pécheur, Publisher CLE International, Paris 2010.
- Echo-1, Cahier d'exercices, J. Girardet, J. Pécheur, Publisher CLE International, Paris 2010.

Reference Books

- CONNEXIONS 1, Méthode de français, Régine Mérieux, Yves Loiseau, Les Éditions Didier, 2004.

- CONNEXIONS 1, Le cahier d'exercices, Régine Mérieux, Yves Loiseau, Les Éditions Didier, 2004.

- ALTER EGO 1, Méthode de français, Annie Berthet, Catherine Hugo, Véronique M. Kizirian, Béatrix Sampsonis, Monique Waendendries, Hachette livre 2006.

Mode of Evaluation: CAT / Assignment / Quiz / FAT			
Recommended by Board of Studies	26-2-2016		
Approved by Academic Council	No 41	Date	17-6-2016

Course Code	Course Title	L	T	P	J	C
GER5001	**Deutsch für Anfänger**	**2**	**0**	**0**	**0**	**2**
Pre-Requisite	**NIL**	**Syllabus Version**				
		1.0				

Course Objectives:

The course gives students the necessary background to:
- enable students to read and communicate in German in their day to day life
- become industry-ready
- make them understand the usage of grammar in the German Language.

Expected Course Outcome: Students will be able to

- Create the basics of the German language in their day to day life.
- Understand the conjugation of different forms of regular/irregular verbs.
- Understand the rule to identify the gender of the Nouns and apply articles appropriately.
- Apply the German language skill in writing corresponding letters, E-Mails etc.
- Create the talent of translating passages from English-German and vice versa and to frame simple dialogues based on given situations.

Module:1		**3 hours**

Einleitung, Begrüssungsformen, Landeskunde, Alphabet, Personalpronomen, Verb Konjugation, Zahlen (1-100), W-fragen, Aussagesätze, Nomen – Singular und Plural
Lernziel:
Elementares Verständnis von Deutsch, Genus- Artikelwörter

Module:2		**3 hours**

Konjugation der Verben (regelmässig /unregelmässig) die Monate, die Wochentage, Hobbys, Berufe, Jahreszeiten, Artikel, Zahlen (Hundert bis eine Million), Ja-/Nein- Frage, Imperativ mit Sie
Lernziel :
Sätze schreiben, über Hobbys erzählen, über Berufe sprechen usw.

Module:3		**4 hours**

Possessivpronomen, Negation, Kasus- AkkusatitvundDativ (bestimmter, unbestimmterArtikel), trennnbare verben, Modalverben, Adjektive, Uhrzeit, Präpositionen, Mahlzeiten, Lebensmittel, Getränke
Lernziel :
Sätze mit Modalverben, Verwendung von Artikel, über Länder und Sprachen sprechen, über eine Wohnung beschreiben.

Module:4		**6 hours**

Übersetzungen : (Deutsch – Englisch / Englisch – Deutsch)
Lernziel :
Grammatik – Wortschatz – Übung

Module:5		5 hours
Leseverständnis,Mindmap machen,Korrespondenz- Briefe, Postkarten, E-Mail		
Lernziel :		
Wortschatzbildung und aktiver Sprach gebrauch		
Module:6	.	3 hours
Aufsätze :		
Meine Universität, Das Essen, mein Freund oder meine Freundin, meine Familie, ein Fest in Deutschland usw		
Module:7		4 hours
Dialoge:		
e) Gespräche mit Familienmitgliedern, Am Bahnhof, f) Gespräche beim Einkaufen ; in einem Supermarkt ; in einer Buchhandlung ; g) in einem Hotel - an der Rezeption ;ein Termin beim Arzt. Treffen im Cafe		
Module:8	**Contemporary issues**	2 hours
Lecture by Industry Experts		
	Total Lecture hours:	30 hours	
Text Book(s)		
• **Studio d A1 Deutsch als Fremdsprache, Hermann Funk, Christina Kuhn, Silke Demme : 2012**		
Reference Books		
• Netzwerk Deutsch als Fremdsprache A1, Stefanie Dengler, Paul Rusch, Helen Schmtiz, Tanja Sieber, 2013		
• Lagune ,Hartmut Aufderstrasse, Jutta Müller, Thomas Storz, 2012.		
• Deutsche SprachlehrefürAUsländer, Heinz Griesbach, Dora Schulz, 2011		
• ThemenAktuell 1, HartmurtAufderstrasse, Heiko Bock, MechthildGerdes, Jutta Müller und Helmut Müller, 2010		
www.goethe.de wirtschaftsdeutsch.de hueber.de, klett-sprachen.de www.deutschtraning.org		
Mode of Evaluation: CAT / Assignment / Quiz / FAT		
Recommended by Board of Studies	04-03-2016	
Approved by Academic Council	No. 41	Date	17-06-2016

Course Code	Course Title	L	T	P	J	C
STS4001	**Essentials of Business Etiquettes**	**3**	**0**	**0**	**0**	**1**
Pre-Requisite		**Syllabus Version**				
		2.0				

Course Objectives:
- To develop the students' logical thinking skills
- To learn the strategies of solving quantitative ability problems
- To enrich the verbal ability of the students
- To enhance critical thinking and innovative skills

Expected Course Outcome:
- Enabling students to use relevant aptitude and appropriate language to express themselves
- To communicate the message to the target audience clearly

Module:1	Business Etiquette: Social and Cultural Etiquette and Writing Company Blogs and Internal Communications and Planning and Writing press release and meeting notes	9 hours

Value, Manners, Customs, Language, Tradition, Building a blog, Developing brand message, FAQs', Assessing Competition, Open and objective Communication, Two-way dialogue, Understanding the audience, Identifying, Gathering Information, Analysis, Determining, Selecting plan, Progress check, Types of planning, Write a short, catchy headline, Get to the Point –summarize your subject in the first paragraph., Body – Make it relevant to your audience.

Module:2	Study skills – Time management skills	3 hours

Prioritization, Procrastination, Scheduling, Multitasking, Monitoring, Working under pressure and adhering to deadlines

Module:3	Presentation skills – Preparing presentation and Organizing materials and Maintaining and preparing visual aids and Dealing with questions	7 hours

10 Tips to prepare PowerPoint presentation, Outlining the content, Passing the Elevator Test, Blue sky thinking, Introduction, body and conclusion, Use of Font, Use of Color, Strategic presentation, Importance and types of visual aids, Animation to captivate your audience, Design of posters, Setting out the ground rules, Dealing with interruptions, Staying in control of the questions, Handling difficult questions

Module:4	Quantitative Ability -L1 – Number properties and Averages and Progressions and Percentages and Ratios	11 hours

Number of factors, Factorials, Remainder Theorem, Unit digit position, Tens digit position, Averages, Weighted Average, Arithmetic Progression, Geometric Progression, Harmonic Progression, Increase & Decrease or successive increase, Types of ratios and proportions.

Module:5	Reasoning Ability-L1 – Analytical Reasoning	8 hours
Data Arrangement(Linear and circular & Cross Variable Relationship), Blood Relations, Ordering/ranking/grouping, Puzzle test, Selection Decision table		
Module:6	Verbal Ability-L1 – Vocabulary Building	7 hours
Synonyms & Antonyms, One-word substitutes, Word Pairs, Spellings, Idioms, Sentence completion, Analogies		
	Total Lecture hours:	45 hours

Reference Books

1.	Kerry Patterson, Joseph Grenny, Ron McMillan, Al Switzler(2001) Crucial Conversations: Tools for Talking When Stakes are High. Bangalore. McGraw-Hill Contemporary
2.	Dale Carnegie,(1936) How to Win Friends and Influence People. New York. Gallery Books
3.	Scott Peck. M(1978) Road Less Travelled. New York City. M. Scott Peck.
4.	FACE(2016) Aptipedia Aptitude Encyclopedia. Delhi. Wiley publications
5.	ETHNUS(2013) Aptimithra. Bangalore. McGraw-Hill Education Pvt. Ltd.

Websites:

1.	www.chalkstreet.com
2.	www.skillsyouneed.com
3.	www.mindtools.com
4.	www.thebalance.com
5.	www.eguru.ooo

Mode of Evaluation: FAT, Assignments, Projects, Case studies, Roleplays,
3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45th AC	Date	15/06/2017

Course Code	Course Title	L	T	P	J	C
STS4002	Preparing for Industry	3	0	0	0	1
Pre-Requisite	Nil	Syllabus Version				
		2.0				

Course Objectives:
- To develop the students' logical thinking skills
- To learn the strategies of solving quantitative ability problems
- To enrich the verbal ability of the students
- To enhance critical thinking and innovative skills

Expected Course Outcome:
- Enabling students to simplify, evaluate, analyze and use functions and expressions to simulate real situations to be industry-ready.

Module:1	Interview skills – Types of interview and Techniques to face remote interviews and Mock Interview	3 hours

Structured and unstructured interview orientation, Closed questions and hypothetical questions, Interviewers' perspective, Questions to ask/not ask during an interview, Video interview, Recorded feedback, Phone interview preparation, Tips to customize preparation for personal interview, Practice rounds

Module:2	Resume skills – Resume Template and Use of power verbs and Types of resume and Customizing resume	2 hours

Structure of a standard resume, Content, color, font, Introduction to Power verbs and Write up, Quiz on types of resume, Frequent mistakes in customizing resume, Layout - Understanding different company's requirement, Digitizing career portfolio

Module:3	Emotional Intelligence - L1 – Transactional Analysis and Brain storming and Psychometric Analysis and Rebus Puzzles/Problem Solving	12 hours

Introduction, Contracting, ego states, Life positions, Individual Brainstorming, Group Brainstorming, Stepladder Technique, Brain writing, Crawford's Slip writing approach, Reverse brainstorming, Star bursting, Charlette procedure, Round robin brainstorming, Skill Test, Personality Test, More than one answer, Unique ways

Module:4	Quantitative Ability-L3 – Permutation-Combinations and Probability and Geometry and mensuration and Trigonometry and Logarithms and Functions and Quadratic Equations and Set Theory	14 hours

Counting, Grouping, Linear Arrangement, Circular Arrangements, Conditional Probability, Independent and Dependent Events, Properties of Polygon, 2D & 3D Figures, Area & Volumes,

Heights and distances, Simple trigonometric functions, Introduction to logarithms, Basic rules of logarithms, Introduction to functions, Basic rules of functions, Understanding Quadratic Equations, Rules & probabilities of Quadratic Equations, Basic concepts of Venn Diagram.

Module:5	Reasoning ability-L3 – Logical reasoning and Data Analysis and Interpretation	7 hours

Syllogisms, Binary logic, Sequential output tracing, Crypto arithmetic, Data Sufficiency, Data interpretation-Advanced, Interpretation tables, pie charts & bar chats

Module:6	Verbal Ability-L3 – Comprehension and Logic	7 hours

Reading comprehension, Para Jumbles, Critical Reasoning (a) Premise and Conclusion, (b) Assumption & Inference, (c) Strengthening & Weakening an Argument

	Total Lecture hours:	45 hours

Reference Books

- Michael Farra and JIST Editors(2011) Quick Resume & Cover Letter Book: Write and Use an Effective Resume in Just One Day. Saint Paul, Minnesota. Jist Works
- Daniel Flage Ph.D(2003) The Art of Questioning: An Introduction to Critical Thinking. London. Pearson
- David Allen(2002) Getting Things done : The Art of Stress -Free productivity. New York City. Penguin Books.
- FACE(2016) Aptipedia Aptitude Encyclopedia.Delhi. Wiley publications
- ETHNUS(2013) Aptimithra. Bangalore. McGraw-Hill Education Pvt. Ltd.

Websites:

1.	www.chalkstreet.com
2.	www.skillsyouneed.com
3.	www.mindtools.com
4.	www.thebalance.com
5.	www.eguru.ooo

Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays,
3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45th AC	Date	15/06/2017

Course Code	Course Title	L	T	P	J	C
SET5001	**Science, Engineering and Technology Project– I**	**0**	**0**	**0**	**0**	**2**
Pre-Requisite		**Syllabus Version**				
		1.10				

Course Objectives:
- To provide opportunity to involve in research related to science / engineering
- To inculcate research culture
- To enhance the rational and innovative thinking capabilities

Expected Course Outcome:

Student will be able to
- Identify a research problem and carry out literature survey
- Analyse the research gap and formulate the problem
- Interpret the data and synthesize research findings
- Report research findings in written and verbal forms

Modalities / Requirements
1. Individual or group projects can be taken up
2. Involve in literature survey in the chosen field
3. Use Science/Engineering principles to solve identified issues
4. Adopt relevant and well-defined / innovative methodologies to fulfill the specified objective
5. Submission of scientific report in a specified format (after plagiarism check)

Student Assessment : Periodical reviews, oral/poster presentation

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course Code	Course Title	L	T	P	J	C
SET5002	**Science, Engineering and Technology Project– II**	**0**	**0**	**0**	**0**	**2**
Pre-Requisite		**Syllabus Version**				
		1.10				

Course Objectives:
- To provide an opportunity to involve in research related to science/engineering
- To inculcate research culture
- To enhance the rational and innovative thinking capabilities

Expected Course Outcome:

Student will be able to
- Identify a research problem and carry out a literature survey
- Analyse the research gap and formulate the problem
- Interpret the data and synthesize research findings
- Report research findings in written and verbal forms

Modalities / Requirements
1. Individual or group projects can be taken up
2. Involve in literature survey in the chosen field
3. Use Science/Engineering principles to solve identified issues
4. Adopt relevant and well-defined / innovative methodologies to fulfill the specified objective
5. Submission of scientific report in a specified format (after plagiarism check)

Student Assessment : Periodical reviews, oral/poster presentation

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course Code	Course Title	L	T	P	J	C
SET5003	**Science, Engineering and Technology Project– III**	**0**	**0**	**0**	**0**	**2**
Pre-Requisite			**Syllabus Version**
			1.10

Course Objectives:
- To provide an opportunity to involve in research related to science/engineering
- To inculcate research culture
- To enhance the rational and innovative thinking capabilities

Expected Course Outcome:

Student will be able to
- Identify a research problem and carry out a literature survey
- Analyse the research gap and formulate the problem
- Interpret the data and synthesize research findings
- Report research findings in written and verbal forms

Modalities / Requirements
1. Individual or group projects can be taken up
2. Involve in literature survey in the chosen field
3. Use Science/Engineering principles to solve identified issues
4. Adopt relevant and well-defined / innovative methodologies to fulfill the specified objective
5. Submission of scientific report in a specified format (after plagiarism check)

Student Assessment: Periodical reviews, oral/poster presentation

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course Code	Course Title	L	T	P	J	C
RES5001	**Research Methodology**	**2**	**0**	**0**	**0**	**2**
Pre-Requisite	**Nil**	**Syllabus Version**
		1.0

Course Objectives:

- Impart skills to develop a research topic and design
- Define a purpose statement, a research question or hypothesis, and a research objective
- Analyze the data and arrive at a valid conclusion
- Compile and present research findings

Expected Course Outcome:

Student will be able to

- Explain the basic aspects of research and its ethics
- Outline research problems, their types and objectives
- Formulate good research designs and carry out statistically relevant sampling
- Collect, collate, analyze and interpret data systematically
- Experiment with animals ethically
- Make use of literature and other search engines judiciously for research purposes

Module:1	Introduction and Foundation of Research	2 hours

Meaning, Objectives, Motivation, Utility for research. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method –Understanding the language of research.

Module:2	Problem identification and formulation	4 hours

Scientific Research: Problem, Definition, Objectives, Types, Purposes and components of Research problem

Module:3	Research Design	4 hours

Concept and Importance in Research : Features of a good research design, Exploratory Research Design and Descriptive Research Designs

Module:4	Sampling	6 hours

Sampling methods, Merits and Demerits. Observation methods, Sampling Errors (Type I and Type II). Determining size of the sample. Experimental Design: Concept of Independent & Dependent variables.

Module:5	Data analysis and Reporting	6 hours

Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression; Research Reports: Structure, Components, Types and Layout of Research report and articles, Writing and interpreting research results, Figures and Graphs

Module:6	Animal handling	2 hours

Guidelines-animal ethical committee, animal models, various routes of drug administrations, LD_{50}, ED_{50}

Module:7	Use of encyclopedias and tools in research	4 hours

Research Guides, Handbook, Academic Databases for Biological Science Discipline. Methods to search required information effectively.

Module:8	Contemporary issues:	2 hours	

Lecture by Industry Experts

	Total Lecture hours:	30 hours	

Text Book(s)
- Catherine Dawson, Introduction to research methods : a practical guide for anyone undertaking a research project, Oxford : How To Books, Reprint 2010
- Julius S. Bendat, Allan G. Piersol, Random Data: Analysis and Measurement Procedures, 4^{th}Edition, ISBN: 978-1-118-21082-6, 640 pages, September 2011

- Research in Medical and Biological Sciences, 1st Edition, From Planning and Preparation to Grant Application and Publication, Editos: Petter Laake Haakon Benestad Bjorn Olsen,
  ISBN: 9780128001547, Academic Press, March 2015

Reference Books
- John Creswell, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, Fourth Edition (March 14, 2013)

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	03-08-2017		
Approved by Academic Council	No. 46	Date	24-08-2017

Course Code	Course Title	L	T	P	J	C
MBS6099	**Master's Thesis**	**0**	**0**	**0**	**0**	**14**
Pre-Requisite	**As per the Academic Regulations**	**Syllabus Version**				
		1.0				

Course Objectives:

To provide sufficient hands-on learning experience related to the area of specialization with a focus on research orientation

Expected Course Outcome:

Student will be able to
- Formulate specific problem statements for ill-defined real-life problems with reasonable assumptions and constraints.
- Perform a literature search and/or patent search in the area of interest.
- Develop a suitable solution methodology for the problem
- Conduct experiments / Design & Analysis / solution iterations and document the results
- Perform error analysis / benchmarking/costing
- Synthesise the results and arrive at scientific conclusions/products/solution
- Document the results in the form of technical report/presentation

1. Can be a theoretical analysis, modelling & simulation, experimentation & analysis, prototype design, correlation and analysis of data, software development, applied research and any other related activities.
2. The project can be for one or two semesters based on the completion of the required number of credits as per the academic regulations.
3. Should be individual work.
4. Carried out inside or outside the university, in any relevant industry or research institution.
5. Publications in the peer-reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

Recommended by Board of Studies			
Approved by Academic Council		Date	

Programme Core

Course Code	Course Title	L	T	P	J	C
MAT5019	**Business Statistics with R**	**2**	**0**	**2**	**0**	**3**
Pre-Requisite	**NIL**	**Syllabus Version**				
		1.0				

Course Objectives:

- To understand the functioning of industries and business strategies.
- To provide a wide range of applications of statistics in solving business related problems.
- To apply basic statistical inference methods for tackling real-world business questions and equips them with basic knowledge of the R statistical programming package.

Expected Course Outcome (CO):

- Compute and interpret descriptive statistics using numerical and graphical techniques.
- Understand the basic concepts of random variables and find an appropriate distribution for analyzing data specific to an experiment.
- Display conceptual understanding of the nature of data analysis and probability modelling.
- Apply statistical methods like correlation, regression analysis in analysing, interpreting experimental data.
- Make appropriate decisions using statistical inference that is the central to experimental research.
- Demonstrate R programming for statistical data.

Module:1	Introduction to Statistical Analysis	2 hours	

Introduction to Statistics - Data Collection and Presentation - Categories of Data Groupings - Exploring Data Analysis - Descriptive Statistics: Measure of Central Tendency, Measure of Dispersion.

Module:2	Introduction to R Software	5 hours	

Installation of R Software - Basics of R: Scalars, Vectors, Matrices, Data Frames, Lists, Data Creation, Data Type Conversion, Variable Information – Basic Operations in R – Control Structures – Statistical Probability Functions in R – Importing Data – Packages – Working Directory and R Script – Data Exploration and Visualization.

Module:3	Basic Probability and Random Variable Concepts	5 hours	

Experiment - Sample Space – Event - Axioms of Probability - Basic Properties of Probability - Conditional Probability - Computation of Probability in R - Simulation of a Random Sample in R - Random Variables: Discrete and Continuous Random Variables, Marginal, Conditional Distributions – Mathematical Expectation and its Properties – Covariance – Moment Generating Function – Characteristic Function.

Module:4	Probability Distributions	4 hours	

Binomial Distribution – Poisson Distribution – Normal Distribution and Standardized Normal Distribution– Exponential Distribution – Student's t-Distribution – Chi-square Distribution – F-Distribution – Use of the Probability Distribution in Business Problem Solving Using R.

Module:5	Sampling and Sampling Distribution	5 hours	

Probability and Non Probability Sampling - Probability Sampling Technique: Simple Random, Systematic, Cluster and Stratified - Non Probability Sampling Technique: Judgment, Quota and Convenience – Advantages and Disadvantages - Sampling Distribution of the Mean - Central Limit Theorem and Its Significance.

Module:6	Statistical Inference	5 hours	

Testing of Hypothesis – Types of Errors – Critical Region – Large Sample Tests: Z-Test for Single Proportion, Difference of Proportions, Single Mean and Difference of Means - Small Sample Tests: Student's *t*-Test and *F*-Test - Chi-Square Test: Goodness of Fit and Independence of Attributes – Design of Experiments – Analysis of Variance: One and Two Way Classifications – Point Estimates and Interval Estimates - Method of Moments and Maximum Likelihood – Confidence Interval.

Module:7	Correlation and Regression	2 hours	

Correlation and Regression – Rank Correlation – Partial and Multiple Correlation – Multiple Regression.

Module:8	Contemporary issues:	2 hours	

Lecture by Industry Experts

	Total Lecture hours:	30 hours	

Text Book(s)

- Sharma J.K.(2004): Business Statistics, Pearson Education
- Peter Dalgaard (2008), Introductory Statistics with R, 2nd edition, Springer.
- Akinkunmi, M. (2019). Business Statistics with Solutions in R. Berlin, Boston.
- Kapoor.V.K. and Gupta.S. (1978): Fundamentals of Applied Statistics,Sultan Chand and Sons.

Reference Books

- Hooda.R.P.(2003) : Statistics for Business and Economics , 3/e, Mac Millan
- Agarwal.B.L(1996): Basic statistics , 3/e, New Age International (P) Ltd
- Anderson.R, Sweeney.J and Williams.A (2002): Statistics for Business and Economics, 8/e, Thomson.
- Bowerman.L.B, O'Connell.R.Murphree.S,(2010): Business Statistics in Practice, Tata McGraw-Hill Edition
- Amir.D.Aczel and Sounder Pandian (2006): Complete Business Statistics, 6/e, Tata McGraw Hill Publishing Company Limited.
- Michael J.Crawley (2007), The R Book, John Wiley and Sons Ltd.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative) | | |

1.	Introduction: Understanding Data types, importing/exporting data.	2 hours
2.	Computing Summary Statistics /plotting and visualizing data using Tabulation and Graphical Representations.	4 hours
3.	Applying correlation and simple linear regression model to real dataset; computing and interpreting the coefficient of determination.	4 hours
4.	Applying multiple linear regression model to real dataset;	3 hours

	computing and interpreting the multiple coefficient of determination.	
5.	Fitting the following probability distributions: Binomial distribution, Normal distribution, Poisson distribution.	4 hours
6.	Testing of hypothesis for One sample mean and proportion from real-time problems.	2 hours
7.	Testing of hypothesis for Two sample means and proportion from real-time problems.	2hours
8.	Applying the t test for independent and dependent samples	2 hours
9.	Applying Chi-square test for goodness of fit test and Contingency test to real dataset.	3 hours
10.	Performing ANOVA for real dataset for Completely randomized design, Randomized Block design, Latin square Design.	4 hours
Total Laboratory Hours		30 hours
Mode of assessment: Weekly Assessment / FAT		
Recommended by Board of Studies	24-06-2020	

Approved by Academic Council	No. 59	Date	24-09-2020

Course Code	Course Title	L	T	P	J	C
MAT5020	**Data Analytics and Decision Making**	**2**	**0**	**2**	**0**	**3**
Pre-Requisite	**Knowledge of basic Statistics and Mathematics**	with Syllabus Version				
		1.0				

Course Objectives:

The objective of the course is to make the student:

- Understand the fundamental concepts of data analysis, data description, decision making, simulation, random number generation, regression modeling, decision modeling, and simulation modeling.
- Conversant with various methods and techniques used in summarization and analysis of data.
- Prepare for investigation of data and examine the possible diagnostics of regression model.
- Formulate real time problem in a form of model.
- Develop feasible solution of real-life problems, using spreadsheet, decision, simulation modeling techniques.
- Conduct research using data analysis and decision models.

Expected Course Outcomes:

- At the end of the course students will be able to:
- Learn to develop in-depth understanding of the data analysis and decision modeling.
- Demonstrate the knowledge and skill of data scaling, acquisition, handling, and manipulation..
- Examine the relationships between dependent and independent variables of simple and
- multiple regression models estimate the parameters and fit a model.
- Perform, handle and manipulate the analysis of various types of data and develop an appropriate decision model.
- Apply the methods of random number generators and use it to solve real life problems.
- Investigate various types of model using spreadsheet, simulation and decision modeling.
- Conduct application of regression modeling to real time observations.
- Research on real time problems from various disciplines using data analysis and decision modeling.

Module:1	Introduction to Data Analysis	4 hours

Data and its measurement, absolute and relative measures of data, data scale (nominal, ordinal, interval, and ratio), data types, methods of data acquisition, normalization of data, visualization of data, Time series plots, Box plot, stem and leaf diagram, exploring data with pivot table, data cleansing, concept of outliers, concept of Z- score, identification of an outliers using Z score and box plot.

Module:2	Data Processing and Manipulation	4 hours

Processing of data, methods of getting right data, sources of data, data sources on webs, official statistics, data handling using excel auto-filter, complex queries with advanced filter, importing external data from Access, creating pivot table from external data, data cleansing, handling the missing data, data manipulation, summary statistics and process of decision making.

Module:3	Decision Making under Uncertainties	4 hours
Introduction, elements of decision making,, the precision tree, decision problems: single and multistage, Bayes rule, numerical problems cases, and applications based on Binomial, Poisson, Normal and Exponential distributions.		

Module:4	Random Number Generation	4 hours
Concept and meaning of random number and its relevance, methods of random number generator. Techniques for Generating Continuous Random Variates, Generating Discrete Random Variates, simulating a non – homogeneous Poisson Process and queuing system.		

Module:5	Modeling through Regression	6 hours
Concept and definition of a model, steps of modeling, simple and multiple regression model, estimation of coefficients, fitting of a model, drawing inferences for regression coefficients, concept of $\square^2$ and adjusted $\square^2$. Problem of overfitting of regression model, model validation, construction of confidence interval for regression coefficients, developing prediction interval. Concept of autocorrelation, multi-collinearity. Test of linearity, test of normality, and the test of heteroscedasticity for a given regression model. Error analysis and measurement of the forecast accuracy.		

Module:6	Decision Modelling	3 hours
Work force scheduling models, aggregate planning models, logistic models, dynamic financial models, integer programming models		

Module:7	Simulation Modelling	03 hours
Introduction to Simulation modeling, Discrete Simulation model, Continuous Simulation model, Monte-Carlo simulation. Spreadsheet simulation modelling, selecting probability distributions for specific simulation, simulating correlated values.		

Module:8	Contemporary issues	02 hours
Lecture by Industry Experts		

Total Lecture Hours:		30 hours

Text Book(s)

- Albright, S. C., Winston, W. L. and Zappe, C.(**2017**); Data Analysis and Decision Making, 6th Edition, Cengage Learning Pvt. Ltd.

Reference Books

- A.M. Law and W.D. Kelton. Simulation Modeling and Analysis, T.M.H. Edition(2016)
- S.M. Ross. Simulation, India Elsevier Publication(2016)
- Wendy L. Martinez, Angel R. Martinez., Computational Statistics handbook with MATLAB, Chapman & Hall / CRC (2002)

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1.	Introduction to Data Analysis	2 hours
2.	Data using statistics	3 hours

3.	Graphical techniques	3 hours
4.	Probability to make Business decisions	3 hours
5.	Discrete random variables to make business decisions	3 hours
6.	Pivot Tables and Conditional Formatting	2 hours
7.	Data Processing and Manipulation	3 hours
8.	Decision Making under Uncertainties	3 hours
9.	Random number generation	2 hours
10	Modelling Through Regression	3 hours
Total laboratory hours		**30 hours**

Mode of assessment: CAT / FAT			
Recommended by Board of Studies			24-06-2020
Approved by Academic Council	No. 59	Date	24-09-2020

Course Code	Curse Title	L	T	P	J	C
MAT5021	**Business Computer Applications**	**1**	**0**	**2**	**0**	**2**
Pre-Requisite	Nil	**Syllabus Version**				
		1.0				

Course Objectives:

Upon completion of this course, the student will be able to:
- Identify Computer Concepts terminology and concepts; basic operating system functionality and terminology; and internet browsers functionality
- Apply basic and advanced formatting techniques skills to produce word processing documents, including Letters and Memos, Business Reports, Flyers, Newsletters.
- Demonstrate basic skills involving spreadsheet functions; create formulas, charts, and graphs; manipulate data; and generate reports including AutoFill, Absolute Cell References, Grouping sheets and linking formulas
- Develop a database; create and format tables, queries, and reports; and enter and modify table data.
- Develop and deliver business presentations using presentation software; Create presentations using text, visual and/or sound elements; use techniques as slide layout, themes, transitions and animations, charts and tables.

Expected Course Outcome:

- Gain familiarity with the concepts and terminology used in the development, implementation and operation of business application systems.
- Explore various methods that Information Technology can be used to support existing businesses and strategies.
- Achieve hands-on experience with productivity/application software to enhance business activities.
- Accomplish projects utilizing business theories, Internet resources and computer technology.
- Work with simple design and development tasks for the main types of business information systems

Module:1	Computer Basics	2 hours
Fundamentals of information technology concepts – hardware, software, security, and privacy.

Module:2	File Management	2 hours
File management techniques to manipulate electronic files and folders in local, network, and online environments

Module:3	Business Documentation	2 hours
Business documents with word processing software using spelling and grammar check, format and layout, tables, citations, graphics, and mail merge.

Module:4	Data Analysis in Excel and Spreadsheets	2 hours
Business documents and analyze data with spreadsheet software using (i) tables, sorting, filtering, charts and graphics, pivot tables, macros; (ii) statistical, financial, logical and look-up functions

and formulas; and (iii) add-ins.

Module:5	Business presentations	2 hours
Business multimedia presentations with presentation software using templates, lists, groups, themes, colors, clip art, pictures, tables, transitions, animation, video, charts, and views.		

Module:6	Database Management	2 hours
Databases and manage data with database software using tables, fields, relationships, indexes, keys, views, queries, forms, reports, and import/export functions		

Module:7	Business software applications	2 hours
Web-based technologies to conduct ethical business research.-goal seeking and what-if analysis to solve problems and make adjustments/recommendations in a business environment		

Module:8	Contemporary issues:	1 hours
Lecture by Industry Experts		

	Total Lecture hours:	15 hours

Text Book(s)

- Skills for Success with Microsoft Office 2019
- Access to Word, Excel, Access, and Power Point 2019

Reference Books

- Technology in action : complete, ISBN : 9780133802962

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1	Create Letters and Memos	2 hours
2	Create Business Reports	3 hours
3	Create Flyers	2 hours
4	Create Newsletters and Mail Merge Documents	3 hours
5	Create Workbooks with Excel 2013	3 hours
6	Insert Summary Functions Create Charts	3 hours
7	Manage Multiple Worksheets	3 hours
8	Create Databases Tables	3 hours
9	Getting Started with PowerPoint 2013	2 hours
10	Format a Presentation	2 hours
11	Enhance Presentations with Graphics	2 hours
12	Present Data Using Tables, Charts and Animation	2 hours
Total Laboratory Hours		30 hours

Mode of assessment:: Continuous Assessment and FAT.

Recommended by Board of Studies	24-06-2020		
Approved by Academic Council	No.:59	Date	24-09-2020

Course Code	Course Title	L	T	P	J	C
MAT5022	**Modelling and Simulation**	**2**	**0**	**2**	**0**	**3**
Pre-Requisite	**Calculus and Basic Probability and Statistic Concepts**	**Syllabus Version**				
		1.0				

Course Objectives:

- To understand the functioning of industries and business strategies.
- To provide students hands-on experience in using industry-standard simulation modelling software in order to structure and solve complex and large-scale managerial decision problems.

Expected Course Outcome:

- Have a comprehensive understanding of the theoretical foundations of stochastic simulation, including
- Random number generation, sampling from discrete and continuous distributions, and statistical analysis of transient/steady-state outputs.
- Build realistic discrete-event simulation models using industry-standard software.
- Apply simulation model building and analysis skills to systematically frame and solve complex business planning problems.
- Explain Verification and Validation of simulation model.
- Interpret the model and apply the results to resolve critical issues in a real world environment.
- Demonstrate various statistical software for simulation technique.

Module:1	Introduction to Modelling and Simulation	4 hours	

Introduction to Simulation modeling, Advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, steps in a simulation study. Simulation Examples: Simulation of Queuing systems, Simulation of Inventory System, Other simulation examples.

Module:2	General Principles	2 hours	

Concepts in discrete - event simulation, event scheduling/ Time advance algorithm, simulation using event scheduling.

Module:3	Random Number and Random Variate Generation	6 hours	

Random Numbers: Properties, Generations methods, Tests for Random number- Frequency test, Runs test, Autocorrelation test. Random Variate Generation: Inverse Transform Technique-Exponential, Uniform, Weibull, Triangular distributions, Direct transformation for Normal and log normal Distributions, convolution methods- Erlang distribution, Acceptance Rejection Technique

Module:4	Optimization via Simulation	3 hours	

Meaning, difficulty, Robust Heuristics, Random Search.

Module:5	Analysis of Simulation Data	4 hours	

Input Modelling: Data collection, Identification and distribution with data, parameter estimation, Goodness of fit tests, Selection of input models without data, Multivariate and time series analysis.

Verification and Validation of Model – Model Building, Verification, Calibration and Validation of Models.

Module:6	Output Analysis	5 hours	

Types of Simulations with Respect to Output Analysis, Stochastic Nature of output data, Measures of Performance and their estimation, Output analysis of terminating simulation, Output analysis of steady state simulations.

Module:7	Simulation Software	4 hours	

Selection of Simulation Software, Simulation packages, Trend in Simulation Software.

Module:8	Contemporary issues	2 hours	

Lecture by Industry Experts

	Total Lecture hours:	30 hours	

Text Book(s)

- Robinson, S. (2014) Simulation: The Practice of Model Development and Use (2nd Edition). Palgrave Macmillan.
- Averill M Law, W David Kelton, Simulation Modelling & Analysis, McGraw Hill International Editions – Industrial Engineering series, 4th Edition, ISBN: 0-07-100803-9.

Reference Books

- Geoffrey Gordon, (1978) System Simulation, Prentice Hall publication, 2nd Edition, ISBN: 81-203-0140-4.
- Pidd, M., (2004) Computer Simulation in Management Science. John Wiley & Sons.
- Narsingh Deo (2004), Systems Simulation with Digital Computer, PHI Publication (EEE), 3rd Edition, ISBN : 0-87692-028-8.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)		
1.	Features of Pro model Package and Input Modelling	6 hours
2.	Simulation of Manufacturing System	6 hours
3.	Simulation of Service Operations	6 hours
4.	Modelling a Live Problem	6 hours
5.	Modelling and simulation problems	6 hours
Total Laboratory Hours		30 hours
Mode of assessment: Weekly Assessment / FAT		
Recommended by Board of Studies	24-06-2020	
Approved by Academic Council	No. 59	Date	24-09-2020

Course Code	Course Title	L	T	P	J	C
MAT5023	**Machine Learning in Business Applications**	**2**	**0**	**2**	**0**	**3**
Pre-Requisite	**NIL**	**Syllabus Version**				
		1.0				

Course Objectives:

- Apply quantitative modeling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques.
- Apply principles of Data Science to the analysis of business problems.
- Develop self-learning algorithms using training data to classify or predict the outcome of future datasets.
- Apply algorithms to build machine intelligence.

Expected Course Outcome:

At the end of the course students will be able to:

- Describe what Data Science is and the skill sets needed to be a data scientist.
- Explain in basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modelling. Fit a model to data.
- Understand the most popular machine learning algorithms
- Analyse and perform an evaluation of learning algorithms and model selection.
- Compare the strengths and weaknesses of many popular machine learning approaches
- Appreciate the underlying mathematical relationships within and across machine learning algorithms and the paradigms of supervised and unsupervised learning.
- Design and implement various machine learning algorithms in a range of real-world applications.

Module:1	Introduction to Data Science	2 hours

Big Data Analytics, Business intelligence vs Big data, big data frameworks, Current landscape of analytics.

Module:2	Exploratory data analysis	4 hours

Exploratory Data Analysis (EDA), statistical measures, Data Analytics Lifecycle and Discovery, data visualization techniques.

Module:3	Statistical Inference	4 hours

Population and Sample, Statistical modelling, probability distributions, fitting a model.

Module:4	Introduction to Machine Learning	4 hours

The origins of machine learning-How machines learn - Machine learning in practice- Exploring and understanding state-of-the-art methods.

Module:5	Classification	4 hours

Learning Associations-Classification-Regression- Decision Trees - Reinforcement Learning-Probably Approximately Correct Learning (PAC)-Noise-Learning-Multiple classes-Model Selection and Generalization- Support Vector Machines.

Module:6	Dimensionality Reduction	4 hours

Introduction- Subset Selection-Principal Component Analysis, Feature Embedding-Factor Analysis-Singular Value Decomposition.

Module:7	Supervised Learning and Unsupervised Learning	6 hours

Linear Discrimination: Introduction- Generalizing the Linear Model-Geometry of the Linear

Discriminant- Linear Discriminant Analysis- Pairwise Separation-Gradient Descent-Logistic Discrimination. Clustering: Introduction, K-Means Clustering- Mixtures of Latent Variable Models- Spectral Clustering-Hierarchical Clustering-Clustering, Choosing the number of Clusters.

Module:8	Contemporary issues	2 hours
Lecture by Industry Experts		
	Total Lecture hours:	30 hours

Text Book(s)

- Seema Acharya, Subhasini Chellappan, (2019) Big Data Analytics, 2nd edition, Wiley India.
- E. Alpaydin,(2015), Introduction to Machine Learning, 3rd Edition, MIT Press.

Reference Book(s)

- R N Prasad and Seema Acharya (2016), Fundamentals of Business Analytics, 2ed, Wiley India.
- C.M. Bishop (2016), Pattern Recognition and Machine Learning, Springer.
- K. P. Murphy(2012), Machine Learning: A Probabilistic Perspective, MIT Press.

Mode of Evaluation: CAT, Quiz, Digital Assignment and FAT

List of Challenging Experiments (Indicative)

1	Exploring and Understanding data and formats	3 hour	
2	Data visualization	3 hours	
3	Model fitting	4 hours	
4	Classification techniques using Decision Trees	4 hours	
5	Support Vector Machines	4 hours	
6	Principle component analysis	4 hours	
7	Clustering Algorithms	4 hours	
8	Discriminant analysis	4 hours	
	Total Lecture hours:	30 hours	

Mode of evaluation: Continuous Assessment and FAT.

Recommended by Board of Studies			24-06-2020
Approved by Academic Council	No.: 59	Date	24-09-2020

Course Code	Course Title	L	T	P	J	C
MAT5024	**Decision Support Systems**	**2**	**0**	**0**	**4**	**3**
Pre-Requisite	**NIL**			**Syllabus Version**		
				1.0		

Course Objectives:

- To review and clarify the fundamental terms, concepts and theories associated with Decision Support Systems, computerized decision aids, expert systems, group support systems and executive information systems.
- To discuss and develop skills in the analysis, design and implementation of computerized Decision Support Systems.
- To discuss organizational and social implications of Decision Support Systems.

Expected Course Outcomes:

- Explain the nature of modelling and how real-world systems may be represented in mathematical form and realized on a computer.
- Determine when a realistic problem is in non-standard form and represent it quantitatively using a computer.
- To examine examples and case studies documenting computer support for organizational decision making, and various planning, analysis and control tasks.
- Distinguish among data processing systems, management information systems, and decision support/expert systems.
- Analyze how information is used to solve problems.

Module:1	Introduction to Systems Principles	4 hours	

The Characteristics and elements of systems, General systems model, Explore communication systems, Differentiate between data processing systems, management information systems, and decision support systems.

Module:2	Methods of Decision Making and Problem Solving	2 hours	

Elements of problem solving process - Problems versus systems - Structured, unstructured, and semi-structured problems - The systems approach and its relationship to the scientific approach.

Module:3	Decision Support Systems (DSS)	5 hours	

Development of DSS - Relationship to data processing and database systems - DSS development and implementation - DSS features and capabilities - DSS in the information center.

Module:4	Expert Systems Overview	5 hours	

Expert behaviour in decision-making situations - Knowledge capture - Expert systems development process - Build a minimal expert system - Apply and modify the system - Multiple levels of knowledge representation - Multiple levels of control and search procedures.

Module:5	Spreadsheet Facilities	4 hours	

Modelling with a spread sheet - Hands-on use of a spreadsheet for business decision-making - Spreadsheet in the information center.

| Module:6 | Manipulation of Models as a decision making procedure | 5 hours | |

Effects of data manipulation to support decisions in pricing, production, cash flow, and new product evaluation models - Proficiency in utilizing expert system, spreadsheet, database, graphic and statistical software for "what if" analyses.

| Module:7 | Building Management Models | 3 hours | |

Picking a model type - Validation of models - Management models and expert systems in the information center.

| Module:8 | Contemporary issues | 2 hours | |

Lecture by Industry Experts

| | Total Lecture hours: | 30 hours | |

Text Book(s)

- Bennett, John L. Building Decision Support Systems. Reading, MA: Addison Wesley, 1983.
- S. Christian Albright. VBA for Modelers: Developing Decision Support Systems with Microsoft Office Excel (5th Edition) Cengage Learning. 2016.

Reference Books

- Leigh, William E. & Michael E. Doherty. Decision Support and Expert Systems. Cincinnati: South Western Publishing, 1986.
- Sprague, Ralph H., Jr., & Hugh J. Watson, eds. Decision Support Systems. Englewood Cliffs, NJ: Prentice-Hall, 1986.
- Turban, Efraim. Decision Support and Expert System: Managerial Perspectives. New York: Macmillan, 1988.
- Young, Lawrence F. Decision Support and Idea Processing Systems, Dubuque, IA: Wm. C. Brown Publishers, 1989.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	24-06-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

Course Code	Course Title	L	T	P	J	C
MAT5025	**Applied Multivariate Analysis**	**2**	**0**	**2**	**0**	**3**
Pre-Requisite	**NIL**	**Syllabus Version**
		1.0

Course Objectives:
- To understand the functioning of industries and business strategies.
- To provide a wide range of applications of statistics in solving business related problems.
- To apply classical multivariate analysis and techniques which are useful for analyzing both designed experiments and observational studies.

Expected Course Outcome:
- Explain the fundamental principles of multivariate normal distribution and sampling theory
- Apply hypotheses tests to analyze multivariate data
- Evaluate the different multivariate methods
- Interpret findings in a scientific and concise manner
- Demonstrate various statistical softwares such as SPSS, MINITAB and R programming for statistical data.

Module:1	Introduction and Matrices	4 hours	

Introduction to multivariate analysis - Basic statistics of a data set - Data displays and graphical representations – Matrices: Rank, inverse, trace and their properties – Characteristic roots and vectors – Idempotent and partitioned matrices – G-inverse and properties – Reduction of a matrix into diagonal, canonical and triangular forms.

Module:2	System of Linear Equations	2 hours	

Consistency – different types of solutions - Quadratic forms – reductions of different types – Definite quadratic forms – Cochran's theorem.

Module:3	Multivariate Normal Distribution	5 hours	

Normal distribution – Bivariate Normal distribution – Multivariate Normal distribution - Marginal and conditional distributions – characteristic function. Maximum likelihood estimation of the parameters of Multivariate Normal and their sampling distributions – Inference concerning the mean vector when covariance matrix is known

Module:4	Multivariate Linear Model and Analysis of Variance and Covariance	5 hours	

Total, Partial, Multiple correlation in the Multivariate setup – MLEs of Total, Partial and Multiple correlation coefficients. Sampling distributions of Total and Multiple Correlation in the null case - Hotelling T^2 statistic, derivation and its distribution – Uses of T^2 statistic - D^2 statistic and its distribution, relation between T^2 and D^2 statistics.

Module:5	Discriminant Model and Analysis	2 hours	

A two group discriminant analysis, a three group discriminant analysis, the decision process of discriminant analysis(objective, research design, assumptions, estimation of the model, assessing overall fit of a model, interpretation of the results, validation of the results).

Module:6	Problem Classification and Analysis of Variance	5 hours	

Classification problems - Scope and its applications - Categorical Data Analysis: Categorical response data, logistic regression-odds ratio, Wald's statistic - Classification into one of two populations (known and unknown dispersion matrix) - Classification in to one of several populations Linear discriminant function - Multivariate analysis of variance (MANOVA): One-Way classification.

Module:7	Multivariate Methods in Multivariate Analysis	5 hours	

Principal components – Definition and Properties - Extraction of Principal components and their variances - Canonical correlation – Estimation of canonical correlation and variates. Factor analysis – Mathematical model- Estimation of Factor Loadings — Concept of factor rotation – Varimax criterion.

Module:8	Contemporary issues:	2 hours	

Lecture by Industry Experts

	Total Lecture hours:	30 hours	

Text Book(s)

- Johnson, Richard A and. Wichern D.W , Applied Multivariate Statistical Analysis, 7/e, Prentice-Hall of India Private Ltd., New Delhi, 2019.
- Hardly W.K. and Simor L., Applied Multivariate Statistical Analysis, 4th Edition, Springer- Verlag, 2015.
- D.F. Morrison, Multivariate Statistical Methods, 3rd Ed., McGraw-Hill International Book Company,1990.

Reference Books

- Anderson, T.W. (2003) : An Introduction to Multivariate Statistical Analysis, Wiley Eastern Ltd.
- Rao, C.R (1998): Linear Statistical Inference and its Applications, Wiley Eastern Ltd,.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Test for equality of mean vectors when covariance matrix is unknown	4 hours
2.	Lab Experiment on the concept of Covariance matrices	4 hours
3.	Experiment based on Discriminant Analysis	4 hours
4.	Lab Experiment on Canonical correlation and canonical variables	4 hours
5.	Experiment based on the concept of One Way MANOVA with Post hoc tests	5 hours
6.	Lab experiment on Principal Component Analysis and Factor Analysis	4 hours
7.	Hoteling $\square^2$ and Mahalanobis $\square^2$	5 hours
Total Laboratory Hours		30 hours

Mode of assessment: Weekly Assessment / FAT

Recommended by Board of Studies	24-06-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

Course Code	Course Title	L	T	P	J	C
MAT5026	**Time Series Analysis for Business Forecasting**	**2**	**0**	**2**	**0**	**3**
Pre-Requisite	**NIL**	**Syllabus Version**				
		1.0				

Course Objectives:

- To understand the functioning of industries and business strategies.
- To provide a clear explanation of the fundamental theory of time series analysis and forecasting models, which are significant for business study.
- To provide students with a practical experience that will help them in handling modern statistical software in the analysis of real-life data.

Expected Course Outcome:

- Explain the fundamental principles of different time series models.
- Identify suitable time series models for a given real-life problem.
- Apply time series analysis skills and techniques to analyze real-life problems through statistical software.
- Demonstrate advanced knowledge of the types of data analysis problems that can be appropriately dealt with using forecasting techniques.
- Successfully develop forecasting models and apply them to real life problems.
- Demonstrate various statistical softwares such as SPSS, MINITAB and R programming for statistical data.

Module:1	Introduction to Time Series	3 hours	

Definition and examples of time series models, graphical representation of time series data, Components and various decompositions of time series models, numerical description of time series, data transformations, methods of estimation, trend and seasonal adjustments.

Module:2	Smoothing Techniques	4 hours	

Moving average (MA), weighted moving average, single and double exponential smoothing, Holt's and winter's methods, exponential smoothing techniques for series with trend and seasonality, basic evaluation of exponential smoothing.

Module:3	Stationary and Non-Stationary Time Series Models	5 hours	

Weak and strong stationary, auto covariance, autocorrelation function (ACF), partial autocorrelation function (PACF), conditions for stationarity and invertibility, autoregressive (AR), , autoregressive and moving average (ARMA) models and their statistical Properties, autoregressive integrated moving average (ARIMA) processes, choice between stationary and non-stationary models.

Module:4	Spectral Analysis and Decomposition	5 hours	

Spectral analysis of weakly stationary process, periodogram and correlogram analysis, spectral decomposition of weakly AR process and representation as a one-sided MA process, implication in prediction problems.

Module:5	Fundamentals of Forecasting	4 hours	

Forecasting methods: qualitative and quantitative methods, steps involved in stochastic model building, forecasting model evaluation, model selection techniques: AIC, BIC and AICC, forecasting model monitoring.

Module:6	Modelling Volatility	4 hours	

Nonlinear modeling of financial time series: meaning of non-linearity, non-constant conditional variance models for volatility, definition and representation of ARCH and GARCH Models and their use in financial time series data, diagnostic checking of model, analysis of residuals.

Module:7	Evaluating and Combining Forecast	3 hours	

Introduction to business forecasting, forecasting cycle, different forecasting techniques, exploring data patterns and choosing forecasting technique, managing forecasting process, measuring forecasting error, forecasting error comparison.

Module:8	Contemporary Issues	2 hours	

Lecture by Industry Experts

	Total Lecture hours:	30 hours	

Text Book(s)

- P.J. Brockwell and R.A. Davis, Introduction to Time Series and Forecasting, Springer, 2016.
- Terence C. Mills, Applied Time Series Analysis: A Practical Guide to Modeling and Forecasting, Academic Press, 2019.
- Chan, Ngai Hang, Time series: applications to finance, New York : Wiley Interscience, 2002.
- Shumway R. H. and Stoffer. D. S.: Time Series Analysis and its Applications with R Examples, Springer, 2011.

Reference Books

- Walter Enders, Applied Econometric Time Series. 2nd edition, New York, Wiley, 2004.
- Shumway, Robert H, Time series analysis and its applications, New York : Springer, 2000.
- Yaffee, Robert A. Introduction to time series analysis and forecasting with applications of SAS and SPSS, San Diego, Academic Press, 2000.
- Montgomery D.C., C.L. Jennigs and M. Kulachi, Introduction to Time Series analysis and Forecasting, Wiley InterScience, 2006.
- Ruey S. Tsay, "Analysis of Financial Time Series, Financial Econometrics", 3/e Wiley.2014.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)		
1.	Exploration of time series data	4 hours
2.	Autoregressive time series: for the identification, estimation and forecasting based on autoregressive order obtained from a time series.	5 hours
3.	Detecting trend & autocorrelation in time series	4 hours
4.	Plot of a time series and calculates a set of seasonal index values from a set of values forming a time series.	4 hours

5.	Runs test for random fluctuations in a time series.	4 hours
6.	Introduction to ARMA time series modeling and application of ARIMA time series modeling	4 hours
7.	Forecasting by smoothing technique: estimates the next number using moving average and exponential smoothing.	5 hours
Total Laboratory Hours		30 hours

Mode of assessment: Weekly Assessment / FAT				
Recommended by Board of Studies	24-06-2020			
Approved by Academic Council	No. 59	Date	24-09-2020	

Programme Elective

Course Code	Course Title	L	T	P	J	C
MAT6013	**Survey Sampling and Design**	**2**	**0**	**0**	**4**	**3**
Pre-Requisite	**NIL**	Syllabus Version				
		1.0				

Course Objectives:

- To understand different introductory concepts in sampling and Experimental Design
- To help the students for the analysis of agriculture Experiments.
- To link and analyse the various Designs in Medical and agriculture Experiments.

Expected Course Outcome:

On completion of the course students will be able to

- understand the fundamental advantages and apply essential of life policies.
- apply an appropriate Designs for construction of Experimental designs
- apply some standard Experimental Designs for Analysis of Variance
- able to construct the Mathematical formulation of the Designs
- learn and apply ANOVA for different experiments.

Module:1	Sampling Basics	5 hours

The concept of sampling - Need for sampling - population and sample - sampling unit and sample frame - Types of Population - Basic properties of the population - sample survey and census - Principal steps in a Sample survey - Notion of sampling error.

Module:2	Simple Random Sampling	4hours

Simple Random Sampling with and without replacement - Estimation of Population mean and proportion and their variances- Determination of sample size

Module:3	Stratified Random Sampling	3 hours

Stratified sampling - Principles of stratification - Estimation of population mean and its variance - Allocation techniques - Estimation of gain due to stratification

Module:4	Systematic Sampling	4 hours

Systematic sampling - Estimation of population mean and its sampling variance - Circular systematic sampling - comparison of systematic, simple random and stratified random sampling - cluster sampling with equal sized clusters - estimation of population mean and variance.

Module:5	Experimental Principles	4hours

Basic Principles for designing statistical experiments: Randomization, Replication and local control techniques - Determination of experimental units and notion of experimental error - Analysis of variance with one–way and two–way classifications - Models and Methods of analysis.

Module:6	Randomised Designs	4 hours

Completely Randomized Design (CRD) and Randomized Block Design (RBD)- Models and estimates of parameters and their standard error - Analysis of data arising from such designs, Analysis when one or two observations are missing.

Module:7	Latin Square Design	4 hours

Latin Square Design (LSD) – Model – Estimation of parameters – Method of analysis – Missing Plot technique in LSD

Module:8	Contemporary issues	2 hours

Lecture by Industry Experts

	Total Lecture hours:	30 hours	

Text Book(s)	
•	Hanif M., Qaiser Shahbaz M. and Munir Ahmad (2018), Sampling Techniques: Methods and Applications, Nova Science Publishers.
•	Montgomery, C.D (2012): Design of Experiments, 8/e, John Wiley and Sons.
Reference Books	
•	Goon.A.M, Gupta and Dasgupta.B. (2001): An Outline of statistical theory, vol. II, 6/e World Press Calcutta.
•	Gupta .S.C. and Kapoor.V.K.(2000): Fundamentals of Applied Statistics, Sultan Chand

Mode of Evaluation: CAT, Quiz, Digital Assignment and FAT.

Mode of Evaluation: Continuous assessment and FAT.

Recommended by Board of Studies	24-06-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

Course Code	Course Title	L	T	P	J	C
MAT 6014	**Production and Operations Management**	**3**	**0**	**0**	**0**	**3**
Pre-Requisite	**Nil**		**Syllabus Version**			
			1.0			

Course Objectives:

Upon completion of this course, the student will be able to:
- Understand the basic concepts and theories of the production management.
- Comprehend the operations management situations with greater confidence.
- 3.Anticipate issues in production and operations processes they may face during their careers
- Expand individual knowledge of operations management principles and practices.
- Apply operations management concepts and their influence on business decisions.

Expected Course Outcome:

- Gaining knowledge about managing production processes.
- How to run operations effectively.
- Better understanding of modern production techniques.
- Better understanding of quality management.
- Management skills needed for the effective operations management

Module:1	Productivity	6 hours

Importance, Productivity ratio, productivity measurement, Productivity Index, Awareness-improvement-maintenance (A.I.M) Process. Production System: Models of production system, Product Vs Services, Process-focused &product focused systems, product strategies, product life cycle, and production function.

Module:2	Production Planning and Control:	6 hours

Aggregate Planning, Sequencing, Line Balancing, Flow control, Dispatching, expediting, Gantt chart, line of balance, learning curve

Module:3	Production and Operations Management	6 hours

Production Management: Integrated Production Management, System Productivity, Capital Productivity, Labour Productivity, Personnel Productivity, Training. Operations Management: Introduction, Operations Management and Strategy, Tools for Implementation of Operations, Industry Best Practices

Module:4	Operations Strategy	6 hours

Operations Strategy, Competitive Capabilities and Core Competencies, Operations Strategy as a Competitive Weapon, Linkage Between Corporate, Business, and Operations Strategy, Developing Operations Strategy, Elements or Components of Operations Strategy, Competitive Priorities, Manufacturing Strategies, Service Strategies, Global Strategies and Role of Operations Strategy, Case-lets

Module:5	Forecasting	7 hours

Introduction, The Strategic Importance of Forecasting, Benefits, Cost implications and Decision making using forecasting, Classification of Forecasting Process, Methods of Forecasting,

Forecasting and Product Life Cycle, Selection of the Forecasting Method, Qualitative Methods of Forecasting, Quantitative Methods, Associative Models of Forecasting, Accuracy of Forecasting

Module:6	Facility or Layout Planning and Analysis	6 hours

Introduction, Objectives of Layout, Classification of Facilities, Basis for Types of Layouts, Why Layout decisions are important, Nature of layout problems, Redesigning of a layout, Manufacturing facility layouts, Types of Layouts, Layout Planning, Evaluating Plant Layouts, Assembly Line Balancing, Material handling

Module:7	Total Quality Management	6 hours

Introduction, Meaning and Dimensions of Quality, Quality Control Techniques, Quality Based Strategy, Total Quality Management (TQM), Towards TQM – ISO 9000 as a Platform – Working with Intranet, Total Productive Maintenance (TPM)

Module:8	Contemporary issues	2 hours

Lecture by Industry Experts

	Total Lecture hours:	45 hours

Text Book(s)

- Production Systems: Planning, Analysis & Control : By Riggs, J.L.(4th Edn.) John Wiley & Sons
- Modern Production/Operation management: By Buffa, E.S. & Sarin,.K.(8`" Edn.) John Wiley & Sons.

Reference Books

- Production & Operations Management: By Panneer saivem, R.(2' 1 Edn.) PHI
- Production & Operations Management : By Chary, S.N.(TMH).

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	24-06-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

Course Code	Course Title	L	T	P	J	C
MAT6015	**Big Data Analytics and Visualization**	**2**	**0**	**2**	**0**	**3**
Pre-Requisite	**NIL**	**Syllabus Version**				
		1.0				

Course Objectives:

- To understand the functioning of industries and business strategies.
- To introduce the power of big data analytics and data visualisation techniques in contributing to business value creation.
- To solve a variety of complex data centred business problems using computer software tools.

Expected Course Outcome:

- Display conceptual understanding of big data analytics and visualization techniques.
- Demonstrate a systematic understanding of database management concepts and their connections with big data analytics.
- Develop a systematic understanding in order to build and apply skills in big data network analytics, text mining, and social media data mining.
- Demonstrate critical awareness of how managers and executives utilise big data analytics for business value creation by improving their operational, social, and financial performance and create opportunities for new business development.
- Critically evaluate and apply big data techniques using statistical software.

Module:1	Introduction to Big Data Analytics	3 hours	

Big Data Overview - State of the Practice in Analytics - The Data Scientist - Big Data Analytics in Industry Verticals - Data Analytics Lifecycle.

Module:2	Advanced Analytics	4 hours	

K-means clustering - Association rules- Linear Regression- Logistic Regression- Naïve Bayes Decision Trees- Time Series Analysis- Text Analysis.

Module:3	Big Data Analysis Models and Algorithms	5 hours	

Analytics for Unstructured Data (Map Reduce and Hadoop)- The Hadoop Ecosystem- In-database Analytics – SQL Essentials- Advanced SQL and MADlib for in-database Analytics.

Module:4	Research Trends and Applications	2 hours	

Operationalizing an Analytics Project -Creating the Final Deliverables- Data Visualization Techniques- Final Lab: Application of Data Analytics Lifecycle to a Big Data Analytics Challenge.

Module:5	Data Analytics Methods Using Statistical Packages	4 hours	

Analyzing and Exploring the Data - Importing and Exporting of files – Recoding and Computing new variables – Visual Binning – Selection of cases – splitting and merging of files – multiple responses – Graphical plots : Box Plot, Scatter plot, Histogram, Bar and Pie charts - Fitting of Curves: Parabola, cubic and exponential – correlation and regression: simple, multiple – Rank correlation – Variable Selection in Multiple Regression - Residual Analysis: model adequacy,

detection of outliers and influence observations.

Module:6		6 hours	

Testing of Hypotheses – two sample and paired samples t – test; F-test for two sample variances; Chi-square test for independence of attributes – One way and Two Way Analysis of Variance – Multiple Comparison tests : Tukey's test, Duncan's Multiple range test and Dunnett's test. Non-Parametric tests: One sample and Two sample Kolmogorov – Smirnov test, Kruskal – Wallis test, Friedman test, Median Test – One Way MANOVA – Hotelling's T^2 two sample test – Test for two Covariance matrices – One way Repeated Measures ANOVA.

Module:7	Factor Analysis	4 hours	

Identification of Principle Component, Varimax rotation – Discriminant Analysis – Enter and Stepwise procedures, discriminant scores – Logistic regression – variable selection procedures (Backward and Forward with conditional and wald methods), Odds ratio, Classification matrix – 2^2 , 2^3, 3^2 and 3^3 factorial designs – Split Plot designs.

Module:8	Contemporary issues	2 hours	

Lecture by Industry Experts

	Total Lecture hours:	30 hours	

Text Book(s)

- Lemahieu, W., vanden Broucke, S., Baesens, B. (2018). Principles of Database Management: The Practical Guide to Storing, Managing and Analyzing Big and Small Data. Cambridge University Press.
- Sanders, R.N. (2014). Big Data Driven Supply Chain Management: A Framework for Implementing Analytics and Turning Information into Intelligence. Pearson FT Press.

Reference Books

- Luke, D.A. (2015). A User's Guide to Network Analysis in R. Springer.
- Kolaczyk, E.D., Csardi, G. (2014) Statistical Analysis of Network Data with R. Springer.
- Frank J. Ohlhorst (2013): Big data Analytics, Turning Big data into big money, John Wiley and Sons.
- Michael Minelli, Michele Chambers, Ambiga Dhiraj (2013): Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends . John Wiley and Sons.
- Arvind Sathi (2012): Big Data Analytics: Disruptive Technologies for Changing the Game., MC PressLLC.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Import and Export of data files, Recoding into different variables, visual binning. Summary statistics using Descriptive option and Means option.	2 hours
2.	Fitting of curves and Simple Correlation	3 hours
3.	Multiple regression with variable selection	3 hours
4.	Parametric and Non-parametric Tests	3 hours
5.	One Way ANOVA, Two Way ANOVA, One way MANOVA post hoc tests – Tukey, Bonferonni	4 hours

6.	Pictorial Representations of Multivariate data: 2D-bar, pie, histogram; 3D- pie, bar, histogram and bivariate Box plot, scatter matrix plot.	3 hours
7.	Logistic regression – odds ratio, Wald's statistic – Variable Selection	3 hours
8.	Discriminant Analysis – Stepwise Method – classification matrix and cross validation	3 hours
9.	Principal Component Analysis – Scree plot – eigen values – Interpretation and its uses – Factor analysis – Initial extraction of factors through Principal Components – varimax rotation - Assigning factor scores and its Applications	3 hours
10.	Concept of Change point analysis – ecp package for detecting single and multiple change points in univariate and multivariate data structures.	3 hours
Total Laboratory Hours		30 hours
Mode of assessment: Weekly Assessment / FAT		
Recommended by Board of Studies	24-06-2020	
Approved by Academic Council	No. 59	Date	24-09-2020

Course Code	Course Title	L	T	P	J	C
MAT6016	**Network and Project Management**	**3**	**0**	**0**	**0**	**3**
Pre-Requisite	**Nil**			**Syllabus Version**		
				1.0		

Course Objectives:

Upon successful completion of this course, students should be able to:
- Explain the fundamental principles of network and transportation models
- Apply appropriate algorithms to solve a given network problem
- Formulate real-life transportation and assignment problems as mathematical programming problems
- Apply network models to project management.

Expected Course Outcome:

- Understanding the concepts of Project Management for planning to execution of Projects.
- Understand the feasibility analysis in Project Management and network analysis tools
- Analyze the learning and understand techniques for Project planning, scheduling and Execution
- To analyze, apply and appreciate contemporary project management tools and methodologies

Module:1	Network Models	4 hours

Shortest route problems-Minimum spanning tree problem-Maximum flow problems

Module:2	Transportation Models	4 hours

Introduction, Formulation of Transportation Problem (TP), Transportation Algorithm (MODI Method), the Initial Basic Feasible Solution, Moving Towards Optimality

Module:3	Assignment Models	4 hours

Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Routing Problem, Travelling Salesman Problem

Module:4	Project Management	4 hours

Basic Differences between PERT and CPM, Steps of PERT/CPM Techniques, PERT/CPM Network Components and Precedence Relationships

Module:5	Network Scheduling	4 hours

Critical Path Analysis, Probability in PERT Analysis Project Time Cost Trade off, Updating of the Project, Resource Allocation

Module:6	Decision Theory	4 hours

Decision Environments, Decision-Making under Certainty, Decision-Making under Risk, Decision under Uncertainty

Module:7	Markov Chains	4 hours

Stochastic processes - States, Markov Chains - Transition matrices - Types of chains - Steady-state probabilities

Module:8	Contemporary issues:		2 hours	
Lecture by Industry Experts				
	Total Lecture hours:		**45 hours**	
Text Book(s)				
•	F. S. Hillier and G. J. Lieberman, Introduction to Operations Research, McGraw Hill 2005, eighth edition.			
•	H. A. Taha, Operations Research, an introduction, Prentice Hall, 2010, ninth edition.			
Reference Books				
•	W. L. Winston, Operations Research: applications and algorithms, Thomson Brooks/Cole, 2004, fourth edition.			
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar				
Recommended by Board of Studies	24-06-2020			
Approved by Academic Council	No. 59	Date	24-09-2020	

Course Code	Course Title	L	T	P	J	C
MAT6017	**Actuarial Statistics**	3	0	0	0	3
Pre-Requisite	NIL		Syllabus Version			
				1.0		

Course Objectives:

- To understand different introductory concepts in Actuarial science.
- To help the students for taking decision for lfe policies.
- To link and analyse the various stochastic models for Actuarial statistical applications.

Expected Course Outcome:

On completion of the course students will be able to

- understand the fundamental advantages and apply essential of life policies.
- apply an appropriate models for construction of life tables.
- apply some standard distributions for construction of sampling plans.
- able to construct the life tables of the policy holders.
- learn and apply variance transformation techniques

Module:1	Basic deterministic model	4 hours

Cash flows, discount function, interest and discount rates, balances and reserves, internal rate of return, The life table: Basic definitions, probabilities, construction of life tables, life expectancy.

Module:2	Life Annuities	6 hours

Introduction, calculating annuity premium, interest and survivorship discount function, guaranteed payments, deferred annuities

Module:3	Fractional durations	6 hours

 Life annuities paid monthly, immediate annuities, fractional period premium and reserves, reserves at fractional durations, Continuous payments: Continuous annuities, force of discount, force of mortality, Insurance payable at the moment of death, premiums and reserves.

Module:4	The General Insurance	9 hours

Annuity identity, Select morality: Select an ultimate tables, Changed in formulas.

Module:5	Multiple life contracts	6 hours

 Joint life status, joint annuities and insurances, last survivor annuities and insurances, moment of death insurances. The general two life annuity and insurance contracts, contingent insurances

Module:6	Multiple Decrement Theory	6 hours

 Basic model, insurances, Determination of the models from the forces of decrement. Stochastic approach to insurance and annuities; Stochastic approach to insurance and annuity benefits, deferred contracts, Stochastic approach to reserves and premiums, variance formula.

Module:7	Stochastic approach to life policies	6 hours

Stochastic approach to insurance and annuity benefits, deferred contracts, Stochastic approach to reserves and premiums, variance formula.

Module:8	Contemporary issues	2 hours

Lecture by Industry Experts

	Total Lecture hours:	45 hours

Text Book(s)

•	Promislow, S.D (2006): Fundamentals of Actuarial Mathematics, John Willey
•	Neill, A. (1977): Life contingencies, Heinemann, London

Reference Books

•	Donald D.W.A. (1970): Compound Interest and Annuities, Heinemann, London
•	Hooker, P.F. and Longley Cook, L.W. (1953): Life and other Contingencies, Volume I and Volume II (1957) Cambridge University Press.

Mode of Evaluation: CAT, Quiz, Digital Assignment and FAT.	
Mode of Evaluation: Continuous assessment and FAT.	
Recommended by Board of Studies	24-06-2020
Approved by Academic Council	No. 59	Date	24-09-2020

Course Code	Course Title	L	T	P	J	C
MAT6018	**Optimization Modelling**	**3**	**0**	**0**	**0**	**3**
Pre-Requisite	**NIL**		**Syllabus Version**
			1.0

Course Objectives:

- To understand different concepts business problems for analyzing industrial experiments.
- To help the students for taking decision under business environment.
- To link and analyse the various quantitative models for industrial planning solutions.

Expected Course Outcome:

On completion of the course students will be able to

- Understand the fundamental advantages and apply essential of business models.
- Apply an appropriate Charts for the industrial experiments.
- Apply some standard distributions for construction of sampling plans.
- Able to construct the AOQL plans for normal inspection scheme.
- Learn and apply variance transformation techniques
- Understand the difference between sampling plans for attributes and variables.

Module:1	Linear Models	4 hours

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis

Module:2	Integer Programming	6 hours

Integer Programming Problem (IPP) - Gomory's cutting plane algorithm– Mixed IPP – Branch and Bound technique

Module:3	Dynamic Programming	6 hours

Dynamic programming problem (DPP) - Bellman's principle of optimality - General formulation - computation methods and application of DPP - Solving LPP through DPP approach

Module:4	Inventory Models	9 hours

Deterministic inventory models – Classic EOQ model – EOQ with price breaks – EOQ with storage limitations – Probabilistic Inventory models – Continuous review model – Single period model - No setup model – setup model (s-S policy)

Module:5	Non-Linear Programming	6 hours

Non-linearprogramming problem–KuhnTuckerconditions–Quadratic Programming Problem(QPP) - Wolfe's and Beale's algorithms for solving QPP – Convex programming

Module:6	General Queuing Models	6 hours

Queuing theory–Basic characteristics of queuing models–Arrival and service distribution– steady state solution of M/M/1andM/M/C models with associated distribution of queue length and waiting time - M/G/1 queue-steady results using embedded Markov chain Methods- Pollazcek Khinchin formula.

Module:7	Poisson Queuing Models	6 hours

Poisson Queuing Models with single server: Descriptions of the model, Assumptions, Probability distributions for number of Units (steady state), waiting time distribution, Derivation of characteristics on (M/M/1): (∞/FIFO) and (M/M/1): (N/FIFO) Models, simple numerical problems

Module:8	Contemporary issues	2 hours

Lecture by Industry Experts

	Total Lecture hours:	45 hours

Text Book(s)

- Hillier FS and LibermannGJ (2002):IntroductiontoOperationsResearch,7 th Edition,

●	McGraw Hill
	Kanti Swarup, P.K.Gupta and Man Mohan (2004):OperationsResearch, SultanChand and Sons, New Delhi.

Reference Books

●	V.K.Kapoor,Operations Research:Quantitative Techniques for Management,Sultan chand and sons.
●	N D Vohra,Quantitative Techniques in Management,Tata Mc Hill book series.

Mode of Evaluation: CAT, Quiz, Digital Assignment and FAT.

Mode of Evaluation: Continuous assessment and FAT.

Recommended by Board of Studies			24-06-2020
Approved by Academic Council	No.: 59	Date	24-09-2020

Course Code	Course Title	L	T	P	J	C
MAT6019	**Inventory Analysis**	**3**	**0**	**0**	**0**	**3**
Pre-Requisite	**NIL**	**Syllabus Version**				
		1.0				

Course Objectives:

- To develop the foundations of Inventory which are how much to order, when should the order placed and how much safety stock should be kept.
- To acquaint the students with the concepts Inventory with knowledge of Calculus and Statistics for computations and analysis of data

Expected Course Outcomes(COs):

- Students are able to acquire the fundamental knowledge of Inventory in terms of basic definitions, Importance of Inventory for Industries, Different types of Inventories, Various Inventory Models and its solutions and results.
- Students will improve their knowledge in Economic order quantity and Economic Production Quantity.
- Understand the principles underlying minimization of total cost and maximization of total profit.
- Students are expected to understand the Predictive knowledge in Demand Forecasting
- Students will be able to find out the various costs involved in Inventory.

Module:1	Basics in Inventory	6 hours	

Inventory – Reason for carrying Inventories - Types of inventory- Inventory decisions- Costs and other factors involved in inventory - Variables in Inventory - Concept of average inventory and economic order quantity – Classification of Inventory models.

Module:2	Deterministic Inventory Models	7 hours	

EOQ model without shortage – EOQ model with different rates of demand in different cycles-Production model without shortages - EOQ model with shortages –Production model with shortages

Module:3	Dynamic demand and Deterministic inventory models with price breaks	6 hours	

Re-order level and optimum buffer stock – Fixed order quantity system with variable lead time - Periodic review inventory system – Purchase inventory model with one price break - Purchase inventory model with two price break - Purchase inventory model with n number of price breaks.

Module:4	Stochastic inventory models	6 hours	

Instantaneous demand, no set-up cost model –Discrete and Continuous case-Uniform demand, no set-up cost model – Continuous and Discrete case-Probabilistic order-level system with constant lead time – Discrete and Continuous case.

Module:5	Selective Inventory Management	6 hours	

Always Better Control (ABC)Analysis- Limitations of ABC Analysis- Vital, essential and Desirable (VED)Analysis-XYZ Analysis based on Inventory value-FNSD Analysis based on usage rate of items

Module:6	Time Series Analysis	6 hours	
Level, trend & Seasonality models- Moving average, Simple exponential smoothing, Exponential smoothing with trend, Damped trends, Double exponential smoothing model for level & seasonality, Holt-Winter model for level, trend and seasonality			
Module:7	**Stochastic models with continuous review**	**6 hours**	
Method of State Probabilities - Poisson Demand, Exponential Delivery Time - Poisson Demand, Fixed Delivery Time - Poisson Demand, Stochastic Delivery Time, Single Order - Poisson Demand, Stochastic Delivery Time, Multiple Orders			
Module:8	**Contemporary issues**	**2 hours**	
Lecture by Industry Experts			
	Total Lecture hours:	**45 hours**	
Tutorial	• A minimum of 5 problems to be worked out by students in every tutorial class • Another 5 problems per tutorial class to be given as a home work	**15 hours**	

Text Book(s)

- Dieter Bartmann and Martin J. Beckmann," Inventory Control Models and Methods", Springer-Verlag Berlin Heidelberg, 1992.
- S.D .Sharma, "Operation Research, Theory Methods and Applications", Kedar Nath Ram Nath & Co, 15th edition, 2017.

Reference Books

- Max Muller, "Essentials of Inventory Management", American Management Association, Second edition, 2011.
- F.S. Hillier & J.Lieberman, "Introduction to Operation Research", Tata- McGraw Hill Company, New Delhi, 2001.
- Edward A.Silver, David A.Pyke, Douglas A.Thomas, "Inventory and Production Management in Supply Chains", Taylors & Francis group, Fourth Edition 2017, Boca Raton.
- Paul S.P. Cowpertwait, Andrew V.Metcalfe, "Introductory Time series with R", Springer, 2009..

Mode of evaluation:	CAT / Digital Assignment / Quiz / FAT			
Recommended by Board of Studies	24-06-2020			
Approved by Academic Council	No. 59	Date	24-09-2020	

Course Code	Course Title	L	T	P	J	C
MAT6020	**Financial Mathematics**	**3**	**0**	**0**	**0**	**3**
Pre-Requisite	**None**	**Syllabus Version**				
		1.0				

Course Objectives :

The course is aimed at providing
- To familiarize with application of mathematics in finance.
- Exposure to Black-Scholes equation, portfolio management.
- To understand the concept of arbitrage and hedging.

Course Outcomes (CO):

At the end of the course the student should be able to
- Have a basic understanding in Matrices.
- Have a basic understanding of financial mathematics, investment appraisal and Asse pricing model.
- Exposure to Black-Scholes equation, portfolio management.
- To understand the concept of arbitrage and hedging.
- Understand the concepts of Samples and Populations.

Module:1	Matrices	5 hours	

Matrices - types of matrices - operations on matrices - determinants - adjoint matrix - inverse of a matrix - solution of a system of linear equations by inversion method - elementary transformations – rank of a matrix - consistency and inconsistency of system of equations

Module:2	Fundamentals of the financial markets	6 hours	

Fundamentals of the financial markets, meaning of notions like asset portfolio derivatives (example: futures, options forwards etc.).

Module:3	Asset pricing model	6 hours	

Binomial asset pricing model under no arbitrage condition single-period model, multi-period model. Risk-neutral probabilities, martingales in the discrete framework, risk-neutral valuation of European and American options under no arbitrage condition in the Binomial framework.

Module:4	Black-Scholes formula	6 hours	

Random walk and Brownian motion, Geometric Brownian motion, Black-Scholes formula, properties of Black-Scholes option cost, estimation of sigma, pricing American put option and European call option.

Module:5	Portfolio Management Risk	5 hours	

Risk and expected return on a portfolio, capital asset pricing model: capital market line, beta factor and security market line.

Module:6	Arbitrage	2 hours	

Arbitrage theorem, multi-period binomial model, hedging: delta hedging, Greek parameters,

hedging business risk, value at risk, speculating with derivatives. Tutorials: Tutorial sheets with relevant problems will be provided by the instructor.

Module:7	Statistics	2 hours	
Introduction to Statistics: - estimation and confidence in intervals; - hypothesis testing (inferences on means and proportions); - correlation; - Simple Regression analysis.			

	Total Lecture hours:	45 hours
Tutorial	- A minimum of 10 problems to be worked out by students in every Tutorial Class - Another 5 problems per Tutorial Class to be given as home work Mode: Individual Exercises, Team Exercises, Online Quizzes, Online Discussion Forums	30 hours

Text Book(s):
- S. M. Ross, An Introduction to Mathematical Finance, Cambridge University Press, 1999.

Reference Books:
- D. G. Luenberger, Investment Science, Oxford University Press, NY, 1998.
- J. C. Hull, Options, Futures and Other Derivatives, Prentice Hall Inc., Upper Saddle River, 4 th Ed., 2000.
- Wai-Sum Chan and Yiu-Kuen Tse, Financial Mathematics for Actuaries, 2nd Edition, World Scientific (2018).

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies			24-06-2020
Approved by Academic Council	NO.: 59	Date	24-09-2020

Course code	Course title	L	T	P	J	C
MAT6021	**Artificial Intelligence in Business**	**3**	**0**	**2**	**0**	**4**
Pre-requisite	NIL	**Syllabus version**				

Course Objectives:
1. The main purpose of this course is to provide the most fundamental knowledge to the students so that they can understand Artificial Intelligence.
2. To provide the foundations for Artificial Intelligence problem-solving techniques and knowledge representation formalisms.

Expected Course Outcome:
Upon successful completion of this course, the student shall be able to:
1. Demonstrate fundamental understanding of the history of Artificial Intelligence (AI) and its foundations.
2. Ability to identify the type of AI problem (search, inference, decision making under uncertainty, game theory, etc).
3. Ability to implement AI methods and algorithms in business problem.
4. Ability to compare the difficulty of different versions of AI problems, in terms of computational complexity and the efficiency of existing algorithms.
5. Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.

Module:1	Introduction	4 hours
The AI problems, AI technique, philosophy and development of Artificial intelligence.		

Module:2	Problem Spaces and Search	7 hours
State-space search, Uninformed and informed search techniques: BFS, A*, variations of A*. Local search and optimization: hill-climbing, simulated annealing.		

Module:3	Adversarial Search and Game Playing	6 hours
Minimax algorithm, alpha-beta pruning, stochastic games, Constraint- satisfaction problems.		

Module:4	Knowledge and Reasoning	6 hours
Logical agents, Propositional logic, First-order logic, Inference in FoL: forward chaining, backward chaining, resolution, Knowledge representation: Frames, Ontologies, Semantic web and RDF.		

Module:5	Introduction to PROLOG	6 hours
Facts and predicates, data types, goal finding, backtracking, simple object, compound objects, use of cut and fail predicates, recursion, lists, simple input/output, dynamic database.		

Module:6	Uncertain knowledge and reasoning	7 hours
Probabilistic reasoning, Bayesian networks, Fuzzy logic		

Module:7	Natural Language Processing	7 hours
An Introduction to Natural language Understanding, Perception, Learning.		

Module:8	Applications	2 hours
AI in E-commerce, E-tourism, Industry, Medicine, etc.		
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Elaine Rich, Kevin Knight, Artificial Intelligence, Second Ed., Tata McGraw Hill, 2008.
2.	Dan W. Patterson, Introduction to AI and ES, Pearson Education, 2007.

Reference Books	
1.	Deepak Khemani, Artificial Intelligence, Tata Mc Graw Hill Education, 2013.
2.	E. Charniack, D. McDermott, Artificial Intelligence, Addison Wesley, 1987.

3.	N.J.Nilsson, Principles of Artificial Intelligence, Morgan Kaufman, 1985.	
4.	N.P. padhy: Artificial Intelligence and Intelligent Systems, Oxford Higher Education, Oxford University Press.	
5.	Ivan Bratko, PROLOG Programming, 2nd Ed., Pearson Education.	

Mode of Evaluation: CAT, Quiz, Digital Assignment and FAT.

List of Challenging Experiments (Indicative)

1	Study of facts, objects, predicates and variables in PROLOG.	4 hours
2	Study of Rules and Unification in PROLOG.	2 hour
3	Study of "cut" and "fail" predicate in PROLOG.	2 hour
4	Study of arithmetic operators, simple input/output and compound goals in PROLOG.	4 hours
5	Study of recursion in PROLOG.	2 hour
6	Study of Lists in PROLOG.	2 hour
7	Study of dynamic database in PROLOG.	2 hour
8	Study of string operations in PROLOG. Implement string operations like substring, string position, palindrome etc.)	4 hours
9	Write a prolog program to maintain family tree.	4 hours
10	Write a prolog program to implement all set operations (Union, intersection, complement etc.)	4 hours
	Total Laboratory hours	**30 hours**

Mode of Evaluation: Continuous assessment and FAT.

Recommended by Board of Studies	30-06-2021		
Approved by Academic Council	No. 63	Date	

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