COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

(Abstract)

Faculty of Social Sciences - Resolution of the Academic Council- Communicated -Orders issued.

ACADEMIC A SECTION

No.CUSAT/AC(A).A3/7/2026   Dated,KOCHI-22,01.01.2026

Read:-Short Minutes of Item No. I(d) (v) of the Minutes of the meeting of the Academic Council held on 29.11.2025

ORDER

The Academic Council vide item read above, considered along with the recommendations of its Standing Committee, the minutes of the meeting of the Faculty of Social Sciences held on 15.11.2025 and resolved to approve the following:

1. The Regulations, Curriculum and Syllabi of the Four Year Under Graduate Bachelor of Vocation Honours (B.Voc Honours) Data Science and Analytics Programme, with effect from 2026 admissions, in place of the existing Three Year B.Voc Business Process and Data Analytics Programme in Deen Dayal Upadhyay Kaushal Kendra (DDUKK).**(Appendix-I)**

2. The modified Regulations and Syllabi of B.Voc Business Process and Data Analytics programme in Deen Dayal Upadhyay Kaushal Kendra (DDUKK) with effect from 2025 admissions.   **(Appendix-II)**

3. The minor courses offered by Deen Dayal Upadhyay Kaushal Kendra (DDUKK) in the Data Science and Analytics and Business Studies Disciplines with effect from 2026 admissions.

Dr. Arun A U *
Registrar

To:
1. The Dean, Faculty of Social Sciences
2. The Chairperson, Board of Studies, Business Process and Data Analytics
3. The Director, Deen Dayal Upadhyay Kaushal Kendra (DDUKK)
4. All AR/DRs Examination wing - with a request to forward the U.O to sections concerned
5. The Director, IQAC/ DoA
6. CIRM/Conference Sections
7. PS to VC/PVC;PA To Registrar/CE.

* This is a computer generated document. Hence no signature is required.

Curriculum and Syllabi of
Bachelor of Vocation Honours Data Science and Analytics
(B. Voc. Honours)

(2026 Admission Onwards)

Submitted by

Deen Dayal Upadhyay KAUSHAL Kendra (DDUKK)
Cochin University of Science and Technology

November 2025

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DDU KAUSHAL KENDRA
Cochin University of Science and Technology

1. Introduction

1.1. Vision

"Empowering Youth for a Skilled and Sustainable Nation"

1.2. Mission

1. Offer quality education in emerging vocational domains in technology and management.
2. Impart skills education to develop industry-ready, employable professionals.
3. Promote entrepreneurial orientation and skills among the students.
4. Inculcate innovation mind-set in students to excel in the emerging dynamic, global economy.
5. Foster social commitment and sustainable business philosophy in students.

1.3. Programme Description

The B.Voc. Honours Data Science and Analytics is a bachelor-level vocational programme designed in accordance with the New Curriculum and Credit Framework for B.Voc. Programmes (2025) by Kerala State Higher Education Council in sync with the latest UGC and National Credit Framework (NCrF) guidelines. It offers flexible exit options in the first year with UG Certificate in Data Science and Analytics, second year with two-year UG Diploma in Data Science and Analytics, third year with B. Voc. in Data Science and Analytics. Each exit point corresponds to progressively advanced job roles in the domains of Data Science and Analytics. The curriculum is carefully aligned with the standards of relevant Sector Skill Council (SSC), enabling students to earn recognized skill certifications at multiple stages. The programme combines foundational knowledge in mathematics, computing, statistics and social sciences with applied skills in data science and analytics business processes and quantitative management methods, equipping graduates with the expertise needed to meet the evolving demands of the industry.

This programme aims to develop graduates who are industry-ready, blending vocational skill development with interdisciplinary knowledge. Students gain hands-on experience with modern computing and data analytics tools, preparing them for high-demand roles such as Data Scientist, Data Analyst, Business Analyst, and Big Data Analyst. Through apprenticeships, internships, and industry-integrated projects, students acquire practical competencies aligned with National Occupational Standards (NOS) and Qualification Packs (QPs). The programme also emphasizes ethical, responsible, and sustainable use of data and technologies, while providing a clear pathway for both immediate employability and higher education in data-driven disciplines.

2. Scope and Application

The Regulation shall apply to the Under Graduate Vocational (B.Voc Honours) in Data Science and Analytics Programme of DDUKK, CUSAT for the admissions commencing from the academic year 2026-27 and onwards.

3. B. Voc. Honours Data Science and Analytics

3.1. Programme Objectives

1. Equip students with practical skills and theoretical knowledge aligned with industry standards.
2. Provide a pathway for higher education and skill development through NSQF levels.
3. Enable flexible learning with apprenticeship/industry-integrated components.
4. Allow students to exit with certifications at intermediate stages.
5. Develop job-specific skills aligned with industry standards as defined by NOS and QPs.
6. Foster competency-based learning to achieve specific NSQF levels for progressive career advancement.
7. Provide hands-on, practical training to meet occupational standards required for respective job roles.

3.2. Programme Outcomes (POs)

Students in the B.Voc Honours Data Science and Analytics programme are expected to attain the following programme outcomes by the time they graduate the programme:

PO 1: Demonstrate comprehensive knowledge of the fundamental principles, theories, and mathematical foundations of data science, machine learning, and statistical analysis.

PO 2: Apply technical proficiency and analytical skills to design, develop, and implement data-driven solutions using modern tools, programming languages, and technologies for real-world business and research problems.

PO 3: Design and construct effective data systems, machine learning models, and analytical workflows to extract insights and support decision-making, integrating concepts from database management, programming, and big data analytics.

PO 4: Evaluate data science solutions and practices based on ethical frameworks, legal compliance, and principles of responsible governance to ensure sustainable and socially beneficial outcomes.

PO 5: Demonstrate professional competency and job-ready skills as defined by the National Occupational Standards (NOS) and Qualification Packs (QPs) for specific roles such as Data Analyst, Business Analyst, and Machine Learning Analyst.

PO 6: Integrate theoretical knowledge with practical expertise through hands-on projects, apprenticeships, and industry collaboration, demonstrating readiness for the workplace and effective teamwork.

PO 7: Formulate a clear and adaptable pathway for career progression, higher education, and continuous skill development in the evolving field of data science and analytics.

3.3. Programme Specific Objectives

Graduates of the B.Voc. Honours programme are expected to attain or achieve the following Programme Specific Objectives within a few years of graduation:

1. To equip students with robust theoretical knowledge and practical skills in data science, machine learning, and statistical analysis, using modern tools and technologies aligned with industry standards.
2. To equip students with specialized competencies for high-demand roles such as Data Scientist, Data Analyst, Business Analyst, Big Data Analyst, Machine Learning Innovative Analyst and Data Science Research Intern, aligned with relevant National Occupational Standards (NOS) and Qualification Packs (QPs).
3. To develop job-specific competencies for entry-level roles such as Data Base Administrator, Python Programmer and Web Developer, as defined by relevant National Occupational Standards (NOS) and Qualification Packs (QPs).
4. To promote understanding of digital ethics, governance and entrepreneurship to ensure responsible and sustainable use of data and technologies.
5. To enhance management and research skills through courses integrated across the semesters.
6. To provide hands-on, industry-integrated experience through apprenticeships/internships/OJT and projects with IT and analytics companies, ensuring readiness for the workplace.
7. To establish a clear pathway for both immediate employability and advanced higher education primarily in data-driven disciplines.

3.4. Programme Specific Outcomes (PSOs)

Students in the B.Voc Honours programme are expected to attain the following programme specific outcomes by the time they graduate the course.

PSO 1: Demonstrate robust theoretical knowledge and practical proficiency in data science, machine learning, and statistical analysis by solving complex, real-world problems using modern tools and technologies.

PSO 2: Attain and exhibit the specialized competencies required for high-demand roles such as Data Scientist, Data Analyst, Business Analyst, Big Data Analyst, Machine Learning Innovative Analyst, and Data Science Research Intern, as outlined in relevant National Occupational Standards (NOS) and Qualification Packs (QPs).

PSO 3: Attain the job-specific competencies necessary for entry-level roles such as Database Administrator, Python Programmer, and Web Developer, as defined by relevant National Occupational Standards (NOS) and Qualification Packs (QPs)

PSO 4: Evaluate and implement data-driven solutions within a framework of digital ethics, data governance, and entrepreneurial thinking to ensure responsible, legal, and sustainable technological practices.

PSO 5: Formulate and execute data science projects by applying fundamental principles of project management and research methodology to ensure systematic, efficient, and evidence-based outcomes.

PSO 6: Integrate and apply academic knowledge to solve authentic business challenges during apprenticeships, internships, or on-the-job training, demonstrating professional readiness and workplace competence.

PSO 7: Make informed decisions to successfully transition into the data science workforce in specialized roles or pursue advanced higher education in data-driven disciplines.

3.5. Mapping of POs and PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
PO 1	3	2	1	-	2	2	-
PO 2	3	2	2	-	-	1	-
PO 3	3	2	1	-	-	-	-
PO 4	1	-	-	3	2	2	-
PO 5	-	3	2	-	-	2	-
PO 6	1	-	-	-	3	3	1
PO 7	1	1	-	-	-	-	3

4. Curriculum

The features of the B.Voc. Honours programmes are in line with the stipulations made by the UGC and as adapted by the Curriculum and Credit Framework for Bachelor of Vocation (B.Voc.) programmes proposed by Kerala State Higher Education Council.

4. 1. Skill Development Components (60%-70% Weightage)

Skill Development Components (SDC) shall include any domain specific demand led skill training activity, enabling students to equip with practical skills leading to employment or improving employability or enabling them to acquire a duly assessed and certified skill in the chosen discipline. The skill development components shall be designed and delivered in line with National Occupational Standards (NOS) and Qualification Packs (QP), ensuring relevance to specific job roles and industries.

The proposed number of credits per course and the credit distribution of them for the B.Voc. Honours programmes are given below:

B.VOC Degree 3 years	General Education Component (GEC) (Credits)					Total Credits (GEC)	Skill Development Components (SDC) (Credits)	Total Credits
	MDC	AEC	VAC	SEC	Minor		90	144
	9	9	9	3	24	54	61% 30 credit at NSQF 4.5 30 credit at NSQF 5.0 30 credit at NSQF 5.5	
					Maximum of 3 four credit SWAYAM courses may be acquired to satisfy 24 credit Minor Course requirement	38.5%		
	Exit with a B.Voc Degree with 140 credit or proceed to the Honours level							
Honours Degree 4th year	3 online courses*				12	66 (37%)	114 (63%) 28 credits from Apprenticeship /Research internship	184

*3 online courses as per the regulation for online/MOOC courses of CUSAT

4.2. Notional Hours and Creditisation

- A course that includes one hour of lecture or two hours of lab work/ practical work/ field work/ practicum/hands-on skill training per week is given one credit hour.
- One credit in a semester should be designed for 15 hours of lectures or 30 hours of lab work/ practical work/ field work/ practicum and 30 hours of learner engagement in terms of course-related activities such as seminar preparation, submitting assignments, etc.
- A one-credit seminar or internship or field work/ projects or community engagement and service will have two-hour engagements per week (30 hours of engagement per semester).
- A course can have a combination of lecture credits, practical credits, hands-on skill training credits, OJT credits and practicum credits.
- Minimum credit for one Course should be 2 (Two), and the maximum credit should be 4 (Four).
- All Skill Development Components/ Minor Pathway Courses shall be of 4 (Four) credits. A four-credit course can include four modules.
- Each semester requires a minimum of 18 skill credits (including theory, practicals, activities-based learning and on the job-training) over six semesters.
- For all Skill Development Components/ Minor Pathway Courses, there may be practical/ practicum of two or four hours per week.
- All Courses under the Multi-Disciplinary, Ability Enhancement, Value Addition and Skill Enhancement categories are of 3 credits. A 3-credit course can include three modules.
- A two credit OJT in a semester should be designed for 5 hours per week.
- 10-days of Apprenticeship/Research Internship is equivalent to one credit.
- Summer Internship, Community outreach activities, etc. may require sixty hours (or as appropriate) of engagement for acquiring one credit.
- A student shall be able to opt for a certain number of extra credits over and above the requirements for the award of a degree.
- Maximum number of credits that a student can earn per semester shall be restricted to 30. Hence, a student shall have the option of acquiring credits to a maximum of 180 credits for a 6-semester B.Voc programme and 240 credits for a 4-year (8-semester) programme.

4.3. Programme Structure

SEMESTER I

S.No.	Course Code	Type	Course Title	L	T	P	Hrs/Week	CA	ESE	Credits
				Hours				**Marks**		
1	26-252-0101	Major	Mathematics I for Data Science and Analytics	4	0	0	4	50	50	4
2	26-252-0102	Major	Introduction to Python	2	0	4	6	50	50	4
3	26-252-0103	Major	Fundamentals of Computer Systems	4	0	0	4	50	50	4
4	xx-xxx-xxxx	Minor	Minor Course 1	4	0	0	4	50	50	4
5	26-252-0105	MDC	Principles of Management	4	0	0	4	50	50	3
6	xx-xxx-xxxx	AEC	English 1	4	0	0	4	50	50	3
7	26-252-0106	OJT	On the Job Training I					100		2
			Total				27	400	300	24

*Minor course is to be selected from another discipline.
L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

SEMESTER II

S.No.	Course Code	Type	Course Title	L	T	P	Hrs/Week	CA	ESE	Credits
				Hours				**Marks**		
1	26-252-0201	Major	Mathematics II for Data Science and Analytics	4	0	0	4	50	50	4
2	26-252-0202	Major	Database Fundamentals	2	0	4	6	50	50	4
3	26-252-0203	Major	Data Structures and Algorithms	2	0	4	6	50	50	4
4	xx-xxx-xxxx	Minor	Minor Course 2	2	0	4	6	50	50	4
5	26-252-0205	MDC	Fundamentals of Business Process Management	4	0	0	4	50	50	3
6	xx-xxx-xxxx	AEC	English 2	4	0	0	4	50	50	3
7	26-252-0206	OJT	On the Job Training II					100		2
8	26-252-0207	PST	Professional Skill Training I					100		2
			Total				30	500	300	26

*Minor course is to be selected from another discipline.
L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

SEMESTER III

S.No.	Course Code	Type	Course Title	Hours				Marks		Credits
				L	T	P	Hrs/Week	CA	ESE	
1	26-252-0301	Major	Data Visualization Techniques	2	0	4	6	50	50	4
2	26-252-0302	Major	Machine Learning Fundamentals	2	0	4	6	50	50	4
3	26-252-0303	Major	Python for Data Science and Analytics	2	0	4	6	50	50	4
4	xx-xxx-xxx	Minor	Minor Course 3	4	0	0	4	50	50	4
5	26-252-0305	MDC	Enterprise Resource Planning	4	0	0	4	50	50	3
6	xx-xxx-xxxx	AEC	Other Language	4	0	0	4	50	50	3
7	26-252-0306	OJT	On the Job Training III					100		2
			Total				30	400	300	24

*Minor course is to be selected from another discipline.
L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

SEMESTER IV

S.No.	Course Code	Type	Course Title	Hours				Marks		Credits
				L	T	P	Hrs/Week	CA	ESE	
1	26-252-0401	Major	Data Mining Techniques	2	0	4	6	50	50	4
2	26-252-0402	Major	R for Data Science and Analytics	2	0	4	6	50	50	4
3	26-252-0403	Major	Introduction to Artificial Intelligence	2	0	4	6	50	50	4
4	xx-xxx-xxx	Minor	Minor Course 4	4	0	0	4	50	50	4
5	26-252-0405	SEC	Business Analytics Using Spreadsheet	4	0	0	4	50	50	3
6	26-252-0406	VAC	Financial Accounting	4	0	0	4	50	50	3
7	26-252-0407	Project	Summer Internship with Project		One Month			50	50	2
8	26-252-0408	PST	Professional Skill Training II					100		2
			Total				30	450	350	26

*Minor course is to be selected from another discipline.
L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

SEMESTER V

S.No.	Course Code	Type	Course Title	L	T	P	Hrs/ Week	CA	ESE	Credits
				\multicolumn{4}{Hours}			Marks		
1	26-252-0501	Major	Cloud Computing for Data Analytics	4	0	0	6	50	50	4
2	26-252-0502	Major	Natural Language Processing	4	0	0	4	50	50	4
3	26-252-0503	Major	Text and Web Analytics	2	0	4	6	50	50	4
4	xx-xxx-xxx	Minor	Minor Course 5	4	0	0	4	50	50	4
5	26-252-0505	SEC	Web Development and App Design	3	0	2	5	50	50	3
6	26-252-0506	VAC	Ethics and Governance in the Digital Age	4	0	0	4	50	50	3
			Total				**29**	**300**	**300**	**22**

*Minor course is to be selected from another discipline.
L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

SEMESTER VI

S.No.	Course Code	Type	Course Title	L	T	P	Hrs/ Week	CA	ESE	Credits
1	26-252-0601	Major	Big Data Analytics	3	0	2	5	50	50	4
2	26-252-0602	Major	Deep Learning and Neural Networks	4	0	0	4	50	50	4
3	xx-xxx-xxx	Minor	Minor Course 6	4	0	0	4	50	50	4
4	26-252-0604	SEC	HR Analytics	3	0	0	3	50	50	3
5	26-252-0605	VAC	Research Methodology	3	0	0	3	50	50	3
6	26-252-0606	Project	Main Project	0	0	8	4	50	50	4
			Total				**23**	**300**	**300**	**22**
			Overall SEM I – SEM VI							**144**

*Minor course is to be selected from another discipline.
L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

SEMESTER VII & SEMESTER VIII

S.No.	Course Code	Type	Course Title	L	T	P	Hrs/Week	CA	ESE	Credits
1	xx-xxx-xxx	Minor	Online course 1				4	50	50	4
2	xx-xxx-xxx	Minor	Online course 2				4	50	50	4
3	xx-xxx-xxx	Minor	Online course 3				4	50	50	4
4	26-252-0701	Apprenticeship	Apprenticeship/Internship		One Year			50	50	28
			Total					**200**	**200**	**184**

*Minor course is to be selected from another discipline.
L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

Minor Courses Offered by DDUKK in the Business Studies Discipline

Sem	Course Code	Type	Course Title	L	T	P	Hrs/Week	CA	ESE	Credits
I	26-252-0104	Minor	Managerial Economics	4	0	0	4	50	50	4
II	26-252-0204	Minor	Productions and Operations Management	4	0	0	4	50	50	4
III	26-252-0304	Minor	Business Model Analysis and Strategy	4	0	0	4	50	50	4
IV	26-252-0404	Minor	Entrepreneurship Development and Management of Startups	4	0	0	4	50	50	4
V	26-252-0504	Minor	Digital business and E-commerce	4	0	0	4	50	50	4
VI	26-252-0603	Minor	Intellectual Property Rights	4	0	0	4	50	50	4
	26-252-xxxx	Minor	Operations Research	4	0	0	4	50	50	4

L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

Minor Courses Offered by DDUKK in the Data Science and Analytics Discipline

Sl.No.	Course Code	Type	Course Title	L	T	P	Hrs/ Week	CA	ESE	Credits
				Hours				Marks		
1	26-252-xx10	Minor	Programming Languages for Data Science and Analytics	3	0	2	5	50	50	4
2	26-252-xx11	Minor	Principles of Database Management	3	0	2	5	50	50	4
3	26-252-xx12	Minor	Data Visualization Techniques	3	0	2	5	50	50	4
4	26-252-xx13	Minor	Principles of Data Mining	3	0	2	5	50	50	4
5	26-252-xx14	Minor	Big Data Analytics	3	0	2	5	50	50	4
6	26-252-xx15	Minor	Text and Web Analytics	3	0	2	5	50	50	4

L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

4.4. Skill Development Framework

*JOB ROLE ALLIGNMENT	NHEQF LEVEL	EXIT OPTION	SSC
Python programmer			
Junior Data Analyst	4.5	After 1 year (Sem 1&Sem2)	
Database Administrator			
Machine Learning Innovative Analyst	5	After 2 year (Sem 3&Sem4)	
Data Analyst			IT/ITeS
Data Scientist	5.5	After 3 year (Sem 5&Sem6)	
Big Data & Cloud Analyst			
Data Science Research Intern	6	After 4 year (Sem 7&Sem8)	

*Allied job roles associated with the above position are also applicable.

Minor Courses are chosen by the students shall be in a discipline different from the discipline of the major course discipline. Thus, the B.Voc. Programme awarded a Major Degree in Data Science and Analytics, is also eligible to be awarded a Minor in another discipline of the student's choice, if the student earns a minimum of 24 credits from 6 pathway courses in that discipline. B.Voc. programme can be awarded with Major in Data Science and Analytics with multiple disciplines of study. This pathway is recommended for students who wish to develop core competencies in multiple disciplines of study. In this case, the credits for the minor pathway shall be distributed among the constituent disciplines/subjects. The student pursuing B.Voc. Degree in Data Science and Analytics is eligible to get mentioned his or her core competencies in other disciplines of choice if he or she has earned 18 credits from the pathway courses of that discipline. (Refer Regulation for other possible pathways.

5. Mode of Evaluation of Courses

5.1. Mode of Evaluation

The whole system of evaluation and grading will be made as per the "Regulation for Under Graduate Programmes under Choice Based Credit System (CBCS) offered by the University Departments/Schools/Centres" and the amendments made on it from time to time by the University, except for certain special cases applicable to B.Voc programme. As per the regulation, the entire system of evaluation is internal for University Departments/Schools/Centres. Out of which 50% marks are for Continuous Assessment/ Evaluation (CA/CE) throughout each semester and 50% marks are for End Semester Examination (ESE).

5.2. Mode of Evaluation of On-the-Job Training (OJT)

The OJT will have summative continuous assessment only. The assessment will be based on a report of OJT submitted by each student and a viva voce conducted by internal faculty members.
- Feedback from the hosting institution (30% weightage).
- OJT Report: A formal report submitted by the student detailing their training experience, learnings, and outcomes (30% weightage).
- Viva Voce: An oral examination conducted by internal faculty to assess the student's understanding and application of their training (40% weightage).

5.3. Evaluation of Professional Skill Training (PST)

In the case of Professional Skills Training (PST) the entire marks will be awarded through continuous assessment (CA) by the external experts engaging the training.

5.4. Evaluation of Summer Internship with Project

For the Summer Internship with Project (One month with minimum 20 working days) in semester IV, 50% marks will be awarded through continuous assessment (CA) by internal faculty members. The rest fifty per cent (50%) of the marks will be awarded on the basis of End Semester Examination (ESE) in the form of a term-end viva-voce conducted by a board of examiners (summative assessment). The board of examiners (at least one external examiner) shall be constituted by the Director/HoD of the Centre. Students who have failed in the continuous evaluation (CA) of the internship (less than 40%) have to repeat the internship under the guidance of a faculty assigned in the subsequent year(s). In case of a student who secured 40% marks or more for the continuous evaluation of the Summer Internship Project by internal faculty but failed to appear for the viva-voce can appear for the viva-voce along with subsequent batch(es).

5.5. Evaluation of Main Project

For the Main Project during the semester VI, 50% marks will be awarded through continuous assessment (CA) by internal faculty members. The rest fifty per cent (50%) of the marks will be awarded on the basis of End Semester Examination (ESE) in the form of a term-end viva-voce conducted by a board of examiners (summative assessment). The board of examiners (at least one external examiner) shall be constituted by the Director/HoD of the Centre. Students who have failed in the continuous evaluation (CA) of the main project (less than 40%) have to repeat the main project under the guidance of a faculty assigned in the subsequent year(s). In case of a student who secured 40% marks or more for the continuous evaluation of the Main Project by internal faculty but failed to appear for the viva-voce can appear for the viva-voce along with subsequent batch(es). However,

the curriculum allows for a special viva-voce board to be constituted upon a student's formal request. This provision is intended for students who are unable to await their turn in the subsequent regular batch schedule. Such a request must be made via a prescribed application and will be subject to the payment of an applicable special fee, as determined by the institution. The convening of this special board will be at the discretion of the university and is contingent upon the availability of examiners.

5.6. Evaluation of Apprenticeship/Internship during the 7th and 8th Semesters

The Internship/Apprenticeship during the 7th and 8th semesters (280 working days) will be evaluated through Continuous Assessment (CA) and End Semester Examination (ESE), each carrying 50% marks. CA will be conducted by internal faculty through reviews, reports, and viva-voce. The ESE will be a final viva-voce conducted by a board including at least one external examiner. A minimum of 40% overall is required to pass. Students who miss the term-end viva can appear with the next batch. If needed earlier, they may apply for a special viva-voce by submitting a request and paying the prescribed fee, subject to examiner availability and university approval.

5.6. Continuous Evaluation Marks Allocation

Out of the 50% weightage for continuous assessment (CA), a minimum of 50 per cent weightage shall be given for internal tests/lab exams or practical assignments. Out of the rest,

1. A maximum of 20 per cent weightage shall be given for written assignments
2. A maximum of 20 per cent weightage shall be given for class room presentations, Viva-voce and mini projects.
3. A maximum of 10 per cent weightage shall be given for other items such as class participation or other activities that the teacher of the concerned course believes as relevant for the course and assigned to the students.

However, Department/Centre Council can change the guidelines for the distribution of internal marks given above, as and when required. Continuous evaluation in the case of internships, professional skill training and projects shall be subject to the guidelines approved by the Centre Council from time to time.

5.7. Structure of the Question Paper of End-Semester Examinations

The End Semester Examination (ESE) question paper shall have three parts (except for practical examinations), namely Part-A, Part-B and Part C. The maximum marks for Semester End Examinations will be 50 (except for MOOCs, Professional Skill Training, and Internships).

- In Part A, there will be 5 compulsory questions which will be of short answer. Each question in Part A carries two marks.
- Part-B will consist of seven questions out of which students must answer four questions. Each question will carry five marks in this part.
- In Part-C, student will have to answer two questions of 10 marks each from a group of three questions. One case study would be preferred among the three questions in this section.
- In case of practical exams, this pattern need not be followed. The number of questions can be varied according to the nature of the subject and the same will be decided.

6. Syllabi

6.1. SEMESTER I

S.No.	Course Code	Type	Course Title	Hours				Marks		Credits
				L	T	P	Hrs/ Week	CA	ESE	
1	26-252-0101	Major	Mathematics I for Data Science and Analytics	4	0	0	4	50	50	4
2	26-252-0102	Major	Introduction to Python	2	0	4	6	50	50	4
3	26-252-0103	Major	Fundamentals of Computer Systems	4	0	0	4	50	50	4
4	xx-xxx-xxxx	Minor	Minor Course 1	4	0	0	4	50	50	4
5	26-252-0105	MDC	Principles of Management	4	0	0	4	50	50	3
6	xx-xxx-xxxx	AEC	English 1	4	0	0	4	50	50	3
7	26-252-0106	OJT	On the Job Training I					100		2
			Total				**27**	**400**	**300**	**24**

*Minor course is to be selected from another discipline.
L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

26-252-0101 MATHEMATICS I FOR DATA SCIENCE AND ANALYTICS

Course Objectives:

1. To understand the basic concepts of sets, matrices, and linear algebra.

2. To provide knowledge of differentiation and foundational principles of calculus.

3. To develop the ability to apply probability concepts for analyzing and interpreting uncertain situations.

4. To encourage logical and critical thinking through the application of fundamental mathematical techniques.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand sets, functions, and logical propositions and their properties.	Understand
CO2	Comprehend basic numerical techniques to solve linear equations	Apply
CO3	Apply different methods to find the inverse and rank of a matrix	Apply
CO4	Apply mathematical principles to the analysis of data	Analyze

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1				1
CO2	3	2	2				1
CO3	3	2	2				1
CO4	3	3	1	2	2		2

Module 1

Logic, Propositional Logic, Propositional equivalences, Predicates and Quantifiers, Sets, Set operations, Functions, Sequences, and summation.

Module 2

Matrices, determinants, and inverse of a matrix. System of equations, Linear transformation - rank and nullity, Consistency and inconsistency of linear system of equations, rank nullity theorem, Echelon form of a matrix, and row- reduced echelon form of a matrix. Eigenvalues and eigenvectors, Linear Independence.

Module 3

Vectors, Scalars, Vector Addition, Scalar multiplication, dot product, cross product, vector projection, cosine similarity, Linear Independence of Vectors, Application of Vectors: Curl - Divergence- Triple product.

Module 4

Differentiation: Limits and continuity, Derivatives of standard Functions, Rules for finding derivatives; Different types of differentiation; Integration: Integration of Standard function, Rule of Integrations, Formulas in Integration, Definite Integrals.

References:

1. Kenneth H. Rosen, "Discrete Mathematics And Its Applications", 7th Ed, McGraw-Hill, 2012.
2. Sipser, "Introduction to the Theory of Computation, CENGAGE Learning, 2014. 4. Ernest Davis, "Linear Algebra and Probability for Computer Science Applications ", 1st Edition, CRC Press 2012.
3. Michael Mitzenmacher and Eli Upfal; Probability and Computing, 2ed, Cambridge University Press, 2017.
4. Sheldon M Ross; A First Course in Probability, 10ed, Pearson, 2018
5. Introductory Algebra: a real-world approach (4th Edition) - by Ignacio Bello.

26-252-0102 INTRODUCTION TO PYTHON

Course Objectives:

1. To develop a strong foundation in problem-solving and programming using Python.
2. To train students in structured thinking through the use of flowcharts and pseudocode for logical reasoning.
3. To enable learners to understand and apply core Python programming concepts in practical situations.
4. To equip students to write modular, reusable, and object-oriented Python code with appropriate use of data structures and exception handling.

Course Outcomes:

Course Outcomes (COs)	Bloom's Taxonomy Level
After completion of the course, the student will be able to:	
CO1 Develop problem-solving logic using flowcharts, pseudocode, and structured thinking to represent computational processes.	Understand
CO2 Apply Python programming constructs such as data types, conditionals, loops, and functions for solving basic problems.	Apply
CO3 Analyze program flow through recursion, exception handling, and functional programming concepts such as lambda and closures.	Analyse
CO4 Design and evaluate efficient Python solutions using object-oriented programming, iterators, generators, and regular expressions.	Evaluate

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	3				2
CO2	2	2	3			1	2
CO3	3	2	2		1		2
CO4	3	3	3	1	2	1	2

Module 1

Basic logic building — Flowcharts – Decision-making using if-else –Algorithms – Pseudocode - Variables and expressions (no code syntax) – Understanding data flow – Control structures: Condition – Loop – Writing basic pseudocode with conditions and repetitions – Problem-solving flow using structured thinking

Module 2

Python overview – Basic data types – Functions: arguments, block structure, scope, recursion – Modules – Conditionals and Boolean expressions – Sequences: Strings, Tuples, Lists – Iteration, looping, and control flow – String methods and formatting.

Module 3

Functions: Defining and calling functions - Scope and lifetime - Local functions - Returning single and multiple values - Parameter passing - Namespaces - Keyword & default arguments - Optional parameters - Variable number of arguments - Passing collections to a function - Closures - Lambda functions - Function redefinition - Exceptions: Catching and handling exceptions - multiple exceptions.

Module 4

Introduction to Classes – Class instances and Methods – Iterators and Generators – Regular expressions – Exception handling and testing, Dictionaries and Sets.

References:
1. Eric Matthes (2019); Python Crash Course, Second Edition, No Starch Press.
2. Al Sweigart (2020); Automate the Boring Stuff with Python, Second Edition, No Starch Press.
3. Wes McKinney (2018); Python for Data Analysis, Second Edition, O'Reilly Media.
4. Allen B. Downey (2015); Think Python: How to Think Like a Computer Scientist, Second Edition, Green Tea Press.
5. Paul Barry (2016); Head First Python, Second Edition, O'Reilly Media.
6. Ashok Namdev Kamthane, Amit Ashok Kamthane, "Programming and Problem Solving with Python", McGraw Hill Education.
7. https://developers.google.com/edu/python – Google's Python Class (Free Online Resource).

26-252-0103 FUNDAMENTALS OF COMPUTER SYSTEMS

Course Objectives:

1. To introduce the fundamental components and functioning of computer systems, including data representation and storage technologies.
2. To provide an understanding of CPU architecture, memory hierarchy, operating system concepts, and basic computer networking.
3. To learn number systems, binary arithmetic, and logic gates essential for understanding digital circuits.
4. To build a foundational base that supports further study in computing and information technology.

Course Outcomes:

	Course Outcomes (COs)	Bloom's Taxonomy Level
	After completion of the course, the student will be able to:	
CO1	Identify and describe the major components of a computer system, data representation formats, and various storage devices.	Understand
CO2	Understand CPU architecture, memory hierarchy, and differentiate between hardware and software types.	Understand
CO3	Analyze the functions of operating systems and computer networks, including OS types, process management, network types, OSI layers, and networking devices.	Analyze
CO4	Perform number system conversions and binary arithmetic, and construct basic logic gate circuits.	Apply

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	2				2
CO2	3	1	2				2
CO3	3	2	2		1		2
CO4	3	2	2				2

Module I

Computer Components, Data Representation, and Storage Devices Overview of computer components, including their roles and evolution milestones. Binary representation and data storage concepts such as binary data representation, data units (bits, bytes, kilobytes, etc.), ASCII, and Unicode. Various storage devices like HDDs, SSDs, and optical drives, along with file systems.

Module II

CPU Architecture, Memory Hierarchy, and Output Devices Basic CPU architecture covering ALU, registers, control unit, fetch-execute cycle, instruction sets, and assembly language. Memory hierarchy, including registers, cache, RAM, and virtual memory. Hardware and Software: Definition - Categories of Software, Application of Computers.

Module III

Definition and functions of Operating System, Types of OS: Batch – Interactive - Real-time, etc, Processes and Threads, Process States and Life Cycle, Context Switching and Multitasking, Virtual Memory and Paging, CLI vs GUI.
Definition and importance of computer networks, Types of networks: LAN – WAN – MAN – PAN – WLAN. OSI Model and its 7 layers, Networking devices: Router – Switch – Hub – Gateway, Network topologies: Star, Bus, Ring, Mesh, Hybrid.

Module IV

Number Systems: Binary, Octal, Decimal, Hexadecimal, Conversion between Number Systems, Binary Arithmetic (Addition, Subtraction). Basic Logic Gates: AND, OR, NOT. Universal Gates: NAND, NOR, Exclusive Gates: XOR, XNOR.

References:

1. Structured Computer Organization by Andrew S. Tanenbaum
2. Operating System Concepts by Abraham Silberschatz, Peter B. Galvin, and Greg Gagne
3. Modern Operating Systems by Andrew S. Tanenbaum and Herbert Bos
4. Computer Networking: A Top-Down Approach by James F. Kurose and Keith W. Ross
5. Floyd, Thomas L. Digital fundamentals, 11/e. Pearson Education India, 2017. 978-9332584600
6. Kumar, A. Anand. Fundamentals of digital circuits.4/e PHI Learning, 2016. 978-8120352681

26-252-0105 PRINCIPLES OF MANAGEMENT

Course Objectives:

1. To introduce the fundamental management concepts, the evolution of management thought, and the major functions of management in different organizational forms.
2. To familiarize the key business areas such as marketing, operations, finance, and human resource management.
3. To understand motivation theories, leadership styles, organizational communication, and strategies for effective teamwork.
4. To promote an understanding of entrepreneurship and its role in driving economic growth and social development.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Explain the evolution of management thought and describe the core functions, roles, and responsibilities of managers within different forms of organizations.	Understand
CO2	Examine how key functional areas—marketing, operations, human resources, and finance—interrelate and contribute to overall organizational performance.	Understand
CO3	Apply basic theories of motivation, learning, and communication to managerial contexts and recognize the role of entrepreneurship in driving innovation and organizational growth.	Apply

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1				1	3		2
CO2		1		1	3		2
CO3		1		3	3		2

Module I

Introduction to Management: Definition - nature and importance of management, Roles and skills of managers – Mintzberg – Katz, Evolution of Management Thought: Classical theories - Scientific Management (Taylor) - Administrative (Fayol) - Bureaucratic (Weber), Human Relations Movement (Mayo, Follett), Contemporary Approaches (Quantitative, Systems, Contingency, TQM), Functions of Management: Overview of PODSCORB, Forms of organization: Sole proprietorship – Partnership - Joint-stock company, Public/Private enterprises, LLP, Corporation, Emerging forms (Startups, Social enterprises).

Module II

Marketing Management: Core marketing concepts – segmentation – targeting - positioning (STP) - Marketing mix (4Ps) - Extended Marketing Mix (7Ps), Operations and Production Management: Basics of production systems – productivity - quality management - supply chain overview, Financial Management: Meaning - scope and importance of financial management -Sources of finance - budgeting basics - financial control, Human Resource Management: HR functions, Integrative Perspective: How different functional areas interrelate for organizational performance and strategy execution.

Module III

Motivation Theories: Maslow's Needs hierarchy - Alderfer's ERG Theory - Herzberg's two-factor theory - McGregor's Theory X & Theory Y - Vroom's Expectancy theory, Communication in Management: Process – Formal and Informal communication - Barriers - Effective communication strategies, Leadership: Behavioural Theory – Situational leadership Theory - Fiedler's Contingency theory, Groups and Teams, Entrepreneurship and Innovation: Traits of successful entrepreneurs - Role of entrepreneurship in economic and social development.

References:

1. Stephen P. Robbins, Mary K. Coulter, David A. DeCenzo (2017) Fundamentals of Management, 10E, Pearson 2017.
2. Kinicki, A., & Soignet DB (2021). Management: A Practical Introduction (10th ed.) McGraw-Hill Education.
3. Principles of Management (OpenStax / similar): A freely available open-access textbook (2015), open.umn.edu/opentextbooks.
4. Griffin, R. W. (2020). Management: Principles and practices (13th ed.). Cengage Learning.

26-252-0106 ON-THE-JOB TRAINING I (OJT)

Course Description:

Students undertaking this On-the-Job Training (OJT) course for the roles of Python Programmer and Junior Data Analyst must, in alignment with the IT-ITeS Sector Skill Council standards, actively engage in practical projects to develop core competencies. You are expected to apply Python programming to design, develop, and test efficient software components and scripts, ensuring code quality and integration. Concurrently, for data analysis, you must demonstrate the ability to collect, clean, and process datasets; perform exploratory data analysis using libraries like Pandas and NumPy; and create clear visualizations and reports to communicate actionable insights. This hands-on experience is designed to streamline your continuous and end-semester assessment by directly linking your project work to the specific skill requirements of the target job roles, ensuring clarity of learning outcomes and readiness for the industry.

Course Objectives:

1. Gain understanding of practical application of classroom knowledge in real-world work environments for roles such as Python Programmer and Junior Data Analyst.
2. Develop hands-on skills by performing tasks under the guidance of experienced professionals in IT and data-related sectors.
3. Bridge the gap between academic theory and professional practice to enhance employability in programming and data analysis roles.
4. Acquire industry-specific competencies through structured On-the-Job Training in the IT and IT-enabled sector.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Explain and apply classroom concepts to real-world IT and data-related tasks, demonstrating practical problem-solving in programming and data analysis scenarios.	Apply
CO2	Perform hands-on tasks under professional guidance, analyze outcomes, and adapt solutions to meet industry standards in programming and data analysis	Apply
CO3	Analyze existing professional practices and workflows to identify gaps, and propose data-driven improvements in IT and data-centric projects to enhance employability and industry readiness.	Analyze

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2			2		
CO2	3	3	2		2	3	
CO3	3	3		2	3	3	2

Mode of Evaluation of On-the-Job Training I (OJT)

Mode of Evaluation	Details	Marks
Feedback from Hosting Institution	Evaluation based on feedback provided by the organization where the student underwent OJT	40
OJT Report	A formal report submitted by the student detailing their training experience, learnings, and outcomes	40
Viva Voce	Oral examination conducted by internal faculty to assess the student's understanding and application of their training	20
Total Marks		**100**

6.2. SEMESTER II

S.No.	Course Code	Type	Course Title	L	T	P	Hrs/Week	CA	ESE	Credits
					Hours			**Marks**		
1	26-252-0201	Major	Mathematics II for Data Science and Analytics	4	0	0	4	50	50	4
2	26-252-0202	Major	Database Fundamentals	2	0	4	6	50	50	4
3	26-252-0203	Major	Data Structures and Algorithms	2	0	4	6	50	50	4
4	xx-xxx-xxxx	Minor	Minor Course 2	2	0	4	6	50	50	4
5	26-252-0205	MDC	Fundamentals of Business Process Management	4	0	0	4	50	50	3
6	xx-xxx-xxxx	AEC	English 2	4	0	0	4	50	50	3
7	26-252-0206	OJT	On the Job Training II					100		2
8	26-252-0207	PST	Professional Skill Training I					100		2
			Total				30	500	300	26

*Minor course is to be selected from another discipline.
L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

26-252-0201 MATHEMATICS II FOR DATA SCIENCE AND ANALYTICS

Course Objectives:

1. To provide a strong foundation in statistical methods and techniques for business decision-making.
2. To develop the ability to analyze data, interpret results, and generate meaningful insights.
3. To enable the application of modern quantitative tools to real-world business problems.
4. To prepare students to make informed, data-driven decisions in professional settings.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Discuss critically the uses and limitations of statistical analysis	Understand
CO2	Understand and critically discuss the issues surrounding sampling and significance	Apply
CO3	Critically evaluate the underlying assumptions of analysis tools.	Evaluate
CO4	Solve a range of problems using the techniques covered	Apply

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1				1
CO2	3	2	1				1
CO3	3	2		2	1		
CO4	3	3	2		2	1	1

Module 1

Introduction to statistics, Introduction Data collection; Presenting data in tables and charts, measures of central tendency and dispersion.

Module 2

Probability, Bayers Theorem, Discrete probability distributions; Continuous probability distributions. Sampling distributions; statistical estimation; Hypothesis testing, Statistical inferences based on one sample test, Statistical quality control.

Module 3

Regression: Experimental design and analysis of variance - Simple linear regression analysis - correlation - Multiple regression. Time series forecasting: Decomposition of Time Series using Additive Models - Index numbers.

Module 4

Chi-square tests; Nonparametric tests: sign test, rank sum tests, one-sample runs tests, Rank correlation, K-S.

References:

1. Chandrasekaran, N., & Umaparvathi, M. (2016). *Statistics for Management*. PHI Learning Pvt. Ltd..
2. Gupta, S. C. (2016). *Fundamentals of Statistics*. Himalaya Publishing House.
3. Keller, G. (2014). *Statistics for management and economics* Abbreviated. Nelson Education.
4. Levin, R. I. (2008). *Statistics for management*. Pearson Education India.
5. Sharma, J. K. (2010). *Fundamentals of business statistics*. Vikas Publishing House.
6. Bajpai, N. (2009). *Business Statistics*. Pearson.
7. Shenoy, G. V.,Srivastava, U.K.,Sharma, S.C. (2002*). Business Statistics*. New Age International

26-252-0202 DATABASE FUNDAMENTALS

Course Objectives:

1. To provide a comprehensive understanding of database management systems relevant to data analytics.
2. To teach database design principles, data modeling, normalization, and relational schema development.
3. To enable students to use SQL for data manipulation, querying, analysis, and reporting.
4. To introduce modern database technologies, including NoSQL and cloud-based systems.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand the fundamental concepts, architectures, and data models of database management systems.	Understand
CO2	Use normalization techniques to organize relational database tables effectively, ensuring data consistency and reduced duplication during practical database operations.	Apply
CO3	Apply SQL commands and analytical functions to query, manipulate, and analyze data effectively.	Apply
CO4	Design and develop NoSQL and cloud-based databases for managing and integrating large-scale analytical data.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1				
CO2	3	2	2				
CO3	3	3	2		1		
CO4	3	3	2	1	2	1	2

Module I
Overview of DBMS, Data Models, Database Administrator, Database Users, Three Schema architecture of DBMS. Database architectures and classification. Entity- Relationship Model: Basic concepts, Design Issues, Mapping Constraints, Keys, Entity- Relationship Diagram, Weak Entity Sets, and Relational Model: Structure of relational Databases, Integrity Constraints, synthesizing ER diagram to relational schema.

Module II
Relational Database Design – Data Redundancy and Anomalies – Functional Dependencies (FD) – Normalization: 1NF, 2NF, 3NF, BCNF – Concept of Denormalization in Analytics Systems. Overview of Transactions and Concurrency Control – ACID Properties – Serializability – Recovery Concepts.

Module III
DatabaseLanguages: DDL, DML and DCL. Structured Query Language (SQL): Creating and Managing Databases – SELECT, WHERE, GROUP BY, HAVING, ORDER BY, and Aggregate Functions – Joins, Subqueries, Views, Indexes, and Triggers. Analytical SQL Functions: Window Functions, Ranking, and Conditional Expressions for Data Analysis.

Module IV
Introduction to NoSQL Databases – Key-Value, Document, and Column-Oriented Stores (Redis, MongoDB, Cassandra). Cloud Databases and Database-as-a-Service (DBaaS): Amazon DynamoDB, Google BigQuery. Overview – Integration of Databases with Analytical Tools (Python, R).

References:

1. Elmasri R., Navathe S. (2013). Database Systems: Models, Languages, Design and Application Programming, Pearson Education.
2. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2011). Database system concepts, 6/e, McGraw Hill.
3. Akerkar, R. (2009). Foundations of the semantic Web: XML, RDF & ontology. Alpha Science International, Ltd.
4. Plunkett, T., Mohiuddin, K., Macdonald, B., Harding, D., Nelson, B., Segleau, D., Sun, H., Mishra, G., Hornick, M., Stackowiak, R. and Laker, K., 2013. Oracle Big Data Handbook. Oracle Press, New York.
5. Perkins, L., Redmond, E., & Wilson, J. (2018). Seven databases in seven weeks: a guide to modern databases and the NoSQL movement. Pragmatic Bookshelf.
6. Thomasian, A. (2013). Database Concurrency Control: Methods, Performance, and Analysis (Vol. 1). Springer Science & Business Media.
7. Lee Chao, Cloud Database Development and Management, 1e, CRC Press, 2013.

26-252-0203 DATA STRUCTURES AND ALGORITHMS

Course Objectives:

1. To provide essential mathematical tools and techniques for algorithm analysis.
2. To familiarize students with basic data structures and their selection for efficient algorithm design.
3. To teach fundamental algorithms along with rigorous proofs of their correctness.
4. To develop the ability to analyze the efficiency of algorithm implementations using appropriate data structures.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Explain the fundamental concepts of data structures, algorithm analysis, and asymptotic notations used to evaluate algorithm performance.	Understand
CO2	Apply various searching and sorting algorithms to solve computational problems efficiently.	Apply
CO3	Analyze and implement linear data structures such as stacks, queues, and linked lists to perform data manipulation and organization.	Analyze
CO4	Design and construct hierarchical data structures such as binary trees and binary search trees for effective data storage, retrieval, and manipulation.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1				
CO2	3	3	2				
CO3	3	3	2		1		
CO4	3	3	2		2	1	2

Module 1

Data Structures and Algorithms: Asymptotic Analysis - Big O Notation - Tight and Loose Upper Bounds - Big O analysis of Algorithms - Finding Time Complexity - Worst case - Best case - Average Case Analysis, Sorting and Searching: Introduction to Sorting Algorithms - Sort Stability - Selection Sort - Bubble Sort - Insertion Sort - Linear Search – Binary.

Module 2

Stacks: Stack Abstract Data Type - Simple Array - Based Stack Implementation - Reversing Data Using a Stack - Matching Parentheses and HTML Tags , Queues: Queue Abstract Data Type - Array-Based Queue Implementation - Double-Ended Queues - Deque Abstract Data Type.

Module 3

Linked List: Types of Linked List - Singly Linked List - Doubly Linked List - Circular Linked List - Basic operations of linked list - Insertion - Deletion - Reversal.

Module 4

Introduction to trees: Binary Tree introduction - Traversal in Binary Tree - Preorder Traversal, Inorder Traversal - Postorder Traversal - Level order traversal, Constructing Binary tree from Traversals. Binary Search Tree: Introduction - Traversal in Binary Search Tree - Searching in a Binary Search Tree - Constructing Binary Tree from Inorder and Postorder Traversals - Insertion in a Binary Search Tree - Deletion in a Binary Search Tree.

References:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein. Introduction to Algorithms, Third Edition, PHI Learning, 2009. ISBN:978-81-203-4007-7.
2. Sanjoy DasGupta, C. H. Papadimitriou, Umesh Vazirani. Algorithms, First Edition, Tata McGraw Hill, 2006. ISBN: 978-0073523408.
3. Aaron M. Tanenbaum, Moshe J. Augenstein, Yedidyah Langsam, Data Structures using Java, Pearson Education, 2003, ISBN 13: 9780130477217.
4. Ellis Horowitz, SartajSahni, Dinesh P. Mehta, Fundamentals of Data Structures in C++, Silicon Press, 2007.
5. Jean Paul Tremblay and Paul G Sorenson, An introduction to Data Structures with Applications,McGraw- Hill, Singapore, 1984.

26-252-0205 FUNDAMENTALS OF BUSINESS PROCESS MANAGEMENT

Course Objectives:

1. To provide a foundational understanding of business processes and their role in organizational success.
2. To explain how business processes are designed, analyzed, and improved for operational efficiency.
3. To teach simple tools and techniques used in Business Process Management (BPM).
4. To highlight how BPM contributes to improved performance, efficiency, and customer satisfaction.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Explain the meaning, purpose, and importance of business processes and describe how business processes are modelled and documented.	Understand
CO2	Identify methods and technologies used to improve and automate processes Recognize the role of BPM in modern organizations and digital change.	Apply
CO3	Analyze simple business processes to find areas for improvement.	Analyze

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2					
CO2	3	3	2				
CO3	3	3	2	2	2	1	

Module I

Understanding Business Processes and BPM: Meaning and concept of a business process-Examples of business processes in different sectors (banking, education, retail, manufacturing), Introduction to Business Process: Management (BPM) - Evolution of BPM – from traditional management to process thinking - process lifecycle from design to monitoring, introduction to process modelling (using flowcharts or BPMN basics) - Benefits of process orientation in organizations

Module II

Modelling and Analysing Business Processes: Process architecture and workflow basics- Process modelling tools – flowcharts and Swimlane diagrams- Process documentation – steps, inputs, outputs, and responsibilities- Understanding current (As-Is) and future (To-Be) processes- Basic process analysis – finding delays, errors, and waste- Case examples: order processing, admission process, payroll system.

Module III

Improving and Automating Business Processes: Introduction to process improvement – why it is needed- Common methods – Lean, Six Sigma, and Total Quality Management (TQM)- How technology supports process improvement – introduction to workflow tools and automation- Concept of Robotic Process Automation (RPA) – simple explanation with examples- Continuous improvement and performance tracking- BPM in the digital age – how organizations use BPM for innovation and efficiency.

References:

1. Dumas, M. et al. Fundamentals of Business Process Management. Springer.
2. Harmon, P. Business Process Change. Morgan Kaufmann.
3. Jeston, J., & Nelis, J. Business Process Management: Practical Guidelines to Successful Implementations. Routledge.
4. Selected articles and case studies on BPM applications in services and manufacturing.

26-252-0206 ON-THE-JOB TRAINING II (OJT)

Course Description:

This On-the-Job Training (OJT) course, aligned with the IT-ITeS Sector Skill Council standards, requires you to actively engage in practical projects to develop core competencies for roles such as Database Administrator and Machine Learning Innovative Analyst. You are expected to design, implement, and manage robust database systems, ensuring data integrity, security, and performance through efficient querying, backup, and recovery procedures. Concurrently, for machine learning, you must demonstrate the ability to preprocess and analyze complex datasets, build, train, and evaluate predictive models using appropriate algorithms and frameworks, and deploy these solutions to generate actionable, data-driven insights. This hands-on experience is designed to streamline your continuous and end-semester assessment by directly linking your project work to the specific skill requirements of the target job roles, ensuring clarity of learning outcomes and readiness for the industry.

Course Objectives:

1. To gain understanding of the practical application of classroom knowledge in real-world work environments for roles such as Python Programmer, Junior Data Analyst, and Database Administrator.
2. To develop hands-on skills by performing tasks under the guidance of experienced professionals in IT and data-related sectors.
3. To bridge the gap between academic theory and professional practice, enhancing employability in programming, data analysis, and database management roles.
4. To acquire industry-specific competencies through structured On-the-Job Training in the IT and IT-enabled sector.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand and apply classroom knowledge in real-world work environments for roles such as Python Programmer, Junior Data Analyst, and Database Administrator.	Apply
CO2	Perform hands-on tasks under professional guidance, analyze outcomes, and adapt solutions to meet industry standards in programming, data analysis, and database management.	Apply
CO3	Apply suitable IT and data-centric solution design approaches to improve project outcomes and enhance employability and industry readiness.	Apply

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2			2		1
CO2	3	3	2		2	3	
CO3	3	3		2	3	3	2

Mode of Evaluation of On-the-Job Training II (OJT)

Mode of Evaluation	Details	Marks
Feedback from Hosting Institution	Evaluation based on feedback provided by the organization where the student underwent OJT	40
OJT Report	A formal report submitted by the student detailing their training experience, learnings, and outcomes	40
Viva Voce	Oral examination conducted by internal faculty to assess the student's understanding and application of their training	20
Total Marks		**100**

26-252-0207 PROFESSIONAL SKILL TRAINING I

Course Objectives:

1. To equip students with industry-aligned expertise and professional competencies in IT and IT-enabled sectors.
2. To provide hands-on training using industry-specific tools and emerging practices.
3. To enhance employability by bridging the gap between academic learning and real-world industry requirements.
4. To encourage participation in certified training programmes from recognized institutions for practical exposure.
5. To develop students' ability to apply learned skills in professional scenarios through evaluation-based learning.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand industry-aligned tools, practices, and professional competencies relevant to IT and IT-enabled sectors.	Understand
CO2	Apply learned skills in hands-on exercises and real-world tasks using industry-specific tools and techniques.	Apply
CO3	Analyze professional workflows and training scenarios to identify gaps and propose effective solutions for improved performance.	Analyze
CO4	Evaluate training outcomes and design practical improvements in professional tasks to enhance employability and industry readiness.	Evaluate

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2			1		1
CO2	3	3	2		2	3	
CO3	3	3		2	3	3	2
CO4	3	3		2	3	3	2

6.3. SEMESTER III

S.No.	Course Code	Type	Course Title	Hours				Marks		Credits
				L	T	P	Hrs/Week	CA	ESE	
1	26-252-0301	Major	Data Visualization Techniques	2	0	4	6	50	50	4
2	26-252-0302	Major	Machine Learning Fundamentals	2	0	4	6	50	50	4
3	26-252-0303	Major	Python for Data Science and Analytics	2	0	4	6	50	50	4
4	xx-xxx-xxx	Minor	Minor Course 3	4	0	0	4	50	50	4
5	26-252-0305	MDC	Enterprise Resource Planning	4	0	0	4	50	50	3
6	xx-xxx-xxxx	AEC	Other Language	4	0	0	4	50	50	3
7	26-252-0306	OJT	On the Job Training III					100		2
			Total				30	400	300	24

*Minor course is to be selected from another discipline.
L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

26-252-0301 DATA VISUALIZATION TECHNIQUES

Course Objectives:

1. To introduce the principles and techniques of effective data visualization for analytical storytelling and decision-making.
2. To enable students to design and develop insightful dashboards using modern visualization tools such as Tableau and Power BI.
3. To provide practical skills in transforming, modeling, and analyzing data through visual design, interactivity, and advanced analytics.
4. To teach DAX functions, AI-driven visuals, and publishing insights through cloud-based business intelligence platforms.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand the principles of effective data visualization and storytelling for analytical communication.	Understand
CO2	Apply Tableau to create interactive dashboards using expressive and effective visual designs.	Apply
CO3	Analyze and model data using Power BI and DAX functions to support business intelligence insights.	Analyze
CO4	Create integrated, advanced visual analytics solutions by combining time intelligence and AI-powered techniques for real-world decision-making.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2			2		1
CO2	2	3	1			2	2
CO3	3	3	1		2		2
CO4	3	3		1	2	2	2

Module I

Value of data visualization – Telling stories with data – Principles of effective data visualization – Understanding visual perception – Data checking and verification – Types of visualizations: Bar charts, line charts, scatter plots, heatmaps, time series, and data maps – Graphical excellence and integrity.

Module II

Introduction to Tableau – Dimensions and measures – Visual encoding and image properties – Roll-up and drill-down – Mapping data to visuals using expressive and effective design – Creating charts (bar, line, dot plots, tables, heatmaps) – Titles, captions, annotations, legends and grid lines – Designing and testing dashboards – Sharing interactive visualizations for analytical insights.

Module III

Overview of Business Intelligence (BI) – Power BI ecosystem: Desktop, Service, Mobile – Connecting to data sources (Excel, SQL, Web, APIs) – Data transformation using Power Query – Data modeling: relationships, cardinality, cross-filter directions – Overview of the data preparation workflow – Introduction to DAX: syntax and basic functions (SUM, AVERAGE, MIN, MAX COUNT) – Calculated columns and measures.

Module IV

Advanced DAX functions: CALCULATE, ALL, DISTINCT – Visualizations: bar, column, line, pie, matrix, table, card, KPIs – Filters, slicers, and hierarchies – Conditional formatting – Time intelligence functions (YTD, QTD, MTD) – Custom visuals from Power BI Marketplace – AI-powered features: Key Influencers, Decomposition Tree, Quick Insights – Publishing, collaboration, and report sharing via Power BI Service.

References:

1. Tamara Munzner (2014); *Visualization Analysis and Design*, CRC Press.
2. Nathan Yau (2011); *Visualize This: The FlowingData Guide to Design, Visualization, and Statistics*, Wiley.
3. Ryan Sleeper (2020); *Innovative Tableau: 100 More Tips, Tutorials, and Strategies*, O'Reilly Media.
4. Alexander Loth (2019); *Visual Analytics with Tableau*, Wiley.
5. Alberto Ferrari & Marco Russo (2019); *Introducing DAX: Fundamental Concepts*, Microsoft Press.
6. Matt Allington (2016); *Learn to Write DAX: A Practical Guide to Learning Power Pivot for Excel and Power BI*, Self-published.

26-252-0302 MACHINE LEARNING FUNDAMENTALS

Course Objectives:

1. To introduce the basic concepts and intuition behind modern machine learning methods.
2. To provide a foundational understanding of how, why, and when these methods work.
3. To teach techniques for learning patterns and extracting insights from data.
4. To build the groundwork for applying machine learning approaches in real-world problem-solving.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Explain the fundamental concepts, techniques, and applications of Machine Learning.	Understand
CO2	Apply appropriate Machine Learning algorithms to solve classification, regression, and clustering problems.	Apply
CO3	Compare and assess popular Machine Learning models based on their strengths, limitations, and suitability for different tasks.	Analyze
CO4	Evaluate the performance of Machine Learning systems using suitable metrics and validation strategies.	Evaluate

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2		1	2		2
CO2	3	3	3			2	2
CO3	3	3			3		2
CO4	3	3			3	1	2

Module 1

Definition of machine learning, Introduction to learning: supervised and unsupervised learning – classification – clustering – regression, Python for Machine Learning: scikit-learn - Essential

Libraries, and Tools: Jupyter notebook – NumPy – SciPy – matplotlib - pandas - Python exercise on classifying Iris Species.

Module 2

Machine learning models for classification and regression: K Nearest Neighbour classifier - k-neighbors regression - Ridge regression - multiclass classification - Python exercise on KNN, Ensemble models - Variable selection - Categorical input consolidation - Surrogate models.

Module 3

Types of unsupervised learning: Challenges, Preprocessing and scaling: Different kinds of preprocessing - applying data transformations, Dimensionality reduction: Principal Component Analysis (PCA) - Non-Negative Matrix Factorization (NMF), Clustering: K- means clustering, Case study: Comparing image reconstructions using k- means - PCA and NMF – Python exercise on PCA - K-means clustering.

Module 4

Cross-validation: Benefits of cross-validation, Stratified k-Fold Cross-Validation and Other Strategies – Evaluation metrics and scoring: Metrics for Binary classification- Confusion matrices, precision, recall, and f-score - Metrics for Multiclass Classification, Regression metrics

Suggested Projects:

1. Apply/Develop a machine learning method to solve a specific problem.
2. A machine learning approach to classifying emails.
3. Predict stock prices based on past price variation.
4. Predict how people would rate movies, books, etc.
5. Sentiment Analysis of Movie Reviews.
6. Cluster gene expression data, how to modify existing methods to solve the problem better

References:

1. Andreas C. Müller & Sarah Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists, O'Reilly, 20172. Fritz Matt, Machine Learning: Mastering the Basics; an In-depth Look at Machine Learning, Createspace Independent, 2017.
2. Peter Harrington, Machine Learning in Action, Dreamtech Press, 2012.
3. Ian H. Witten, Eibe Frank and Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, 3 e., 2018.
4. Yaser S. Abu-Mostafa, Malik Magdon-Ismail and Hsuan-Tien Lin, Learning From Data, AMLBook, 2012.
5. Stephen Marsland, Machine Learning: An Algorithmic Perspective, Chapman and Hall/CRC, 2014.
6. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning,2e., Springer Series, 2017.

Online Courses:

1. Prof. Ravindran, Introduction to machine learning, http://nptel.ac.in
2. Prof. S. Sarkar, Introduction to machine learning, http://nptel.ac.in
3. MIT OCW on Machine Learning, https://ocw.mit.edu/courses/electrical-engineering- and-computer-science/6-867-machine-learning-fall-2006/index.htm

26-252-0303 PYTHON FOR DATA SCIENCE AND ANALYTICS

Course Objectives:

1. To introduce Python programming for data science using libraries such as NumPy, Pandas, and SciPy for data manipulation and statistical modeling.
2. To teach file handling, text processing, and data visualization techniques using Matplotlib and Seaborn.
3. To develop skills in numerical computations, data cleaning, and exploratory data analysis.
4. To provide hands-on practice through mini-projects with real-world datasets to build strong analytical and visualization skills.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand and apply Python libraries such as NumPy, Pandas, and SciPy for data manipulation and statistical modeling.	Understand
CO2	Apply file and text processing techniques and utilize the Turtle module to create basic graphical representations.	Apply
CO3	Analyze datasets by performing array operations, data selection, filtering, and handling missing data using Pandas for effective data analysis.	Analyze
CO4	Create meaningful visualizations and conduct exploratory data analysis using Matplotlib and Seaborn to support data-driven decision-making.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	3		1		2
CO2		2	3				2
CO3	3	3	2		3	2	2
CO4	3	3	2	1	3	2	2

Module 1

Introduction to popular Python libraries for data science Pandas- NumPy. Applied statistics in Python- Statistical modelling with scipy.

Module 2

File processing– File handling and Text processing –Types of files- Opening- Closing- Reading and Writing files. Graphics: Turtle Module- drawing with colours- Drawing basic shapes using iterations.

Module 3

NumPy for numerical operations – Creating and manipulating arrays – Array indexing, slicing, and broadcasting – Vectorized operations – Statistical functions – Introduction to Pandas – Series and DataFrames – Data selection, filtering, and manipulation – Handling missing data – Reading and writing files using Pandas.

Module 4

Data analysis with Pandas – Grouping, merging, and pivoting – Descriptive statistics and exploratory data analysis – Introduction to data visualization using Matplotlib and Seaborn – Plot types: line, bar, histogram, boxplot, scatter – Customizing plots – Introduction to basic data analysis workflows – Mini-projects using real datasets.

References:

1. Python Data Science Handbook by Jake VanderPlas (O'Reilly Media, 2016)
2. Davy Cielen, Arno DB Meysman and Mohamed Ali. Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, Dreamtech Press 2016
3. Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow by Aurélien Géron
4. (O'Reilly Media, 2019)
5. Data Science in Production: Building Scalable Model Pipelines by Jake VanderPlas (O'Reilly Media, 2020)
6. Jake Vander Plas, "Python Data Science Handbook – Essential Tools for Working with Data", O'Reilly Media, Inc.
7. Wes McKinney (2018); Python for Data Analysis, Second Edition, O'Reilly Media.

26-252-0305 ENTERPRISE RESOURCE PLANNING

Course Objectives:

1. To introduce students to the fundamental concepts and applications of Enterprise Resource Planning (ERP) systems.
2. To explain how ERP integrates business processes and functions to enhance efficiency and information flow.
3. To develop understanding of how ERP supports better organizational decision-making.
4. To discuss ERP implementation processes and emerging trends in modern business environments.

Course Outcomes:

Course Outcomes (COs)	Bloom's Taxonomy Level
After completion of the course, the student will be able to:	
CO1 — Explain the basic concepts, evolution, and need for ERP in modern business organizations.	Understand
CO2 — Describe the major ERP modules and their role in integrating business processes.	Apply
CO3 — Outline the process of ERP implementation and identify emerging trends and technologies in ERP systems.	Analyze

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2			3	2	2	2
CO2	2	2	1	3	3	3	2
CO3	2	2	1	3	3	3	2

Module 1

Concept and Definition of ERP- Evolution and Growth of ERP Systems- Need, Scope, and Significance of ERP in Business- Benefits and Limitations of ERP- Overview of Core Business Functions (Finance, HR, Production, Marketing, etc.)- Integration of Business Processes through ERP- ERP for Small and Medium Enterprises (SMEs).

Module 2

Overview of Major ERP Modules: Finance, Human Resource, Production, Materials Management, Marketing, Supply Chain, Customer Relationship- Concept of Business Process Reengineering (BPR)- Relationship of ERP with MIS, DSS, and SCM- Overview of Popular ERP Software Packages (SAP, Oracle, Microsoft Dynamics, etc.)- Introduction to Cloud-based and Web-enabled ERP Systems.

Module 3

ERP Implementation Life Cycle: Planning, Selection, Customization, Testing, Training, and Go-live- Implementation Challenges and Critical Success Factors- Roles of Vendors, Consultants, and End Users- Post-Implementation Support and Maintenance- Future Directions in ERP: AI and Analytics Integration, Mobile ERP, Industry-specific Solutions, and Sustainability.

References:

1. Alexis Leon, Enterprise Resource Planning, Tata McGraw Hill.

2. Jagan Nathan Vaman, Enterprise Resource Planning, PHI Learning.

3. Mary Sumner, Enterprise Resource Planning, Pearson Education.

4. Vinod Kumar Garg & N.K. Venkitakrishnan, Enterprise Resource Planning: Concepts and Practice, PHI.

26-252-0306 ON-THE-JOB TRAINING III (OJT)

Course Description:

This On-the-Job Training (OJT) course, aligned with the IT-ITeS Sector Skill Council standards, requires you to actively engage in practical projects to develop core competencies for roles such as Data Analyst and Data Scientist. You are expected to demonstrate proficiency in the entire data lifecycle, from acquiring and cleaning complex datasets using tools like SQL and Python to performing rigorous statistical analysis and exploratory data analysis. Furthermore, you must apply machine learning techniques to build, validate, and interpret predictive models, and effectively communicate your findings through clear visualizations, dashboards, and comprehensive reports that translate data into actionable business insights. This hands-on experience is designed to streamline your continuous and end-semester assessment by directly linking your project work to the specific skill requirements of the target job roles, ensuring clarity of learning outcomes and readiness for the industry.

Course Objectives:

1. To enable students to understand and apply classroom knowledge in real-world work environments for roles such as Business Data Support Executive, Visualization & Reporting Associate, and Machine Learning Assistant.
2. To develop hands-on skills by performing tasks under the guidance of experienced professionals in IT and data-related sectors.
3. To bridge the gap between academic theory and professional practice, enhancing employability in data support, visualization, reporting, and machine learning tasks.
4. To help students acquire industry-specific competencies through structured On-the-Job Training in IT and IT-enabled sectors.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand and apply classroom knowledge in real-world work environments for roles such as Business Data Support Executive, Visualization & Reporting Associate, and Machine Learning Assistant.	Apply
CO2	Perform hands-on tasks under professional guidance, analyze data, generate reports, and support machine learning workflows in IT and data-related sectors.	Apply
CO3	Analyze data visualization, reporting, and machine learning workflows to identify improvement opportunities, and evaluate how these enhancements can strengthen competencies required for industry-specific roles.	Analyze

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2			2		1
CO2	3	3	2		2	3	
CO3	3	3		2	3	3	2

Mode of Evaluation of On-the-Job Training III (OJT)

Mode of Evaluation	Details	Marks
Feedback from Hosting Institution	Evaluation based on feedback provided by the organization where the student underwent OJT	40
OJT Report	A formal report submitted by the student detailing their training experience, learnings, and outcomes	40
Viva Voce	Oral examination conducted by internal faculty to assess the student's understanding and application of their training	20
Total Marks		**100**

6.4. SEMESTER IV

| S.No. | Course Code | Type | Course Title | Hours | | | | Marks | | Credits |
				L	T	P	Hrs/ Week	CA	ESE	
1	26-252-0401	Major	Data Mining Techniques	2	0	4	6	50	50	4
2	26-252-0402	Major	R for Data Science and Analytics	2	0	4	6	50	50	4
3	26-252-0403	Major	Introduction to Artificial Intelligence	2	0	4	6	50	50	4
4	xx-xxx-xxx	Minor	Minor Course 4	4	0	0	4	50	50	4
5	26-252-0405	SEC	Business Analytics Using Spreadsheet	4	0	0	4	50	50	3
6	26-252-0406	VAC	Financial Accounting	4	0	0	4	50	50	3
7	26-252-0407	Project	Summer Internship with Project		One Month			50	50	2
8	26-252-0408	PST	Professional Skill Training II					100		2
			Total				30	450	350	26

*Minor course is to be selected from another discipline.
L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

26-252-0401 DATA MINING TECHNIQUES

Course Objectives:

1. To provide a comprehensive introduction to the theory and practice of data mining.
2. To develop understanding of major techniques used to discover patterns and insights from data.
3. To teach basic concepts, principles, methods, and implementation techniques in data mining.
4. To highlight real-world applications of data mining across various domains.

Course Outcomes:

	Course Outcomes (COs)	Bloom's Taxonomy Level
	After completion of the course, the student will be able to:	
CO1	Understand the fundamental concepts, stages, and applications of data mining and data preprocessing techniques.	Understand
CO2	Implement data classification and association rule mining techniques to solve real-world data problems.	Apply
CO3	Analyze and transform large datasets through cleaning, integration, and reduction to derive meaningful business insights.	Analyze
CO4	Develop and demonstrate data mining applications using tools such as R, WEKA, MATLAB, or Python.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1		2		1
CO2	2	3	2		2	2	3
CO3	2	2	1		3	2	2
CO4	1	3	3		2	3	3

Module I

Basics of data mining- data mining stages- Applications of data mining- Data Pre-processing: Need for Pre- processing the Data - Data Cleaning - Data Integration and Transformation - Data Reduction - Introduction to data warehouse and business intelligence. CASE studies: Download free data sets from online repositories - analyse and clean them using tools such as MS Excel and SPSS.

Module II

Classification models: Classification and Prediction: Issues Regarding Classification and Prediction- Classification by Decision Tree Induction- KNN- Bayesian Classification- neural networks - Support Vector Machines. Case studies: Using the clean data prepared in case study of module 1- classify using the decision tree and SVM models using tools such as R/WEKA/MATLAB/PYTHON

Module III

Association rules mining: Mining Frequent Patterns - Associations and Correlations: Basic Concepts - Efficient and Scalable Frequent Item set Mining Methods - Mining various kinds of Association Rules - From Association Mining to Correlation Analysis- Improvement of Apriori algorithms and FP - Trees. Case studies: Using WEKA - perform association rule mining over the standard transaction datasets.

Module IV

Advances in data mining- Time Series and Sequence patterns in Transactional Databases- Mining Sequence Patterns in Biological Data- Graph Mining- Social Network Analysis and web mining. Case studies: Create a sample text mining application using python/R to create a keyword index for a set of uploaded files in a directory.

References:

1. Han, J., Pei, J., & Kamber, M. (2011). *Data mining: concepts and techniques*. Elsevier.
2. Hall, M., Frank, E., Holmes, G., Pfahringer, B., Reutemann, P., & Witten, I. H. (2009). The WEKA data mining software: an update. *ACM SIGKDD explorations newsletter*, *11*(1), 10-18.
3. Gupta, G.K (2014) Introduction to Data Mining with Case Studies, 2014, Prentice Hall India.
4. Elayidom, M.Sudheep (2014) Data Mining and WareHousing, , Cengage Learning India Pvt.Ltd,
5. Zhao, Y (2015) R and data mining: Examples and case studies, Access at www.RDatamining.com
6. Pujari, Arun K (2016) Data Mining Techniques,Third edition, Universities Press.
7. Soman, K.P, Diwakar, S, Ajay, V (2008)Insight into Data Mining, Prentice Hall India

Online support training materials and videos:

- The NPTEL data mining course from IITKGP
- Introduction to data analytics:‖ MOOC course from IITM
- The EDUREKA data mining certification program
- The Intellipaat Data Science Certification program
- Data mining with WEKA, MOOC courses from University of Waikato, Newzeland.

26-252-0402 R FOR DATA SCIENCE AND ANALYTICS

Course Objectives:

1. To provide a comprehensive introduction to R programming for data analysis and statistical computing.
2. To teach fundamental R concepts, including data types, control statements, vectors, arrays, matrices, lists, and data frames.
3. To develop skills in creating and interpreting charts and graphs for effective data visualization.
4. To introduce statistical modeling and machine learning techniques such as regression, decision trees, random forests, and time series analysis using R.

Course Outcomes:

	Course Outcomes (COs)	Bloom's Taxonomy Level
	After completion of the course, the student will be able to:	
CO1	Understand the fundamentals of R programming, including data types, control structures, and data manipulation.	Understand
CO2	Apply concepts of arrays, matrices, lists, and data frames for data organization and computation.	Apply
CO3	Implement statistical and machine learning methods such as regression, decision trees, random forests, and time series analysis using R.	Apply
CO4	Create and interpret visual representations of data using various R charting and graphing techniques.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2		1		1
CO2	2	2	3		1	2	2
CO3	3	3	3		2	2	3
CO4	2	3	3		2	2	3

Module 1

Introduction to R: Why R – Getting started with an IDE – Arithmetic in R, Basic data types: Common errors – Type checking – Type conversion – Familiarization with packages, Introduction to vectors: creating vectors – Naming elements – Vector arithmetic – Selecting and modifying elements – Comparing vectors – Logical vectors – Handling missing values – Control statements: using if - if-else – for – while - repeat with basic examples.

Module 2

Arrays in R: Creating arrays – Indexing and basic arithmetic – Matrices – Creating matrices– Matrix naming and indexing – Simple matrix operations – Matrix applications - Frequency tables and factors – levels() and summary() functions: Ordered and unordered factors, Lists: Creating and modifying lists – Selecting elements – Concatenating lists, Data frames: Creating data frames – Selecting frame elements, Sorting: Use of attach() and detach().

Module 3
Working with R Charts and Graphs: Histograms, Boxplots, Bar Charts, Line Graphs, Scatterplots, Pie Charts.

Module 4
Statistics with R: Random Forest, Decision Tree, Normal and Binomial distributions , Linear and Multiple Regression, Logistic Regression, Time Series Analysis.

Reference:

1. Grolemund, G. (2014). *Hands-On Programming with R: Write Your Own Functions and Simulations*. O'Reilly Media.
2. Wickham, H., & Grolemund, G. (2017). *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data*. O'Reilly Media.
3. Gardener, M. (2012). *Beginning R: The Statistical Programming Language.* Wiley. *(A more accessible alternative to Crawley for beginners.)*
4. Jared P. Lander, R for Everyone: Advanced Analytics and Graphics, 1e, Pearson Education
5. India, 2014.
6. Mark Gardener, Beginning R - The Statistical Programming Language, John Wiley & Sons, Inc., 2013.
7. W. N. Venables, D.M. Smith and the R Development Core Team, An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

26-252-0403 INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Course Objectives:

1. To introduce the fundamental concepts and techniques of Artificial Intelligence, including its scope, domains, and real-world applications.
2. To teach problem-solving strategies using search algorithms, heuristic approaches, and game-playing techniques.
3. To develop skills in logical reasoning, knowledge representation, and inference mechanisms for designing intelligent systems.
4. To explore advanced AI applications such as natural language processing, information retrieval, and fuzzy logic-based reasoning.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand the fundamental concepts, domains, and problem-solving approaches in Artificial Intelligence.	Understand
CO2	Apply classical and heuristic search algorithms to solve complex AI problems and game-playing scenarios.	Apply
CO3	Analyze logical reasoning techniques using propositional and predicate logic, including inference and unification methods.	Analyze
CO4	Develop knowledge representation models and implement intelligent systems using tools and concepts such as PROLOG, fuzzy logic, and natural language processing.	Evaluate

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1	1	2		1
CO2	2	3	2		2	1	2
CO3	3	2	1		3		2
CO4	2	3	3		2	2	3

Module I

Introduction to AI, Turing test, Categories of AI, Applications of AI, AI domains-Problem Characteristics – Problem spaces- search: DFS, BFS - Production systems- Swarm intelligence- genetic algorithm.

Module II

Heuristic search techniques: Generate and Test - Hill climbing -Best first - A* algorithm. Problem reduction –AO*algorithm, constraint satisfaction - Means Ends analysis. Game playing: Minimax – Alpha-beta cut-off.

Module III

Logic and Deduction: Introduction to symbolic logic - Propositional logic - Well Formed Formula- Predicate Logic - predicates variables and constants - First order logic, Quantifiers- Forward and backward chaining-Resolution by refutation- Unification- Goal trees.

Module IV

Representing Knowledge: Procedural versus Declarative. PROLOG programming

Fuzzy Logic, Semantic Nets, Frames, Conceptual Dependency, Scripts, CYC.

Language Models – Information Retrieval- Information Extraction – Natural Language Processing.

References:

1. Elaine Rich and Kevin Knight, Artificial Intelligence, Tata McGraw-Hill, Third Edition, ISBN: 13:978-0-07-008770-5, 2010.
2. Jeffrey M. Bradshaw, Software Agents, AAAI Press/ The MIT Press (1997) (Module 1), ISBN: 0-262-52234-9.
3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hall India Ltd., 2009, ISBN: 81-203-0777-1 (modules 2,3and 4).
4. Stuart Russell and Peter Norvig, Artificial Intelligence – A Modern Approach. 3rd Edition, Prentice Hall, 2009.
5. Padhy, N.P., Artificial intelligence and intelligent systems, 2010, 0-19-567154-6.
6. Jurafsky D., Martin J.H., Speech and natural language processing, Second Edition, Prentice Hall, 2008, ISBN 10: 0131873210.

26-252-0405 BUSINESS ANALYTICS USING SPREADSHEET

Course Objectives:

1. To explain how managers use business analytics to identify, formulate, and solve business problems.
2. To highlight the importance of analytics in supporting effective and informed managerial decision-making.
3. To equip students with the ability to apply analytical techniques using spreadsheet-based tools.
4. To develop practical skills for performing common business analytics tasks using spreadsheet software.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Identify and describe complex business problems in terms of analytical models & apply basic excel functions and tools for basic spreadsheet operations and analysis	Understand
CO2	Use excel for data visualization	Apply
CO3	Use Excel to perform regression, correlation, ANOVA, andcross tabulation in relevant data analysis problems & Apply forecasting techniques using Excel.	Analyze

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	3	3		2	2	2
CO2	1	3	3		2	2	2
CO3	3	3	3		3	2	3

Module 1

Scope of analytics – descriptive, predictive, and prescriptive analytics – metrics and types of data – decision models – and basic Excel skills such as AVERAGE, SUM, PRODUCT, VLOOKUP, HLOOKUP, logical functions, Pivot Tables, Goal Seek, What-If Analysis, Interest, Arrays, and Add-ons. Data visualization and exploration techniques including frequency distribution, charts, percentiles, quartiles, contingency tables, pivot charts, and cross-tabulation.

Module 2

Measures of central tendency – mean, median, and mode – and measures of dispersion – range, interquartile range, variance, standard deviation, coefficient of variation - measures of location and dispersion for grouped data; Covariance and correlation; Introduction to statistical inference and hypothesis testing - ANOVA and Chi-square tests.

Module 3

Regression analysis – simple and multiple linear regression, and regression with categorical variables –Best-fit line - least squares coefficients; Forecasting techniques – both qualitative and quantitative – moving averages, exponential smoothing, and regression-based time series forecasting. Data mining techniques – Data exploration and reduction (cluster analysis), classification (k-NN and discriminant analysis), Association rules, Cause and effect models.

References:

1. Sharda, R., Delen, D., & Turban, E. (2022). *Business Analytics: Descriptive, Predictive, Prescriptive.* Pearson Education, New Delhi.
2. Jaggia, S., Lertwachara, K., Kelly, A., & Chen, L. (2023). *Business Analytics: Communicating with Numbers.* McGraw Hill Education (India) Pvt. Ltd., New Delhi.
3. Raj, S. (2021). *Business Analytics.* Cengage Learning India Pvt. Ltd., New Delhi.
4. Arpana, D., Madhu, S., & Swapna, H. R. (2020). *Business Analytics: Analytics in Commerce and Business*. Himalaya Publishing House, Mumbai.
5. Gupta, S. C., & Kapoor, V. K. (2014). *Fundamentals of Mathematical Statistics.* Sultan Chand & Sons, New Delhi.
6. Montgomery, D. C., Peck, E. A., & Vining, G. G. (2015). *Introduction to Linear Regression Analysis* (Indian Adaptation, 6th Ed.). Wiley India Pvt. Ltd., New Delhi.
7. Bhandarkar, K. M. (2019). *Statistics for Education.* Neelkamal Publications Pvt. Ltd., Hyderabad.

26-252-0406 FINANCIAL ACCOUNTING

Course Objectives:

1. To provide students with a solid foundation in financial accounting principles and practices.
2. To explain the accounting process, including the recording and classification of business transactions.
3. To teach students to prepare and interpret key financial statements accurately.
4. To enable students to analyze financial data and make informed business decisions.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand and apply fundamental accounting principles, concepts and systems to accurately record and classify business transactions.	Remember & Understand
CO2	Prepare journals, ledgers, subsidiary books, and trial balances, and effectively identify and rectify accounting errors.	Apply & Analyze
CO3	Prepare and interpret final accounts, apply depreciation methods, and analyse financial statements to assess business performance.	Evaluate

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	2	2	1		1
CO2	2	3	3		2	2	2
CO3	2	3	1	3	3	2	3

Module 1

Introduction to accounting and book keeping – objectives and functions of accounting – basic terms including assets, liabilities, and capital – types of accounts – accounting principles, concepts, and conventions – double entry system and golden rules of accounting – accounting equation approach –and systems of accounting.

Module 2

Journal and journalizing - Posting transactions- Ledgers, and Subsidiary Books- purchases, sales, returns, cash, petty cash, bills receivable, and bills payable books. Preparation of the trial balance-identification of errors-types of errors and rectification of errors-use of suspense accounts - Preparation of bank reconciliation statements.

Module 3

Depreciation –Methods of providing depreciation - calculation of profit or loss on the sale of depreciable assets. Preparation of final accounts of sole proprietors and joint stock companies - Trading, Manufacturing, and Profit & Loss accounts, and Balance Sheet- Treatment of Provisions and Reserves- Analysis of Financial Statements -Limitations of financial statements.

References:

1. Shukla, M. C., Grewal, T. S., & Gupta, S. C. (2016). Advanced Accounts. S. Chand & Company Ltd., New Delhi.
2. Bhattacharyya, A. K. (2012). Essentials of Financial Accounting: PHI Learning Pvt. Ltd.
3. Jain, S. P., & Narang, K. L. (2008). Advanced Cost Accounting. Kalyani Publishers.
4. Gupta, R. L., & Radhaswamy, M. (2017). Advanced Accountancy. Sultan Chand & Sons,
5. Maheshwari, S. N., Maheshwari, S. K., & Maheswari, S. K. (2013). An Introduction to Accountancy. Vikas Publishing House.
6. Narayanswamy R. (2017). Financial Accounting: A managerial perspective. PHI publication
7. Raman B. S. (2018) Financial Accounting, United Publishers & Distributors

26-252-0407 SUMMER INTERNSHIP WITH PROJECT

Course Objectives:

1. To apply academic knowledge to real-world IT and ITES challenges through a one-month summer internship.
2. To develop practical skills, professional ethics, and domain-specific competencies by working on industry-relevant projects.
3. To bridge the gap between theoretical learning and professional practice to enhance employability.
4. To prepare a project report demonstrating applied learning, analytical skills, and problem-solving abilities in a vocational context.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand and apply academic knowledge to solve real-world problems in IT and ITES sectors during the summer internship.	Understand
CO2	Develop practical skills, professional ethics, and domain-specific competencies through hands-on project work.	Apply
CO3	Analyze and bridge theoretical concepts with professional practice to enhance employability and industry readiness.	Analyze
CO4	Create a comprehensive project report demonstrating applied learning, analytical thinking, and problem-solving abilities.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1		2		1
CO2	3	3	2	2	3	3	
CO3	2	2		2	2	3	2
CO4	3	3		2	3	3	2

26-252-0408 PROFESSIONAL SKILL TRAINING II

Course Objectives:

1. To equip students with industry-aligned expertise and professional competencies in IT and IT-enabled sectors through hands-on training and emerging tools.
2. To bridge the gap between academic learning and real-world industry requirements, enhancing employability and practical exposure.
3. To develop communication, presentation, interpersonal, creativity, adaptability, and critical thinking skills for professional effectiveness.
4. To enable students to apply learned skills in professional scenarios, strengthening leadership, teamwork, and problem-solving abilities.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand industry-aligned tools, emerging practices, and professional competencies in IT and IT-enabled sectors, and apply them in practical scenarios.	Understand
CO2	Apply learned skills to real-world industry tasks, analyze workflows, and adapt solutions to meet professional requirements.	Apply
CO3	Develop and evaluate communication, presentation, interpersonal, creativity, adaptability, and critical thinking skills for professional effectiveness.	Analyze
CO4	Design and implement solutions in professional settings, demonstrating leadership, teamwork, and problem-solving abilities to enhance employability.	Evaluate

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2			1		1
CO2	3	3	2		2	3	
CO3	2	2		2	3	3	2
CO4	3	3		2	3	3	2

6.5. SEMESTER V

S.No.	Course Code	Type	Course Title	Hours				Marks		Credits
				L	T	P	Hrs/ Week	CA	ESE	
1	26-252-0501	Major	Cloud Computing for Data Analytics	4	0	0	6	50	50	4
2	26-252-0502	Major	Natural Language Processing	4	0	0	4	50	50	4
3	26-252-0503	Major	Text and Web Analytics	2	0	4	6	50	50	4
4	xx-xxx-xxx	Minor	Minor Course 5	4	0	0	4	50	50	4
5	26-252-0505	SEC	Web Development and App Design	3	0	2	5	50	50	3
6	26-252-0506	VAC	Ethics and Governance in the Digital Age	4	0	0	4	50	50	3
			Total				29	300	300	22

*Minor course is to be selected from another discipline.
L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

26-252-0501 CLOUD COMPUTING FOR DATA ANALYTICS

Course Objectives:

1. To develop a comprehensive understanding of cloud computing concepts, its evolution, and architectural frameworks.
2. To familiarize learners with various cloud service models such as SaaS, PaaS, and IaaS and their real-world applications.
3. To develop practical skills in working with major cloud platforms like AWS, Azure, and GCP for storage, deployment, and scalability.
4. To introduce containerization, micro services, and essential cloud security practices for building secure and efficient cloud-based systems.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Explain the evolution of computing and the role of virtualization, edge, and fog computing in modern cloud environments.	Understand
CO2	Apply containerization, microservices, and cloud security mechanisms to ensure efficient and secure cloud operations.	Apply
CO3	Analyze cloud architecture layers and differentiate between SaaS, PaaS, and IaaS models with real-world examples.	Analyze
CO4	Evaluate major cloud platforms and storage solutions for data management and application deployment.	Evaluate

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2					
CO2	3	3	2	3			
CO3	3	2			2		2
CO4	3	3		2	3		

Module I

Evolution of Computing: On-premise computing- client-server model- Distr2ibuted computing- multi-core computing. Virtualization: virtual machines- Desktop virtualization- hypervisor- microkernel- full and para virtualization. Benefits of cloud computing- Edge and fog computing- MQTT.

Module II

Cloud architecture: Layers in cloud architecture- Hosting and management of applications. Software as a Service (SaaS)- Platform as a Service (PaaS)- Infrastructure as a Service (IaaS). Scalability and reliability in the cloud. Examples for each model. SLAs. Hybrid cloud.

Module III

Usage of cloud: AWS/ Azure/ GCP. Use of lambda or cloud functions as API. Storage of data in the cloud. Software defined storage. Disaster recovery. Distributed File Systems (HDFS- Ceph FS)- Cloud Databases (HBase- MongoDB- Cassandra- DynamoDB)- Cloud Object Storage (Amazon S3- OpenStack Swift- Ceph).

Module IV

Microservices and containerization: Introduction to Docker and Kubernetes.

Cloud Security: Authentication and authorization- tokens- API keys- and Identity & Access Management (IAM). Data encryption techniques – symmetric- asymmetric- and digital signatures. Security threats in cloud-based analytics and IoT environments- and preventive measures.

References:

1. Toby Velte, Anthony Velte, Robert Elsenpeter: Cloud Computing, A Practical Approach, 1e, McGraw-Hill Education, 2009.
2. Rajkumar Buyya, James Broberg, Andrzej Goscinski: Cloud Computing: Principles and Paradigms, 1e, Wiley, 2013.
3. R. Buyya, S N. Srirama, Fog and Edge Computing: Principles and Paradigms, Wiley Series on Parallel and Distributed Computing, 1st Edition, Wiley, 2019.
4. Giacomo Veneri and Antonio Capasso, Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0, 1st Edition, Packt Publishing, 2018.
5. Mayur Ramgir, Internet of Things: Architecture, Implementation and Security, 1st Edition, Pearson, 2019.
6. Edward A. Lee and Sanjit A. Seshia, Introduction to Embedded Systems, A Cyber-Physical Systems Approach, 2nd Edition, MIT Press, 2017.

26-252-0502 NATURAL LANGUAGE PROCESSING

Course Objectives:

1. To introduce the fundamental concepts and linguistic foundations of Natural Language Processing.
2. To enable students to understand and apply grammatical formalisms, parsing algorithms, and statistical techniques for language analysis.
3. To develop the ability to perform semantic interpretation, resolve ambiguity, and connect syntactic structures with meaning in natural language.
4. To familiarize learners with advanced NLP applications, including machine translation, information retrieval, and conversational agent systems.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand the fundamentals of natural language understanding, linguistic structures, and various levels of language analysis.	Understand
CO2	Apply grammar formalisms and parsing techniques, including probabilistic methods, to analyze natural language structures.	Apply
CO3	Analyze semantic and logical representations to resolve ambiguity and interpret meaning in language processing.	Analyze
CO4	Develop NLP applications involving discourse understanding, machine translation, information retrieval, and conversational systems.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2					
CO2	3	3	2				
CO3	3	2		2			
CO4	3	3	2	2	3	1	2

Module I

Introduction to Natural Language Understanding- Levels of language analysis- Syntax, Semantics, Pragmatics. Linguistic Background- An Outline of English Syntax. Lexicons, POS Tagging, Word Senses. Grammars and Parsing- Features, Agreement and Augmented Grammars.

Module II

Grammars for Natural Language, Parsing methods and Efficient Parsing. Ambiguity Resolution- Statistical Methods. Probabilistic Context Free Grammar.

Module III

Semantics and Logical Form: Linking Syntax and Semantics-Ambiguity Resolution- other Strategies for Semantic Interpretation-Scoping and the Interpretation of Noun Phrases.

Module IV

Knowledge Representation and Reasoning- Local Discourse-Context and Reference- Using World Knowledge- Discourse Structure- Defining a Conversational Agent. Applications- Machine Translation, Information Retrieval and Extraction, Text Categorization and Summarization.

References:

1. D. Jurafsky and J. H. Martin, Speech and Language Processing, Prentice Hall India, 2000.
2. James Allen, Natural Language Understanding, 2e, The Benjamin/Cummings Publishing Company Inc., Redwood City, CA.
3. Charniak, Eugene, Introduction to Artificial intelligence, Addison-Wesley, 1985.
4. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Modern Information Retrieval, Addison Wesley,1999.
5. U. S. Tiwary and Tanveer Siddiqui, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

26-252-0503 TEXT AND WEB ANALYTICS

Course Objectives:

1. To introduce students to the key principles and methods of text and web analytics for extracting insights from unstructured data.
2. To enable learners to apply techniques such as text preprocessing, vectorization, sentiment analysis, and topic modeling.
3. To develop skills in stream data mining and web data extraction using appropriate analytical tools.
4. To emphasize practical, real-world applications that strengthen students' ability to analyze and interpret textual and web-based data.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand text preprocessing and vectorization techniques to transform unstructured text into meaningful representations for analysis.	Understand
CO2	Analyze and implement topic modeling and sentiment analysis using appropriate algorithms and tools.	Analyze
CO3	Evaluate real-time text data streams to perform sentiment and trend analysis effectively.	Evaluate
CO4	Develop web mining and data extraction applications using XML technologies and modern web scraping tools ethically.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1				
CO2	3	3	2	1			
CO3	3	2	1		2	1	
CO4	3	2		2	2		1

Module I

Introduction to Text Analytics – Text Analytics Steps – Collecting Raw Text – Text Preprocessing - Tokenization, Stemming, Lemmatization, Stopword Removal– Representing Text – Bag of Words and N-grams – Term Frequency-Inverse Document Frequency (TFIDF) - Cosine Similarity – Word Embeddings ,Word2Vec – Applications of Text Analytics in Business and Social Media

Module II

Topic Models – Probabilistic Latent Semantic Analysis (PLSA) – Latent Dirichlet Allocation (LDA) Sentiment Analysis – Lexicon-based Approaches –SentiWordNet – VADER and AFINN – Polarity Computation – Positive/Negative/Neutral Classification – Subjectivity vs Objectivity

Module III

Introduction to Data Streams – Opportunities and Challenges in Stream Mining – Real-time Data Processing– Data Summarization Techniques – Stream Mining Models (Online Learning, Sliding Window, Reservoir Sampling) – Case Study on Tweet Analysis – Real-time Sentiment and Trend Analysis

Module IV

Introduction to XML – XML Structure and Syntax – XSLT for Styling XML – XPath for Querying XML – Web Mining – Web Content Mining – Web Structure Mining – Web Usage Mining – Web Scrapers – Web Crawlers – Tools: BeautifulSoup, Scrapy, Selenium – Ethical Considerations in Web Scraping

References:

1. Zhai, C.X. & Massung, S. (2016); *Text Data Management and Analysis: A Practical Introduction to Information Retrieval and Text Mining*, ACM Books.
2. Miner, G., Elder IV, J., & Hill, T. (2012); *Practical Text Mining and Statistical Analysis for Non-Structured Text Data Applications*, Academic Press.
3. Struhl, S. (2015); *Practical Text Analytics: Interpreting Text and Unstructured Data for Business Intelligence*, Kogan Page.
4. Silge, J. & Robinson, D. (2017); *Text Mining with R: A Tidy Approach*, O'Reilly Media.
5. Kaushik, A. (2007); *Web Analytics: An Hour a Day*, John Wiley & Sons.
6. Clifton, B. (2012); *Advanced Web Metrics with Google Analytics*, John Wiley & Sons.
7. Kelly, N. (2012); *How to Measure Social Media: A Step-by-Step Guide to Developing and Assessing Social Media ROI*, Que Publishing.

Course Objectives:

1. To provide students with a comprehensive understanding of core web technologies used in modern web development.
2. To enable learners to design structured and visually appealing web pages using HTML, XHTML, and CSS frameworks.
3. To develop skills in client-side scripting through JavaScript and jQuery to enhance interactivity and dynamic functionality.
4. To introduce server-side scripting with PHP and the use of XML and JSON for efficient data representation and exchange in web applications.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Develop well-structured and styled web pages using HTML, XHTML, and CSS frameworks.	Apply
CO2	Implement dynamic and interactive functionalities using JavaScript and jQuery.	Create
CO3	Apply XML, JSON, and PHP for effective data handling and server-side web development.	Apply
CO4	Develop web mining and data extraction applications using XML technologies and modern web scraping tools ethically.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	3			2	1
CO2	2	2	3			2	1
CO3	3	2		1	2	2	1

Module I

HTML/XHTML: Origins - Syntax- Structure- Text Markup- Images- Links- Lists- Tables- Forms- HTML5- HTML vs XHTML. Style Sheets & Frameworks: Introduction and Basics.

Module II

JavaScript: Overview- OOP Concepts- Syntax- I/O- Control Statements- Objects- Arrays- Functions- Callbacks- HTML DOM. jQuery: Overview and Basics.

Module III

XML: Syntax- Structure- Namespaces- Schemas- Displaying (Raw-CSS-XSLT)- Applications. JSON: Basics- Syntax- Data Types- Objects- Schema- XML Comparison. PHP: Overview- Syntax- Control- Arrays- Functions- Forms- Cookies- Sessions.

References:

1. P. J. Deitel, H.M. Deitel, Internet &World Wide Web How To Program, 4/e, Pearson International Edition 2010.
2. Robert W Sebesta, Programming the World Wide Web, 7/e, Pearson Education Inc., 2014.
3. Bear Bibeault and Yehuda Katz, jQuery in Action, Second Edition, Manning
4. Publications.[Chapter 1] Black Book, Kogent Learning Solutions Inc. 2009.
5. Bob Boiko, Content Management Bible, 2nd Edition, Wiley Publishers. [Chapter 1, 2]
6. Chris Bates, Web Programming Building Internet Applications, 3/e, Wiley India Edition 2009.
7. Dream Tech, Web Technologies: HTML, JS, PHP, Java, JSP, ASP.NET, XML, AJAX

26-252-0506 ETHICS AND GOVERNANCE IN THE DIGITAL AGE

Course Objectives:

1. To develop students' understanding of ethical principles, corporate governance frameworks, and responsible business practices.
2. To enable learners to analyze ethical dilemmas and make decisions with integrity and accountability.
3. To emphasize the importance of transparency, stakeholder responsibility, and sustainable governance in organizations.
4. To prepare students to navigate emerging ethical and governance challenges in the digital and global business environment.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand the fundamental concepts of ethics, business ethics, and their significance in responsible managerial decision-making.	Understand
CO2	Apply principles of corporate governance and stakeholder accountability to analyze real-world business and organizational scenarios.	Apply
CO3	Evaluate ethical and governance challenges arising from digital transformation and propose strategies for sustainable and transparent business practices.	Evaluate

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	1		3			2
CO2	2	2		3	2	1	2
CO3	2	1		3	3	2	3

Module 1

Meaning, nature, and importance of ethics – need and purpose of business ethics – role of moral values in decision-making and leadership – major ethical theories and approaches (utilitarianism, deontology, virtue ethics, relativism) – sources of ethical knowledge and ethical reasoning processes – importance of ethical decision-making – moral dilemmas and factors influencing ethical behavior – frameworks for ethical analysis in managerial and digital contexts – unethical business practices and ethical leadership – strategies to manage workplace ethics and foster integrity and accountability.

Module 2

Meaning, need, and importance of corporate governance – role in promoting transparency, fairness, and corporate responsibility – models of corporate governance (Anglo-American, German, Japanese, and Indian) – OECD Principles of Corporate Governance (fairness, accountability, disclosure, and stakeholder engagement) – corporate obligations toward stakeholders (investors, employees, customers, society) – benefits of strong governance frameworks and impact of governance failures – Indian and global case studies. CSR- Models of CSR-importance of CSR.

Module 3

Ethical issues in digital technologies and data-driven decision-making – algorithmic bias, AI ethics, and accountability in automated systems – privacy, data protection, and digital rights – ethical implications of big data, surveillance, and predictive analytics – cybersecurity ethics and responsible data governance – ethical use of social media, misinformation, and digital manipulation – environmental sustainability and Green IT – role of policy, regulation, and digital ethics frameworks – and future perspectives on ethical leadership in AI, blockchain, and decentralized governance systems.

References:

1. Kumar, S., & Rai, A. K. (2019). *Business Ethics* (1st Ed.). Cengage Learning India, New Delhi. Cengage
2. Muraleedharan, K. P., & Satheesh, E. K. (2020). *Fernando's Business Ethics and Corporate Governance*. Pearson Education, New Delhi. Pearson Education
3. Hasnan Baber (Ed.). (2024). *Business Ethics and Corporate Governance: A Textbook with Cases* (2nd Ed.). [Publisher not specified], New Delhi. Goonebook
4. Veliz, Carissa. (2023). *Privacy Is Power: Why and How You Should Take Back Control of Your Data*. Oxford University Press, Oxford.
5. Kogan Page / (2023). *Data Ethics: Practical Strategies for Implementing Ethical Information Management and Governance*. Kogan Page, London. Kogan Page
6. Dang, D. (Ed.) (2024). "Balancing Ethics and Economics" in *Navigating Data Governance in India's Marketing World*. IGI Global, USA. igi-global.com
7. Muraleedharan, K. P. & Satheesh, E. K. (2024). *Fernando's Business Ethics and Corporate Governance* (3rd Ed.). Pearson India, New Delhi.

6.6. SEMESTER VI

S.No.	Course Code	Type	Course Title	Hours				Marks		Credits
				L	T	P	Hrs/Week	CA	ESE	
1	26-252-0601	Major	Big Data Analytics	3	0	2	5	50	50	4
2	26-252-0602	Major	Deep Learning and Neural Networks	4	0	0	4	50	50	4
3	xx-xxx-xxx	Minor	Minor Course 6	4	0	0	4	50	50	4
4	26-252-0604	SEC	HR Analytics	3	0	0	3	50	50	3
5	26-252-0605	VAC	Research Methodology	3	0	0	3	50	50	3
6	26-252-0606	Project	Main Project	0	0	8	4	50	50	4
			Total				**23**	**300**	**300**	**22**
			Overall SEM I – SEM VI							**144**

*Minor course is to be selected from another discipline.
L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

26-252-0501 BIG DATA ANALYTICS

Course Objectives:

1. To introduce students to the fundamental concepts, architectures, and tools used in Big Data processing and analytics.
2. To enable learners to work with the Hadoop ecosystem, including HDFS, YARN, and MapReduce, for building data storage and processing pipelines.
3. To develop practical skills using high-level frameworks such as Hive, Pig, and Spark, with hands-on experience in PySpark and streaming data analytics.
4. To familiarize students with emerging Big Data technologies, cloud integration approaches, and performance optimization techniques for efficient and secure data management.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand the characteristics, architecture, and ecosystem components of Big Data systems, including Hadoop and its distributed processing framework.	Understand
CO2	Apply HDFS and MapReduce concepts to store, process, and analyze large datasets efficiently.	Apply
CO3	Utilize tools such as Hive, Pig, and Spark for data transformation, and analytics on structured and unstructured d	Apply
CO4	Evaluate Big Data solutions in terms of scalability, security, cloud deployment, and performance optimization.	Evaluate
CO5	Develop real-time Big Data processing solutions using Kafka and Spark Streaming for practical applications.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2			1		1
CO2	3	3	2		2	3	
CO3	3	3	2		2	3	
CO4	2	2		2	2	3	2
CO5	3	3	2		3	3	2

Module I

Introduction to Big Data: Characteristics, Types of Data- Traditional vs Big Data Systems- Big Data Architecture & Data Pipeline Overview- Hadoop Ecosystem Components (HDFS, YARN, MapReduce)-Cluster Architecture: NameNode, DataNode- Overview of Distributed Computing & Parallel Processing.

Module II

HDFS Architecture, block size, replication, fault tolerance - MapReduce Framework: Mapper, Reducer, Combiner, Input/Output formats- Data flow, shuffle, and sort phase- YARN Architecture – ResourceManager, NodeManager- Data ingestion tools overview (Sqoop, Flume, Kafka)

Module III

Apache Hive: Data warehouse concept, schema, tables, partitions, bucketing, HiveQL basics-Apache Pig: Pig Latin language, data flow, execution- Apache Spark: RDD, DataFrame, DAG execution, Spark architecture and advantages- Basics of PySpark, Spark SQL, and DataFrame operations

Module IV

Real-time Big Data Processing: Kafka overview and integration with Spark- Introduction to Apache Flink and Storm (conceptual)- Case Studies in Big Data Analytics: Social Media, Recommendation, IoT, Financial & Retail Analytics- Big Data in Cloud (AWS, Azure, GCP – overview)- Security & Privacy in Big Data Systems- Performance Optimization & Best Practices

Suggested Practical:

1. Setting up Hadoop in single-node pseudo-distributed mode- HDFS commands (upload, copy, remove, view, replication factor)- Explore real-world datasets (e.g., airline, log, or tweet data)
2. Writing MapReduce programs (Word Count, Inverted Index, Join operations) - Use Hadoop streaming with Python- Ingest CSV data into HDFS- Simple Flume setup to collect and store streaming data
3. Create and query Hive tables from CSV/JSON data- Data cleaning using HiveQL- Write Pig scripts for data transformation-Implement Spark DataFrame operations
4. Kafka - Spark Streaming simulation- Mini simulation of Big Data Pipeline: Kafka - HDFS-Spark – Hive.

References:

1. Clifton, B. (2010). *Advanced web metrics mit Google Analytics: Praxis-Handbuch*. MITP-Verlags GmbH & Co. KG.
2. Prajapati, V. (2013). Big data analytics with R and Hadoop. Packt Publishing Ltd..
3. Marconi, K., & Lehmann, H. (Eds.). (2014). *Big data and health analytics*. CRC Press.
4. Warden, P. (2011). *Big data glossary*. O'Reilly Media, Inc.
5. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing andPresenting Data, EMC Education Services, WILEY, 2015
6. Elayidom, M. S. (2015). Datamining and Warehousing. *Cengage Learning India Pvt Ltd*.
7. Berthold, M. R., & Hand, D. J. (Eds.). (2007). *Intelligent data analysis: an introduction*. Springer.

26-252-0602 DEEP LEARNING AND NEURAL NETWORKS

Course Objectives:

1. To introduce the fundamental concepts of Deep Learning and its role in modern data analytics.
2. To enable students to understand neural network architectures, gradient-based optimization, and model regularization techniques.
3. To develop hands-on skills in implementing convolutional and recurrent neural networks for image, text, and sequential data analysis.
4. To apply deep learning frameworks such as TensorFlow and Keras to solve real-world analytical and predictive problems.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Explain the fundamental concepts, architectures, and significance of deep learning in the context of data analytics.	Understand
CO2	Apply optimization and regularization techniques to train and fine-tune deep learning models for improved performance.	Apply
CO3	Analyze the structure and functionality of CNN and RNN models to interpret their application in image, text, and time-series analytics.	Analyze
CO4	Evaluate the performance of various deep learning models using appropriate metrics and validation techniques.	Evaluate

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2			1		1
CO2	3	3	2		2	3	
CO3	3	3	2		2	3	2
CO4	2	2		2	2	3	2

Module I

Overview and motivation for deep learning – Basics of supervised learning and classification – Gradient Descent and its variants (SGD, Momentum, Adam) – Evaluating model performance – Introduction to key deep learning frameworks (TensorFlow, Keras, PyTorch).

Module II

Structure of feedforward neural networks – Activation functions – Forward and backward propagation – Overfitting and regularization techniques (Dropout, Early stopping, Batch normalization) – Hyperparameter tuning and model optimization.

Module III

Concept and architecture of CNNs – Convolution, pooling, and feature extraction Applications in image and text analytics – Transfer learning and pre-trained models for analytics tasks.

Module IV

Introduction to Recurrent Neural Networks (RNNs) – Long Short-Term Memory (LSTM) networks for time-series and sequential data – Autoencoders for dimensionality reduction and feature learning – Case studies in predictive analytics and anomaly detection.

References:

1. Ian Goodfellow, Deep Learning, MIT Press, 2016.

2. Jeff Heaton, Deep Learning and Neural Networks, Heaton Research Inc, 2015.

3. Mindy L Hall, Deep Learning, VDM Verlag, 2011

26-252-0604 HR ANALYTICS

Course Objectives:

1. To introduce the foundational concepts of HR analytics and the role of data in human resource decision-making.
2. To enable students to understand and interpret HR metrics that support workforce planning and performance improvement.
3. To develop skills in applying analytical tools and techniques to evaluate HR processes and outcomes.
4. To enhance students' ability to use data-driven insights to support strategic and operational HR decisions within organizations.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Explain the fundamental concepts, frameworks, and ethical aspects of HR analytics.	Understand
CO2	Apply HR metrics and visualization tools to analyze and interpret workforce data for decision-making.	Apply
CO3	Develop simple HR dashboards and predictive insights to support organizational planning and performance improvement.	Analyze

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2		2	1		1
CO2	3	3	2		2	3	
CO3	3	3		2	2	3	2

Module I

Evolution, concepts, HR analytics framework (LAMP, HCM:21)- HR analytics maturity model-Role of HR metrics and data quality- Ethics and data privacy

(Practical: Identifying HR data sources and simple Excel data entry)

Module II

Quantitative HRM: DCOVA framework (Define–Collect–Organize–Visualize–Analyze)- Key HR metrics in recruitment, performance, training, and compensation- HR scorecard and dashboards

(Practical: Create a simple HR dashboard in Excel or Google Sheets)

Module III

Linking HR measures to business results- Root cause analysis of HR issues- Predictive and descriptive analytics (simple introduction)- HR modeling using past data

(Practical: Analyze a small HR dataset and interpret results)

Suggested Simple Practicals / Skill Activities:

- Creating HR metrics tables in Excel

- Data visualization using charts (bar, line, pie)

- Developing an HR dashboard using sample data

- Short case study: Using HR data for decision-making

References:

1. Becker, B. E., Huselid, M. A., & Ulrich, D. (2001). *The HR scorecard: Linking people, strategy, and performance.* Harvard Business Review Press.

2. Bhattacharyya, D. K. (2017). *HR analytics: Understanding theories and applications.* Sage Publications.

3. Christman, W. (2012). *HR metrics that matter.* HR Smart. O'Neill, M., & Seibert, L. (2021).
4. *People analytics for dummies.* Wiley.

5. Gregory, L. E. (2013). *HR metrics: Practical measurement tools for people management.*
6. Knowledge Resources.

26-252-0605 RESEARCH METHODOLOGY

Course Objectives:

1. To introduce the fundamental principles and processes of research with emphasis on data-driven decision-making in analytics.
2. To enable students to formulate research problems and apply appropriate research designs, measurement approaches, and data collection methods for both qualitative and quantitative studies.
3. To develop skills in data preparation, hypothesis testing, and visualization for generating meaningful analytical insights.
4. To equip learners with the ability to structure, write, and present research reports effectively for academic and professional use.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Explain the research process, ethics, and various research designs applicable to data-driven problem solving.	Understand
CO2	Apply measurement, scaling, sampling, and questionnaire design techniques to collect and organize analytical data.	Apply
CO3	Analyze data using appropriate validation, coding, tabulation, and hypothesis testing methods to derive meaningful insights.	Analyze

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2		2	1		1
CO2	3	3	2		2	3	
CO3	3	3	2	2	2	3	2

Module 1

Research Process and Research Ethics- Identifying and Formulating Research Problems from Data-Driven Decision Problems-Conducting a Problem Audit and Framing Research Questions-Research Design: Types, Characteristics, and Data Collection Methods- Literature Review and Reference Management Tools (e.g., Mendeley, Zotero)- Overview of Quantitative vs. Qualitative Research

Module 2

Measurement and Scaling Concepts: Validity, Reliability, and Levels of Measurement- Scale Development and Attitude Measurement: Comparative and Non-Comparative Scales - Questionnaire and Survey Design for Research - Sampling Fundamentals: Techniques, Sample Size Determination, and Sampling Plan Design. Data Collection Methods: Surveys, Observations, and Secondary Data Sources

Module 3

Data Preparation: Validation, Editing, Coding, and Tabulation (Single & Cross) - Data Visualization and Graphical Representation Techniques - Hypothesis Testing: Concepts, Errors (Type I & II), and Testing for Means & Associations - Structuring and Writing a Research Report for Data-Driven Studies

References:

1. Booth, W. C., Colomb, G. G., & Williams, J. M. (2003). *The craft of research*. University of Chicago press.
2. Bryman, A., & Bell, E. (2015). *Business research methods*. Oxford University Press, USA.
3. Cooper, D. R., Schindler, P. S., & Sun, J. (2006). *Business research methods* (Vol. 9). New York: McGraw-Hill Irwin.
4. Field, A. (2009). *Discovering statistics using SPSS*. Sage publications.
5. Hair, J. F., Celsi, M. W., Ortinau, D. J., & Bush, R. P. (2008). *Essentials of marketing research*. McGraw-Hill/Higher Education.
6. Malhotra, N. K. (2008). *Marketing research: An applied orientation, 5/e*. Pearson Education India.
7. Saunders, M. N. (2011). *Research methods for business students, 5/e*. Pearson Education India.
8. Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill building approach*. John Wiley & Sons.

26-252-0606 MAIN PROJECT

Course Objectives:

1. To gain understanding of applying academic knowledge to real-world industry challenges in IT and ITES sectors.
2. To develop specialized technical and professional skills under professional mentorship through hands-on project work.
3. To Bridge the gap between theoretical learning and professional practice to enhance employability and industry readiness.
4. To apply expertise in areas such as data science, data analytics, cloud computing, and related domains to deliver tangible outcomes.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Apply academic knowledge to solve real-world industry challenges in IT and ITES sectors.	Apply
CO2	Analyze and integrate theoretical concepts with practical experience to enhance employability and industry readiness.	Analyze
CO3	Develop and demonstrate specialized technical and professional skills through hands-on project work under mentorship.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1		2		1
CO2	2	2		2	2	3	2
CO3	3	3	2		3	3	2

Mode of Evaluation of Main Project

Component	Description	Marks
Continuous Assessment (CA)	Ongoing project work evaluation during the semester (progress review, documentation, implementation, regularity, etc.)	50
End Semester Examination (ESE) – Viva-Voce	Final evaluation based on project report, presentation, demonstration, and oral examination.	50

6.7. SEMESTER VII & SEMESTER VIII

S.No.	Course Code	Type	Course Title	Hours				Marks		Credits
				L	T	P	Hrs/ Week	CA	ESE	
1	xx-xxx-xxx	Minor	Online course 1				4	50	50	4
2	xx-xxx-xxx	Minor	Online course 2				4	50	50	4
3	xx-xxx-xxx	Minor	Online course 3				4	50	50	4
4	26-252-0701	Apprenticeship	Internship/apprenticeship/ Work integrated	280 Days				50	50	28
			Total					**200**	**200**	**184**

*Minor course to be selected from another discipline.
L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

26-252-0701 APPRENTICESHIP/INTERNSHIP WITH PROJECT

Course Objectives:

1. Provide students with immersive, real-world experience in the IT and ITES sector through a year-long apprenticeship/internship.
2. Enable students to apply academic knowledge to solve practical industry challenges.
3. Develop specialized technical and professional skills in areas such as data science, data analytics, and cloud computing.
4. Foster the ability to undertake and deliver a significant live project under professional mentorship.
5. Bridge the gap between theoretical learning and professional practice to enhance employability and industry readiness.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand and apply academic knowledge to real-world industry scenarios in IT and ITES sectors.	Understand
CO2	Perform hands-on tasks and analyze practical challenges to develop solutions in areas such as data science, data analytics, and cloud computing..	Apply
CO3	Evaluate project outcomes, industry practices, and workflow effectiveness to improve performance and professional competence.	Evaluate
CO4	Undertake and execute a significant live project under professional mentorship, applying technical and professional skills effectively.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1		2	3	1
CO2	3	3	2		2	3	
CO3	2	2		2	2	3	2
CO4	3	3		2	3		2

Mode of Evaluation

Evaluation Component	Description	Marks
Continuous Assessment (CA)	Evaluation of apprenticeship/internship project work by internal faculty through interim presentations, mid-term reports, internal viva-voce, etc.	50
End Semester Examination (ESE)	Viva-voce conducted by a board of examiners (including at least one external examiner) constituted by the Director/HoD of the Centre	50

ONLINE COURSES (VII and VIII SEMs)

As part of the B.Voc (Hons.) programme, students shall complete three online courses approved by the Board of Studies (BoS), each carrying 4 credits through SWAYAM/MOOCs/other University-recognized online platforms in accordance with the University's Regulations.

Minor Courses Offered by DDUKK in the Business Studies Discipline

Sem	Course Code	Type	Course Title	Hours				Marks		Credits
				L	T	P	Hrs/ Week	CE	SEE	
I	26-252-0104	Minor	Managerial Economics	4	0	0	4	50	50	4
II	26-252-0204	Minor	Productions and Operations Management	4	0	0	4	50	50	4
III	26-252-0304	Minor	Business Model Analysis and Strategy	4	0	0	4	50	50	4
IV	26-252-0404	Minor	Entrepreneurship Development and Management of Startups	4	0	0	4	50	50	4
V	26-252-0504	Minor	Digital business and E-commerce	4	0	0	4	50	50	4
VI	26-252-0603	Minor	Intellectual Property Rights	4	0	0	4	50	50	4
	26-252-xx04	Minor	Operations Research	4	0	0	4	50	50	4

L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

26-252-0104 MANAGERIAL ECONOMICS

Course objectives:

1. To introduce students to the basic concepts of economics that support managerial decision-making.
2. To apply fundamental economic principles, such as demand, supply, cost, and pricing, to real-world business problems.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand the fundamental concepts and importance of managerial economics in business.	Understand
CO2	Apply demand and supply principles to analyze market behavior and business decisions.	Apply
CO3	Examine production and cost relationships for effective business planning.	Analyse
CO4	Evaluate different market structures and basic pricing strategies used by firms.	Evaluate

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2					
CO2	2	3	2				
CO3	2	2	3				
CO4		2	1	3			

Module I

Meaning, Nature, and Scope of Managerial Economics- Importance and Role in Business Decision-Making- Relationship with Other Disciplines (Accounting, Finance, Marketing)- Basic Concepts: Opportunity Cost, Incremental Concept, Marginal Analysis- Objectives of the Firm – Profit Maximization, Sales Maximization.

Module II

Meaning and Determinants of Demand- Law of Demand and Exceptions- Elasticity of Demand – Price Elasticity - Demand Forecasting – Meaning and Basic Methods- Supply – Law of Supply, Determinants of Supply, Market Equilibrium.

Module III

Meaning of Production and Factors of Production- Law of Variable Proportion (Short Run Production)- Returns to Scale (Long Run Production)- Cost Concepts: Fixed, Variable, Total, Average and Marginal Costs- Short Run and Long Run Cost Curves

Module IV

Market – Meaning and Types- Pricing under Perfect Competition and Monopoly (Basic Concepts)- Monopolistic Competition and Oligopoly – Simple Understanding- Break-even Analysis – Concept and Graphical Representation- Role of Government in Price Regulation

References:

1. Dwivedi, D. N. (2015). Managerial economics (8th ed.). Vikas Publishing House.

2. Jhingan, M. L. (2020). Micro economics (2nd ed.). Vrinda Publications.

3. Mehta, P. L. (2016). Managerial economics: Analysis, problems and cases (9th ed.).

   Sultan Chand & Sons.

4. Varshney, R. L., &; Maheshwari, K. L. (2019). Managerial economics (20th ed.).

   Sultan Chand & Sons.

SEMESTER II

26-252-0204 PRODUCTIONS AND OPERATIONS MANAGEMENT

Course objectives:

1. To gain understanding of efficient production and delivery of products and services.
2. To understand key operational functions in manufacturing and service organizations.
3. To apply tools and techniques for effective planning, control, and process improvement.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Explain the role of operations strategy in business success.	Understand
CO2	Apply forecasting and planning techniques for production decisions	Apply
CO3	Analyse plant location, layout, and material management systems.	Analyse
CO4	Evaluate plant location, layout, and material management systems.	Evaluate

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1				3	2	2	2
CO2	2			3	3	2	2
CO3	1			3	3	3	2
CO4	2			3	3	3	2

Module I

Meaning, Nature, and Scope of Managerial Economics- Importance and Role in Business Decision-Making- Relationship with Other Disciplines (Accounting, Finance, Marketing)- Basic Concepts: Opportunity Cost, Incremental Concept, Marginal Analysis- Objectives of the Firm – Profit Maximization, Sales Maximization.

Module 2

Meaning and Determinants of Demand- Law of Demand and Exceptions- Elasticity of Demand – Price Elasticity - Demand Forecasting – Meaning and Basic Methods- Supply – Law of Supply, Determinants of Supply, Market Equilibrium.

Module 3

Meaning of Production and Factors of Production- Law of Variable Proportion (Short Run Production)- Returns to Scale (Long Run Production)- Cost Concepts: Fixed, Variable, Total, Average and Marginal Costs- Short Run and Long Run Cost Curves.

Module 4

Market – Meaning and Types- Pricing under Perfect Competition and Monopoly (Basic Concepts)- Monopolistic Competition and Oligopoly – Simple Understanding- Break-even Analysis – Concept and Graphical Representation- Role of Government in Price Regulation

References:

1. Chaffey, D. (2015). Digital business and e-commerce management (6th ed.). Pearson Education.

2. Laudon, K. C., & Traver, C. G. (2021). E-commerce: Business, technology, society (16th ed.). Pearson Education.

3. Schneider, G. (2017). Electronic commerce (13th ed.). Cengage Learning.

4. Ray, S. (2011). E-business. Himalaya Publishing House.

SEMESTER III

26-252-0304 BUSINESS MODEL ANALYSIS AND STRATEGY

Course objectives:

1. To develop a strong understanding of conceptual and analytical tools for designing and assessing business models in dynamic markets.
2. To understand the integration of strategic management theories with practical frameworks for value creation, delivery, and capture.
3. To develop skills to design sustainable, technology-driven, and data-informed business models for competitive advantage and long-term success.

Course Outcomes:

Course Outcomes (COs)	Bloom's Taxonomy Level
After completion of the course, the student will be able to:	
CO1 Explain the importance of business models in value creation.	Understand
CO2 Analyse and compare different business model frameworks used across industries.	Analyze
CO3 Design and evaluate innovative business models using contemporary tools and approaches.	Create
CO4 Develop and validate a feasible business model for a new or existing venture through customer and market insights.	Apply

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1				3	2		2
CO2				3	2	2	
CO3				3	3	2	
CO4				3	3	3	2

Module I

Foundations of Business Models: Concept and evolution of business models- Business model vs. strategy: distinctions and linkages- Components of a business model: value creation, delivery, and capture-Tools for visualizing business models: Business Model Canvas, Four Box Model, Business Model Wheel-Case analysis.

Module II

Frameworks and Patterns of Business Models: Business model patterns and archetypes (long-tail, freemium, subscription, multi-sided platforms, etc.)-Business model innovation and transformation-Market segmentation, targeting, and positioning in model design- Blue Ocean Strategy and disruptive innovation-Case study: Platform-based and digital business models (e.g., Uber, Airbnb, Netflix).

Module III

Strategy, Resources, and Revenue Models: Linking business models to competitive strategy-Resource-Based View (RBV), core competencies, and dynamic capabilities- Competitive advantage and differentiation through business model innovation- Designing revenue and cost structures; pricing and monetization models- Financial sustainability and performance indicators of business models- Case study: Revenue model analysis of SaaS and subscription-based firms.

Module IV

Business Model Validation and Sustainability: Designing and testing business models: Lean Start-up approach, MVP, customer development- Risk management through business model portfolios-Scaling and pivoting strategies- Sustainable and circular business models- Digital and AI-driven business models for the future- Capstone Project: Develop and present a business model for an innovative, viable venture.

References:

1. Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation. Wiley.

2. Afuah, A. (2014). Business Model Innovation: Concepts, Analysis, and Cases. Routledge.

3. Ries, E. (2011). The Lean Startup. Crown Books.

4. Blank, S., & Dorf, B. (2012). The Startup Owner's Manual. BookBaby.

5. Kaplan, S. (2012). The Business Model Innovation Factory. Wiley.

6. Johnson, M. W. (2018). Reinvent Your Business Model. Harvard Business Review Press.

7. Chesbrough, H. (2020). Open Business Models: How to Thrive in the New Innovation Landscape. Harvard Business School Press.

SEMESTER IV

26-252-0404 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT OF STARTUPS

Course Objectives:

1. To gain a strong understanding of entrepreneurial thinking and the functioning of startups in a dynamic business environment.
2. To understand the essentials of entrepreneurship, including startup creation, management, and emerging innovations.
3. To develop creativity, innovation, and sustainable business practices across diverse disciplines.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand the fundamental concepts, nature, and significance of entrepreneurship, and recognize the traits, competencies, and motivations that drive entrepreneurial behaviour.	Understand
CO2	Identify and evaluate business opportunities, analyze industrial location factors, and prepare effective business plans with appropriate financial and resource planning.	Apply
CO3	Analyze managerial, financial, and operational challenges in establishing new enterprises and apply knowledge of legal and documentation processes for business setup.	Analyze
CO4	Examine the startup ecosystem, assess government initiatives and funding options, and evaluate the strategic and socio-economic impact of startups on national development.	Evaluate

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1				3			2
CO2				2	3	2	
CO3				3	2	3	
CO4				3		2	3

Module I

Fundamentals of Entrepreneurship: Meaning – nature- importance of entrepreneurship- Entrepreneurial traits – competencies – motivation – Creativity - innovation and opportunity recognition - Role of entrepreneurship in economic and social development - Definition, meaning, and significance of entrepreneurship - Entrepreneurial traits, types, and characteristics - Qualities and functions of entrepreneurs - Entrepreneurial behaviour and motivation- Achievement, innovation, and management success- Role of entrepreneurship in a developing economy

Module II

Industrial location factors- Identification and selection of business ideas – sources and processing of ideas- Input requirements and resource planning- Preparation of business plans – components and format-Sources of finance for entrepreneurs

Module III

Managerial problems of new enterprises – production, financing, labour, and marketing- Preparation of feasibility reports-Legal processes and documentation for business setup - Establishing entrepreneurial systems and compliance framework

Module IV

Startups – concepts, models, characteristics, and ecosystem-Business incubators, startup communities, and funding options-Startups in India – profiles, causes, effects, and trends- Government initiatives – Startup India, women and marginalized group initiatives-Strategic planning and financial performance of startups-Economic and social impact of startups; role of education and training.

References:

1. Barringer, Bruce R. (2015) Preparing Effective Business Plans : An Entrepreneurial Approach. Second edition, Pearson Education.
2. Barringer, Bruce R., and Ireland,R. Duane (2008) Entrepreneurship : Successfully Launching New Ventures, Second Edition, Pearson Education.
3. Blank, Steven G., and Dorf, Bob (2012). The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company.KetS Ranch, Inc.
4. Drucker, Peter Ferdinand (2007). Innovation and Entrepreneurship: Practice and Principles. Harper & Row.
5. Kuratko, Donald F., and Welsch, Harold P. (2004) Strategic Entrepreneurial Growth. , Second edition, Thomson/South-Western.
6. Christensen, C. M., &Christensen, C. M. (2003).The Innovator's Dilemma, HarperBusiness Essentials.
7. Baron, R. A. (2014). Essentials of Entrepreneurship: Evidence and Practice. Edward Elgar Publishing.
8. Blank, S., & Dorf, B. (2012). The Startup Owner's Manual: The step-by-step guide for building a great company; BookBaby.

SEMESTER V

26-252-0504 DIGITAL BUSINESS AND E-COMMERCE

Course Objectives:

1. To acquire foundational knowledge of digital business principles and e-commerce practices.
2. To understand how technology transforms business activities such as buying, selling, marketing, and customer communication.
3. To learn about online business models, digital tools, and safe e-commerce practices.

Course Outcomes:

Course Outcomes (COs)	Bloom's Taxonomy Level
After completion of the course, the student will be able to:	
CO1 Understand the basic concepts and importance of digital business and e-commerce.	Understand
CO2 Identify different e-commerce business models and their applications.	Apply
CO3 Explain the process of online buying, payment systems, and security issues.	Analyze
CO4 Recognize the role of digital marketing and emerging technologies in e-business.	Evaluate

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2					
CO2	2	3	2				
CO3		3	2				
CO4	2	3	2				

Module I

Meaning and Nature of Digital Business- Difference between Traditional and Digital Business- Importance and Benefits of Digital Transformation- Key Components of a Digital Business- Challenges and Risks in Digital Business.

Module II

Meaning and Scope of E-Commerce- Types of E-Commerce: B2B, B2C, C2C, C2B, G2C- E-Commerce Business Models – Overview and Examples- E-Commerce in India – Growth and Opportunities- Steps to Start an Online Business

Module III

E-Commerce Website – Basic Components and Design Elements- Online Buying and Selling Process- Electronic Payment Systems – Debit/Credit Cards, UPI, Wallets, Net Banking- Security and Privacy Issues in E-Commerce- Legal and Ethical Issues in Online Business

Module IV

Introduction to Digital Marketing- Role of Social Media and Search Engines in E-Business- Basics of SEO, Email Marketing, and Online Advertising- Mobile Commerce (M-Commerce) – Concept and Applications- Emerging Trends – Artificial Intelligence, Cloud Computing, and Analytics in Business.

References:

1. Chaffey, D. (2015). Digital business and e-commerce management (6th ed.). Pearson
2. Education.
3. Laudon, K. C., & Traver, C. G. (2021). E-commerce: Business, technology, society
4. (16th ed.). Pearson Education.
5. Schneider, G. (2017). Electronic commerce (13th ed.). Cengage Learning.
6. Ray, S. (2011). E-business. Himalaya Publishing House.

SEMESTER VI

26-252-0603 INTELLECTUAL PROPERTY RIGHTS

Course Objectives:

1. To build awareness of Intellectual Property Rights (IPR) and their role in protecting creative and innovative endeavours.
2. To understand the laws, procedures, and enforcement mechanisms related to patents, trademarks, geographical indications, copyrights, and industrial designs.
3. To learn about registration, rights, licensing, and infringement of various forms of intellectual property.
4. To explore the application of IPR in technology, software, and innovation-driven industries.

Course Outcomes:

Course Outcomes (Cos)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand the fundamental concepts, scope, and significance of Intellectual Property Rights (IPR) and their role in technology, innovation, and digital industries.	Understand
CO2	Apply the procedures and legal requirements for obtaining patents, and interpret their implications in software, data science, and AI-related innovations.	Apply
CO3	Analyze the purpose, registration process, and protection mechanisms of trademarks and geographical indications in the digital and business environment.	Analyze
CO4	Evaluate the legal aspects of copyright and industrial design protection, focusing on software copyright, infringement issues, and ethical use of digital content.	Evaluate

Mapping of course outcomes (Cos) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	3	2				
CO2		3	2	3			
CO3		2	3		2		
CO4		3	2		3	2	

Module I

Concept and importance of Intellectual Property (IP) Types of IPR: Patents, Trademarks, Copyright, Industrial Designs, and Trade Secrets Scope and significance of IPR in innovation and business. Overview of international IPR frameworks: WIPO and TRIPS Agreement. Role of IPR in digital and technology-driven industries

Module II

Meaning, purpose, and types of patents- Conditions for patentability – Procedure for filing and granting of patents in India- Rights and duties of a patentee- Patent infringement and remedies- Emerging areas: Biotechnology, Software, and AI-related patents -International patent cooperation and treaties (PCT overview)

Module III

Concept and functions of trademarks-Types of trademarks and process of registration-Rights of the trademark owner and protection against infringement-Licensing, assignment, and renewal-Concept of Geographical Indications (Gis) and their importance in trade

Module IV

Copyright: Copyright Registration procedure and copyright authorities, Assignment and transfer of copyright, copyright infringement and exceptions to infringement, Software copyright. Introduction to the law on Industrial Designs.

References:

1. Vinod V Sople, Managing Intellectual Property- The Strategic Imperative, PHI, 5/e (2016), ISBN 9788120352650.
2. Krishna Kumar, Cyber law, intellectual property and e-commerce security, Dominent Publication and distribution, (2011), ISBN 8187336897.
3. Craig Fellenstein, Rachel Ralson, Inventors Guide to Trademarks and Patents, Prentice Hall, 1/e, (2011), ISBN 9780132597562.
4. David Bainbridge, Intellectual Property, Longman, 8/e, (2010), ISBN 9781408229286.

26-252-xx04 OPERATIONS RESEARCH

Course Objectives:

1. To apply optimization techniques for solving engineering and business problems under resource constraints.
2. To learn the fundamentals of Linear Programming, including the Simplex Algorithm, Duality, Transportation, and Assignment problems.
3. To understand the principles of Dynamic Programming for solving large-scale optimization problems.
4. To apply inventory models to formulate and solve real-world resource-constrained optimization problems.

Course Outcomes:

Course Outcomes (Cos)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand the concept of optimal solutions for constrained problems and mathematical formulation of real-world constrained problems.	Understand
CO2	Apply selected algorithms to identify linear programming problems.	Apply
CO3	Analyse problems under the general class of transportation and assignment problems.	Analyze
CO4	Evaluate the constraining conditions in real situations, develop mathematical formulations and appropriate mathematical models using linear programming or dynamic programming methods.	Evaluate

Mapping of course outcomes (Cos) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2		2	2		
CO2	3	2	1	2	3	2	
CO3	3	2	1	2	3	2	
CO4	3	2		3	3	2	1

Module 1

Introduction to Operations Research: Basics definition, scope, objectives, phases, models and limitations of Operations Research – Linear Programming Problem – Formulation of LPP, Graphical solution of LPP – Simplex Method – Artificial variables – big-M method – Two- phase method – Degeneracy and unbound solutions.

Module 2

Transportation Problem – Formulation, solution, unbalanced Transportation problem – Finding basic feasible solutions – Northwest corner rule – Least Cost method and Vogel's approximation method - Optimality test: Stepping Stone method and MODI method.

Module 3

Assignment model – Formulation – Hungarian method for optimal solution – Solving unbalanced problem – Travelling salesman problem and assignment problem – Solving LPs using Solver – Revisiting the formulation – Three types of LPs – Dual solution – Sensitivity analysis.

Module 4

Dynamic programming: Characteristics of dynamic programming – Dynamic programming approach for Priority Management - Employment smoothening - Capital budgeting - Stage Coach/Shortest Path - Cargo loading and Reliability problems. Inventory model: demand rate uniform and production rate infinite.

References:

1. Srinivasan G. (2017) Operations Research: Principles and Applications, PHI Learning Private Limited.
2. Taha H. A. (2013) Operations Research: An Introduction, Pearson.
3. Ravindran, A. R. (2016). Operations research and management science handbook. Crc Press.
4. Hillier, F. S. (2012). Introduction to operations research. Tata McGraw-Hill Education.
5. Kasana, H. S., & Kumar, K. D. (2013). Introductory operations research: theory and applications. Springer Science & Business Media.
6. Shah, N. H, Gor, R. M. Soni H. (2007) Operations Research, Eastern Economy Edition.

6.9. Minor Courses Offered by DDUKK in the Data Science and Analytics Discipline

Sl.No.	Course Code	Type	Course Title	Hours				Marks		Credits
				L	T	P	Hrs/ Week	CA	ESE	
1	26-252-xx10	Minor	Programming Languages for Data Science and Analytics	3	0	2	5	50	50	4
2	26-252-xx11	Minor	Principles of Database Management	3	0	2	5	50	50	4
3	26-252-xx12	Minor	Data Visualization Techniques	3	0	2	5	50	50	4
4	26-252-xx13	Minor	Principles of Data Mining	3	0	2	5	50	50	4
5	26-252-xx14	Minor	Big Data Analytics	3	0	2	5	50	50	4
6	26-252-xx15	Minor	Text and Web Analytics	3	0	2	5	50	50	4

L=Lecture hours, T=tutorial hours, P=Practical hours, CE= Continuous Evaluation, SEE=Semester End Examination

26-252-xx10 PROGRAMMING LANGUAGES FOR DATA ANALYTICS

Course Objectives:
1. Gain understanding of the fundamentals of R and Python programming for data analytics.
2. Learn to use R for data management, visualization, and basic statistical analysis.
3. Develop programming skills in Python for analytical problem-solving and data-driven applications.
4. Build the ability to integrate R and Python tools to support effective data analysis and interpretation.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand the fundamentals of Python programming, including data types, functions, conditionals, and control structures.	Understand
CO2	Apply file handling, data structures, classes, exceptions, and regular expressions to solve computational problems in Python.	Apply
CO3	Analyze and organize data using R arrays, matrices, lists, and data frames for efficient data handling and processing.	Analyze
CO4	Develop basic programs in R using variables, data types, vectors, and control statements for data manipulation and computation.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2					
CO2	3	3	2		1		
CO3	3	3	2		2	1	
CO4	3	3	2		2	1	

Module 1
Python overview: Basic data types – Functions: arguments, block structure, scope, recursion – Modules - Conditionals and Boolean expressions - Sequences: Strings, Tuples, Lists – Iteration, looping and control flow - String methods and formatting.

Module 2
File processing and Classes in Python: Dictionaries, Sets, Files – Text processing. Classes - Class instances, Methods - Iterators and Generators - Regular expression – Exceptions handling and testing.

Module 3

Introduction to R: Getting started with an IDE – R Studio; Console as a calculator – variable assignment – arithmetic in R - basic data types: numeric, integers, logical and characters – type match errors – type checking – type conversion; Familiarization with packages. Vectors and Loop functions: Create vectors – Element naming – Vector arithmetic – Select elements – Multiple elements – Compare vectors – Logical vectors – Missing values – Modify subset of elements. Control statements – if statements, for loop, repeat, while.

Module 4

Arrays and Matrices: Array indexing – Array function – Array arithmetic. Construct matrix – Matrix naming – Matrix indexing Lists and Data frames: Creating and modifying lists – select list elements - concatenate lists. Creating data frame - select frame elements – Sorting – attach() and detach() functions – Search path.

References:

1. William N. Venables, David M. Smith (2009); An Introduction to R, Second edition,
2. Network Theory Limited.
3. Robert Kabacoff (2015); R in Action: Data Analysis and Graphics with R, Manning
4. Publication Company.
5. Guttag, John (2013); Introduction to Computation and Programming Using Python,
6. Spring 2013 edition, MIT Press.
7. Marl Lutz (2013); Learning Python, Fifth edition, OReilly media.
8. William MKinney (2012);Python for Data Analysis, OReilly media.
9. https://developers.google.com/edu/python/

26-252-xx11   PRINCIPLES OF DATABASE MANAGEMENT

Course Objectives:

1. Gain understanding of the fundamentals and importance of database management systems (DBMS) in data storage, organization, and analysis.

2. Learn concepts of data modeling, normalization, SQL operations, and transaction management for efficient and reliable data handling.

3. Develop knowledge of NoSQL and cloud databases and their integration with Python or R for basic data analytics applications.

4.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand the core concepts of DBMS, data models, and schema architecture for effective data organization.	Understand
CO2	Apply Entity-Relationship modeling and normalization techniques to design efficient and consistent databases.	Apply
CO3	Analyze and integrate data using NoSQL and cloud-based databases with programming tools like Python or R.	Analyze
CO4	Develop and execute SQL queries for data definition, manipulation, and analytical processing.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1				
CO2	3	3	2		1		
CO3	3	3	2	2	2	1	
CO4	3	3	2		2	1	

Module I

Overview of DBMS, Data Models, Schema Architecture, DBMS Users and Roles. Entity-Relationship Modeling: Keys, Constraints, ERD components, and mapping ERD to relational schema.

Module II

Data redundancy and anomalies, Functional Dependencies (FD), Normalization up to 3NF (brief intro to BCNF). Basic concepts of Transactions and ACID properties for reliable data handling.

Module III

SQL: Creating and managing databases using DDL and DML. Data Retrieval and Analysis: Filtering, Grouping, Joins, Subqueries, Views, Indexes. Analytical SQL Functions: Aggregates, Ranking, and Conditional Expressions for decision-making.

Module IV

Introduction to NoSQL: Key-Value and Document Databases (e.g., Redis, MongoDB). Cloud Databases (DBaaS) basics: DynamoDB / BigQuery. Connecting databases with Python/R for basic data analytics tasks.

References:

1. Elmasri R., Navathe S. (2013). Database Systems: Models, Languages, Design and Application Programming, Pearson Education.
2. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2011). Database system concepts, 6/e, McGraw Hill.
3. Akerkar, R. (2009). Foundations of the semantic Web: XML, RDF & ontology. Alpha Science International, Ltd.
4. Plunkett, T., Mohiuddin, K., Macdonald, B., Harding, D., Nelson, B., Segleau, D., Sun, H., Mishra, G., Hornick, M., Stackowiak, R. and Laker, K., 2013. Oracle Big Data Handbook. Oracle Press, New York.
5. Perkins, L., Redmond, E., & Wilson, J. (2018). Seven databases in seven weeks: a guide to modern databases and the NoSQL movement. Pragmatic Bookshelf.
6. Thomasian, A. (2013). Database Concurrency Control: Methods, Performance, and Analysis (Vol. 1). Springer Science & Business Media.
7. Lee Chao, Cloud Database Development and Management, 1e, CRC Press, 2013.
8. Hoffer Jeffrey, V. Ramesh, Topi Heikki, Modern database management, 12e, Pearson, 2015.
9. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, 6e, McGraw-Hill, 2013.
10. Benjamin Bengfort, Jenny Kim, Data Analytics with Hadoop, O'Reilly Media, June 2016.

26-252-xx12 DATA VISUALIZATION TECHNIQUES

Course Objectives:
1. Gain understanding of the fundamentals of data visualization and storytelling using visual analytics tools.
2. Learn to apply design principles and perceptual understanding to create clear, meaningful, and accurate visual representations of data.
3. Develop hands-on skills in using Tableau and Power BI to design interactive dashboards for data-driven decision-making.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand the purpose, principles, and visual perception aspects underlying effective data visualization.	Understand
CO2	Apply visualization design techniques using Tableau to represent data through charts, plots, and simple dashboards.	Apply
CO3	Use Power BI to connect, transform, and model data, and create visual reports using DAX functions.	Analyze
CO4	Design and customize interactive dashboards with filters, slicers, and AI-driven visuals to derive analytical insights.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2					
CO2	3	3	2		2		
CO3	3	3	2		3	1	2
CO4	3	3	2	1	3	1	3

Module I
Value and purpose of data visualization-Telling stories with data- Principles of effective visualization and design-Basics of visual perception and graphical integrity- Common visualization types: bar charts, line charts, scatter plots, heatmaps, and time series.

Module II
Introduction to Tableau: dimensions and measures-Mapping data to visuals (bar, line, dot plots, tables, heatmaps)-Visual encoding, color, and layout principles-Adding titles, captions, legends, and annotations-Designing simple dashboards and sharing visual insights

Module III
Overview of Power BI Desktop-Connecting to common data sources (Excel, CSV, SQL)-Basic data transformation using Power Query-Simple data modeling and relationships-Basic DAX functions: SUM, AVERAGE, COUNT, MIN, MAX-Creating visuals: bar, column, pie, line, table, and KPI cards.

Module IV
Filters, slicers, and hierarchies-Conditional formatting and customization-Time-based visuals (YTD, MTD)-Combining visuals into interactive dashboards-Introduction to AI visuals (Key Influencers, Quick Insights).

References:

1. Tamara Munzner (2014); *Visualization Analysis and Design*, CRC Press.
2. Nathan Yau (2011); *Visualize This: The FlowingData Guide to Design, Visualization, and Statistics*, Wiley.
3. Ryan Sleeper (2020); *Innovative Tableau: 100 More Tips, Tutorials, and Strategies*, O'Reilly Media.
4. Alexander Loth (2019); *Visual Analytics with Tableau*, Wiley.
5. Alberto Ferrari & Marco Russo (2019); *Introducing DAX: Fundamental Concepts*, Microsoft Press.
6. Matt Allington (2016); *Learn to Write DAX: A Practical Guide to Learning Power Pivot for Excel and Power BI*, Self-published.
7. Reid Havens (2021); *Microsoft Power BI Data Analyst Certification Guide*, Packt Publishing.

26-252-xx13 PRINCIPLES OF DATA MINING

Course Objectives:

1. Gain understanding of the fundamental concepts, principles, and methods of data mining.
2. Learn major data mining techniques and their practical applications.
3. Develop skills to implement data mining processes and analyze real-world datasets effectively.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand the fundamental concepts, stages, and applications of data mining, and perform data preprocessing using analytical tools.	Understand
CO2	Apply various classification and prediction models such as Decision Tree, KNN, Bayesian, and SVM to real-world datasets using analytical tools.	Apply
CO3	Analyze transactional data to discover frequent patterns and association rules for meaningful insights.	Analyze
CO4	Evaluate and implement advanced data mining techniques such as time series, sequence, graph, and social network analysis using modern tools.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1		2	1		
CO2	3	3	1	1	2	1	
CO3	2	2	1	1	3	2	
CO4	2	2	1	3	2	1	2

Module 1
Basics of data mining, data mining stages, Applications of data mining, Data Pre-processing: Need for Pre- processing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction. CASE studies: Download free data sets from online repositories, analyse and clean them using tools such as MS Excel.

Module 2

Classification models: Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, KNN, Bayesian Classification, Support Vector Machines. Case studies: Using the clean data prepared in case study of module 1, classify using the decision tree and SVM models using tools such as R/WEKA/MATLAB/PYTHON

Module 3

Association rules mining: Mining Frequent Patterns, Associations and Correlations: Basic Concepts, Mining various kinds of Association Rules, From Association Mining to Correlation Analysis, Case studies: Using WEKA, perform association rule mining over the standard transaction datasets.

Module 4

Advances in data mining, Time Series and Sequence patterns in Transactional Databases, Mining Sequence Patterns in Biological Data, Graph Mining, Social Network Analysis.

References:

1. Han, J., Pei, J., & Kamber, M. (2011). *Data mining: concepts and techniques*. Elsevier.
2. Hall, M., Frank, E., Holmes, G., Pfahringer, B., Reutemann, P., & Witten, I. H. (2009). The WEKA data mining software: an update. *ACM SIGKDD explorations newsletter*, *11*(1), 10-18.
3. Gupta, G.K (2014) Introduction to Data Mining with Case Studies, 2014, Prentice Hall India.
4. Elayidom, M.Sudheep (2014) Data Mining and WareHousing, , Cengage Learning India Pvt.Ltd,
5. Zhao, Y (2015) R and data mining: Examples and case studies, Access at www.RDatamining.com
6. Pujari, Arun K (2016) Data Mining Techniques,Third edition, Universities Press.
7. Soman, K.P, Diwakar, S, Ajay, V (2008)Insight into Data Mining, Prentice Hall India
8. PaulrajPonnaiah (2001) Data Warehousing Fundamentals, John Wiley& Sons
9. Roiger, R., Gaetz , M .W (2003) Data Mining – A Tutorial Based Primer, Pearson.

Online support training materials and videos:

1. The NPTEL data mining course from IITKGP
2. ―Introduction to data analytics:‖ MOOC course from IITM
3. The EDUREKA data mining certification program
4. The Intellipaat Data Science Certification program
5. Data mining with WEKA, MOOC courses from University of Waikato, Newzeland

26-252-xx14 BIG DATA ANALYTICS

Course Objectives:
1. Gain understanding of Big Data concepts, architectures, and tools for large-scale data storage, processing, and analysis.
2. Learn the Hadoop ecosystem, including HDFS, YARN, MapReduce, and data ingestion tools like Sqoop, Flume, and Kafka.
3. Develop skills in data warehousing and analytics frameworks such as Hive, Pig, and Spark.
4. Gain hands-on experience with PySpark and real-time data streaming using Kafka and Spark Streaming.
5. Understand Big Data deployment on cloud platforms and best practices for performance, scalability, and data security.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Explain the characteristics, architecture, and components of Big Data systems, including Hadoop, HDFS, YARN, and MapReduce.	Understand
CO2	Apply data storage, processing, and ingestion techniques using Hadoop ecosystem tools such as HDFS, MapReduce, Sqoop, Flume, and Kafka.	Apply
CO3	Utilize Hive, Pig, and Spark frameworks for data transformation, and large-scale analytics using structured and ur datasets.	Analyze
CO4	Develop and evaluate real-time Big Data processing solutions integrating Kafka, Spark Streaming, and cloud platforms with attention to security and performance optimization.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1		2			
CO2	3	3	1	2	2	1	
CO3	3	2	1	1	2	1	
CO4	3	3	1	3	3	2	2

Module I
Introduction to Big Data: Characteristics, Types of Data- Traditional vs Big Data Systems- Big Data Architecture & Data Pipeline Overview- Hadoop Ecosystem Components (HDFS, YARN, MapReduce)-Cluster Architecture: NameNode, DataNode- Overview of Distributed Computing & Parallel Processing.

Module II
HDFS Architecture, block size, replication, fault tolerance - MapReduce Framework: Mapper, Reducer, Combiner, Input/Output formats- Data flow, shuffle, and sort phase- YARN Architecture – ResourceManager, NodeManager.

Module III
Apache Hive: Data warehouse concept, schema, tables, partitions, bucketing, HiveQL basics- Apache Pig: Pig Latin language, data flow, execution- Apache Spark: RDD, DataFrame, DAG execution, Spark architecture and advantages- Basics of PySpark.

Module IV
Real-time Big Data Processing: Kafka overview and integration with Spark- Introduction to Apache Flink and Storm (conceptual)- Big Data in Cloud (AWS, Azure, GCP – overview)- Security & Privacy in Big Data Systems- Performance Optimization & Best Practices

References:

1. Clifton, B. (2010). *Advanced web metrics mit Google Analytics: Praxis-Handbuch*. MITP- Verlags GmbH & Co. KG.
2. Prajapati, V. (2013). Big data analytics with R and Hadoop. Packt Publishing Ltd..
3. Marconi, K., & Lehmann, H. (Eds.). (2014). *Big data and health analytics*. CRC Press.
4. Warden, P. (2011). *Big data glossary*. O'Reilly Media, Inc.
5. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing andPresenting Data, EMC Education Services, WILEY, 2015
6. Elayidom, M. S. (2015). Datamining and Warehousing. *Cengage Learning India Pvt Ltd.*
7. Berthold, M. R., & Hand, D. J. (Eds.). (2007). *Intelligent data analysis: an introduction*. Springer.
8. Plunkett, T., Macdonald, B., Nelson, B., Hornick, M., Sun, H., Mohiuddin, K., ... & Segleau, D. (2014). *Oracle big data handbook*. McGraw-Hill Education.
9. White, T. (2012). *Hadoop: The definitive guide*. " O'Reilly Media, Inc.
10. Zikopoulos, P., & Eaton, C. (2011). *Understanding big data: Analytics for enterprise class*

26-252-xx15 TEXT AND WEB ANALYTICS

Course Objectives:

1. Gain understanding of text and web analytics for extracting insights from unstructured and streaming data.
2. Learn techniques such as text preprocessing, topic modeling, sentiment analysis, and real-time data stream processing.
3. Develop skills in web mining, including content, structure, and usage mining, while considering ethical aspects of web scraping.

Course Outcomes:

Course Outcomes (COs)		Bloom's Taxonomy Level
After completion of the course, the student will be able to:		
CO1	Understand text analytics processes including text collection, preprocessing, and representation using Bag of Words and TF-IDF models.	Understand
CO2	Apply topic modeling and sentiment analysis techniques such as PLSA, LDA, and lexicon-based methods for text understanding.	Apply
CO3	Analyze real-time data streams for sentiment and trend detection using stream processing and summarization techniques.	Analyze
CO4	Evaluate web mining approaches for extracting insights from online data while addressing ethical considerations in web scraping.	Create

Mapping of course outcomes (COs) with programme specific outcomes (PSOs): Low=1, medium=2, High=3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1		2			
CO2	3	3	1	1	2	1	
CO3	3	2	1		2	1	
CO4	2	1		3	2	1	2

Module 1

Introduction to Text Analytics – Text Analytics Steps – Collecting Raw Text – Text Preprocessing - Tokenization, Stemming, Lemmatization, Stopword Removal– Representing Text – Bag of Words – Term Frequency-Inverse Document Frequency (TFIDF) - Cosine Similarity – Applications of Text Analytics in Business and Social Media

Module 2

Topic Models – Probabilistic Latent Semantic Analysis (PLSA) – Latent Dirichlet Allocation (LDA) . Sentiment Analysis – Lexicon-based Approaches –SentiWordNet

Module 3

Introduction to Data Streams – Opportunities and Challenges in Stream Mining – Real-time Data Processing– Data Summarization Techniques – Case Study on Tweet Analysis – Real-time Sentiment and Trend Analysis.

Module 4

Introduction to XML – XSLT for Styling XML – XPath for Querying XML – Web Mining – Web Content Mining – Web Structure Mining – Web Usage Mining – Web Scrapers – Web Crawlers – Ethical Considerations in Web Scraping

References:

1. Zhai, C.X. & Massung, S. (2016); *Text Data Management and Analysis: A Practical Introduction to Information Retrieval and Text Mining*, ACM Books.
2. Miner, G., Elder IV, J., & Hill, T. (2012); *Practical Text Mining and Statistical Analysis for Non-Structured Text Data Applications*, Academic Press.
3. Struhl, S. (2015); *Practical Text Analytics: Interpreting Text and Unstructured Data for Business Intelligence*, Kogan Page.
4. Silge, J. & Robinson, D. (2017); *Text Mining with R: A Tidy Approach*, O'Reilly Media.
5. Kaushik, A. (2007); *Web Analytics: An Hour a Day*, John Wiley & Sons.
6. Clifton, B. (2012); *Advanced Web Metrics with Google Analytics*, John Wiley & Sons.
7. Kelly, N. (2012); *How to Measure Social Media: A Step-by-Step Guide to Developing and Assessing Social Media ROI*, Que Publishing.

7.1 MODEL QESTION PAPER TEMPLATE

Reg. No: …………………

B.Voc. HONOURS DATA SCIENCE AND ANALYTICS

I SEMESTER REGULAR EXAMINATION

NOVEMBER 2025

26-252-xxxx SUBJECT

(2026 Scheme)

Time: 3 Hours   Maximum Marks: 50

Course Outcomes:

CO1	
CO2	
CO3	
CO4	
CO5	

BL- Bloom's Taxonomy Levels: (LI-Remember, L2- Understand, L3- Apply, L4- Analyse, L5-Evaluate, L6 Create)
PO- Programme Outcome

PART A

(Answer *ALL* questions)

Q No.	Questions	Marks	BL	CO	PO
1.		2	L?	CO?	PO?
2.		2			
3.		2			
4.		2			
5.		2			

(5 x 2 = 10 Marks)

PART B

(Answer *ANY FOUR* questions)

Q No.	Questions	Marks	BL	CO	PO

6.		5	L?	CO?	PO?
7.		5			
8.		5			
9.		5			
10.		5			
11.		5			
12.		5			

(5 x 4 = 20 Marks)

PART C
(Answer *ANY TWO* questions)

Q No.	Questions	Marks	BL	CO	PO
13.		10	L?	CO?	PO?
14.		10			
15.		10			

(10 x 2 = 20 Marks)

Ll- % L2- %, L3- % , L4- %, L5- % , L6 – %

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Regulations for Four Year "Bachelor of Vocation Honours (B.Voc. Honours) Data Science and Analytics" Programme - 2026 of Cochin University of Science and Technology

(2026 Admission Onwards)

1. Short Title and Commencement

This Regulations may be called **Regulations for Four Year "Bachelor of Vocation Honours (B.Voc. Honours) in Data Science and Analytics" Programmes - 2026 of** Cochin University of Science and Technology under the New Curriculum and Credit Framework for B.Voc. Programmes (2025) by Kerala State Higher Education Council in sync with the latest UGC and National Credit Framework (NCrF) guidelines. The provisions of this regulation shall come into effect commencing with the 2026-27 academic year and shall have prospective application.

2. Scope and Application

This Regulation shall apply to the Under Graduate Vocational (B.Voc Honours) in Data Science and Analytics Programme of DDUKK, CUSAT for the admissions commencing from the academic year 2026-27 and onwards.

3. Definitions

3.1 **University:** means Cochin University of Science and Technology established by the Cochin University of Science and Technology Act, 1986.

3.2 **FYUGP:** means Four Year Under Graduate Programme.

3.3 **Department/School/Centre**: means Department/School/Centre instituted in the University as per Cochin University of Science and Technology Statutes and Act.

3.4 **Academic Year**: Two consecutive (one odd and one even) semester followed by a vacation in one academic year.

3.5 **Academic Week**: A unit of five working days in which the distribution of work is organized, with six hours of one-hour duration on each day.

3.6 **Credit:** is the quantity of instruction given or the learning outcomes and a notional time to achieve those outcomes. It is a unit by which the course work is measured. It determines the number of hours of instructions required per week in a semester. It is defined both in terms of student efforts and teacher's efforts. A course which includes one hour of lecture or minimum 2 hours of lab work/ practical work/practicum/ hands-on skill training/field work per week is given one credit hour. Accordingly, one credit is equivalent to one hour of lecture or two hours of lab work /practical work/hands-on skill training/ field work/ practicum and learner engagement in terms of course related activities (such as seminars preparation, submitting assignments, group discussion, recognized club-related activities etc.) per week. Generally, a one credit course in a semester should be designed for 15 hours lectures or 30 hours of practical/ field work/ practicum/ hands-on skill training and 30 hours learner engagement. A two credit On the Job Training (OJT) in a semester should be designed for 5 hours per week. One credit of Apprenticeship/Research Internship is equivalent to 10 days.

3.7 **Major component**: is the subject that is the main focus of the study. By selecting a major, the student would be provided with an opportunity to pursue an in-depth study of a particular subject or discipline.

3.8 **Minor component**: is a secondary field of study that broadens a student's knowledge beyond their primary or major discipline.

3.9 **Discipline Specific Course**: is that focuses on a specific subject or field of study. These courses are designed to provide students with a deep understanding of the theories, concepts, and practices within a particular discipline.

3.10 **Discipline Specific Core (DSC)**: is a course that should be pursued by a student as a mandatory requirement of his/her programme of study.

3.11 **Discipline Specific Elective (DSE)**: is a course of a particular discipline that a student has the choice to select from a pool of such courses from his/her programme of study. The DSEs to offer in a programme of study would be identified by the concerned Department/School.

3.12 **Capstone level courses**: allow the students to demonstrate their cumulative knowledge in their field of study. It plays a vital role in preparing students for the world of work with practical applications, professional knowledge, and skills.

3.13 **Ability Enhancement Courses (AEC)**: are the courses designed specifically to achieve competency in modern Indian/world languages and English with special emphasis on communication skills.

3.14 **Skill Enhancement Courses (SEC):** are designed to develop Creativity, Critical Thinking, Communication, and Collaboration, which are known as 21st-century skills.

3.15 **Value Addition Courses (VAC)**: are the courses meant for personality development, perspective building and developing self-awareness of a graduate student.

3.16 **Multi-Disciplinary Courses (MDC)**: are the courses intended to broaden the intellectual experience and to build a conceptual foundation about arts, science, commerce, language, and social sciences among students.

3.17 **Audit Course**: means a course which can be opted by a student but which will not accrue any credit.

3.18 **MOOC Course**: means a Massive Open Online Course offered in SWAYAM platform by UGC, CUSAT or any other recognized educational agencies approved by the University.

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

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

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

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

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

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

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

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

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

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

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

3.29 **Course Faculty**: A faculty member nominated by the Head of the Department shall be in charge of offering a particular course in a particular semester of B.Voc. programme.

3.30 **CSDCCP:** means Centre for Skill Development Courses and Career Planning (CSDCCP)

3.31 **Graduate Attributes**: means the qualities and characteristics to be obtained by the graduates of a programme of study at the University or the Higher Education Institution, which include the learning outcomes related to the disciplinary areas in the chosen field of learning and generic learning outcomes. University will specify graduate attributes for its programmes.

3.32 Regulations for Conducting Online Courses (MOOC): The regulations and guidelines issued by CUSAT, from time to time, for the conduct of MOOC courses as part of Undergraduate and Postgraduate programmes of CUSAT.

3.33 **Cumulative Grade Point Average (CGPA)**: It is a measure of overall performance cumulative of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

3.34 **National Council for Vocational Education and Training (NCVET)**: NCVET was established under the Ministry of Skill Development and Entrepreneurship as a regulatory body by the Government of India in 2018 and fully operational since 1st

August 2020. The NCVET serves as an overarching national regulator with the aim of setting standards, developing comprehensive regulations, and improving the vocational education, training, and skilling ecosystem. National Council for Vocational Education & Training (NCVET) is the apex body for implementation of National Skill Qualification Framework (NSQF).

3.35 **National Skill Qualification Framework (NSQF)**: The National Skills Qualification Framework (NSQF) is an outcome and competency-based framework which organizes qualifications according to a series of levels of knowledge, skills, aptitude, and responsibility defined in terms of learning outcomes which the learner must acquire through formal, non-formal or informal learning which may comprise of academics, vocational education, training & skilling and experiential learning including relevant experience and proficiency/ professional levels acquired, subject to assessment.

3.36 National Skills Qualification Committee (NSQC): NSQC refers to the Committee set up for approval of Qualifications under NSQF.

3.37 Learning Outcomes (LOs): Learning Outcomes represent what a learner knows, understands and is able to do on completion of a learning process, and which would be expressed in terms of knowledge, skills and competence.

3.37.1 **Job Role**: It refers to specific occupation or position within an industry, defined by a set of competencies, knowledge, and skills required to perform task effectively. Each job role is aligned with a particular NHEQF/NSQF level.

3.38 **National Occupational Standards (NOS)**: National Occupational Standards (NOS) specify the standard of performance that a person must meet when performing a job along with the skills and knowledge required to satisfy a standard consistently. These standards can form the benchmarks for various education and training programs to match with the job requirements.

3.39 **NHEQF**: means National Higher Education Qualification Framework

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

3.41 **Programme Pathway**: Combination of courses that can be chosen by a student that give options to pursue interesting and unconventional combinations of courses drawn from different disciplinary areas, such as sciences, social sciences, humanities, and a wide range of vocational fields including information technology, tourism, logistics, agriculture, fashion technology etc. The pathways could be in terms of major- minor options with different complementary/ allied disciplines.

3.42 **Qualification Pack (QP)**: A Qualification Pack (QP) is a set of NOS aligned to a job role. A QP is available for every job role in each industry sector.

3.43 **Sector Skill Council (SSC)**: The NOSs and QPs for each job role corresponding to each level of the NSQF are being formulated by the respective Sector Skill Councils (SSCs) set up by NSDC with industry leadership.

3.44 **Signature Courses**: Signature courses are specialized courses classified under Skill Development Component Elective (SDCE) Courses, Skill Enhancement Courses (SEC) or Value Addition Courses (VAC) designed and offered by the regular/ ad hoc/ visiting/ emeritus/ adjunct faculty member of a particular college with the prior recommendation of the BoS and the approval of Academic Council of the University.

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

3.46   **Bloom's Taxonomy**: Bloom's Taxonomy, originally developed in 1956 and revised in 2001, provides an important framework to design curriculum and teaching methodologies, and appropriate examination questions belonging to various cognitive levels. It outlines different levels of cognitive learning, from basic recall to creating new ideas, and is often depicted as a pyramid with six levels.

4. Salient Features of the Multidisciplinary B.Voc. (Honours) Programme

4.1 The features of the B.Voc. (Honours) programme are in line with the stipulations made by the UGC and as adapted by the Curriculum and Credit Framework for Bachelor of Vocation (B.Voc.) programmes proposed by Kerala State Higher Education Council.

4.2 The B.Voc. programme shall have five Broad Pathways,

> (a) 1-year UG Certificate
>
> (b) 2-year UG Diploma
>
> (c) 3-year B.Voc. Degree
>
> (d) 4-year B.Voc. Honours Degree
>
> (e) 4-year B.Voc. Honours with Research Degree.

4.3 Students who choose to exit after 1 year shall be awarded *UG Certificate -NHEQF Level 4.5* after the successful completion of the required minimum Courses with 50 credits and an additional 4-credits from Skill Enhancement Courses (SEC) in order to attain 60% of total credits in skill components.

4.4 Students who choose to exit after 2 years shall be awarded *UG Diploma-NHEQF Level 5.0* after the successful completion of the required minimum Courses with 100 credits and an additional 4-credits from Skill Enhancement Courses (SEC) in order to attain 60% of total credits in skill components.

4.5 Students who choose to exit after 3 years shall be awarded *B.Voc. Degree with Minor-NHEQF Level 5.5* in their respective Discipline/Disciplines after the successful completion of the required minimum Courses with 144 credits.

4.6 A 4-year *B.Voc. (Honours) Degree - NHEQF Level 6.0* in the Discipline/Disciplines shall be awarded to those who complete a specific number of Courses with 184 credits. Students who have chosen the Honours programme shall do a one-year structured apprenticeship/internship and 3 online courses from a minor discipline contributing 40 credits.

4.7 The practice of lateral entry of students to various semesters exists. The students who exit with Certification and Diploma shall be eligible to re-enter the programme at the exit level to complete the programme or to complete the next level within three years after exiting the programme.

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

4.9 The mentor shall prescribe suitable advanced level/capstone level courses for a minimum of 8 credits to be taken along with the courses on research methodology, research ethics, and research topic-specific courses including online and blended modes.

4.10 Students who have opted for the Honours with Research should successfully complete an industry-linked research project under the guidance of the mentor and should submit a research report for evaluation. The research shall be in the Major/Allied discipline.

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

*4.12 **The B.Voc. programme curriculum comprises Two Broad Parts:***

> Part I) General Education Components (GEC) and

> Part II) Skill Development Components (SDC).

4.13 The General Education Component of B.Voc. programmes shall consist of a set of General Foundation Courses and Minor Pathway Courses (MPC).

General Foundation Courses shall be grouped into 4 major baskets as

> 1. Ability Enhancement Courses (AEC),
> 2. Skill Enhancement Courses (SEC),
> 3. Value Addition Courses (VAC), and
> 4. Multi-Disciplinary Courses (MDC).

4.14 ***Ability Enhancement*** Courses shall be designed specifically to achieve competency in English and other languages as per the student's choice with special emphasis on language and communication skills. Students must complete 3 AECs with two mandatory English Courses and one Elective, which may be in English or other language.

4.15 English or other language courses shall be designed to enable the students to acquire and demonstrate the core linguistic skills, including critical reading, academic and expository writing skills as well as the cultural and intellectual heritage of the language chosen.

4.16 ***Multi-Disciplinary Courses*** (MDC) shall be so designed as to enable the students to broaden their intellectual experience by understanding the conceptual foundations of Science, Social Sciences, Humanities, and Liberal Arts. Students may not be permitted to take the MDC in all three semesters in the same discipline as studied under Part III during their Plus Two education, and MDC selection must also comply with the exclusion list published by the university. This shall be the sole condition for eligibility for MDC course selection. Third semester MDC can be Kerala specific content. BoS can prepare basket of courses under MDC in first and second semesters.

4.17 ***Skill Enhancement Courses*** (SEC) shall be designed to include modules on Employability Skills, Soft Skills and Life Skills with specific modules to enhance employability. These modules are NHEQF-aligned and approved, offering certification options of 30, 60, 90, or 120 hours through professional skilling agencies or University Skilling Centre or Vocational departments/centres. Among 9 credits, students are flexible to take 6 credits of SEC from Skill Development Courses.

4.18 ***Value Addition Courses*** (VAC) are tailored to the students' skill domains, designed by the respective Boards of Studies (BoS) with CSDCCP's assistance and included in University VAC course baskets. Value Addition Courses (VAC) shall be so designed as to empower the students

with personality development, perspective building, and self-awareness.

4.19 *Minor Pathway Courses* (MPC) offer the flexibility to select discipline(s) either related or unrelated to their vocational domain (major), promoting interdisciplinary learning and broadening academic horizons.

4.20 *Skill Development Components* (SDC) shall include any domain specific demand led skill training activity, enabling students to equip with practical skills leading to employment or improving employability or enabling them to acquire a duly assessed and certified skill in the chosen discipline. The skill development components shall be designed and delivered in line with National Occupational Standards (NOS) and Qualification Packs (QP), ensuring relevance to specific job roles and industries.

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

4.21 Major area of specialization shall be focused on Skill Development in the appropriate areas. By selecting a Major, the student shall be provided with an opportunity to pursue an in-depth study of a particular discipline.

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

4.23 Students should opt their 5th and 6th semester VAC and SEC from their SDC only.

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

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

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

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

4.28 All students shall undergo Summer Internship or Apprenticeship in a Firm, Industry or Organization; or Training in labs with faculty and researchers or other Higher Education Institutions (HEIs) or Research Institutions. The University will publish a separate guideline for Internship Programmes.

4.29 Students will be provided the opportunities for internships with local industries, business organizations, agriculture, health and allied sectors, Local Government institutions (such as panchayats, municipalities), State Planning Board, State Councils/ Boards, Research

Institutions, Research Labs, Library, elected representatives to the parliament/ state assembly/ panchayath, media organizations etc. These opportunities will enable the students to actively engage with the practical aspects of their learning and to improve their employability.

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

4.31 For the effective operation of this four-year vocational programme, a system of flexible academic transaction timings shall be implemented for the students and teachers.

5. Eligibility for Admission, Admission Process and Maximum Intake

A student who has passed the 10+2 examination with at least 50% marks from a recognized national or state board is eligible to apply, provided they have studied one of the following subjects for their +2 board examinations:

- Mathematics (Basic or Advanced)
- Applied Mathematics
- Business Mathematics
- Statistics

Recognized Boards include:

- Directorate of General Education, Kerala (DHSE & VHSE)
- Central Board of Secondary Education (CBSE)
- Council for the Indian School Certificate Examinations (CISCE)
- National Institute of Open Schooling (NIOS)
- Other State Boards recognized by the Government of Kerala.

5.2 Admission to the B.Voc. programme will be determined solely based on the candidate's performance in the relevant CUSAT CAT (Common Admission Test) examination. The selection process adheres to the reservation policies mandated by the Government of Kerala, with seats allocated for candidates belonging to Scheduled Castes (SC), Scheduled Tribes (ST), and Other Backward Communities (OBC) and so on as per the applicable rules. The maximum number of students that can be admitted to the programme will be decided by the University, from time to time, taking into account the infrastructure and facilities available at the Centre offering the programme.

5.3 The students at the end of second semester may be permitted to change their major component of study to any other vocational programme/institution/university across the state.

Based on the availability of seats and other facilities, the students may be permitted to opt any vocational discipline which had been studied during the first two semesters as Minor Pathway Courses (MPC) /Multidisciplinary Courses (MDC). If ranking is required it will be in the order of the highest-grade points secured in the discipline to which the switching of Major is sought.

5.4 Students shall be allowed to change their major vocational components, if required, to a maximum of 10% of the sanctioned strength of those particular programmes depending upon the academic and infrastructural facilities available in the university.

5.5 Students who exit with Certificate or Diploma shall be eligible to re-enter the programme at the exit level to complete the programme or to complete the next level.

5.6 The University shall admit candidates not only for programmes, but also for courses, however, the admission is subject to the availability of seats in the respective departments.

6. Course Registration

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

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

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

6.4 A student may withdraw from registered courses within 30 days of the semester's commencement, provided that the minimum credit-hour requirement is still met. This option is available to students who feel their course load is unmanageable.

7. Duration of Programmes, Credits Requirements and Options

7.1 Though the B.Voc. programme is of four-year duration, students will be offered the opportunity to take breaks during the programme and resume after the break, but the total duration for completing the B.Voc programme shall not exceed 6 years.

7.2 Students will get a NHEQF Level 4.5 Undergraduate Certificate after completing first two semesters with a credit of 50 (30 credits from SDC and 20 credits from GEC) and an additional 4-credits from Skill Enhancement Courses (SEC) in order to attain 60% of total credits in skill components.

7.3 Students will get a NHEQF Level 5.0 Undergraduate Diploma after completing first four semesters with a credit of 100 (60 credits from SDC and 40 credits from GEC) and an additional 4-credits from Skill Enhancement Courses (SEC) in order to attain 60% of total credits in skill components.

7.4 Students will get a NHEQF Level 5.5 B.Voc. degree after completing six semesters with a credit of 144 (90 credits from SDC and 54 credits from GEC).

7.5 Students will get a NHEQF Level 6.0 Honours degree after completing eight semesters with a credit of 184 (114 credits from SDC and 70 credits from GEC).

7.6 Students who wish to complete the undergraduate programmes faster may do so by completing different courses equivalent to the required number of credits and fulfilling all other requirements in N-1 semesters, where N is the number of semesters in the B.Voc programme of CUSAT.

7.7 For students who crossed 6 semesters at a slower pace, the requirement of 16 credits per semester from the institutions where they enrolled may be relaxed.

7.8 Credit Structure and Levels of Awards

NHEQF Level	Skill Development Component Credits	General Education Component Credits	Total Credits for Award	Normal Duration	Exit Points
4.5	30	20	50	Two Semesters	UG Certificate (50 credits) + SEC (4 credits)
5.0	60	40	100	Four Semesters	UG Diploma (100 credits) + SEC (4 credits)
5.5	90	54	144	Six Semesters	B.Voc. Degree with Minor
6.0	114	70	184	Eight Semesters	B.Voc. Honours/ Honours with Research

8. Re-admission and Scheme Migration

8.1 Students may complete the B.Voc programme at a slower pace. They will be allowed to pursue a 3-year B.Voc. programme within a period of 5 years and 4-year B.Voc programme within a period of 6 years without obtaining readmission.

8.2. The lateral entry for B.Voc programmes in the odd semesters are allowed based on the admission rules of the University from time to time, and subject to the availability of seats in the concerned Department/School.

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

8.2 Students who exit with Certificate or Diploma shall be eligible to re-enter the programme at the exit level to complete the programme or to complete the next level.

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

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

9. Credit Structure

The proposed number of credits per course and the credit distribution of them for the B.Voc. programme are given below-

	General Education Component (GEC) (Credits)					Total Credits (GEC)	Skill Development Components (SDC) (Credits)	Total Credits
B.VOC Degree 3 years	MDC	AEC	VAC	SEC	Minor		90	144
	9	9	9	3	24	54	61% 30 credit at NSQF 4.5 30 credit at NSQF 5.0 30 credit at NSQF 5.5	
						38.5%		
	Exit with a B.Voc Degree with 140 credit or proceed to the Honours level							
Honours Degree 4th year	3 online courses as per the regulation for online/MOOC courses of CUSAT			12		66 (37%)	114 (63%) 28 credits from apprenticeship /Research internship	184

9.1 A course that includes one hour of lecture or two hours of lab work/ practical work/ field work/ practicum/hands-on skill training per week is given one credit hour.

9.2 One credit in a semester should be designed for 15 hours of lectures or 30 hours of lab work/ practical work/ field work/ practicum and 30 hours of learner engagement in terms of course-related activities such as seminar preparation, submitting assignments, etc.

9.3 A one-credit seminar or internship or field work/ projects or community engagement and service will have two-hour engagements per week (30 hours of engagement per semester).

9.4 A course can have a combination of lecture credits, practical credits, hands-on skill training credits, OJT credits and practicum credits.

9.5 Minimum credit for one Course should be 2 (Two), and the maximum credit should be 4 (Four).

9.6 All Skill Development Components/ Minor Pathway Courses shall be of 4 (Four) credits. A four-credit course can include four modules.

9.7 Each semester requires a minimum of 18 skill credits (including theory, practical, activities based learning and, on-the-job-training) over six semesters.

9.8 For all Skill Development Components/ Minor Pathway Courses, there may be practical/ practicum of two or four hours per week.

9.9 All Courses under the Multi-Disciplinary, Ability Enhancement, Value Addition and Skill Enhancement categories are of 3 credits. A 3-credit course can include three modules.

9.10 A two credit OJT in a semester should be designed for 5 hours per week.

9.11 10-days of Apprenticeship/Research Internship is equivalent to one credit.

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

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

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

10. Course Structure of B.Voc. Data Science and Analytics Programme

The B.Voc. programme consists of the following categories of courses and the minimum credit requirements for pathway option-one shall be as follows;

Sl. No.	Categorization of Courses for the Programme	Minimum Number of Credits Required	
		3-year B.Voc	4-year B.Voc
1	Skill Development Components (SDC)	72	72
2	Minor Pathway Courses (MPC)***	24	36
3	Multi-Disciplinary Courses (MDC)	9	9
4	Skill Enhancement Courses (SEC)*	9	9
5	Ability Enhancement Courses (AEC)	9	9
6	Value Addition Courses (VAC)	9	9
7	Summer Internship**	2	2
8	On the Job Training (OJT)**	6	6
9	Apprenticeship/Research Internship	-	28
10	Professional Skill Training	4	4
	Total Credits	**144**	**184**

*6 out of 9 credits of the SEC are part of the SDC.
**The Summer Internship/OJT must be undertaken in an area aligned with the SDC. The credits earned through this activity shall contribute to the SDC.
***Students enrolled in the Honours degree programme must earn a minimum of 12 credits from MPC at level 300 or above.

Semester-wise Course Distribution

SEMESTER	Major (4 credit) SDC	Minor (4 Credit) GE	AEC (3 credit) GE	SEC (3 credit)	MDC (3 credit) (GE)	VAC (3 credit) (GE)	Total Courses	OJT/PST/project (Credit per semester)	Total Credits
Number of courses in each category per semester									
I	3	1	1			1	6	2(OJT)	24
II	3	1	1			1	6	2(OJT) 2 (PST)	26
III	3	1	1			1	6	2(OJT)	24
IV	3	1		1		1	6	2 (PST)	24
Summer Internship with Project									2
V	3	1		1		1	6		22
VI	2	1		1		1	5	4 (project)	22
Total	17	6	3	3	3	3	38		144
Exit with a B.Voc degree with Minor									
VII&VIII		3 online courses (12 Credits)						Internship/ apprenticeship/Work integrated 28 credit	184
Exit with a work integrated honours Degree with Minor									

11. Academic Levels of Pathway Courses

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

12. On the Job Training (OJT), Professional Skill Trainings (PSTs), Summer Internship with Project (SIP) and Apprenticeship/Internship with Project

12.1 *OJT (On-the-Job Training)* in vocational degree curriculum is a practical learning method where students apply classroom knowledge to real-world tasks at a worksite under the guidance of experienced professionals. It bridges the gap between academic theory and professional practice, providing hands-on experience with actual equipment, procedures, and workplace challenges to build specific job skills and enhance employability. Five hours of OJT per week in the IT and ITeS sector is mandatory. The department/centre can make flexi arrangements to meet this requirement.

12.2 *PSTs (Professional Skill Trainings)* are embedded in the curriculum to equip students with industry-aligned expertise and professional competencies critical for excelling in the IT and IT enabled sector. These training programmes shall emphasize hands-on learning through

industry-specific tools, and emerging practices IT and ITeS sector. Students shall attend Professional Skill Training with a duration of 60 hours each (2 credits each), in single or multiple spells, in the second and fourth semesters. Students shall be encouraged to participate in training programmes (having evaluation and certification) organized by state/national level Institutes/Centres or Departments of Universities including DDUKK/Professional bodies etc. to satisfy the requirements for acquiring credits for the aforementioned training programmes. In order to attend such training programmes, students have to obtain prior permission from the Centre by submitting the details of the institution offering the training programme. The credits for the participation in such training programme shall be awarded based on the training evaluation report submitted by the students along with the participation certificates. The associated training costs are to be borne by the students. The training contents shall be related to employment opportunities in the IT and ITeS sector.

12.3 *Summer Internship with Project* The one-month Summer Internship with Project in Semester IV provides B.Voc students with a critical industry interface with the IT and ITeS sector. Over a minimum of 20 working days, students apply their academic knowledge to a real-world problem within a professional setting. This mandatory component culminates in a project report, fostering practical skills, professional ethics, and a deeper understanding of their vocational domain. The experience is designed to enhance employability and bridge the gap between theory and practice.

12.4 *Main Project*: During the 6th semester, the students shall undertake a 4-credit Main Project, which can also be a continuation of their IV-semester Summer Internship Project if pre-planned. Students will undertake a significant data-driven project to solve real-world challenges such as building predictive models, optimizing business processes through analytics, or developing data visualization dashboards, thereby demonstrating their technical proficiency and strategic value to the technology industry. Students must submit their main project report by the Centre's deadline, and the final viva-voce is held alongside other end- semester exams before a board that includes at least one external examiner.

12.5 **Apprenticeship/Internship with Project**: One year (280 working days) mandatory Apprenticeship/Internship with Project in the VII and VIII semesters provides B.Voc Honours students with an immersive, capstone experience within the IT and ITeS sector. This extended engagement allows students to apply their academic knowledge to real-world industry challenges, developing specialized technical and professional skills. Under professional mentorship, students will undertake a significant live project, fostering expertise in areas such as, data science, data analytics, cloud computing and so on. This mandatory component is designed to bridge the gap between theory and practice, significantly enhancing graduate employability and ensuring industry readiness. The successful completion and evaluation of a detailed project report will demonstrate a student's ability to deliver tangible outcomes in a professional IT environment.

13. Programme Pathways and Curriculum Structure

Students who have joined for the B.Voc. programme shall have the option to choose the following pathways for their B.Voc. Degree/Honours in Data Science and Analytics.

13.1 *Degree with single Major*: A student pursuing the B.Voc. programme shall be awarded a Major degree in Data Science and Analytics if the student secures at least 60% of the total

credits in Data Science and Analytics discipline which is required for the award of the Degree in that Discipline.

13.2 *Degree Major with Minor*: A student pursuing the B.Voc. Programme is awarded a Major Degree in Data Science and Analytics, is also eligible to be awarded a Minor in another discipline of the student's choice, if the student earns a minimum of 24 credits from 6 pathway courses in that discipline.

Example: Data Science and Analytics Major with Business Studies or Economics or Econometrics or Mathematics or some other discipline as Minor.

13.3 *Major with Multiple Disciplines of Study*: This pathway is recommended for students who wish to develop core competencies in multiple disciplines of study. In this case, the credits for the minor pathway shall be distributed among the constituent disciplines/subjects. The student pursuing B.Voc. Degree in Data Science and Analytics is eligible to get mentioned his or her core competencies in other disciplines of choice if he or she has earned 18 credits from the pathway courses of that discipline.

Example: Data Science and Analytics Major with Minors in Business Studies and Economic or in Banking & Financial Services and Biotechnology or Logistics Management and Commerce etc.

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

Example: Fashion Innovation and Retail Management Major, Agri-Business and Food Technology Major, Financial Technology and Banking Analytics Major, Econometrics Major, Global Studies Major, Biostatistics Major etc.

13.5 *Degree with Double Major*: A student who secures a minimum of 50% credits from the first major will be awarded a second major in another discipline if the student could secure 40% of credits from that discipline for the 3-year/4-year UG degree will be awarded a double major degree.

Example: 'Data Science and Analytics' Major and 'Travel and Tourism' Major; 'Data Science and Analytics' Major and 'Business Studies' Major; Data Science and Analytics Major and Finance and Taxation Major etc.

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

14.1 A student shall register to a minimum of 16 credit per semester from the department (parent department) where he or she officially admitted for a particular programme. However, students enrolled in the parent department can simultaneously enrol for additional credits from other departments within the University or outside University subject to a maximum of 30 credits per semester including the 16 parent departmental credits.

14.2 As part of the B.Voc programme, students may acquire credit for their minor courses through SWAYAM/MOOCs/online sources in adherence to the University's "Regulations for Conducting Online Courses (MOOC)." These courses may strategically be planned to begin early ensuring ample time for completion and the inclusion of the marks and grades in the respective semester mark list. The BoS may prepare and publish a list of online courses at

different levels before the commencement of each semester offered in various online educational platforms recognized by the academic council of the university, which can be opted by the students for acquiring additional credits.

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

15. Mode of Evaluation of Courses

15.1 *Mode of Evaluation:* The whole system of evaluation and grading will be made as per the "Regulation for Under Graduate Programmes under Choice Based Credit System (CBCS) offered by the University Departments/Schools/Centres" and the amendments made on it from time to time by the University, except for certain special cases applicable to B.Voc programme. As per the regulation, the entire system of evaluation is internal for University Departments/Schools/Centres. Out of which 50% marks are for Continuous Assessment/ Evaluation (CA/CE) throughout each semester and 50% marks are for End Semester Examination (ESE).

15.2 *Mode of Evaluation of On-the-Job Training (OJT)*

The OJT will have summative continuous assessment only. The assessment will be based on a report of OJT submitted by each student and a viva voce conducted by internal faculty members.

- Feedback from the hosting institution (30% weightage).

- OJT Report: A formal report submitted by the student detailing their training experience, learnings, and outcomes (30% weightage).

- Viva Voce: An oral examination conducted by internal faculty to assess the student's understanding and application of their training (40% weightage).

15.3 *Evaluation of Professional Skill Training (PST)*

In the case of Professional Skills Training (PST) the entire marks will be awarded through continuous assessment (CA) by the external experts engaging the training.

15.4 *Evaluation of Summer Internship with Project:* For the Summer Internship with Project (One month with minimum 20 working days) in semester IV, 50% marks will be awarded through continuous assessment (CA) by internal faculty members. The rest fifty per cent (50%) of the marks will be awarded on the basis of End Semester Examination (ESE) in the form of a term-end viva-voce conducted by a board of examiners (summative assessment). The board of examiners (at least one external examiner) shall be constituted by the Director/HoD of the Centre. Students who have failed in the continuous evaluation (CA) of the internship (less than 40%) have to repeat the internship under the guidance of a faculty assigned in the subsequent year(s). In case of a student who secured 40% marks or more for the continuous evaluation of the Summer Internship Project by internal faculty but failed to appear for the viva-voce can appear for the viva-voce along with subsequent batch(es).

15.5 *Evaluation of Main Project*: For the Main Project during the semester VI, 50% marks will be awarded through continuous assessment (CA) by internal faculty members. The rest

fifty per cent (50%) of the marks will be awarded on the basis of End Semester Examination (ESE) in the form of a term-end viva-voce conducted by a board of examiners (summative assessment). The board of examiners (at least one external examiner) shall be constituted by the Director/HoD of the Centre. Students who have failed in the continuous evaluation (CA) of the main project (less than 40%) have to repeat the main project under the guidance of a faculty assigned in the subsequent year(s). In case of a student who secured 40% marks or more for the continuous evaluation of the Main Project by internal faculty but failed to appear for the viva-voce can appear for the viva-voce along with subsequent batch(es). However, the curriculum allows for a special viva-voce board to be constituted upon a student's formal request. This provision is intended for students who are unable to await their turn in the subsequent regular batch schedule. Such a request must be made via a prescribed application and will be subject to the payment of an applicable special fee, as determined by the institution. The convening of this special board will be at the discretion of the university and is contingent upon the availability of examiners.

15.6 *Evaluation of Apprenticeship/Internship Project during the 7th and 8th Semesters*

For the Internship/Apprenticeship spread during the 7th and 8th Semesters (280 working days), 50% marks will be awarded through continuous assessment (CA) of the apprenticeship/internship project work by internal faculty members through interim presentations/mid-term reports/internal viva-voce etc. The department/centre council can finally decide the parameters for such continuous assessment. The rest fifty per cent (50%) of the marks will be awarded on the basis of End Semester Examination (ESE) in the form of a viva-voce. The board of examiners (at least one external examiner) shall be constituted by the Director/HoD of the Centre. A combined score of 40% is the pass criterion for the apprenticeship/internship. Students who fail to appear for the term-end viva-voce are permitted to re-appear for the viva voce with subsequent batch(es). However, the curriculum allows for a special viva-voce board to be constituted upon a student's formal request. This provision is intended for students who are unable to await their turn in the subsequent regular batch schedule. Such a request must be made via a prescribed application and will be subject to the payment of an applicable special fee, as determined by the institution. The convening of this special board will be at the discretion of the university and is contingent upon the availability of examiners.

15.7 *Display of Continuous Evaluation Marks:*
Marks obtained by the students in the continuous evaluation (of all courses) shall be displayed on the Centre's notice board and grievances if any may be addressed to the Director/Head of the Centre/Department. The Centre/Department council shall finalise the marks of the continuous evaluation of each course after addressing such grievances.

15.8 *Attendance Requirements:*
A minimum of 75% attendance is compulsory for each student to appear for Semester-End examinations and also to progress to the subsequent semester. But the Vice-Chancellor shall have the power to condone the shortage of attendance up to 10% on medical grounds on the recommendations of the Director/HOD. However, such condonation for shortage of attendance shall be given to a particular student only twice during the entire programme of study. The University's general rules existing from time to time shall be final in the case of attendance requirement.

16. Continuous Evaluation Marks Allocation

16.1 The assessment for B.Voc. programmes includes evaluations of both the General Education Components and the Skill Development Components.

i) The University will conduct examinations for the General Education components and Skill Components of the B.Voc. programme in accordance with the existing norms of the University. In addition, there will be skill assessment and certifications through Professional Skill Trainings (PSTs) engaged and assessed by external experts from industry or Sector Skill Council's certification.

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

iii) 50% weightage shall be given for CCA or continuous evaluation. The remaining 50% weight shall be for the ESE.

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

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

vi) Suggestive methods of FA are as follows: (anyone or in combinations as decided by the course faculty/course coordinator with the approval of Department/Centre Council)

a. Practical assignment	b. Observation of practical skills
c. Viva voce	d. Quiz
e. Interview	f. Oral presentations
g. Computerized adaptive testing	h. In-class discussions
i. Group tutorial work	j. Reflection writing assignments
k. Home assignments	l. Self and peer Assessments

m. Any other method as may be required for specific course/ student by the course faculty/ course coordinator.

A minimum of 50 per cent weightage shall be given for internal tests/lab exams/practical assignments

i) A maximum of 20 per cent weightage shall be given for written assignments
ii) A maximum of 20 per cent weightage shall be given for class room presentations, Viva –voce and mini projects
iii) A maximum of 10 per cent weightage shall be given for other items such as class participation or other activities that the teacher of the concerned course believes as relevant for the course and assigned to the students.

However, Department/Centre Council can change the guidelines for the distribution of internal marks given above, as and when required. Continuous evaluation in the case of internships, professional skill training and projects shall be subject to the guidelines approved by the Centre Council from time to time.

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

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

a. Written test   b. Laboratory report

c. Problem based assignments   d. Individual project report

e. Case study report   f. Team project report

g. Standardized test   h. Viva-voce

i. Any other pedagogic approach specifically designed for a particular course by the course faculty/ course coordinator.

ix) The prerogative of arranging a CCA lies with the course faculty/course coordinator with the approval of DC/CC.

x) The course faculty/ course coordinator shall be responsible for evaluating all the components of CCA. However, the department/centre may involve any other person (External or Internal) for evaluation of any or all the components as decided by the DC/CC/HoD/Director.

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

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

xiii) All courses are to be evaluated in hundred marks irrespective of the credit of the course.

xiv) Continuous evaluation (CCA/CA) marks for general and skill courses shall be awarded on the basis of class tests, assignments, viva-voce, practical assignments, term-papers, mini-projects, practical, simulations etc. as decided by the teacher concerned, considering the relevance of each component with respect to the course he/she handles. However, the student shall be evaluated continuously throughout the semester and marks shall be awarded as per the following guidelines:

1. A minimum of 50 per cent weightage shall be given for internal tests/lab exams/practical assignments

2. A maximum of 20 per cent weightage shall be given for written assignments

3. A maximum of 20 per cent weightage shall be given for class room presentations, Viva –voce and mini projects

4. A maximum of 10 per cent weightage shall be given for other items such as class participation or other activities that the teacher of the concerned course believes as relevant for the course and assigned to the students.

However, Department/Centre Council can change the guidelines for the distribution of internal marks given above, as and when required.

17 End Semester Examinations and Result Finalisation: There shall be only a single evaluation for the End Semester Examination. Immediately after the examination is over (including internship-project viva-voce and Professional Skill Training assessment), the Head of the Department/Centre shall make arrangements to complete the evaluation and finalise the results within 10 working days after the last examination including viva-voce. The marks and grade in all courses obtained by the students will be displayed in the notice board and the answer scripts can be shown to the students for scrutiny on written request by the student addressed to the Director/HoD of the Centre. (Viva-voce marks are exempted from this clause as it is awarded by a board of examiners).

18. Semester-End Examination Question Paper: The question paper for the Semester-End examination shall be set by the concerned teacher in advance which shall be scrutinized by the respective Centre Council or by a committee consisting of the Director/HOD and faculty members offering courses in that semester to ensure that questions are within the scope of the syllabus and that the entire syllabus of the course is fairly covered in the question papers. Modifications can be suggested by the Centre Council, if necessary, and such suggestions shall be incorporated in the final version of the question paper.

19. Passing Criteria, Special Supplementary and Improvement

   a) For each course the pass requirement is **40% of the aggregate marks (continuous assessment marks + semester end exam marks) with a separate requirement of minimum 40% for the semester end examination** and those who fail in the semester end examination of any course may repeat the semester end examination of that course in the next available chance.
   b) Also, a Special "Save an Year" supplementary examination will be conducted for students who fail in their final two semesters (5th and 6th semester for 3 year UG). Special supplementary examination for final semester will be conducted after the publication of that semester results and the exam will be conducted for all courses of that semester. The student will be awarded the actual grade he/she obtains in the special supplementary examination and those who fail in the end-semester examination/special supplementary examination of any course may repeat the semester end examination of that course in the next available chances.
   c) The students of UG programmes are permitted to improve their marks in the end semester examination on certain conditions.
      a) The student can write the improvement exam only for courses where he/she secured P grade or above in the regular chance.

b) The number of courses where a student can register for improvement exam is restricted to a maximum of 2 course per semester.

c) The improvement exam is not permitted for courses offered in the final two semesters of the programme.

d) The improvement exam should be written in the next available chance with the immediate following batch.

e) There will no improvement for internal examinations/practical examinations.

f) The higher of the marks (original marks or improvement marks will be treated as the final end semester marks for grade calculations.

d) In case of the courses such as Professional Skill Training and OJT shall acquire a minimum of 40% marks in continuous evaluation (CA).

e) *Grievance Redressal:* The department shall publish the marks obtained by the students in the continuous evaluation and Semester-End examination. If a student has any grievance, he/she can approach the concerned teacher and submit his/her grievance with supporting documents/arguments. The teacher and the Director/HOD will examine the case and decide on his/her grievance. If the student is not satisfied with the decision, he/she can approach the appellate authority, which is the Centre Council, in writing and the Council shall examine the same and take a final decision which has to be intimated to the student in writing. The decision of the appellate authority shall be final.

f) *Result Finalization for Semesters:* For the semesters I, II, III, V and VI the results of the examinations shall be finalized and published within 30 days from the last date of examinations by the Centre/department council, which will act as the passing board and the minutes shall be sent to the Controller of Examinations of the university for the issue of grade cards. In case of semesters IV and VIII the results shall be finalized and published within 15 working days after the Viva-Voce.

20. Time Limit for Completion of the Programme: A student shall complete the programme within a maximum period of five years from the date of admission by acquiring the total credit requirements as specified for the award of the degree/honours.

21. Grading and Classification

21.1 The following 10-point grading system shall be adopted for all the programmes. The grades will be awarded for each course based on the aggregate marks (continuous assessment marks + semester end exam marks) obtained subject to the requirement of minimum 40% for the semester end examination.

% Marks (Range)	Grade point (G)	Letter Grade	Description
95 - 100	10	O	Outstanding
85 – 94.99	9	A+	Excellent
75 – 84.99	8	A	Very Good
65 – 74.99	7	B+	Good
55 – 64.99	6	B	Above Average

45 – 54.99	5	C	Average
40 – 44.99	4	P	Pass*
Below 40	F	0	Fail
Absent	Ab	0	Absent

21.2 Overall performance at the end of the semester will be indicated by Grade Point Average (GPA) calculated as follows.

$$GPA = G1C1+G2C2+G3C3+\ldots\ldots GnCn \,/\, C1+C2+C3+\ldots\ldots Cn$$

'G' ' refers to the grade point and 'C' refers to the credit value of corresponding course undergone by the student. At the end of the final semester Cumulative Grade Point Average (CGPA) will be calculated based on the above formula, considering the Credits and Grades earned during the entire programme of study.

21.3 Accordingly, the pass requirements shall be as follows: -

1. For each course, 40% of the aggregate marks (continuous assessment marks plus end semester marks) with a separate minimum requirement of 40% for the end semester examination.
2. Minimum aggregate CGPA required for successful completion of the programme will be 4.0
3. The CGPA to percentage conversions shall be done using the following formula

$$\%marks = CGPA * 10$$

21.4 Classification for the Degree/Diploma will be given as follows based on the CGPA:

First Class with Distinction (FCD)	CGPA 7.5 and above
First Class	CGPA 6 to 7.499
Second Class	CGPA 5 to 5.999

21.5 Award of Certificate/Diploma/Degree/Honours

The Certificate/Diploma/Degree/Honours will awarded as follows

S. No.	Criterion	Certificate/Diploma/Degree/Honours	Total Credit
1	Successful completion of the required minimum Courses with 50 credits and an additional exit 4-credits Skill Enhancement Courses (SEC)	One-year UG Certificate in Data Science and Analytics	54

2	Successful completion of the required minimum Courses with 100 credits and an additional exit 4-credits from Skill Enhancement Courses (SEC)	Two-year UG Diploma in Data Science and Analytics	104
3	Successful completion of the required minimum Courses with 144 credits.	Bachelor of Vocation in Data Science and Analytics **OR** Bachelor of Vocation in Data Science and Analytics with Minor in …………	144
4	Successful completion of the required minimum Courses with 184 credits.	Bachelor of Vocation (Honours) in Data Science and Analytics with Minor in …………	184
5	Successful completion of the required minimum Courses with 184 credits.	Bachelor of Vocation (Honours with Research Degree) in Data Science and Analytics with Minor in …………	184

22. Revision of Regulations and Curriculum

The University may from time to time, revise, amend or change the Regulations, Schemes of Examinations and Syllabus. The date of effect of such changes will be as decided by the university.

23. Structure of the Question Paper of End-Semester Examinations

The Semester End question paper shall have three parts (except for practical examinations), namely Part-A, Part-B and Part C. The maximum marks for Semester End Examinations will be 50 (except for MOOCs, Professional Skill Training, and Internships).

In Part A, there will be 5 compulsory questions which will be of short answer. Each question in Part A carries two marks.

Part-B will consist of seven questions out of which students must answer four questions. Each question will carry five marks in this part.

In Part-C, student will have to answer two questions of 10 marks each from a group of three questions. One case study would be preferred among the three questions in this section.

In case of practical exams, this pattern need not be followed. The number of questions can be varied according to the nature of the subject and the same will be decided by the examiners concerned based on the norms set by the Centre/Department council.

* * * * *

SYLLABUS

B.Voc. in

BUSINESS PROCESS AND DATA ANALYTICS

(Modified to be effective from 2025 admission onwards)

(2025 Scheme)

DDU KAUSHAL KENDRA

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

DDU KAUSHAL KENDRA

Vision

"Empowering Youth for a Skilled and Sustainable Nation"

Mission

M1. Offer quality education in emerging vocational domains in technology and management

M2. Impart skills education to develop industry-ready, employable professionals.

M3. Promote entrepreneurial orientation and skills among the students

M4. Inculcate innovation mind-set in students to excel in the emerging dynamic, global economy.

M5. Foster social commitment and sustainable business philosophy in students

Program Description

B.Voc. in Business Process and Data Analytics course is a Bachelors level vocational programme conforming to National Skill Qualification Framework (NSQF). Flexible course exit with certification is provided at Diploma, Advanced Diploma and Degree levels corresponding progressive job roles in the domains of Business Process and Data analytics. Course curriculum is aligned with the norms of the concerned Sector Skill Councils (SSC) for enabling the students to obtain skill certifications from the SSC concerned at various exit points.

The programme syllabus provides a balanced course coverage in the domains of management, business process, data analytics, predictive modelling and quantitative methods of management. The programme blends vocational skill development in these areas with interdisciplinary knowledge of computing, statistics and social science to mould industry ready graduates. Introduction to modern computing and data analytics methods provides the graduates of this programme with a sound base for adapting to innovations in business environment.

Programme Educational Objectives

Graduates of the B.Voc. program are expected to attain or achieve the following Program Educational Objectives within a few years of graduation:

PEO 1: Identify and describe complex business problems in terms of analytical models and find solutions that achieve stated objectives.

PEO 2: Interact effectively and professionally across all levels and functions of businesses in a customer-centric, socially responsible and ethical manner.

PEO 3: Develop new and improved innovative business processes after gap analysis through process redesign that supports organizational strategic objectives.

PEO 4: Identify lifelong learning opportunities to enhance knowledge base and vocational skills that contribute to the professional advancement and societal betterment.

PEO 5: Deliver projects in a timely manner using project management tools and techniques respecting the diversity of the team and exhibiting leadership skills where necessary.

Programme Articulation matrix

	M1	M2	M3	M4	M5
PEO1	2	3		1	2
PEO2	3	2	3		2
PEO3	2	3		3	
PEO4		3	3	2	2
PEO 5	3	3	3	2	

Programme Learning Outcomes

Students in the B.Voc program are expected to attain the following programme learning outcomes by the time they graduate the course.

PLO1: Apply quantitative modelling and data analysis techniques to the solution of real- world business problems, communicate findings, and effectively present results using data visualization techniques.

PLO2: Analyse the key business processes that drive the value chain of an organization using principles of business process management, Big Data Analytical Techniques and data mining methodologies.

PLO3: Identify and develop models using appropriate data analysis software for business decision making.

PLO4: Use research-based knowledge and methods to conduct investigations on complex problems and provide valid conclusions.

PLO5: Create solutions by utilising modern software tools and enhance organizational effectiveness.

PLO6: Apply ethical practices in everyday business activities and make well-reasoned ethical business process and data management decisions.

PLO7: Effectively communicate technical and non-technical information through oral, written and digital forms in an organizational environment.

Mapping of PLOs with PEOs

	PEO 1	PEO 2	PEO 3	PEO 4	PEO 5
Domain Knowledge	*	*			
Problem Analysis	*	*	*		*
Design/Development of solutions	*	*	*		*
Conduct investigations	*		*		
Modern tool usage	*		*	*	*
Societal & Ethical outlook		*			
Individual/Teamwork and communication		*			*

Programme Structure

SEMESTER I

Sl. No	Course No.	Name of the Course	Hours			Marks		Credit
			L	T	P	Internal	End semester	
1	25-251-0101	English Language Skills	4	1	0	50	50	4
2	25-251-0102	Principles and Practice of Management	5	1	0	50	50	5
3	25-251-0103	Statistics for Business	5	2	0	50	50	5
4	25-251-0104	Foundations of Data Structures and R Programming	5	0	0	50	50	4
5	25-251-0105	Python for Data Analytics	2	0	6	50	50	5
6	25-251-0106	Mathematics For Data Analytics	4	1	0	50	50	5
7	25-251-0107	Workshop on Business communication skills (5 Days)					50	2
		Total				**300**	**350**	**30**

SEMESTER II

Sl. No.	Course No.	Name of the Course	Hours			Marks		Credit
			L	T	P	Internal	End semester	
1	25-251-0201	Strategic Communication for Workplaces	5	2	0	50	50	5
2	25-251-0202	Information Systems for Business	4	0	2	50	50	5
3	25-251-0203	Operations Research	6	2	0	50	50	6
4	25-251-0204	Fundamentals of Business Process Management	4	1	2	50	50	5
5	25-251-0205	Database Fundamentals	3	0	4	50	50	5
6	25-251-0206	Project I -Organisation Study- 15 working days. (50 marks for continuous assessment and 50 for written report after completion of the project)					100	4
		Total				**250**	**350**	**30**

SEMESTER III

Sl. No.	Course No.	Name of the Course	Hours			Marks		Credit
			L	T	P	Internal	End semester	
1	25-251-0301	Managerial Skill Development & Design Thinking	3	2	4	50	50	5
2	25-251-0302	Financial Accounting	5	0	0	50	50	5
3	25-251-0303	Business Environment and Ethics	4	0	0	50	50	4
4	25-251-0304	Production and Operations Management	4	1	0	50	50	4
5	25-251-0305	Data Visualization for Analytics	2	0	6	50	50	5
6	25-251-0306	Data Mining Techniques	2	0	6	50	50	5
7	25-251-0307	Workshop on Personal Productivity Improvement (5 Days)					50	2
		Total				**300**	**350**	**30**

SEMESTER IV

Sl.No	Course No.	Name of the Course	Hours			Marks		Credit
			L	T	P	Internal	End semester	
1	25-251-0401	Research Methodology	3	0	2	50	50	4
2	25-251-0402	Environmental Management	3	0	2	50	50	4
3	25-251-0403	Modern Project Management Practices	3	0	2	50	50	4
4	25-251-0404	Introduction to Econometric Methods	5	1	0	50	50	5
5	25-251-0405	Predictive Modelling	2	0	6	50	50	5
6	25-251-0406	Elective 1	3	0	2	50	50	4
7.	25-251-0407	Project II -Business Process Mapping for a duration of 15 working days. (50 Marks for continuous assessment, 50 marks for a written report after the completion of the project)					100	4
		Total				**300**	**400**	**30**

SEMESTER V

Sl.No	Course No.	Name of the Course	Hours			Marks		Credit
			L	T	P	Internal	End semester	
1	25-251-0501	Entrepreneurship Development and Management of Startups	4	0	2	50	50	4
2	25-251-0502	Strategic Self Marketing & Personal Branding	5	2	0	50	50	4
3	25-251-0503	Digital marketing and social media analytics	2	3	4	50	50	4
4	25-251-0504	Big Data Analytics	2	0	4	50	50	4
5	25-251-0505	Text and Web Analytics	3	0	4	50	50	5
6	25-251-0506	Business Model Analysis	5	1	0	50	50	5
7	25-251-0507	Elective 2	3	1	2	50	50	4
		Total				**350**	**350**	**30**

SEMESTER VI

Sl.No	Course No.	Name of the Course	Max. Marks	Credit
1	25-251-0601	Project III - Main Project & Viva-Voce (Duration–80 days) Evaluation scheme will comprise i) Continuous assessment–100 marks ii) Final report – 100 marks &iii) Viva-Voce– 100 marks) This project intends to provide students with real hands-on experience on data analytics. Students can attach themselves to an organisation or work independently for this project. However, the project requires real business data for analytics.	300	26
2	25-251-0602	Workshop on Career Building (10 Days)	**100**	4
		Total	**400**	**30**

LIST OF ELECTIVES

E-1 Practical Accounting in Business Organizations

E-2 Computational Finance

E-3 Investment Analysis and Portfolio Management

E-4 HR Analytics

E-5 Introduction to Machine Learning

E-6 Case Development Skills for Analysts

E-7 Deep Learning

General - Skill Component Ratio

	Credits
Skill Component	113
General Component	67
Total Credit	180

Mode of Evaluation

The courses offered under this programme are categorized into four groups based on the learning objectives and assessment criteria.

I.   **Courses Under Group I**

1. 25-251-0101 English Language Skills
2. 25-251-0102 Foundations of Data Structures and R Programming
3. 25-251-0103 Statistics for Business
4. 25-251-0104 Principles and Practice of Management
5. 25-251-0106 Mathematics for Data Analytics
6. 25-251-0201 Strategic Communication for Workplace
7. 25-251-0202 Information System for Business
8. 25-251-0203 Operations Research
9. 25-251-0204 Fundamentals of Business Process Management
10. 25-251-0302 Financial Accounting
11. 25-251-0303 Business Environment and Ethics
12. 25-251-0304 Production and Operations Management
13. 25-251-0401 Research Methodology
14. 25-251-0402 Environmental Management
15. 25-251-0403 Modern Project Management Practices
16. 25-251-0404 Introduction to Econometrics methods
17. 25-251-0501 Entrepreneurship Development and Management of Startups
18. 25-251-0502 Strategic Self Marketing & Personal Branding
19. 25-251-0503 Digital Marketing and Social Media Analytics
20. 25-251-0504 Big Data Analysis
21. 25-251-0506 Business Model Analysis

Electives:

1. Practical Accounting in Business Organizations
2. Computational Finance
3. Investment Analysis and Portfolio Management
4. HR Analytics
5. Deep Learning

Assessment Scheme for courses under Group I

Assessed Cognitive Ability	Weightage as a Percentage of Total Marks
Remember/ Understand	20%
Apply/Analyse	40 %
Evaluate/ Create	40 %

II.   Courses Under Group II
1.   25-251-0105 Python for Data Analytics
2.   25-251-0205 Database Fundamentals
3.   25-251-0301 Managerial Skill Development & Design Thinking
4.   25-251-0305 Data Visualization for Analytics
5.   25-251-0306 Data Mining Techniques
6.   25-251-0405 Predictive Modelling
7.   25-251-0505 Text and Web Analytics

Electives:
8.   Introduction to Machine Learning
9.   Case Development Skills for Analytics

Assessment Scheme for courses under Group II

Assessed Cognitive Ability	Weightage as a Percentage of Total Marks
Remember/Understand	20%
Apply/ Analyse	20%
Evaluate/ Create	60%

III. Courses Under Group III

1.   25-251-0107: Workshop on Business communication skills (5 Days)

2.   25-251-0307- Workshop on Personal Productivity Improvement (5 Days)

3.   25-251-0602- Workshop on Career Building (10 Days)

Assessment scheme for courses under Group III

Assessed Cognitive Ability	Weightage as a Percentage of Total Marks
Remember	5 %
Understand	5 %
Apply	10 %
Analyse	10 %
Evaluate	30 %
Create	40 %

III. Courses Under Group IV

1. 25-251-0206- Project I -Organization Study
2. 25-251-0407- Project II -Business Process Mapping
3. 25-251-0601- Project III - Main Project & Viva-Voce

Assessment scheme for courses under Group IV

Assessed Cognitive Ability	Weightage as Percentage of Total Marks
Apply/Analyse	30 %
Evaluate/Create	70%

Assessment pattern for End-Semester Examinations

The question paper for the End-Semester examination shall be set by the concerned teacher in advance which shall be scrutinized by the respective Centre/Department Council or by a committee consisting of the HOD and faculty members offering courses in that semester to ensure that:

- Questions are within the scope of the syllabus,
- Entire syllabus of the course is fairly covered in the question papers, and
- The question paper adheres to the assessment methodology for the course.

Modifications can be suggested by the council if necessary and such suggestions shall be incorporated in the final version of the question paper. The End-Semester question paper for Group I subjects shall have three parts namely Part-A, Part-B and Part C. The maximum marks for End-Semester Examinations will be 50. In Part A, there will be 5 compulsory questions which will be of short answer type. Each question in Part A carries two marks. Part- B will consist of seven questions out of which students must answer four questions. Each question will carry five marks in this part. In Part-C, student will answer two questions of 10 marks each from a group of three questions. One case study would be preferred among the three questions in this section. In case of Group II practical exams and Group III this pattern need not be followed. For Group II, the pattern and number of questions can be varied according to the nature of the subject and the same will be decided by the examiners concerned based on the norms set by the Centre/Department council based on course learning outcomes. For Group III, assessment will be conducted by the resource person/s using appropriate evaluation methods following the course learning outcomes. In the case of Group IV, KBD 1206-Project I (Organization Study) and KBD 1407-Project II (Business Process Mapping)

the duration will be 15 working days. Maximum marks for the above subjects will be 100 marks, apportioned as 50 marks for continuous assessment and 50 marks for written report submitted on completion of the project. For KBD 1601- Project III - Main Project and Viva- voce the duration will be 80 days. Evaluation scheme is as follows i) Continuous Assessment- 100 marks ii) Final report – 100 marks and iii) Viva-Voce–100 marks .

Improvement and Pass Criteria

See Appendix I (U.O No.CUSAT/AC(A).A3/3037/2025 Dated, KOCHI-   22, 29.07.2025)

SEMESTER I

Sl. No	Course No.	Name of the Course	Hours			Marks		Credit
			L	T	P	Internal	End semester	
1	25-251-0101	English Language Skills	4	1	0	50	50	4
2	25-251-0102	Principles and Practice of Management	5	0	0	50	50	4
3	25-251-0103	Statistics for Business	5	2	0	50	50	5
4	25-251-0104	Foundations of Data Structures and R Programming	5	1	0	50	50	5
5	25-251-0105	Python for Data Analytics	2	0	6	50	50	5
6	25-251-0106	Mathematics For Data Analytics	4	1	0	50	50	5
7	25-251-0107	Workshop on Business communication skills (5 Days)					50	2
		Total				300	350	30

25-251-0101: ENGLISH LANGUAGE SKILLS

Course Description

The course covers grammar at an advanced application level in both the written and spoken forms of English. Sentence patterns are developed from basic patterns after studying the construction and usage of clauses and phrases. Enhancing communication skills in written contexts, including writing under timed conditions, is the objective in learning written composition. Learning about common errors of spelling, grammar and usage are essential for report writing and helps in developing good editing skills.

Course Learning Outcomes

LO1	Understand the usage patterns of language relating it to the context.	Cognitive level-Understand
LO2	Apply the rules of grammar in speech and written communication to make it clear, concise and unambiguous	Cognitive level- Apply
LO3	Analyse clauses, phrases and sentence structures by comparison with standard forms.	Cognitive level- Analyze
LO4	Evaluate written communication, apply grammatical rules and accepted usage patterns to correct errors in such communication.	Cognitive level-Evaluate
LO5	Create error free written compositions of different forms, avoiding common mistakes under the influence of mother tongue	Cognitive level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	1						3
LO2	1						3
LO3	1						3
LO4				1			3
LO5	1						3

Module 1

Parts of speech: Modern English grammar - relevance - grammar of spoken and written language, Words - parts of speech – brief introduction. Nouns - different types. Pronoun -different types. Adjectives. Verbs - tense-aspect - voice -mood - concord - types of verbs – transitive - intransitive-finite - non-finite.

Module 2

Parts of speech: Helping verbs and modal auxiliaries - function and use. Adverbs - different types. Prepositions - types. Conjunctions - subordinating and coordinating. Articles - possessives – quantifiers

Module 3

Sentence patterns and formation: Basic sentence patterns in English - constituents of sentences – subject – verb - object - complement -adverbials. Clauses – types- analysis and conversion of sentences – Active to Passive and vice versa – Direct to Indirect and vice versa – Degrees of Comparison, one form to the other. Phrases - various types of phrases

Module 4

Writing skills: Written Composition – precis writing – outline story – expansion of proverb – short essay, Practice exercises are to be given in all the forms to develop writing skills.

Module 5

Errors in writing: Errors in sentences – from mistakes in use of parts of speech - concord – collocation - sequences of tense - errors due to mother tongue influence, Examples of common errors to be discussed in class, exercises requiring error correction to be included as class assignments.

Recommended Books

1. Thomson, A. J., & Martinet, A. V. (2010). *A Practical English Grammar*. Oxford University Press.

2. Swan, M. (2005). *Practical English Usage 3rd edition*. Oxford University Press.

3. Sinha, R. P. (2002). *Current English Grammar and Usage with Composition*. Oxford University Press

4. Murphy, R (2012). *English Grammar in Use*, 4th edn, Cambridge University Press.

5. Collins, T. (2012). *Correct your English Errors*. McGraw-Hill.

6. Manser,Martin H (2010), *Guide to Style: An Essential Guide to the Basics of Writing Style*. Viva Books.

7. Nelson, G., & Greenbaum, S. (2015). *An introduction to English grammar*. Routledge.

25-251-0102: PRINCIPLES AND PRACTICE OF MANAGEMENT

Course Description
This course provides a foundational understanding of management concepts and business organization. It introduces key functions of management such as planning, organizing, leading, and controlling. Students will explore classical and modern management theories, along with essential decision-making and motivational approaches. The course also offers an overview of core functional areas including marketing, human resources, and financial management.

Course Outcomes

CO1	Understand various forms of organizations and managerial roles.
CO2	Familiarize with management theories.
CO3	Analyse key managerial functions—planning, organizing, leading, and controlling—to assess their role in organizational effectiveness.
CO4	Understand the physical and service process in industry
CO5	Understand the different functional areas of management and its relation to organisational performance

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1		3		2		2	
CO2		3		2			1
CO3	3	3		2			
CO4		3		2			1
CO5		3		2		2	

Module I: Evolution of Management
Nature and Scope of Management- Types of Business: Manufacturing, Services, Merchandise, Hybrid-Forms of Organization: Sole Proprietorship, Partnership, Corporation, LLC, Cooperatives- Management vs Administration: Ethics and Social Responsibility in Business: Managerial Roles and Skills.

Module II: Functions of Management
Functions of Management - Contributions of Taylor and Fayol- Behavioral, Systems, and Modern Approaches to Management- Planning: Meaning, Importance, Steps, and Types (Strategic, Tactical, Operational, Standing, Single-Use), Limitations of Planning. Organizing: Formal vs. Informal Structures. Authority, Responsibility, and Delegation- Centralization vs Decentralization- Departmentalization and Organization Structures. Directing: Concept and Importance- Leadership: Functions and Styles. Motivation: Concept, Theories: Maslow's Need Hierarchy, Theory X, Y, and Z. Staffing: Recruitment and Selection-Training – Performance Appraisal. Controlling: Concept-Establishment of standards, Measurement of Performance, Comparison of Actual and Standard Performance, Taking remedial action. Coordination.

Module III: Operations Management Process

Introduction to Operations Management, applications in product and service industry, use of competitive advantage. Process analysis in Industry: Physical and Services processes, Facility location and layout, Work study and method study, supply chain management, ISO systems.

Module IV: Marketing and Human Resource Management

Marketing Management- Definition, Scope, Strategic Planning- STP- Marketing Mix (4Ps), Product and Brand Management Fundamentals- Pricing Objectives and Strategies, Distribution Channels- Basics of Promotion and Digital Marketing. HR management: Process, Strategic planning. Marketing & HR management and organisational performance.

Module V: Financial Management

Financial Management- Meaning and Scope of Financial Management- Financial Goals: Profit vs. Wealth Maximization- Core Functions: Investment, Financing, and Dividend Decisions- Working Capital: Meaning, Importance, and Sources of finance.

Reference

- Robbins, S. P., & Coulter, M. (2021). *Management* (15th ed.). Pearson Education.
- Koontz, H., & Weihrich, H. (2016). *Essentials of management: An international and leadership perspective* (10th ed.). McGraw-Hill Education.
- Prasad, L. M. (2020). *Principles and practice of management* (9th ed.). Sultan Chand & Sons.
- Stoner, J. A. F., Freeman, R. E., & Gilbert, D. R. (2013). *Management* (6th ed.). Pearson Education.
- Griffin, R. W. (2020). *Management: Principles and practices* (13th ed.). Cengage Learning.
- Hellriegel, D., Jackson, S. E., & Slocum, J. W. (2011). *Management: A competency-based approach* (11th ed.). South-Western Cengage Learning.
- Drucker, P. F. (2007). *The practice of management*. HarperBusiness.

25-251-0103 : STATISTICS FOR BUSINESS

Course Description

The course intends to provide students with a background on statistical methods and techniques for business decision making. It develops the ability to analyse and interpret data to provide meaningful information to assist in making management decisions; and develop an ability to apply modern quantitative tools (Microsoft Excel) to data analysis in a business context.

Course Learning Outcomes

LO1	Critically evaluate the underlying assumptions of analysis tools	Cognitive level- Evaluate
LO2	Understand and critically discuss the issues surrounding sampling and significance	Cognitive level- Understand
LO3	Discuss critically the uses and limitations of statistical analysis	Cognitive level- Understand
LO4	Solve a range of problems using the techniques covered	Cognitive level-Apply

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	3	2			2		
LO2	3	2		3	2		
LO3	3			3	2		1
LO4	3	3	3		2		

Module 1

Introduction to statistics, Introduction Data collection; Presenting data in tables and charts, measures of central tendency and dispersion;

Module 2

Probability, Discrete probability distributions; Continuous probability distributions. Sampling distributions; statistical estimation; Hypothesis testing, Statistical inferences based on one sample test; statistical inferences based on two samples, Statistical quality control.

Module 3

Experimental design and analysis of variance; Simple linear regression analysis; correlation; Multiple regression.

Module 4

Chi-square tests; Nonparametric tests: sign test, rank sum tests, one-sample runs tests, Rank correlation, K-S.

Module 5

Time series forecasting, Decomposition of Time Series using Additive Models, Index numbers.

Note: The course delivery of this course is to necessarily use practice-oriented case studies and lab-based sessions.

Recommended Books

1. Chandrasekaran, N., & Umaparvathi, M. (2016). *Statistics for Management*. PHI Learning Pvt. Ltd.
2. Gupta, S. C. (2016). *Fundamentals of Statistics*. Himalaya Publishing House.
3. Keller, G. (2014). *Statistics for management and economics* Abbreviated. Nelson Education.
4. Levin, R. I. (2008). *Statistics for management*. Pearson Education India.
5. Sharma, J. K. (2010). *Fundamentals of business statistics*. Vikas Publishing House.
6. Bajpai, N. (2009). *Business Statistics*. Pearson.
7. Shenoy, G. V.,Srivastava, U.K.,Sharma, S.C. (2002*). Business Statistics*. New Age International

25-251-0104: FOUNDATIONS OF DATA STRUCTURES AND R PROGRAMMING

Course Description

This course introduces students to fundamental data structures and the basics of R programming, with a focus on practical understanding and application. Topics include arrays, lists, stacks, queues, trees, and graphs, followed by essential R programming concepts such as data types, vectors, control structures, matrices, and data frames. Designed for beginners, the course builds logical thinking and prepares students for data handling and analysis in real-world contexts.

Course Outcomes

CO1	Understand the importance of data, data types, and structured organization for solving real-world problems.
CO2	Understand the use of linear and non-linear data structures such as arrays, lists, stacks, queues, trees, and graphs.
CO3	Analyze problem contexts and select appropriate data structures for efficient data handling and processing.
CO4	Understand basic R programming constructs including data types, vectors, and control statements.
CO5	Perform data manipulation and analysis using arrays, matrices, lists, and data frames in R.

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2					1
CO2	3	3			2		
CO3	3		3	2			
CO4			3		3		2
CO5	3		3		3		2

Module 1:

Data – Types of data –Real-life examples of data-driven decisions in business, healthcare, and social platforms — Data structures – Need for organizing data for storage, retrieval, and manipulation – Role of data structures in solving real-life problems– Logical representation of data – Overview of data structure types: linear and non-linear , Static vs dynamic structures – Memory allocation differences – Concept of sequential vs linked representation –choice of data structure and the performance – Brief introduction to time and space efficiency in data handling –Choosing the right data structure based on the problem context.

Module 2:

Arrays – Concept of index-based storage – Accessing, inserting, and deleting elements – Traversing arrays – Searching and updating array data – Lists – Idea of dynamic sizing –Access and modify elements – Insertion and deletion with examples – Stack – LIFO principle– Basic stack operations- push, pop, peek, and traversal.

Module 3:

Queue – FIFO concept– Understanding enqueue and dequeue operations – Applications of queues – Trees – Introduction to tree structure – Root, parent, child, and leaf nodes– Graph – Concept of nodes and edges –graph traversal

Module 4:

Introduction to R – Why R– Getting started with an IDE–Arithmetic in R –Basic data types: Common errors – Type checking– Type conversion– Familiarization with packages– Introduction to vectors: creating vectors – Naming elements – Vector arithmetic – Selecting and modifying elements – Comparing vectors – Logical vectors – Handling missing values – Control statements: using if, if-else, for, while, repeat with basic examples.

Module 5:

Arrays in R– Creating arrays– Indexing and basic arithmetic – Matrices – Creating matrices– Matrix naming and indexing – Simple matrix operations– Matrix applications- Frequency tables and factors – levels()and summary()functions – Ordered and unordered factors – Lists – Creating and modifying lists – Selecting elements – Concatenating lists – Data frames – Creating data frames – Selecting frame elements – Sorting – Use of attach()and detach()

Recommended Books

- Lipschutz, S. (2014). *Data Structures (Schaum's Outline Series)*. McGraw-Hill Education.
- Fox, R. L. (2019). *Fundamentals of Data Structures in Python*. CRC Press (Taylor & Francis Group).
- Karumanchi, N. (2016). *Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles*. CareerMonk Publications.
- Grolemund, G. (2014). *Hands-On Programming with R: Write Your Own Functions and Simulations*. O'Reilly Media.
- Wickham, H., & Grolemund, G. (2017). *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data*. O'Reilly Media.
- Gardener, M. (2012). *Beginning R: The Statistical Programming Language*. Wiley. *(A more accessible alternative to Crawley for beginners.)*

25-251-0105: PYTHON FOR DATA ANALYTICS

Course Description

This course introduces fundamental programming concepts and equips students with hands-on skills in Python. Topics include logic building, pseudocode, Python data types, control structures, functions, file handling, object-oriented programming, and use of popular libraries such as NumPy, Pandas, Matplotlib, and Seaborn for data analysis and visualization. Ideal for beginners, the course emphasizes practical problem-solving

Course Learning Outcomes

CO1	Understand the foundational principles of programming using flowcharts, algorithms, and pseudocode.
CO2	Apply core Python concepts such as data types, functions, control structures, and modules to solve problems.
CO3	Implement file handling, exception handling, and basic object-oriented programming concepts using Python.
CO4	Use NumPy and Pandas for data manipulation, transformation, and preprocessing.
CO5	Perform exploratory data analysis and data visualization using Pandas, Matplotlib, and Seaborn on real-world datasets.

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
LO1	2		1				
LO2	2	1	3				
LO3	2		1				
LO4				2			
LO5			2		3		3
LO6			2		3		3

Module 1:

Basic logic building — Flowcharts – Decision-making using if-else –Algorithms – Pseudocode - Variables and expressions (no code syntax) – Understanding data flow – Control structures: Condition – Loop – Writing basic pseudocode with conditions and repetitions – Problem-solving flow using structured thinking.

Module 2:

Python overview – Basic data types – Functions: arguments, block structure, scope, recursion – Modules – Conditionals and Boolean expressions – Sequences: Strings, Tuples, Lists – Iteration, looping, and control flow – String methods and formatting.

Module 3:

File processing and Classes in Python – Dictionaries and Sets – File handling and Text processing – Introduction to Classes – Class instances and Methods – Iterators and Generators – Regular expressions – Exception handling and testing.

Module 4:

NumPy for numerical operations – Creating and manipulating arrays – Array indexing, slicing, and broadcasting – Vectorized operations – Statistical functions – Introduction to Pandas – Series and DataFrames – Data selection, filtering, and manipulation – Handling missing data – Reading and writing files using Pandas.

Module 5:

Data analysis with Pandas – Grouping, merging, and pivoting – Descriptive statistics and exploratory data analysis – Introduction to data visualization using Matplotlib and Seaborn – Plot types: line, bar, histogram, boxplot, scatter – Customizing plots – Introduction to basic data analysis workflows – Mini-projects using real datasets.

Recommended Books:

- Eric Matthes (2019); Python Crash Course, Second Edition, No Starch Press.
- Al Sweigart (2020); Automate the Boring Stuff with Python, Second Edition, No Starch Press.
- Wes McKinney (2018); Python for Data Analysis, Second Edition, O'Reilly Media.
- Allen B. Downey (2015); Think Python: How to Think Like a Computer Scientist, Second Edition, Green Tea Press.
- Paul Barry (2016); Head First Python, Second Edition, O'Reilly Media.
- https://developers.google.com/edu/python – Google's Python Class (Free Online Resource).

25-251-0106: MATHEMATICS FOR DATA ANALYTICS

Course Description

Upon completion of the course, students will be familiar with the concepts of sets, linear algebra, probability, differentiation and matrices. Students will be able to demonstrate an understanding of the foundations of calculus as well as the ability to think logically and critically through the application of fundamental mathematical techniques.

Course Learning Outcomes

LO1	Understand sets, functions, and logical propositions and their properties.	Cognitive Level- Understand
LO2	Comprehend basic numerical techniques to solve linear equations	Cognitive Level - Apply
LO3	Understand fundamentals of Probability Theory and Probability distribution functions	Cognitive Level - Understand
LO4	Apply different methods to find the inverse and rank of a matrix	Cognitive Level - Apply
LO5	Apply mathematical principles to the analysis of data	Cognitive Level - Analyze

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	3						
LO2	3	2	3	2	2		
LO3	3		3		3		
LO4	2		3		2		
LO5	3		3	2			2

Module 1

Foundation-Logic, Sets, Functions – Propositional Logic, Propositional equivalences, Predicates and Quantifiers, Sets, Set operations, Functions, Sequences, and summation.

Module 2

Matrices, determinants, and inverse of a matrix. System of equations, Linear transformation - rank and nullity, Consistency and inconsistency of linear system of equations, rank nullity theorem, Echelon form of a matrix, and row- reduced echelon form of a matrix. Eigenvalues and eigenvectors.

Module 3

Probability, basics, Conditional Probability, Bayes Theorem, Distributions - Binomial, Poisson, Normal distributions, and related problems.

Module 4

Linear Algebra – System of Linear equations, Solving System of Linear equations, Linear Independence, Vectors, Scalars, Addition, Scalar multiplication, dot product, vector projection, cosine similarity.

Module 5

Differentiation: Limits and continuity, Derivatives of standard Functions, Rules for finding derivatives; Different types of differentiation; Integration: Integration of Standard function, Rule of Integrations, Formulas in Integration, Definite Integrals

References

1. Kenneth H. Rosen, "Discrete Mathematics And Its Applications", 7th Ed, McGraw-Hill, 2012.

2. Sipser, "Introduction to the Theory of Computation, CENGAGE Learning, 2014. 4. Ernest Davis, "Linear Algebra and Probability for Computer Science Applications ", 1st Edition, CRC Press 2012.

3. Michael Mitzenmacher and Eli Upfal; Probability and Computing, 2ed, Cambridge University Press, 2017

4. Sheldon M Ross; A First Course in Probability, 10ed, Pearson, 2018

5. Introductory Algebra: a real-world approach (4th Edition) - by Ignacio Bello

6. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 9th Edition 2011.

SEMESTER II

Sl. No.	Course No.	Name of the Course	Hours			Marks		Credit
			L	T	P	Internal	End semester	
1	25-251-0201	Strategic Communication for For Workplaces	5	2	0	50	50	5
2	25-251-0202	Information Systems for Business	4	0	2	50	50	5
3	25-251-0203	Operations Research	6	2	0	50	50	6
4	25-251-0204	Fundamentals of Business Process Management	4	1	2	50	50	5
5	25-251-0205	Database Fundamentals	3	0	4	50	50	5
6	25-251-0206	Project I -Organisation Study- 15 working days. (50 marks for continuous assessment and 50 for written report after completion of the project)					100	4
		Total				**250**	**350**	**30**

25-251-0201: STRATEGIC COMMUNICATION FOR WORKPLACES

Course Description

This course aims to equip students with the tools needed to remain relevant in the modern workplace. At the end of the course, students will be able to navigate the contingencies in a typical workday and be able to put into practice the principles of effective workplace communication and thereby equip themselves to be valuable employees.

Course Learning Outcomes

LO1	Understand how information is transmitted, listened to and interpreted in workplaces and the different models of communication.	Cognitive Level- Understand
LO2	Apply the concepts of nonverbal communication in strengthening the communication process at workplaces.	Cognitive Level- Apply
LO3	Analyse the possible conflict situations arising from lack of communication	Cognitive Level- Analyse
LO4	Evaluate the influence of digital communication tools in workplaces and the difference in using such media over traditional forms	Cognitive Level- Evaluate
LO5	Create appropriate communication frameworks drawing on the verbal and nonverbal tools of communication using traditional or digital media.	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	2						3
LO2	2			1			3
LO3		1		1			2
LO4				2	1		3
LO5			1	1	1	2	3

Module 1

Basics requirements for effective communication in the workplace, understanding the communication loop in a work context - listening, clarifying, giving feedback - confirming if the information has been understood as intended - working according to the information received and sharing the progress of work.

Module 2

Verbal Communication Skills: Conversation - basic techniques - how to begin, interrupt, hesitate and end - how to express time, age, feelings and emotions - how to respond - using language in various contexts/situations - Language/Phrases for meetings; Phrases for telephoning; Phrases for greetings, introductions, partings.

Module 3

Non-verbal Communication Skills: Body language: postures - orientation - eye contact - facial expression - dress - posture - self-concept - self-image - self-esteem - attitudes.

Module 4

Handling Common Workplace Situations: Interviews - Group discussion- addressing an audience - rules for creating effective presentations - How to handle conflict - understanding cultural differences in a work context - Interaction with Clients/Customers; Formal/ Public speeches - informative, persuasive, and ceremonial.

Module 5

Digital Workplaces: Navigating the digital workplace - what is a digital workplace - intranets
- chats and private messaging - discussion forum - internal blogs - email, enterprise social media tools, portals, ticketing, issue tracking and case software - learning digital etiquette - Digital task management using tools such as Trello.

Recommended books

1. Sasikumar V., P Kiranmai Dutt and Geetha Rajeevan. (2013) Communication Skills in English. Cambridge University Press and Mahatma Gandhi University
2. Anderson, K., Lynch, T., & Maclean, J. (2004). Study speaking (Vol. 1). Cambridge University Press.
3. Marilyn, A. (2010). Critical Thinking, Academic Writing and Presentation Skills (Mg University Edition). Pearson Education India.
4. Mukhopadhyay, Lina et al. Polyskills: (2012). A Course in Communication Skills and Life Skills. Foundation.
5. Dhanavel, S. P. (2011). English and communication skills for students of science and Engineering. Orient Blackswan, Chennai.
6. Aggarwal, S. (2009). Essential Communication Skills, ANE Books.
7. Searles G. J. (2014) Workplace Communications: The Basics, Pearson Publications

25-251-0202: INFORMATION SYSTEMS FOR BUSINESS

Course Description

This course aims to help students identify managerial challenges and opportunities for organizational advancement that may be resolved by the application of current new technologies. Students will be equipped to identify opportunities for and successfully apply various information technologies to gain competitive advantage. The course will help define and recognize key enabling technologies that may advance organizations now and in the future.

Course Learning Outcomes

LO1	Understand the information system requirements of an organization	Cognitive Level- Understand
LO2	Understand the role of business intelligence in decision making	Cognitive Level- Understand
LO3	Analyse the process of acquiring Information Systems through Projects	Cognitive Level- Analyse
LO4	Evaluate the various management information systems	Cognitive Level- Evaluate
LO5	Assess the IT security and data privacy levels of an organization	Cognitive Level- Assess

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1		2	2		2		
LO2	2	3	1		3		1
LO3			2	2	3		
LO4		2	2	1	2		
LO5		1				2	1

Module 1

Information, Systems and Management - Information Technology and Strategy - The Virtual Organization.

Module 2

Decision Making and Business Intelligence - e-Commerce - Social Networking and Web 2.0 Management Support Technologies - The Network Economy: Trends and Opportunities.

Module 3

Information Technology Architecture - Knowledge management - Managing systems development - Acquiring Information Systems through Projects - Managing Change.

Module 4

Organizing and Leading the Information Technology Function - Information Technology Planning - Managing Information Technology Outsourcing

Module 5

Governance and Ethics - Managing Information Security and Privacy

Recommended books

1. Laudon, K. C., & Laudon, J. P. (2015). Management information systems (Vol. 8). Prentice Hall.
2. Applegate, L. M., Austin, R. D., & McFarlan, F. W. (2006). Corporate information strategy and management. McGraw-Hill/Irwin Custom Publishing.
3. Robson, W. (2015). Strategic management and information systems. Pearson Higher Ed.McNurlin, S. & Bui. (2013) Information Systems Management in Practice, Prentice Hall (8th Ed).
4. Sousa, K., & Oz, E. (2014). Management information systems. Nelson Education.
5. Efraim Turban, Jay Aronson & Tin-Peng Liang. (2010) Decision Support Systems and Intelligent Systems, Ninth International Edition, Pearson Prentice- Hall.
6. Galliers, R. D., & Leidner, D. E. (2014). Strategic Information Management: challenges and strategies in managing information systems. Routledge.

<div align="center">**25-251-0203: OPERATIONS RESEARCH**</div>

Course Description

This course aims to impart knowledge and training on the use of optimization techniques under resource constraints for various engineering and business problems. The course covers topics on Linear Programming introducing the Simplex Algorithm, Duality, Transportation problem and Assignment problem. Dynamic programming is introduced as a method to solve large optimization problems. Inventory models show how mathematical models of real-world resource constrained problems are generated and solved.

Course Learning Outcomes

LO1	Understand the concept of optimal solutions for constrained problems and mathematical formulation of real-world constrained problems.	Cognitive Level- Understand
LO2	Apply selected algorithms to identified linear programming problems.	Cognitive Level- Apply
LO3	Analyse problems under the general class of transportation and assignment problems.	Cognitive Level- Analyse
LO4	Evaluate the constraining conditions in real situations and develop mathematical formulations.	Cognitive Level- Evaluate
LO5	Create appropriate mathematical models using linear programming or dynamic programming methods.	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	2				2		2
LO2	3	2	2		2		
LO3	2	3	1		1		
LO4		2	2	2	2		
LO5		3	3	3	2		

Module 1

Introduction to Operations Research: Basics definition, scope, objectives, phases, models and limitations of Operations Research - Linear Programming Problem - Formulation of LPP, Graphical solution of LPP - Simplex Method - Artificial variables - big-M method - Two- phase method - Degeneracy and unbound solutions.

Module 2

Transportation Problem - Formulation, solution, unbalanced Transportation problem - Finding basic feasible solutions - Northwest corner rule - Least Cost method and Vogel's approximation method - Optimality test: Stepping Stone method and MODI method.

Module 3

Assignment model – Formulation - Hungarian method for optimal solution - Solving unbalanced problem - Travelling salesman problem and assignment problem - Solving LPs using Solver - Revisiting the formulation - Three types of LPs - Dual solution - Sensitivity analysis.

Module 4

Dynamic programming: Characteristics of dynamic programming - Dynamic programming approach for Priority Management - Employment smoothening - Capital budgeting - Stage Coach/Shortest Path - Cargo loading and Reliability problems.

Module 5

Inventory models: Inventory costs - Models with deterministic demand - model (a) demand rate uniform and production rate infinite - model (b) demand rate non-uniform and production rate infinite - model (c) demand rate uniform and production rate finite.

Recommended books

1. Srinivasan G. (2017) Operations Research: Principles and Applications, PHI Learning Private Limited.
2. Taha H. A. (2013) Operations Research: An Introduction, Pearson.
3. Ravindran, A. R. (2016). Operations research and management science handbook. Crc Press.
4. Hillier, F. S. (2012). Introduction to operations research. Tata McGraw-Hill Education.
5. Kasana, H. S., & Kumar, K. D. (2013). Introductory operations research: theory and applications. Springer Science & Business Media.
6. Shah, N. H, Gor, R. M. Soni H. (2007) Operations Research, Eastern Economy Edition

25-251-0204: FUNDAMENTALS OF BUSINESS PROCESS MANAGEMENT

Course Description

The course introduces the idea of process thinking in business management and workflows in organizations. Theory of business process model generation with specific reference to the symbolic representations of BPMN is explained. Both quantitative and qualitative workflow analysis methods and queue analysis models that help in process analysis and design of new processes are explained.

Course Learning Outcomes

LO1	Understand the terminology of business process management and the notations used in BPMN.	Cognitive Level- Understand
LO2	Apply process discovery, quantitative process analysis methods and business process management principles to workflows in organizations.	Cognitive Level- Apply
LO3	Evaluate business processes as core, support and management processes to identify the process types, process architecture and process landscape.	Cognitive Level- Analyse
LO4	Design processflows in business process modelling software.	Cognitive Level- Evaluate
LO5	Create redesigned business processes on the basis of qualitative and quantitative analyses and process insights.	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1		3	2			1	1
LO2	2	3	2	1	2		
LO3		3	2		1		
LO4			3		3		1
LO5		1	3		3		1

Module 1

Introduction to BPM - The evolution of BPM - Process Modelling Languages- BPMN, Theory of Process Orientation.

Module 2

Process Modeling - Process Technology / Workflow Architecture - Swimlane diagram.

Module 3

Process Automation - Process Discovery - Process improvement methods.

Module 4

Process Analysis (Qualitative & Quantitative) - Modelling and assessing the As-Is process and To-Be process

Module 5

Introduction to Lean and TQM, Creating and Managing a business process using business process management software.

Note: The course delivery of this course is to necessarily use practice-oriented case studies and lab-based sessions.

Recommended Books

1. Dumas, M., La Rosa, M., Mendling, J., & Reijers, H. A. (2013). Fundamentals of business process management (Vol. 1, p. 2). Heidelberg: Springer.

2. Sharp, A., & McDermott, P. (2009). Workflow modeling: tools for process improvement and applications development. Artech House.

3. Harmon, P., & Trends, B. P. (2010). Business process change: A guide for business managers and BPM and Six Sigma professionals. Elsevier.

4. Leymann, F. & Roller, D.(1997) Workflow-based applications, IBM Systems Journal.

5. Jeston, J. (2014). Business process management. Routledge.

6. Rosemann, M., & vom Brocke, J. (2015). The six core elements of business process management. In Handbook on business process management 1 (pp. 105-122). Springer, Berlin, Heidelberg.

7. Smith, H., & Fingar, P. (2003). Business process management: The third wave. Tampa: Meghan-Kiffer Press.

<h1 style="text-align:center">25-251-0205: DATABASE FUNDAMENTALS</h1>

Course Description

The course aims to impart the basic understanding of the theory and applications of database management systems; to give basic level understanding of internals of database systems; to expose to some of the recent trends in databases; to understand database transactions and to understand advancements in data base systems.

Course Learning Outcomes

LO1	Describe the fundamental elements of relational database management systems.	Cognitive Level- Understand
LO2	Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.	Cognitive Level- Understand
LO3	Analyse basic database storage structures and access techniques	Cognitive Level- Analyse
LO4	Describe the fundamental elements of relational database management systems	Cognitive Level- Understand
LO5	Construct the database by normalization.	Cognitive Level- Apply
LO6	Familiarize with Non-relational Database	Cognitive Level- Understand

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	3	3				1	1
LO2	3	3					1
LO3	3	3		1	2		1
LO4			3	2	3		
LO5		1	1		3		
LO6	2		2	2		2	

Module 1

Introduction: Data: structured, semi-structured and unstructured data**,** Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS. Database architectures and classification. Entity- Relationship Model: Basic concepts, Design Issues, Mapping Constraints, Keys, Entity- Relationship Diagram, Weak Entity Sets, and Relational Model: Structure of relational Databases, Integrity Constraints, synthesizing ER diagram to relational schema.

Module 2

Relational Database Design: Different anomalies in designing a database, normalization, functional dependency (FD), Armstrong's Axioms, closures, Equivalence of FDs, minimal

Cover. Concepts: overview of concurrency control and recovery acid properties, serial and concurrent, schedules, conflict serializability, Two-phase locking.

Module 3

Database Languages: Concept of DDL and DML relational algebra Structured Query Language (SQL): Basic SQL Structure, Building and Maintaining a Simple Database Structure: Simple Database, Create, Alter, and Deleting. Normalization using functional dependencies, INF, 2NF, 3NF and BCNF.

Module 4

Database Manipulation operations; Relational Operators: Union, Intersect, Except, Join, On vs. Where, Nested Queries, Recursive Queries. Physical Data Organization: index structures, primary, secondary and clustering indices, single level and Multi-level indexing, B+- Trees. Functions, Triggers, Error Handling, Views.

Module 5

NoSQL Database Management Systems, Key-Value Stores- Document Stores- WideColumn Stores – e.g. Redis, MongoDB, Cassandra. Hadoop data storage – e.g. Pig, Hive, HBase Cloud Databases: Database as a service (DBaS) – e.g. Amazon SimpleDB, DynamoDB, Google. BigQuery

Recommended Books

1. Elmasri R., Navathe S. (2013). Database Systems: Models, Languages, Design and Application Programming, Pearson Education.

2. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2011). Database system concepts, 6/e, McGraw Hill.

3. Akerkar, R. (2009). Foundations of the semantic Web: XML, RDF & ontology. Alpha Science International, Ltd.

4. Plunkett, T., Mohiuddin, K., Macdonald, B., Harding, D., Nelson, B., Segleau, D., Sun, H., Mishra, G., Hornick, M., Stackowiak, R. and Laker, K., 2013. Oracle Big Data Handbook. Oracle Press, New York.

5. Perkins, L., Redmond, E., & Wilson, J. (2018). Seven databases in seven weeks: a guide to modern databases and the NoSQL movement. Pragmatic Bookshelf.

6. Thomasian, A. (2013). Database Concurrency Control: Methods, Performance, and Analysis (Vol. 1). Springer Science & Business Media.

7. Lee Chao, Cloud Database Development and Management, 1e, CRC Press, 2013.

8. Hoffer Jeffrey, V. Ramesh, Topi Heikki, Modern database management, 12e, Pearson, 2015.

9. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, 6e, McGraw-Hill, 2013.

10. Benjamin Bengfort, Jenny Kim, Data Analytics with Hadoop, O'Reilly Media, June 2016.

SEMESTER III

Sl. No.	Course No.	Name of the Course	L	T	P	Internal	End semester	Credit
1	25-251-0301	Managerial Skill Development & Design Thinking	3	2	4	50	50	5
2	25-251-0302	Financial Accounting	5	0	0	50	50	5
3	25-251-0303	Business Environment and Ethics	4	0	0	50	50	4
4	25-251-0304	Production and Operations Management	4	1	0	50	50	4
5	25-251-0305	Data Visualization for Analytics	2	0	6	50	50	5
6	25-251-0306	Data Mining Techniques	2	0	6	50	50	5
7	25-251-0307	Workshop on Personal Productivity Improvement (5 Days)					50	2
		Total				**300**	**350**	**30**

25-251-0301: MANAGERIAL SKILL DEVELOPMENT AND DESIGN THINKING

Course Description

To equip students with basic skills to become effective team players, problem solvers at personal interpersonal, group and organizational levels**.**

Course Learning Outcomes

LO1	Understand the fundamentals of Self discipline	Cognitive Level- Understand
LO2	Understand the methods, processes and tools of design thinking.	Cognitive Level- Understand
LO3	Show one's own ability to work in teams	Cognitive Level- Apply
LO4	Analyse the role of primary and secondary research in design thinking	Cognitive Level- Analyze
LO5	Integrate design thinking approach to develop solutions	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1					1	3	
LO2	2	2		1	2		
LO3					2	1	3
LO4				2	2		
LO5			2	3	2		

Module 1

Self-Management: Self Evaluation, Self-Discipline, Self-Criticism, Recognition of One's Own Limits and Deficiencies, Independency Etc. Thoughtful & Responsible, Self-Awareness

Team Building / Coordination Skills: Team Building Practices Through Group Exercises, Team Task / Role Play, Ability to Mixing & Accommodation, Ability To Work Together

Module 2

Goal Setting: Wish List, Smart Goals, Blue Print for Success, Short Term, Long Term, Life Time Goals. Time Management Value of Time, Diagnosing Time Management, Weekly Planner to Do List, Prioritizing Work

Module 3

Stress Management: Causes of Stress And Its Impact, How To Manage & Distress, Circle Of Control, Stress Busters. Emotional Intelligence What Is Emotional Intelligence, Emotional Quotient Why Emotional Intelligence Matters, Emotion Scales. Managing Emotions.

Module 4

Why Design Thinking, The Design Process, Design Brief, Visualization, Ethnography, Identifying Insights (Using Mind-Mapping Design Tool),

Module 5

Design Criteria, Brainstorming, Concept Development, Pitch, Assumption Testing, Prototyping, Co-Creation, Learning Launch, Applying Design Thinking

Recommended Books:

1. Wentz, F. H. (2012). Soft Skills Training: A workbook to develop skills for employment. CreateSpace.
2. Mitra, B. K. (2016). Personality development and soft skills. Oxford University Press.
3. Mackenzie, A., & Nickerson, P. (2009). The time trap: The classic book on time management. Amacom., 1997.
4. Carnegie, D. (2017). How to win friends & influence people. Musaicum Books.
5. Goleman, D. (2006). Emotional intelligence. Bantam.
6. Liedtka, J., Ogilvie, T., & Brozenske, R. (2014). The designing for growth field book: A step-by-step project guide. Columbia University Press.
7. Martin, R. L. (2009). The design of business: Why design thinking is the next competitive advantage. Harvard Business Press.
8. Stickdorn, M., Schneider, J., Andrews, K., & Lawrence, A. (2011). This is service design thinking: Basics, tools, cases(Vol. 1). Hoboken, NJ: Wiley.

25-251-0302: FINANCIAL ACCOUNTING

Course Description

Course aims to introduce students to the fundamental principles of accounting, maintenance of accounts and finalization of accounts of business organizations. Students are expected to gain the ability of using accounting information as a tool in applying solutions for managerial problems, evaluating the financial performance, and interpreting the financial structure.

Course Learning Outcomes

LO1	Describe the role of accounting information and its limitations	Cognitive Level- Understand
LO2	Develop the skill of recording financial transactions and preparation of reports in accordance with GAAP	Cognitive Level- Apply
LO3	Develop the ability to prepare final accounts of sole trader	Cognitive Level- Apply
LO4	Recognize circumstances providing for increased exposure to errors and frauds	Cognitive Level- Evaluate

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1		3			2		2
LO2	2	2			3		2
LO3	2				2		
LO4			1	3	1	1	

Module 1

Basics of Accounting : Introduction-Book Keeping-Accounting-Objectives & Functions of Accounting-Assets-Liabilities-Capital-Types of Accounts-Accounting Principles-Concepts-Conventions-Double entry system-Golden Rules of Accounting-Accounting Equation Approach-Systems of Accounting.

Module 2

Journal, Subsidiary Books and Ledger: Journal-Journalizing-Ledgers-Posting-Purchases Day Book, Sales Day Book-Purchases, Returns Book-Sales Returns Books-Cash Book-Bills Receivable Book-Bills Payable Book-Journal Proper-Petty Cash Book-Bank Reconciliation Statement.

Module 3

Trial Balance and Rectification of Errors: Objectives of Preparing Trial Balance-Rules for Preparing Trial Balance-Suspense Account-Stages of Errors-Types of Errors-Steps to Locate Errors-Rectification of Errors Before and After Preparation of Trial Balance.

Module 4

Depreciation Accounting: Factors in the measurement of Depreciation-Methods of Providing Depreciation-Profit/Loss in the sale of Depreciable Assets.

Module 5

Preparation of Final Accounts of Sole Proprietors and Joint Stock Companies: Final Accounts of sole proprietors and companies-Trading Account-Manufacturing Account-Profit and Loss Account-Balance Sheet-Arrangement of Assets and Liabilities-Opening Entry-Closing Entry- Adjusting Entry-Provisions and Reserves-Limitations of Financial Statement.

Recommended Books

1. Shukla, M. C., Grewal, T. S., & Gupta, S. C. (2016). Advanced Accounts. S. Chand & Company Ltd., New Delhi.
2. Bhattacharyya, A. K. (2012). Essentials of Financial Accounting: PHI Learning Pvt. Ltd.
3. Jain, S. P., & Narang, K. L. (2008). Advanced Cost Accounting. Kalyani Publishers.
4. Gupta, R. L., & Radhaswamy, M. (2017). Advanced Accountancy. Sultan Chand & Sons,
5. Maheshwari, S. N., Maheshwari, S. K., & Maheswari, S. K. (2013). An Introduction to Accountancy. Vikas Publishing House.
6. Narayanswamy R. (2017). Financial Accounting: A managerial perspective. PHI publication
7. Raman B. S. (2018) Financial Accounting, United Publishers & Distributors

25-251-0303: BUSINESS ENVIRONMENT AND ETHICS

Course Description

The course intends to provide understanding of various components of environment and their interdependence so that students can assess the likely impact of environmental changes on business processes. The course examines the cause and effect relationship in the functional areas of firms; and the economic and non-economic environments like social, political, legal and regulatory, and technological environments - that affect them. It provides the knowledge of Indian Economy, which covers macroeconomic and socio-demographic indicators, planning structure and policies i.e. foreign direct investment, industrial, monetary and fiscal policy implications. To enable students to understand the challenges and complexities faced by businesses as it tries to maximize returns while ethically managing their duties to stakeholders and society. It is also intended to help students develop an understanding of cyber law in India.

Course Learning Outcomes

LO1	Understand the changing dimensions of business environment	Cognitive Level- Understand
LO2	Analyse the impact of monetary and fiscal policies in achieving macroeconomic goals	Cognitive Level- Analyse
LO3	Understand the process of ethical decision making and leadership	Cognitive Level- Understand
LO4	To analyse the Role of Ethical Culture and Relationships in organizations	Cognitive Level- Apply
LO5	Understand the concepts of electronic signatures and Analyse threat to privacy in cyberspace	Cognitive Level- Understand

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	1	1		1		3	1
LO2		1				3	1
LO3		1			1	3	1
LO4				1	1	3	1
LO5		1				3	1

Module 1

Business environment: concept, significance and nature of business environment; elements of environment – internal and external, Public sector and Economic development; economic

reforms New Economic Policy, Globalization, Global Competitiveness, corporate governance Political and legal environment of business: Government and business; Regulatory bodies; SEBI, TRAI, IRDA, RBI

Module 2

Business Environment Analysis tools- SWOT, PESTLE, Value chain Analysis, Porter's Five Forces analysis, Foreign Trade and Balance of Payment, Small and micro enterprises in India, Social responsibility of business; social audit, EXIM policy and role of EXIM bank, FDI policy, Multinational Corporation (MNCs) and Transnational Corporations (TNCs), Indian Financial System: Monetary and Fiscal Policy, Economic Trends, Price Policy, Stock Exchange of India. National Income.

Module 3

Definition & nature Business ethics, Characteristics, The Importance of Business Ethics (Ethical Theory), Stakeholder Relationships (Ethical objectivity), Emerging Business Ethics Issues (Ethical Reasoning), Causes of unethical behaviour; Ethical Decision Making and Leadership (Ethical Reasoning, Core Values, Objectivity), Work ethics

Module 4

Organizational Factors: The Role of Ethical Culture and Relationships (Ethical Theory, Integrity, Objectivity). Managing and Controlling Ethics Programs (Independence, Integrity), Globalization of Ethical Decision-Making (Integrity, Core Values), Sustainability.

Module 5

Cyber Crimes, Right to Privacy and Data Protection on Internet, Breach of sensitive personal information and confidentiality under IT Act. Digital signature and Electronic Signature and Data Protection, Creation and authentication of digital signature – E Contracting, E-mail Contracting, E Commerce- Intellectual Property Issues in Cyber Space. Dispute Resolution in Cyberspace

Recommended Books

1. Shaikh, S. (2010). *Business environment, 2/E*. Pearson Education India.
2. Aswathappa, K. (2014). *Essentials of business environment*. Himalaya Publishing House, Delhi.
3. Business Ethics, 2/e, A.C. Fernado, 2013, Pearson. Fernando, A. C. (2009). Business ethics: an Indian perspective. Pearson Education India.
4. Ferrell, O. C., Fraedrich, J., & Ferrell, L. (2015). Business ethics. Ethical decision making and cases.
5. Singh Y. (2012). Cyber Laws, Universal Law Publishing Co, New Delhi

25-251-0304: PRODUCTION AND OPERATIONS MANAGEMENT

Course Description

To provide a broad understanding of Operations Management; to provide insights into the management of strategic and functional issues in the operational environment of any organization; and to provide the students with various concepts, tools and techniques for operational, tactical and strategic decision making for effective utilization of resources and meeting customer expectations.

Course Learning Outcomes

LO1	Understand the role of operations strategy in manufacturing and non-manufacturing sectors	Cognitive Level- Understand
LO2	Understand the different forecasting methods.	Cognitive Level- Understand
LO3	Evaluate location choices and plant layouts according to requirements of organizations.	Cognitive Level- Analyze
LO4	Examine quality management concepts and SQC techniques in organizations.	Cognitive Level- Analyze
LO5	Evaluate inventory control decision choices after selecting appropriate mathematical models helping develop purchasing plans for organizations.	Cognitive Level- Evaluate

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	3	3			2	1	
LO2	3	2	1				1
LO3	0	0	2	2	1		
LO4	2	2	2		1		
LO5	3	1	3		2		

Module 1

Introduction to Production and Operations Functions, nature and Scope, decision areas, Interaction of Operations Management with other functional areas of Management – Manufacturing and Non-Manufacturing operations and their Classifications – Operations Strategy as a part of Corporate Strategy – Operations Planning and Control – Operations Forecasting: Forecasting methods.

Module 2

Facility Locations – Cost competition and Hidden factors – Steps in location selection – Types of Manufacturing Systems and Layout – Facility Layouts – Layouts by Products and Process – Life

balancing – Design of Operations Systems: Aggregate planning and Master Scheduling, MRP, CRP. Material Handling: Principles, Equipment_s for Materials Handling.

Module 3

Work study, Time and Method study: Definition, Importance, Aims and Procedures, Implications on Productivity, Work measurement, Work sampling, Work environment, and Industrial safety, Value analysis. Design of Manufacturing process

Module 4

Materials Management – Functions – Material planning and Budgeting – Value analysis- Purchase functions and procedure- inventory control- Types of Inventory- safety stock- Inventory control systems- Perpetual- periodic-JIT-KANBAN. Managing vendors; Vendor Analysis, Rating and Selection – Procedure and Criterions.

Module 5

Maintenance Management Function – Types of Maintenance – Total Productive Maintenance (TPM). Statistical Quality Control (SQC), Cost of Quality (COQ), ISO 9000 certification, Total Quality Management, OC curve , Control charts, SCM, Lean and Agile Manufacturing.

Recommended Books

1. B. Mahadevan (2015) Operations Management: Theory and Practice, Pearson.

2. Monks, Joseph, J (1988) Operations Management (Theory and Problems), McGraw Hill .

3. Chase, Richard, B., Aquilano, Nicholaus J and Jacobs, Roberts, F(2009) Production and Operations Management, McGraw Hill.

4. Bhat,K.S (2010) Operations Management, Himalaya Publishing House.

5. Heizer, J and Render, Barry (2008), Operations Management, Pearson Education, New Delhi.

6. S. N. Chary(2012) Production and Operations Management,McGraw Hill.

7. Adam, Everette, and Ebert,Roanld, J (1992) Production and Operations Management, Prentice Hall India, New Delhi.

25-251-0305: DATA VISUALIZATION FOR ANALYTICS

Course Description

This course introduces the principles and practices of data visualization, emphasizing the importance of effectively conveying insights through visual means. It covers the theoretical foundations of visualization, hands-on training with industry-standard tools like Tableau and Power BI, and the role of design in enhancing data communication. The course provides students with the skills to create, evaluate, and share meaningful visualizations that support data-driven decision-making.

Course Learning Outcomes

CO1	To understand the principles and best practices of effective data visualization.
CO2	Apply appropriate visual encodings and chart types based on data characteristics.
CO3	Use Tableau to create and share interactive dashboards.
CO4	Utilize Power BI to connect to data sources, model data, and design interactive reports.
CO5	Demonstrate the ability to use DAX expressions, custom visuals, and AI features for advanced visual analytics.

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3		1				
CO2	2	2	3				
CO3	2		2			3	
CO4		2	3		3	3	
CO5			2	2	3	3	3

Module 1

Value of data visualization – Telling stories with data – Principles of effective data visualization – Understanding visual perception – Data checking and verification – Types of visualizations: Bar charts, line charts, scatter plots, heatmaps, time series, and data maps – Graphical excellence and integrity.

Module 2

Introduction to Tableau – Creating basic visualizations -Dimensions and measures in Tableau – Properties of images and visual encoding – Roll-up and Drill-down – Multidimensional data and large design space – Mapping data to image using sign systems – Design criteria: Expressiveness and effectiveness – Titles, captions, annotations, legends, and grid lines – Charting using bar chart, line chart, dot plot, tables, and heatmaps – Testing designs – Creating dashboards using Tableau – Sharing interactive visualizations.

Module 3
Overview of Business Intelligence (BI) – Power BI ecosystem: Desktop, Service, and Mobile – Installation and interface overview – Connecting to data sources: Excel, CSV, SQL, Web, APIs – Data transformation using Power Query Editor – Data modeling: Relationships, cardinality, and cross-filter directions – Overview of data preparation workflow in Power BI.

Module 4
Introduction to DAX (Data Analysis Expressions): Syntax and basic functions (SUM, AVERAGE, MIN, MAX, COUNT) – Creating calculated columns vs. measures – Advanced DAX functions: CALCULATE, ALL, DISTINCT – Visualizations in Power BI: Bar, Column, Line, Pie, Matrix, Table, Card, KPIs – Using slicers and filters – Drill-down, drill-through, and hierarchies – Conditional formatting – Designing interactive reports and dashboards.

Module 5
Advanced Data Visualization Techniques: Importing and using custom visuals from Power BI Marketplace – Tooltips and visual-level interactivity – Time intelligence with DAX: YTD, QTD, MTD calculations – AI capabilities in Power BI: Key Influencers, Decomposition Tree, Quick Insights – Power BI Service and Collaboration: Publishing reports.

Note: The course is to be delivered through lab-based sessions Recommended

Books

- Tamara Munzner (2014); *Visualization Analysis and Design*, CRC Press.
- Nathan Yau (2011); *Visualize This: The FlowingData Guide to Design, Visualization, and Statistics*, Wiley.
- Ryan Sleeper (2020); *Innovative Tableau: 100 More Tips, Tutorials, and Strategies*, O'Reilly Media.
- Alexander Loth (2019); *Visual Analytics with Tableau*, Wiley.
- Alberto Ferrari & Marco Russo (2019); *Introducing DAX: Fundamental Concepts*, Microsoft Press.
- Matt Allington (2016); *Learn to Write DAX: A Practical Guide to Learning Power Pivot for Excel and Power BI*, Self-published.
- Reid Havens (2021); *Microsoft Power BI Data Analyst Certification Guide*, Packt Publishing.

25-251-0306: DATA MINING TECHNIQUES

Course Description

The course offers a comprehensive introduction to both data mining theory and practice. It provides an understanding of major data mining techniques. This course is an introductory course on data mining. It introduces the basic concepts, principles, methods, implementation techniques, and applications of data mining.

Course Learning Outcomes

LO1	Understand basic concepts and techniques of Data Mining stages	Cognitive Level- Understand
LO2	Analyze and reduce large sets of data to gain useful business understanding	Cognitive Level- Analyze
LO3	Evaluate data classification methods, models and issues regarding the same	Cognitive Level- Evaluate
LO4	Apply association rules for solving data mining problems.	Cognitive Level- Create
LO5	Develop data mining application based on custom requirements using R/WEKA/MATLAB/PYTHON	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	3	2	3		2		
LO2	3		2	s	2		
LO3	3		2		2		
LO4			3	2	3		
LO5				1	3		

Module 1

Basics of data mining: definition of data, information and data analysis, fundamentals of data mining, data mining stages, Applications of data mining, Data Pre-processing: Need for Pre-processing the Data, Data Cleaning

Module 2:

Data Integration and Transformation, Data Reduction, Introduction to data warehouse and business intelligence.CASE studies: Download free data sets from online repositories, analyse and clean them using tools such as MS Excel and SPSS.

Module 3

Classification models: Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, KNN, Bayesian Classification, neural networks, Support Vector Machines

Case studies: Using the clean data prepared in case study of module 1, classify using the decision tree and SVM models using tools such as R/WEKA/MATLAB/PYTHON

Module 4

Association rules mining: Mining Frequent Patterns, Associations and Correlations: Basic Concepts, Efficient and Scalable Frequent Item set Mining Methods, Mining various kinds of Association Rules, From Association Mining to Correlation Analysis, Improvement of Apriori algorithms and FP-Trees. Case studies: Using WEKA, perform association rule mining over the standard transaction datasets.

Module 5

Advances in data mining, Time Series and Sequence patterns in Transactional Databases, Mining Sequence Patterns in Biological Data, Graph Mining, Social Network Analysis and web mining. Case studies: Create a sample text mining application using python/R to create a keyword index for a set of uploaded files in a directory.

Recommended Books

1. Han, J., Pei, J., & Kamber, M. (2011). *Data mining: concepts and techniques*. Elsevier.
2. Hall, M., Frank, E., Holmes, G., Pfahringer, B., Reutemann, P., & Witten, I. H. (2009). The WEKA data mining software: an update. *ACM SIGKDD explorations newsletter*, *11*(1), 10-18.
3. Gupta, G.K (2014) Introduction to Data Mining with Case Studies, 2014, Prentice Hall India.
4. Elayidom, M.Sudheep (2014) Data Mining and WareHousing, , Cengage Learning India Pvt.Ltd,
5. Zhao, Y (2015) R and data mining: Examples and case studies, Access at www.RDatamining.com
6. Pujari, Arun K (2016) Data Mining Techniques,Third edition, Universities Press.
7. Soman, K.P, Diwakar, S, Ajay, V (2008)Insight into Data Mining, Prentice Hall India
8. PaulrajPonnaiah (2001) Data Warehousing Fundamentals, John Wiley& Sons
9. Roiger, R., Gaetz , M .W (2003) Data Mining – A Tutorial Based Primer, Pearson.

Online support training materials and videos:

- The NPTEL data mining course from IITKGP
- ―Introduction to data analytics:‖ MOOC course from IITM
- The EDUREKA data mining certification program
- The Intellipaat Data Science Certification program
- Data mining with WEKA, MOOC courses from University of Waikato, Newzeland

SEMESTER IV

Sl.No	Course No.	Name of the Course	Hours			Marks		Credit
			L	T	P	Internal	End semester	
1	25-251-0401	Research Methodology	3	0	2	50	50	4
2	25-251-0402	Environmental Management	3	0	2	50	50	4
3	25-251-0403	Modern Project Management Practices	3	0	2	50	50	4
4	25-251-0404	Introduction to Econometric Methods	5	1	0	50	50	5
5	25-251-0405	Predictive Modelling	2	0	6	50	50	5
6	25-251-0406	Elective 1	3	0	2	50	50	4
7.	25-251-0407	Project II -Business Process Mapping for a duration of 15 working days. (50 Marks for continuous assessment, 50 marks for a written report after the completion of the project)					100	4
		Total				**300**	**400**	**30**

25-251-0401: RESEARCH METHODOLOGY

Course Description

Research Methodology is a hands‑ on course designed to impart education in the foundational methods and techniques of academic research in social sciences and business management context. Research scholars would examine and be practically exposed to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, report writing, and presentation. Once equipped with this knowledge, participants would be well-placed to conduct disciplined research under supervision in an area of their choosing. Besides their application in an academic setting, many of the methodologies discussed in this course would be like those deployed in professional research environments.

Course Learning Outcomes

LO1	Understand some basic concepts of research and its methodologies	Cognitive Level- Understand
LO2	Be aware of the ethical principles of research, ethical challenges and approval processes.	Cognitive Level- Analyze
LO3	Apply quantitative, qualitative and mixed methods approaches to cases.	Cognitive Level- Evaluate
LO4	Develop literature review for a research problem.	Cognitive Level- Create
LO5	Develop competence in scholarly writing and research presentation.	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	2			3		2	3
LO2				3		3	2
LO3		2	1	3	2	1	
LO4				3		1	2
LO5				3		1	3

Module 1

Research Process - Research Problem Formulation from a Decision Problem- Problem Audit

- Development of Appropriate Research Design: research design types, characteristics, overview of data collection methods used for each type of design. - Research Ethics- Literature Search and Review – Using reference management systems for literature review.

Module 2

Qualitative and Quantitative Approaches to Research: Qualitative and Exploratory Data Collection Methods – Experience Surveys, Focus Groups, Depth Interviews - Secondary Data Research – Observational Techniques – Survey Method –

Module 3

Measurement: Validity and Reliability - Basic Levels of Scales - Criteria for Scale Development, Attitude Measurement Scales: Comparative and Non-comparative Scales. – Questionnaire Design

Module 4

Sampling: fundamental concepts, Sampling methods, Determination of Sample Size – Types of Sampling – Developing Appropriate Sampling Plan - Managing Field Work.

Module 5

Data Preparation: Data Validation – Data Editing and Coding – Tabulation: Single & Cross – Graphical Representation of Data.

Testing of Hypothesis – Process, Type I and Type II Errors –Testing of Difference in Means, Testing for Association. Research report preparation

Recommended Books

1. Booth, W. C., Colomb, G. G., & Williams, J. M. (2003). *The craft of research*. University of Chicago press.
2. Bryman, A., & Bell, E. (2015). *Business research methods*. Oxford University Press, USA.
3. Cooper, D. R., Schindler, P. S., & Sun, J. (2006). *Business research methods* (Vol. 9). New York: McGraw-Hill Irwin.
4. Field, A. (2009). *Discovering statistics using SPSS*. Sage publications.
5. Hair, J. F., Celsi, M. W., Ortinau, D. J., & Bush, R. P. (2008). *Essentials of marketing research*. McGraw-Hill/Higher Education.
6. Malhotra, N. K. (2008). *Marketing research: An applied orientation, 5/e*. Pearson Education India.
7. Saunders, M. N. (2011). *Research methods for business students, 5/e*. Pearson Education India.
8. Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill building approach*. John Wiley & Sons.

25-251-0402: ENVIRONMENTAL MANAGEMENT

Course Description

This course is to raise awareness about the complicated and life supporting relationship of environment and other human endeavours. Intended to be a general course suitable for undergraduates it covers the fundamental relationships and cyclic processes that govern the ecosystems on earth. This course prepares the learner to meaningfully contribute towards sustainable development and reduce environmental degradation.

Course Learning Outcomes

LO1	Understand the relationships between the biotic and abiotic forms in ecological systems	Cognitive Level- Understand
LO2	Understand ecological problems like pollution, loss of habitat, waste generation and disposal.	Cognitive Level- Understand
LO3	Analyse specific case studies on pollution and man-made ecological issues like waste disposal.	Cognitive Level- Analyse
LO4	Evaluate technologies for reducing the ecological footprint of human activities and reduce adverse environmental impacts.	Cognitive Level- Evaluate
LO5	Assess the impacts of human activities on the environment by interpreting the complex relation among population, natural resources and economic development.	Cognitive Level- Evaluate

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1						3	2
LO2		1				3	2
LO3		2		1		3	1
LO4		3				3	
LO5		3				3	

Module 1
Environmental studies as a multidisciplinary field: Definition, scope, importance and components - Natural resources and associated problems (forest, water, food, land and energy resources) - Role of an individual in conservation of natural resources - Equitable use of resources for sustainable lifestyles.

Module 2

Ecosystems and Biodiversity: Concept, Structure and function of an ecosystem - Energy flow in the ecosystem - Ecological succession: Food chains, food webs and ecological pyramids – Types and characteristics of: Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems - Definition of genetic, species and ecosystem diversity -Bio- geographical classification of India - Value of biodiversity - Biodiversity at global, national and local levels -Hot-spots of biodiversity - Threats to biodiversity - Endangered and endemic species of India - Conservation of biodiversity - In-situ and Ex-situ conservation of biodiversity.

Module 3

Environmental pollution and Environmental Legislation: Types of pollution - Solid waste Management: Causes, effects and control measures of urban and industrial wastes   - Role of an individual in prevention of pollution - Pollution case studies - Environment Protection Act
- Air (Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act - Hazardous Waste Handling and Disposal in India - relevant Acts - Issues involved in enforcement of environmental legislation.

Module 4

Environmental ethics - Social issues and the environment - Issues and possible solutions - Climate change - global warming - acid rain - ozone layer depletion - nuclear accidents and holocaust - Case Studies - Wasteland reclamation - Consumerism and waste products - From Unsustainable to Sustainable development - Urban problems related to energy - Water conservation : rain water harvesting and watershed management - Resettlement and rehabilitation of people: its problems and concerns - Case Studies - Public awareness.

Module 5

Human Population and the environment - Population growth - variation among nations - Population explosion - Family Welfare Programme - Environment and human health - Human rights - Role of Information Technology in Environment and human health - Case Studies - Field work.

Note: Field work report: A short report shall be submitted by the students after a field visit with an objective related to any of the broad areas covered in the subject.

Recommended Books

a. Ahluwalia,V.K (2016) Environmental Studies, Second edition, New Delhi, TERI Press.
b. AninditaBasak (2009) Environmental Studies, Pearson.
c. Chawla, Sashi (2012) A Textbook of Environmental Studies, McGrawHill.
d. Davis, Mackenzie L., and Cornwell, David A. (2014) Introduction to Environmental Engineering, Fifth edition, McGrawHill.
e. Glynn Henry, J., and Heinke, Gary W (2015) Environmental Science and Engineering, Pearson.
f. Ramachandra, T.V., and Kulkarni, Vijay (2015) Environmental Management, New Delhi, TERI Press
g. Thomas, Jacob (2014) Environmental Management: Text and Cases, Pearson.

25-251-0403: MODERN PROJECT MANAGEMENT PRACTICES

Course Description

This course aims to familiarize students with the concepts of project life cycle and to develop competency in project scoping, work definition, and work breakdown structure. At the end of this course, students will be able to handle the complex tasks of time estimation and project scheduling. Modules 3 and 4 introduce the students to the Agile methods for project management. Module 4 provides an understanding of project management and its principles in a contemporary iterative, incremental agile project environment. Module 5 introduces the students to some of the powerful practices in agile methodologies.

Course Learning Outcomes

LO1	Understand the challenges in project management.	Cognitive Level- Understand
LO2	Apply project cost estimating techniques and earned value management	Cognitive Level- Apply
LO3	Analyse risks involved in a project and find out methods to reduce risks	Cognitive Level- Analyse
LO4	Evaluate agile practices in latest software projects	Cognitive Level- Evaluate
LO5	Evaluate an agile transition plan	Cognitive Level- Evaluate

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1		2		2	3	2	1
LO2	3	2	2		2	1	2
LO3	3	2	2		2	1	2
LO4		2		3	2		
LO5		2		3	2		

Module 1

Basics of Project Management - need for project management - project management knowledge areas - the project life cycle - project management processes - challenges in project management.

Module 2

Organizational Structure and Organizational Issues: Concept of Organizational Structure - Roles and Responsibilities of Project Manager - Leadership - Conflict Resolution. Resources

Considerations in Projects: Introduction - Resource Allocation - Scheduling - Project Cost Estimating.

Module 3

Project Risk Management - Risk Identification - Risk Analysis - Reducing Risks - Project Quality Management - Quality Concepts, Project Execution - Project Control Process - Purpose of Project Execution - Project Close-out -Termination and Follow-up.

Module 4

Agile project management principles - Agile manifesto - Agile technical team: Roles and responsibilities, team empowerment, leadership collaboration. Agile practices: iterative development methodologies – SCRUM and XP, modeling, time-boxing - Agile project planning – Sprint planning - Agile approach to estimating.

Module 5

Transitioning to agile – Agile metrics - User stories – story points – ideal days - Customer Satisfaction and the KANO modelling – Velocity calculation – burn down chart – Customer testing – Test first – Refactoring – Daily stand up – Pair programming – Continuous delivery – DevOps - Software delivery as the Core Competency.

Recommended Books

1. Bentley, C. (2011).*The Essence of the Project Management Method*, 7th Edition. CAIS Management.
2. Cobb, C. G. and Hoboken (2011). *Making Sense of Agile Project Management: Balancing Control and Agility*, John Wiley and Sons.
3. Kerzner, H. R. (2013). *Project management: a systems approach to planning, scheduling and controlling.* 11th Edition, John Wiley and Sons.
4. Meredith, M.J. (2005) *Project management: a managerial approach*. 6th edition, Wiley and Sons.
5. Project Management Institute (2008). *A guide to the project management body of knowledge (pmbok guide).* 4th edition.
6. Schwalbe, K. (2008) *Information Technology Project Management*, 5th edition.
7. Wysocki, R.K. (2014). *Effective project management: traditional, agile, extreme,* (7thEd): Wiley India
8. Highsmith, J. (2009).*Agile Project Management (2ndEd)*: Addison-Wesley Professional.
9. Goodpasture,J.C.(2014). *Project Management the Agile Way: Making it Work in the Enterprise (1st Ed),*Cengage Learning India.
10. Kim, G., Behr, K., & Spafford, K. (2014). *The phoenix project: A novel about IT, DevOps, and helping your business win*. IT Revolution.
11. Humble, J., & Farley, D. (2010). *Continuous delivery: reliable software releases through build, test, and deployment automation*. Pearson Education.

25-251-0404: INTRODUCTION TO ECONOMETRIC METHODS

Course Description

The course is designed to impart the learning of principles of econometric methods and tools. This is expected to improve student's ability to understand of econometrics in the study of economics. This course intends to provide a thorough and sound understanding of the essential theoretical base, an introduction into the important and useful techniques of modelling and also an understanding of the broad applications of econometrics.

Course Learning Outcomes

LO1	Understand the basic principles of decision making using micro economic analysis	Cognitive Level- Understand
LO2	Build, estimate and interpret linear regression models	Cognitive Level- Apply
LO3	Use LOGIT and ANCOVA models for understanding relationships and variables	Cognitive Level- Analyse
LO4	Interpret key statistics and diagnostics typically generated by software	Cognitive Level- Evaluate

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	3	3	3	2	2		1
LO2	3		3	1			
LO3	3		3	1			
LO4	3				3		2

Module 1

Basics of Econometrics-Linear regression model, two variables and multi variables, BLUE property, general and confidence approach to hypothesis testing, partial effects and elasticity, goodness of fit, model evaluation, matrix approach to linear regression models

Module 2

Nonlinear relationships – transformation of variables – functional forms –three variable regression model – applications using excel

Module 3

General linear model– specification – OLS estimators – testing significance of individual and overall regression coefficients – restricted least squares – structural regression models – dummy variables – problems and application using excel.

Module 4

Violation of classical assumptions – multicollinearity – autocorrelation – heteroscedasticity – problems – causes – consequences – remedial measures – model specification and diagnostic testing- . Excel practical

Module 5

Introduction to time series: Components of time series- Tools of modern time series analysis – stochastic and stationary process – tests of stationary – trend vs difference stationery process –ARIMA. Excel practicals.

Recommended Books

1. Brooks, C. (2014). *Introductory econometrics for finance*. Cambridge university press.
2. Pattersson, K. (2000). An Introduction to Applied Econometrics: A Time series Approach, Palgrave McMillan.
3. Enders, W. (2010). *Applied econometric time series*. John Wiley & Sons.
4. Baltagi, B. (2010). *Econometric analysis of panel data*. John Wiley & Sons.
5. Baltagi, B.H. (2011), Econometrics, Springer, New York.
6. Dongherty, C. (2011), Introduction to Econometrics, Oxford University Press, New York.
7. Guarajti Damodar J. and Dawn C. Porter. (2009), Essentials of Econometrics. Fourth edition.
8. Koutsoyiannis, A. (2001), Theory of Econometrics (2nd ed.), Palgrave Macmillan Press Ltd., London
9. Maddala, G.S. (1998), Econometrics — An Introduction, New York:McGraw-Hill.
10. Wooldridge, J.M.,   (2013), Introductory Econometrics: A Modern Approach, NewDelhi: Cengage.

25-251-0405: PREDICTIVE MODELLING

This course covers deep learning techniques used by practitioners in industry, such as Linear Regression and classification models, the concept of generalisation, deep neural networks, feature engineering, sequence modelling, and practical methodology. This course is useful for those who want to start learning about deep learning and how it can be used to apply in various problems.

Course Learning Outcomes

LO1	Understand basic concepts and techniques of Predictive Modelling	Cognitive Level-Understand
LO2	Visualize and explore data to better understand relationships among variables	Cognitive Level-Evaluate
LO3	Applying dimensionality reduction and feature scaling to normalize the data	Cognitive Level- Apply
LO4	Devise solutions to practical problems using Predictive modeling algorithms	Cognitive Level- Create
LO5	Use of predictive models to uncover unknown patterns and new causal mechanisms in complex data.	Cognitive Level- Synthesis
LO6	Understand basics of Reinforcement learning and deep learning	Cognitive Level- Understand

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	3						
LO2	3	2	3	2	2		
LO3	3		3		3		
LO4	2		3		2		
LO5	3		3	2			2
LO6			3		3		2

Module 1

Introduction to Predictive Modeling - Types of Predictive Models - Stages of Predictive Modeling - Hypothesis Generation - Data Extraction - Data Exploration. Reading the data - Variable Identification - Univariate analysis for Continuous Variables and Categorical Variables, Bivariate Analysis, missing values, Variable Transformation

Module 2

Feature processing and scaling - Feature Transformation, Scaling and Encoding - Frequency Encoding - Feature Generation - Feature Interaction - Date Time Features. Automated Feature Engineering: Familiarization with Tools.

Module 3

Analytics Modeling - Dimensionality Reduction: Factor Analysis - Principal Component Analysis (PCA) - Independent Component Analysis (ICA) – Projection techniques - Linear Discriminant Analysis (LDA) - Selection & Boosting.

Module 4

Linear models: Simple Linear Regression, Multiple Linear Regression, Polynomial Regression; Classification - Logistic Regression - K-Nearest Neighbors (K-NN) - Naive Bayes- Decision Tree - Support Vector Machine (SVM) - Evaluating Performance of Classification Models. Clustering - K-Means Clustering, Hierarchical Clustering.

Module 5

Introduction to Reinforcement learning and Deep learning - Upper Confidence Bound (UCB), Q-learning – Sampling - Artificial Neural Networks - Convolutional Neural Networks – DNN: Implementation ideas.

Recommended Books

1. Aggarwal, Charu C. (2018), Neural Networks and Deep Learning A Textbook, Springer

2. Livingstone, David J. (Ed). (2009), Artificial Neural Networks: Methods and Application, Springer

3. Max Kuhn and Kjell Johnson (2019), Feature Engineering and Selection: A Practical Approach for Predictive Models, Taylor & Francis

4. Simon Haykin (2010) *Neural Networks & Learning Machines,* Third edition, Prentice Hall India.

5. Sudharsan Ravichandiran, 2020, Deep Reinforcement Learning with Python, Packt Publishing; 2nd edition (30 September)

SEMESTER V

Sl.No	Course No.	Name of the Course	Hours			Marks		Credit
			L	T	P	Internal	End semester	
1	25-251-0501	Entrepreneurship Development and Management of Startups	4	0	2	50	50	4
2	25-251-0502	Strategic Self Marketing & Personal Branding	5	2	0	50	50	4
3	25-251-0503	Digital Marketing and Social Media Analytics	2	3	4	50	50	4
4	25-251-0504	Big Data Analytics	2	0	4	50	50	4
5	25-251-0505	Text and Web Analytics	3	0	4	50	50	5
6	25-251-0506	Business Model Analysis	5	1	0	50	50	5
7	25-251-0507	Elective 2	3	1	2	50	50	4
		Total				350	350	30

25-251-0501: ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT OF START-UPS

Course Description

Upon completion of the course, the student will be able to demonstrate knowledge of the following topics: Understanding the dynamic role of entrepreneurship and small businesses; Organizing and Managing a Small Business; Startups- New Product or Service Development; Business Plan Creation; and Small Business Growth and Performance

Course Learning Outcomes

LO1	Understand entrepreneurial behaviours and entrepreneurial motivation	Cognitive Level- Understand
LO2	Understand managerial problems of new enterprises: production, financing and labour and marketing problems	Cognitive Level- Understand

LO3	Analyse the economic costs and benefits of start-ups	Cognitive Level- Analyze
LO4	Evaluate the process of becoming a start-up with current trends and Regulatory environment	Cognitive Level- Evaluate
LO5	Create a business plan for a business idea	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1		2	2	1		1	
LO2		3		3		2	1
LO3		3				2	
LO4		3		2	2	1	
LO5				2	2	2	3

Module 1

Entrepreneurial traits, types and significance, Definitions, characteristics of entrepreneurial types, qualities and functions of entrepreneurs, entrepreneurial behaviours and entrepreneurial motivation, Achievement and management success, Entrepreneurial success in rural area, Innovation and entrepreneur. Role of entrepreneurship in a developing economy.

Module 2

Mechanics of setting of new enterprises – size and location, industrial location factors determining

the industrial location. Search for business idea, sources of ideas, idea processing, input requirements, Business plans: Components and Preparation of business plans, Sources of finance.

Module 3

Feasibility Studies: Technical, marketing and financial: managerial problems of new enterprises: production, financing and labor and marketing problems, Preparation of Feasibility reports and legal process and documentation, establishing entrepreneur systems.

Module 4

The new model of Entrepreneurship- Business incubators and startups, Start up's- Concepts, models, characteristics, startup communities, startup terminologies and funding options of start-up's. Startups in India: Profile, Causes, Effects, Process of becoming a startup, Current trends, Regulatory environment, Budget, Plans and Policies.

Module 5

Strategic planning and financial performance of start-ups, Economic costs and benefits of startups. Role of Business Planning in Startup's. Startup's- Key to unemployment or reason for future unemployed youth, impact of education and training, Resource constraints, Emerging, young and high potential start-ups. Government initiatives- assistance towards Startup's, women initiatives and other backward groups. Startup India program.

Recommended Books

1. Barringer, Bruce R. (2015) Preparing Effective Business Plans : An Entrepreneurial Approach. Second edition, Pearson Education.
2. Barringer, Bruce R., and Ireland,R. Duane (2008) Entrepreneurship : Successfully Launching New Ventures, Second Edition, Pearson Education.
3. Blank, Steven G., and Dorf, Bob (2012). The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company.KetS Ranch, Inc.
4. Drucker, Peter Ferdinand (2007). Innovation and Entrepreneurship: Practice and Principles. Harper & Row.
5. Kuratko, Donald F., and Welsch, Harold P. (2004) Strategic Entrepreneurial Growth. , Second edition, Thomson/South-Western.
6. Kawasaki, G. (2004). The art of the start: The time-tested, battle-hardened guide for anyone starting anything. Penguin.
7. Christensen, C. M., &Christensen, C. M. (2003).The Innovator's Dilemma, HarperBusiness Essentials.
8. Baron, R. A. (2014). Essentials of Entrepreneurship: Evidence and Practice. Edward Elgar Publishing.
9. Kuratko, D. F. (2016). Entrepreneurship: Theory, Process, and Practice. Cengage Learning.
10. Blank, S., & Dorf, B. (2012). The Startup Owner's Manual: The step-by-step guide for building a great company; BookBaby.

25-251-0502: STRATEGIC SELF-MARKETING AND PERSONAL BRANDING

Course Description

The course aims to familiarize students with the use strategic marketing and personal branding techniques for enhancing and promoting professional image. Upon completion of the course, students should be able to create and project a professional image and attitude, demonstrate good interview and networking skills. The course also aims to familiarize the student with global business etiquettes and help them develop a personal brand to advance future career marketability.

Course Learning Outcomes

LO 1	Understand the importance of marketing orientation and career development	Cognitive Level- Understand
LO 2	Analyse strategies for creating personal brand	Cognitive Level- Analyse
LO 3	Create personal branding statements, and integrate social networking into career branding;	Cognitive Level- Evaluate
LO 4	Analyse self-marketing and personal branding related data for self-assessment of self-marketing and personal branding skills.	Cognitive Level- Create
LO 5	Create a strategic self-marketing plan.	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO7
LO1						2	3
LO2						2	3
LO3						2	3
LO4						2	3
LO5						2	3

Module 1

Overview of personal branding - Crafting Personal Brand Profile - Business Cards - Resume writing - LinkedIn - Crafting personal brand - Knowing brand (Personal SWOT).

Module 2

Define branding and career goals - Understand how to position oneself - Define your message - Establish social media accounts - Create digital portfolio - Layout and develop a resume and cover letter

Module 3

Building a personal network - Personal branding in the work place - Writing personal brand - Communicating Brand Online - Social media marketing

Module 4

Determine a brand strategy - how to leverage current professional and personal relationships - Attending professional networking events.

Module 5

Build a brand action plan - Evaluate other successful personal brand campaigns - How to maintain branding efforts.

Recommended Books

1. Susan Chritton(2012) Personal Branding For Dummies; John Wiley & Sons,

2. William Arruda and Dixson, K (2007) Career Distinction: Stand Out by Building Your Brand; John Wiley & Sons.

3. Mobray, Kaplan (2009) The 10Ks of Personal Branding; iUniverse,

4. Michael Janda (2013) Burn Your Portfolio: Stuff They Don't Teach You in Design School, But Should; New Riders.

5. Erik Deckers and Kyle Lacy (2012) Branding Yourself: How to Use Social Media to Invent or Reinvent Yourself,Second edition; Que Publishing

25-251-0503: DIGITAL MARKETING AND SOCIAL MEDIA ANALYTICS

Course Description

To impart theory and practice of digital marketing and social media analytics in the age of big data; to give basic level understanding of paid media, predictive modeling for ad targeting and customer relationship management, measuring and managing product virality, viral product design, native advertising, and engaging the multichannel experience; and to expose to some of the theory and practice of randomized experimentation, AB testing and the importance of causal inference for marketing strategy.

Course Learning Outcomes

LO1	Understand digital marketing concepts, social media analytics and tools	Cognitive Leve-Understand
LO2	Examine social media CRM methods	Cognitive Level- Analyse
LO3	Evaluate digital marketing plans by identifying correct measures	Cognitive Level-Evaluate
LO4	Evaluate strategic options for boosting customer acquisition, conversion, and retention using digital marketing	Cognitive Level-Evaluate
LO5	Create a digital marketing plan and budget	Cognitive Level-Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO7
LO1		3	2		2		
LO2		2			3	2	1
LO3		3	3		3		1
LO4		3	3		3		1
LO5	2	3		3	3	1	2

Module 1

Social Media Analytics: Defining Analytics in Social Media and Types of Analytics Tools, Differences of Social Media Networks, The Analytics Process, Metrics, Dashboards, and Reports, Strategy of Marketing, Prescriptive Analytics, The Future of Social Media Analytics.

Module 2

Tools for Social Media Analytics: Identifying a Social Media Listening Tool, Understanding Social Media Engagement Software, Purchasing Social Media Engagement Tools, Tools: Social Media

Listening, Search Analytics, Audience analysis, Modeling Social Media Programs, Search Analysis.

Module 3

CRM Strategy in the Age of Big Data and Digital Advertising: Defining Social CRM, Rolling Out a Social CRM Initiative, Identifying a Social CRM Solution. Mobile Analytics: Understanding the Current Mobile Market Landscape, Identifying What Is Next for Mobile Marketing, The Current State of Measuring Mobile, The Future State of Measuring Mobile Marketing, Earned vs Paid Media, Predictive Modeling for Ad Targeting

Module 4

Viral Product Design, the Multichannel Experience, Randomized Experimentation: Understanding the Conversation Audit, Identifying Online Influencers, Identifying Known Issues, Social Customer Service Models and Conflicts, Formulating Research Plan, Conduct of Report, Search analysis and ROI.

Module 5

AB Testing and Causal Inference in Marketing Strategy: Understanding Measurement Fundamentals, Developing Your Measurement Reporting Cadence, AB Testing, Collecting and Extracting Social Media Data form Twitter/ Flikr, Data Analysis, Visualization, and Exploration of Data, Case Study on Structured and Unstructured Data.

Activities Recommended:

1. Modeling Exercise of Digital Marketing and Reporting of for easy understanding and communication.
2. Case Study of Media Analytics in Twitter and Flickr.

Recommended Books

1. Noah Gray, Michael Fox, Social Media Marketing: Step by Step Instructions For Advertising Your Business on Facebook, Youtube, Instagram, Twitter, Pinterest, Linkedin and Various Other Platforms, 2nd Edition, 2018.
2. Chuck Hemann, Ken Burbary, Digital Marketing Analytics: Making Sense of Consumer Data in a Digital World, Que Publishing, 2013.
3. Raghav Bali, Dipanjan Sarkar, Tushar Sharma, Learning Social Media Analytics with R: Transform data from social media platforms into actionable business insights, Packt, 2017
4. Alex Gonçalves, Social Media Analytics Strategy: Using Data to Optimize Business Performance 1st ed. Edition, Apress, 2017.
5. Matthew Ganis, Avinash Kohirkar, Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media, IBM Press, 1st Edition, 2015
6. Matthew A. Russell, Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub, and More O'Reilly Media; Second edition, 2013.

Courses Recommended:

https://www.coursera.org/specializations/digital-marketing

https://www.coursera.org/learn/social-media-data-analytics

25-251-0504: BIG DATA ANALYTICS

Course Description

To introduce big data terminologies and concepts, MapReduce programming model and its applications. This course provides an overview of approaches facilitating data analytics on huge datasets. Different strategies are presented including sampling to make classical analytics tools amenable for big datasets, analytics tools that can be applied in the batch or the speed layer of a lambda architecture, stream analytics, and commercial attempts to make big data manageable in massively distributed or in-memory databases. Learners will be able to realistically assess the application of big data analytics technologies for different usage scenarios and start with their own experiments.

Course Learning Outcomes

LO 1	Understand the fundamental concepts of big data analytics.	Cognitive Level- Understand
LO 2	Understand the various search methods and visualization techniques.	Cognitive Level- Understand
LO 3	Apply various techniques for mining data streams.	Cognitive Level- Apply
LO 4	Optimize business decisions and create competitive advantage with Big Data Analytics	Cognitive Level- Create
LO 5	Apply Map Reduce Concepts.	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO7
LO1	3	2	3	2	2		
LO2	2			3	2		1
LO3			3		3		
LO4	3	3	3				
LO5		3	3		3		

Module 1

Introduction to big data: Big Data Overview, The Value of Big Data, State of the Practice in Analytics, Key Roles for the new Big Data Ecosystem, Characteristics of Big Data, Challenges for Big Data Analytics, Big Data Applications, Big Data Use Cases: Patterns for Big Data Deployment

Module 2

Big data analytics: Data Analytics Lifecycle-Discovery, Data Preparation, Model Planning, Model Building, Communicate Results, Operationalize, Case Study: Global Innovation Network And Analysis (GINA), Modern Data Analytic Tools, Intelligent data analysis, Analytic Processes and Tools,

Module 3

Big data technology and tools: analytics for Unstructured Data- Use Cases, MapReduce, Apache Hadoop, The Hadoop Ecosystem- Pig, Hive, HBase, Mahout, NoSQL, In-Database Analytics-SOL Essentials, In-Database Text Analysis, Advanced SOL, Data Analytic Methods Using R-Exploratory Data Analysis, Statistical Methods for Evaluation, Big Data Analytics with R and Hadoop

Case study: Installation and study of Apache Hadoop and implementation of a sample wordcount MapReduce program

Module 4

Apache Hadoop: apache Hadoop and the Hadoop Ecosystem- The Hadoop Distributed File System, Components of Hadoop, Analyzing the Data with Hadoop, Hadoop I/O, Setting up a Hadoop Cluster, Hadoop Configuration, Security in Hadoop, Hadoop benchmarks, Hadoop Ecosystem-Yarn, Pig, HBase, Mahout, Zookeper, Oozie, Flume, Sqoop

Module 5

MapReduce programming**:** Map-Reduce Implementation with Hadoop, How Map Reduce Works, Anatomy of a Map Reduce Job, MapReduce Execution Pipeline, Designing MapReduce Implementation, Map Reduce Types and Formats- Map Reduce Features Case Study- IBM InfoSphere Case studies focussing on clustering application for recommendation systems

Recommended Books

1. Clifton, B. (2010). *Advanced web metrics mit Google Analytics: Praxis-Handbuch*. MITP-Verlags GmbH & Co. KG.
2. Prajapati, V. (2013). Big data analytics with R and Hadoop. Packt Publishing Ltd..
3. Marconi, K., & Lehmann, H. (Eds.). (2014). *Big data and health analytics*. CRC Press.
4. Warden, P. (2011). *Big data glossary*. O'Reilly Media, Inc.
5. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing andPresenting Data, EMC Education Services, WILEY, 2015
6. Elayidom, M. S. (2015). Datamining and Warehousing. *Cengage Learning India Pvt Ltd*.
7. Berthold, M. R., & Hand, D. J. (Eds.). (2007). *Intelligent data analysis: an introduction*. Springer.
8. Plunkett, T., Macdonald, B., Nelson, B., Hornick, M., Sun, H., Mohiuddin, K., ... & Segleau, D. (2014). *Oracle big data handbook*. McGraw-Hill Education.
9. White, T. (2012). *Hadoop: The definitive guide*. " O'Reilly Media, Inc.
10. Zikopoulos, P., & Eaton, C. (2011). *Understanding big data: Analytics for enterprise class*

25-251-0505: TEXT AND WEB ANALYTICS

Course Description

This course introduces students to the principles and techniques of text and web analytics, focusing on extracting meaningful insights from unstructured data. Topics include text preprocessing, vectorization, sentiment analysis, topic modeling, stream data mining, and web data extraction. Emphasis is placed on practical tools and real-world applications.

Course Learning Outcomes

CO1	Apply preprocessing and vectorization techniques to convert text into structured formats.
CO2	Perform topic modeling using suitable algorithms.
CO3	Perform sentiment analysis using suitable algorithms and tools.
CO4	Analyze real-time textual data streams and perform trend analysis.
CO5	Extract and analyze data from web sources using modern web scraping tools and techniques.

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	2	2	1	2
CO2	3	3	3	2	2	2	2
CO3	3	3	3	3	2	1	2
CO4	3	2	3	3	3	2	2
CO5	3	2	3	2	3	3	2

Module 1

Introduction to Text Analytics – Text Analytics Steps – Collecting Raw Text – Text Preprocessing - Tokenization, Stemming, Lemmatization, Stopword Removal– Representing Text – Bag of Words and N-grams – Term Frequency-Inverse Document Frequency (TFIDF) – Word Embeddings ,Word2Vec – Applications of Text Analytics in Business and Social Media

Module 2

Topic Models – Content Similarity Index (CSI) – Probabilistic Latent Semantic Analysis (PLSA) – Latent Dirichlet Allocation (LDA) – Document-Term Matrix –Topic-based Document Index – Cosine Similarity – Topic Discovery and Trend Analysis

Module 3

Sentiment Analysis – Lexicon-based Approaches –SentiWordNet – VADER and AFINN – Polarity Computation – Positive/Negative/Neutral Classification – Subjectivity vs Objectivity

Module 4

Introduction to Data Streams – Opportunities and Challenges in Stream Mining – Real-time Data

Processing– Data Summarization Techniques – Stream Mining Models (Online Learning, Sliding Window, Reservoir Sampling) – Case Study on Tweet Analysis – Real-time Sentiment and Trend Analysis

Module 5

Introduction to XML – XML Structure and Syntax – XSLT for Styling XML – XPath for Querying XML – Web Mining – Web Content Mining – Web Structure Mining – Web Usage Mining – Web Scrapers – Web Crawlers – Tools: BeautifulSoup, Scrapy, Selenium – Ethical Considerations in Web Scraping

Recommended Books
- Zhai, C.X. & Massung, S. (2016); *Text Data Management and Analysis: A Practical Introduction to Information Retrieval and Text Mining*, ACM Books.
- Miner, G., Elder IV, J., & Hill, T. (2012); *Practical Text Mining and Statistical Analysis for Non-Structured Text Data Applications*, Academic Press.
- Struhl, S. (2015); *Practical Text Analytics: Interpreting Text and Unstructured Data for Business Intelligence*, Kogan Page.
- Silge, J. & Robinson, D. (2017); *Text Mining with R: A Tidy Approach*, O'Reilly Media.
- Kaushik, A. (2007); *Web Analytics: An Hour a Day*, John Wiley & Sons.
- Clifton, B. (2012); *Advanced Web Metrics with Google Analytics*, John Wiley & Sons.
- Kelly, N. (2012); *How to Measure Social Media: A Step-by-Step Guide to Developing and Assessing Social Media ROI*, Que Publishing.

25-251-0506: BUSINESS MODEL ANALYSIS

Course Description

To equip the students to apply various conceptual frameworks to understand and analyse business models in diverse markets. The course introduces the concepts, tools, and principles of business model design aligned with the theories of strategic management. The main emphasis will be on understanding how firm's unique resources and capabilities should serve as a basis on which business model can be designed. In addition, throughout the course we will touch up upon the requirements set by the business environments and the theories that explain how companies are creating and maintaining competitive advantage.

Course Learning Outcomes

LO1	Explain the importance of business models in value creation	Cognitive Level- Understand
LO2	Interpret business models used by actual ventures	Cognitive Level- Apply
LO3	Examine different business model frameworks	Cognitive Level- Analyse
LO4	Construct and present a business model for an innovative and viable new venture	Cognitive Level- Create
LO5	Design and conduct tests for different business model building blocks	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1		3	3	2			
LO2		3	3	3			
LO3		3				3	
LO4			2		2	2	1
LO5	1	2		2	2		

Module 1

Business model – conceptual definitions and scope; difference between business model and strategy; Need and relevance of business models; the concept of value: creating, delivering and capturing value. Tool for designing and analysing business models: Business Model Canvas; Four box model, business model wheel.

Module 2

Business Model Patterns; Designing business models; business model innovation; Market segmentation, targeting and positioning. Identifying markets and assessing market attractiveness; blue ocean strategy.

Module 3

Building and managing revenue models: Assessing competition and market structure; Analysing cost structure and gross margin models.

Resource based view of the firm, Core competence, Competitive advantage and Competitive strategy: role and relevance in business models.

Module 4

Designing Business Models from entry into incubation, Risk Management using business model portfolios; Lean Start-ups. Product development and customer development for startups.

Module 5

Practical examples of Business models; Sustainable business practices and business models.

Recommended Books

1. Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: a handbook for visionaries, game changers, and challengers*. John Wiley & Sons.
2. Bernd, W. W. (2011). Business model management: Design-instruments-success factors.
3. Afuah, A. (2014). *Business model innovation: concepts, analysis, and cases*. Routledge.
4. Blank, S., & Dorf, B. (2012). *The startup owner's manual: The step-by-step guide for building a great company*. BookBaby.
5. Ries, E. (2011). *The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses*. Crown Books.
6. Blank, S. (2013). *The four steps to the epiphany: successful strategies for products that win*. BookBaby.
7. Kaplan, S. (2012). *The business model innovation factory: How to stay relevant when the world is changing*. John Wiley & Sons.

LIST OF ELECTIVES

E-1 Practical Accounting in Business Organizations

E-2 Computational Finance

E-3 Investment Analysis and Portfolio Management

E-4 HR Analytics

E-5 Introduction to Machine Learning

E-6 Case Development Skills for Analysts

E-7 Deep Learning

E-1 PRACTICAL ACCOUNTING IN BUSINESS ORGANIZATIONS

Course Description

Develop accounts maintenance and finalization skills by associating the process with the Tally Accounting Package. This course is designed to impart knowledge regarding concepts of Financial Accounting Tally is an accounting package which is used for learning to maintain accounts. As this course is useful for Commerce students to get placements in different offices as well as companies in Accounts departments.

Course Learning Outcomes

LO1	Do Voucher Entries and Inventory Records	Cognitive Level- Apply
LO2	Process and record the business transactions and manage the accounts information	Cognitive Level- Apply
LO3	Understand the concepts of GST	Cognitive Level- Analyse
LO4	Employ payroll accounting using software package	Cognitive Level- Create
LO5	Implement statutory filing through identified software package	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	3	3				1	1
LO2	3	3				1	1
LO3	3	3				1	1
LO4	3	3				1	1
LO5	3	3				1	1

Module 1
Fundamentals of Tally.Erp 9
Introduction of Tally.ERP 9-History of Tally-Versions of Tally-Company Features- Configuration-Getting functions with Tally.ERP9-Creation/setting up of Company in Tally.ERP9-Chart of Groups-Groups-Multiple Groups-Ledgers-Multiple Ledgers-Stock Groups-Multiple Stock Groups-Stock Categories-Multiple Stock Categories-Units of Measure-Godowns-Stock Items.

Module 2

Voucher Entries and Inventory Records in Tally.Erp9

Introduction-Types of Vouchers-Chart of Vouchers-Accounting Vouchers-Inventory Vouchers-Invoicing-Bill wise details-Cost centers and Cost Categories-Multiple currencies- Interest calculations- Budget and controls-Scenario management-Bank Reconciliation-Order Processing-Recorder Levels-Batch-wise details-Bill of Materials-Batch-Wise Details- Different Actual and Billed Quantities-Price Lists-Zero Valued Entries-Additional cost details-POS.

Module 3

GST in Tally.ERP9

GST-GST Repots-CGST-CGST Repots-TDS-TDS Repots-TCS-TCS Repots-Creating Tax Ledgers-Transferring Tax Credits of VAT-Excise and Service Tax to GST-Recording GST Sales and Printing- Invoices-Recording GST Interstate Salesand Printing Invoices-Recording an Advance to Supplier-under GST-

Module 4

Payroll Accounting in Tally.Erp9 and Technological Advantage of Tally.Erp9

Payroll Accounting-Payroll Report-Tally vault-Security controls-Tally audit-Backup and restore-Split company data-Import and export of data-Printing Reports and Cheques-Create Company Logo.

Module 5

Generation of Reports in Tally.Erp9

Financial Statements-Trading Account-Profit & Loss Account-Balance Sheet-Accounts Books and Reports-Inventory Books and Reports-Exception Reports-Statutory Reports- Trail balance-Day Books-List of Accounts-Stock Summary.

Note: 1. Fully practical classes with sufficient examples

2. Essential Software – Tally.Erp9

Reference:

Tally.ERP9 Reference Book

E-2 COMPUTATIONAL FINANCE

Course Description

The computational finance program produces quantitative analysts who design and implement financial models used by banks and investment companies to generate profits and reduce risk. Computational finance support other industries and business functions that reach beyond banking and finance. The program is designed for students interested in computational or quantitative finance careers in banking, finance, and a growing number of industries. The course intends to develop the financial analytical skills by associating the tools and techniques available with Excel for financial data analytics.

Course Learning Outcomes

LO1	Examine the construction of computational algorithms in solving financial problems	Cognitive Level-Understand
LO2	Understand the similarities and differences in efficiency, convergence rate and complexity for the methods	Cognitive Level- Understand
LO3	Interpret computational results both orally and in a written report	Cognitive Level- Analyse
LO4	Develop solvers for analysing financial derivatives	Cognitive Level- Create
LO5	Use advanced software for pricing of financial derivatives	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	2	3	2		1		
LO2	2	3	2		1		
LO3	3	3			3		2
LO4			3	2	3		
LO5			2		3		

Module 1

Introduction to Data Analysis: Analysis and Interpretation; Types of Data Analysis - Data Mining-Business Intelligence-Statistical Analysis-Predictive Analytics-Text Analytics; Data Analysis with Excel-Ranges and Tables-Data Cleaning with Text Functions, Containing Date Values and Containing Time Values; Conditional Formatting; Sorting and Filtering; Subtotals with Ranges; PivotTable; Quick Analysis; Lookup Functions; Data Visualization-Band Chart,

Thermometer Chart, Gantt chart, Waterfall Chart, Sparklines and Pivot Charts; Formula Auditing; Inquire; MS Excel.

Module 2

Financial Data Analysis: Time value of money-Annuity-Present Value of a series of Future Payments (PV);Computation of EMI-Monthly Payment of Principal and Interest on a Loan-Calculating interest and term of loan; Decisions on Investments-Cash Flows at the Beginning, middle and end of the Year-NPV-XNPV IRR-MIRR-XIRR; Data Consolidation; What-if- Analysis with Data Tables, Scenario Manager, Goal Seek; Key Performance Indicators (KIP).

Module 3

Time Series Regression Analysis: Annual Growth Rate (AGR) Compounded Annual Growth Rate (CAGR); Time series plot-Sales and share price forecast using regression-Trend Setting.

Module 4

Financial Market Risk Analysis: Risk-Systematic- Unsystematic; Computation of Beta of securities-computation of Risk Adjusted Rate using CAPM.

Module 5

Financial Statement Analysis: Comparative Statements, Common size Statements-Trend Projection-Profitability Ratios-Debt to Equity Ratio-Fixed Assets to Total Assets Ratio- Current Assets to Total Assets Ratio;

Note: 1. Fully practical classes with sufficient examples

2. Essential Software – MS Excel

Recommended Books

a. https://www.tutorialspoint.com/excel_data_analysis/excel_data_analysis_financial.ht m
b. Excel 2016: QuickStart Guide for Beginners (2016), My Ebook Publishing House
c. Walkenbach,John (2016) Microsoft Excel 2016 Bible: The Comprehensive Tutorial Resource
d. Winston,Wayne L.(2016) Microsoft Excel 2016 - Data Analysis and Business Modeling, Microsoft Press.
e. Makridakis, Spyros and Wheelwright,Steven C(1998), Forecasting: Methods and Applications, Third Edition, John Wiley & Sons.

E-3 INVESTMENT ANALYSIS AND PORTFOLIO MANAGEMENT

Course Description

The focus of this course is on the examination and valuation of the major investment vehicles and strategies popular today. In particular, we will consider how investors allocate their financial assets by forming, managing, and evaluating portfolios containing instruments. This course aims at developing an understanding of the changing domestic and global investment scenario in general and Indian capital market in particular with reference to availability of various financial products and operations of stock exchanges. It aims at providing an in-depth knowledge of the theory and practice of portfolio management. Important theories, techniques, regulations and certain advancements in theory of investment will be covered with an aim of helping the participants make sound investment decisions in the context of portfolio investment.

Course Learning Outcomes

LO1	Familiarize with the theory and practice of investment analysis and portfolio management	Cognitive Level-Understand
LO2	Understand the working of Securities Market	Cognitive Level-Understand
LO3	Analyse the relationship between risk and return.	Cognitive Level- Analyse
LO4	Evaluate strategies followed by various portfolio managers	Cognitive Level- Evaluate
LO5	Valuation of equities and bonds.	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1		3		3			
LO2	3	2		1	2		
LO3	2	2	2	1	1		1
LO4	1		2		2	1	1
LO5	2	2	3		2		

Module 1: Introduction to Investment
Investment: Nature and Scope, Objectives, Investment and Speculation, Types of Financial Investments, Sources of Investment Information.

Module 2: Securities Market
Indian Securities Market: Meaning, Functions, Role of Primary Market, Methods of Floatation of Capital, Problems of New Issues Market, Recent Trends in Primary Market. Secondary Market: Meaning, Nature and Functions of Stock Exchanges, Listing of Securities, Overview of Regulatory Framework for Securities Market.

Module 3: Return and Risk Analysis
Return: Concept of Return, Computation of Return. Risk: Concept of Risk, Systematic and Unsystematic Risk, Sources of Investment Risk, Measurement of Risk

Module 4: Securities Analysis
Fundamental Analysis: Analysis of Economy, Tools for Economic Analysis. Industry Analysis: Different Stages of Industry Life-cycle, Key Factors in Industry Analysis. Company Analysis: Tools for Profitability and Financial Soundness.
Technical Analysis: Theories of Technical Analysis: Dow Theory, Elliot Wave Theory. Charting Tools.

Module 5: Portfolio Management
Introduction to Portfolio Management: Portfolio Management Process, Selection of Securities. Portfolio Theory: Efficient Market Theory, Markowitz Model, Sharpe's Single Index Model.

Recommended Books

1. Fisher,Donal E., Jordan, Ronald J.(1995)*Security Analysis and Portfolio Management*, Pearson.
2. Reilly, Frank R, Keith C. Brown(2012) Investment Analysis and Portfolio Management (Indian Edition), Thomson – South Western.
3. Bodie, Zvie, Alex Kane, Alan J. Marcus, Pitabas Mohanty (2015), *Investments*, Tenth Edition,McGraw-Hill, New Delhi
4. Chandra, Prasanna (2012)*Investment Analysis and Portfolio Management*, Fourth edition, McGraw-Hill.
5. Bhalla V. K.(2013)*Investment Management – Security Analysis and Portfolio Management*, Nineteeenth Edition, S. Chand and Company., New Delhi
6. Khatri, Dhanesh (2017)*Security Analysis and Portfolio Management*, McGrawHill
7. Ranganatham R., Madhumathi R. (2012)*Security Analysis and Portfolio Management*, Pearson Dorling Kindersley (India) Pvt. Ltd.

E-4 HR ANALYTICS

Course Description

The course offers a strategic view of organization's use of HR data and its measurement systems. It helps to understand the characteristics and importance of high-quality data and equips you to find and collect that data, inside or away from the environment of organization. This course intends to increase students' awareness of the usefulness of HRM metrics and analytics and equip in using them at the workplace.

Course Learning Outcomes

LO1	Understand modern HR measurement methods & models	Cognitive Level-Understand
LO2	Interpret HR data to make insightful business decisions	Cognitive Level-Apply
LO3	Apply HR Modeling for Root cause analysis	Cognitive Level- Apply
LO4	Develop predictive management capability for firms using the modern tools of HR analytics	Cognitive Level- Create
LO5	Develop HR metrics considering effectiveness measures	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	3	3	3			1	
LO2	3	3	3	2	3		
LO3	2	3	3		3		
LO4	2		2		3	1	1
LO5	2		2		3	1	1

Module 1:
HR Measurement Models: Evolution of HR Analytics- Concepts- HR Analytics Maturity Model- HR Analytics framework- LAMP, HCM: 21, Ethical issues in Analytics

Module 2:
Quantitative HRM and Applications: DCOVA- Defining the objectives- Collecting the data- Organising the data- Data Visualization- Data Analysis-Descriptive Statistics

Module 3

HR Reporting: HR Metrics: HR Metrices in recruitment, training and compensation, FTE, Utilization ratio, HR Score card, Dashboard creation (Practicals/Workshop mode)

Module 4

HR Effectiveness Measures: Linking HR measures to business results- Identifying and using the key HR Metrics- Association and Causation (Practicals/ Workshop mode)

Module 5

HR Modeling: Root cause analysis of HR issues, Using historical data, Scenario Planning ((Practicals/ Workshop mode)

Recommended Books

1. Becker,B E ., Huafelid,M.A. &Ulrich.D(2001).*The HR Scorecard: Linking people, strategy, and performance*. Harvard Business Review Press.
2. Bhattacharyya, D.K. (2017). *HR Analytics: Understanding Theories and Applications.Sage Publications.*
3. Sullivan, J (2010). *HR metrics*. Kennedy Information.
4. Gregory, l E (2013).*HR Metrics: Practical Measurement Tools for People Management.*Knowledge Resources. (ISBN: 9781869221690)
5. Bucknall. H., Wei Z (2007). Magic Numbers for Human resource Management. Wiley India.
6. Valerie, P., &Andreasson R. HR metrics: Bench marking human resources
7. Christman, W (2012) *HR Metrics That Matter*. HR smart
8. *HR Metrics standards & glossary published by the HR metrics service*. Version 8.0/December 2012
9. *HR metrics service, HR metrics Intrepretation guide published by BC HRMA version 3.4*

/ December 2012.

E-5 INTRODUCTION TO MACHINE LEARNING

The course will give the student the basic ideas and intuition behind modern machine learning methods as well as a bit more formal understanding of how, why, and when they work. It aims to introduce methods for learning from data;

Course Learning Outcomes

LO1	Understand basic concepts and techniques of Machine Learning	Cognitive Level-Understand
LO2	Evaluate the performance of a Machine Learning Systems	Cognitive Level - Evaluate
LO3	Evaluate popular Machine Learning Models	Cognitive Level - Evaluate
LO4	Devise Solutions to practical problems using Machine Learning	Cognitive Level - Create
LO5	Develop Improved Machine Learning Model	Cognitive Level - Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	3		2		2		
LO2		3	3				1
LO3		3	3				
LO4	2	2	3		2		1
LO5	2	1	3	3	3		1

Module 1 Machine Learning Basics

Definition of machine learning, Introduction to learning: supervised and unsupervised learning, classification, clustering, regression - Python for Machine Learning: scikit-learn, Essential Libraries, and Tools: Jupyter notebook, NumPy, SciPy, matplotlib, pandas, - Python exercise on classifying Iris Species

Module 2 Supervised learning I

Machine learning models for classification and regression: K Nearest Neighbour classifier, k- neighbors regression, Ridge regression, multiclass classification - Python exercise on KNN

Module 3 Supervised learning II

Probabilistic classification: Naive Bayes Classifiers, parameter estimation, maximum likelihood method – Decision Trees: Building decision trees, feature importance. Cultivating decision trees - Optimizing the complexity of decision trees. Ensemble models - Variable selection - Categorical input consolidation - Surrogate models.

Module 4 Unsupervised learning

Types of unsupervised learning, Challenges, Preprocessing and scaling: Different kinds of preprocessing, applying data transformations – Dimensionality reduction: Principal Component Analysis(PCA), Non-Negative Matrix Factorization (NMF) – Clustering: K- means clustering, Case study: Comparing image reconstructions using k- means, PCA and NMF – Python exercise on PCA, K-means clustering

Module 5 Model Evaluation and Improvement

Cross-validation: Benefits of cross-validation, Stratified k-Fold Cross-Validation and Other Strategies – Evaluation metrics and scoring: Metrics for Binary classification- Confusion matrices, precision, recall, and f-score - Metrics for Multiclass Classification, Regression metrics

Suggested Projects:

- Apply/Develop a machine learning method to solve a specific problem:
- A machine learning approach to classifying emails
- Predict stock prices based on past price variation
- Predict how people would rate movies, books, etc.
- Sentiment Analysis of Movie Reviews
- Cluster gene expression data, how to modify existing methods to solve the problem better

Recommended Books

1. Andreas C. Müller & Sarah Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists, O'Reilly, 20172. Fritz Matt, Machine Learning: Mastering the Basics; an In-depth Look at Machine Learning, Createspace Independent, 2017
2. Peter Harrington, Machine Learning in Action, Dreamtech Press, 2012.
3. Ian H. Witten, Eibe Frank and Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, 3 e., 2018.
4. Yaser S. Abu-Mostafa, Malik Magdon-Ismail and Hsuan-Tien Lin, Learning From Data, AMLBook, 2012
5. Stephen Marsland, Machine Learning: An Algorithmic Perspective, Chapman and Hall/CRC, 2014
6. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning,2e., Springer Series, 2017.
7. Christopher Bishop. Pattern Recognition and Machine Learning. 2e., Springer- verlag, 2011

Online Courses:

1. Prof. Ravindran, Introduction to machine learning, http://nptel.ac.in

2. Prof. S. Sarkar, Introduction to machine learning, http://nptel.ac.in

MIT OCW on Machine Learning, https://ocw.mit.edu/courses/electrical-engineering- and-computer-science/6-867-machine-learning-fall-2006/index.htm

<center>**E-6 CASE DEVELOPMENT SKILLS FOR ANALYSTS**</center>

Course Description

The course focuses on developing skills in building cases from client requirement analysis and documentation & reporting involved in an analyst job. To provide understanding of the process of developing cases from a client perspective and to develop writing skills for preparing and delivering effective reports including informational reports, problem-solving reports, and formal analytical reports. The delivery of this course is mostly through practical assignments and group and individual tasks.

Course Learning Outcomes

LO1	Demonstrate skills in understanding client requirement and identifying relevant variables related to decision problem/Case	Cognitive Level- Apply
LO2	Apply skills in data gathering for analysing the various dimensions of the given business situation	Cognitive Level- Apply
LO3	Analyse alternatives, risks and returns associated	Cognitive Level- Analyse
LO4	Document and report business case	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1		3	1	2		1	1
LO2		2	1	2		1	
LO3		2	1	2		1	2
LO4		1		3			3

Module 1
Scoping the case- Identifying client requirements – Know the stake holders & key decision makers; Understand the objectives of the client; Understand the strategic context; critical success factors- Indicative costs- Time framework- Expected deliverables; Case Development framework–6D framework

Module 2
Building the case - Identification of pain points/problems, developing the problem statement, identify objectives; assigning metrics to objectives; Data gathering – Field Research Vs Desk Research; Identifying sources of information- Developing instruments – Interview /survey protocols; Case study Investigator skills & training; drafting the case – testing and refining case.

Module 3

Analysing risk and returns/ cost and benefits –evaluate alternatives against metrics- creating a framework for alternatives –selecting a course of action – accounting of risks; Presentation of the case – Identification and justification of the case- methodology- assumptions-Alternatives – pros & cons - lessons learned.

Module 4

Case interview- Concept- types of case interviews- Skills for cracking a case interview -Case Interview Frameworks – Common myths and misconceptions. Technical Research: Conducting Technical Research, Researching at Work, Finding & Documenting Primary and Secondary data, Evaluating Sources

Module 5

Writing Process: Drafting, Revising, Editing, Copyediting and Publishing, Document Design and Graphics: Designing the document, ABC's of Print Document Design, Page Design, Designing Graphics, Constructing Graphics, Tables, Figures, Using Visuals Ethically.

Recommended Books

1. Chaturvedi, P.D & Chaturvedi, M (2017) *The Art and Science of Business Communication,* 4e, Pearson.
2. Cosentino Marc P**,**(2016),*Case in Point 9: Complete Case Interview Preparation,*9e, Burgee Press.
3. *Developing a Business Case (2010), Pocket Mentor series, Harvard Business Review Press*
4. Garner, B. A. (2012*), HBR Guide to Better Business Writing: Engage Readers Tighten and Brighten Make Your Case ,*Harvard Business Review Press
5. Houp,K.W., Pearsall,T & Elizabeth Tebeaux (2005) *Reporting Technical Information*,11e,Oxford University Press.
6. Kolin,P.C (2009) *Successful Writing at Work*,2e, Houghton Mifflin Harcourt.
7. Netzley, M & Snow,Craig (2016) *Guide to Report Writing*, Pearson.
8. Peter O.(2016),*Consulting Frameworks: Use on your next startup, in an existing small business, or to ace the case interview (Business Success*) (Volume 7)
9. Raman, Meenakshi & Singh, Prakash (2012) *Business Communication*, 2e, Oxford University Press.
10. Raymond, S. &Amy, G. (2015), *HBR Guide to Building Your Business Case,* ,HBR Guide Series.
11. Smith-Worthington, D & Jefferson,S (2008) *Technical Writing for Succes*,3e,South Western Cengage Learning.
12. Stephen,P.(2014), *Case Interviews For Beginners*, Create Space Independent Publishing Platform
13. Tom, R. (2011) *Case interview success, 2e, Create Space Independent Publishing Platform*
14. Victor C., (012) *Case interview Secrets, Innovation* Press
15. William, N. and Margaret, N.(2006), *The Art and Craft of Case Writing,* M.E. Sharpe N.Y

E-7 DEEP LEARNING

Course Description:
This course provides a comprehensive introduction to the fundamental concepts of neural Networks and deep learning using popular frameworks such as TensorFlow and Keras. Participants will gain hands-on experience through practical case studies, implementing and experimenting with various neural network architectures.

Course Outcomes

CO1	Understand the foundational concepts of neural networks and deep learning.
CO2	Identify and define the essential components and architecture of neural networks.
CO3	Implement the backpropagation algorithm and understand its role in training models.
CO4	Comprehend CNN structures and their real-world applications.
CO5	Analyze the effectiveness of RNNs in handling sequential data.

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2		2	
CO2	3	2	2		2	2	
CO3	3	3		2		2	
CO4	3		2	3	2	3	2
CO5	3	3	2	2	2	3	2

Module 1
Introduction to Neural Networks - Overview of artificial neural networks, Historical context and evolution of neural networks, Emerging trends in neural networks and deep learning, Basics of perceptron and activation functions, Introduction to Deep Learning Libraries – TensorFlow.
Case Study: Implementing a simple perceptron in a programming language or framework like TensorFlow.

Module 2
Building Blocks of Neural Networks -Layers, nodes, and architecture, Loss functions and optimization. Regularization techniques: dropout, L1, L2 regularization
Case Study: Hands-on exercises implementing different regularization techniques and building a basic neural network using TensorFlow.

Module 3
Backpropagation algorithm, Stochastic gradient descent, Learning rates and adaptive learning methods.
Case Study: Implementing backpropagation and experimenting with different learning rates using TensorFlow.

Module 4

Introduction to CNNs-Motivation and applications, Convolution and pooling layers, CNN Architectures: LeNet, AlexNet, VGG.
Case Study: Building and training a simple CNN for image classification using TensorFlow.
Advanced CNN Architectures-Transfer learning and fine-tuning Architectures: GoogLeNet, ResNet, Object detection and image segmentation using CNNs

Module

Introduction to RNN -Sequential data and challenges, vanishing gradient problem, Basic RNN Architectures, Case Study: Building an RNN for a sequence prediction task.

Recommended Books

- Goodfellow, I., Bengio, Y., & Courville, A. (2016) – *Deep Learning*, MIT Press
  (Gold standard reference covering the theory and applications of deep learning.)
- Chollet, F. (2021) – *Deep Learning with Python*, Manning
  (Practical introduction using Keras and TensorFlow.)
- Geron, A. (2019) – *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly
  (Excellent hands-on book with end-to-end projects.)
- Nielsen, M. (2015) – *Neural Networks and Deep Learning*
  (Free online book, very intuitive and beginner-friendly.)
- Brownlee, J. (2018) – *Deep Learning for Time Series Forecasting*, Machine Learning Mastery
  (Focus on RNNs, LSTM for sequential data.)
- Aggarwal, C.C. (2018) – *Neural Networks and Deep Learning: A Textbook*, Springer
  (Academic yet readable text with practical insights.)
- Raschka, S., & Mirjalili, V. (2019) – *Python Machine Learning*, Packt
  (Combines ML and DL techniques, ideal for applied projects.)

WORKSHOPS AND PROJECTS

25-251-0107: WORKSHOP ON BUSINESS COMMUNICATION SKILLS (DURATION: 5 DAYS)

Course Description

This workshop will help to create dynamic and professional presentations, organizing their content for maximum impact, and creating a stronger connection with the audience. Participants will learn to get important points across quickly in their business writing, examining how best to target readers, select and organize information, use clear language, be strategic, and achieve a stronger business tone. This workshop will provide participants with easy to apply tools and strategies that can be implemented immediately, resulting in more effective business communication.

Course Learning Outcomes

LO1	To understand the communication process for interpersonal communication	Cognitive Level- Understand
LO2	To apply communication techniques for effective public speaking	Cognitive Level- Apply
LO3	To collate data for presentations and reports	Cognitive Level- Analyse
LO4	To decide on presentation formats based on communication requirements	Cognitive Level- Evaluate
LO5	To prepare effective Business reports	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1						1	3
LO2	1			2			3
LO3	1						3
LO4				2	2		3
LO5	3			2	2	1	3

25-251-0307- WORKSHOP ON PERSONAL PRODUCTIVITY IMPROVEMENT (DURATION: 5 DAYS)

Course Description

This workshop focusses on increasing productivity by controlling priorities, improving leadership skills to empower others effectively, enhance communication skills, develop a positive attitude and become leader in team development and the increased productivity that comes through collaboration.

Course Learning Outcomes

LO1	To understand the concepts of time management, goal setting, personal productivity	Cognitive Level- Understand
LO2	To apply modern time management techniques	Cognitive Level- Apply
LO3	To analyse one's strength and weakness	Cognitive Level- Analyse
LO4	To evaluate goals in the context of teams	Cognitive Level- Evaluate
LO5	To develop a personal growth plan	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1					3	2	3
LO2				2	3	2	3
LO3					3	2	3
LO4					3	2	3
LO5					3	2	3

25-251-0602- WORKSHOP ON CAREER BUILDING (DURATION: 10 DAYS)

Course Learning Outcomes

LO1	To Understand the possibilities of digital self-branding for career success	Cognitive Level- Understand
LO2	To apply digital marketing techniques in developing online professional identity	Cognitive Level- Apply
LO3	To analyse alternate career pathways	Cognitive Level- Analyse
LO4	To evaluate professional development plans	Cognitive Level- Evaluate
LO5	To develop career growth strategy	Cognitive Level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1					3	2	3
LO2				2	3	2	3
LO3				3	3	2	3
LO4				2	3	2	3
LO5				2	3	2	3

25-251-0206: PROJECT I -ORGANIZATION STUDY (DURATION: 15 WORKING DAYS)

Course Description

This study aims to understand organizational structures, processes, and practices. The study needs to cover the structure, function and process of various departments. The Study will try to analyse the business environment and the performance of organization and also interpret the findings.

Course Learning Outcomes

LO1	To understand the organizational structure and functions of departments	Cognitive Level- Understand
LO2	To understand the application of principles of management in real organizations	Cognitive Level- Understand
LO3	To analyse the business environment of the firm	Cognitive Level- Analyse
LO4	To interpret the findings from business environment analysis	Cognitive Level- Evaluate

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1				1		2	3
LO2				1		2	3
LO3				3		2	3
LO4				3		2	3

(50 marks for continuous assessment and 50 marks for written report after completion of the project)

25-251-0407: PROJECT II – BUSINESS PROCESS MAPPING

(DURATION: 15 WORKING DAYS)

Course Description

The purpose of this project is to develop business process map using process mapping software. The project will present who and what is involved in business processes and will reveal areas where processes should be improved.

Course Learning Outcomes

LO1	Understand the business processes in an organization	Cognitive level-Understand
LO2	Apply process discovery methods in a business organization.	Cognitive level- Apply
LO3	Analyse identified business processes using the tools of BPM	Cognitive level- Analyze
LO4	Evaluate the As-Is process using necessary frameworks	Cognitive level-Evaluate
LO5	Create models of the business processes using representation tools like swimlane diagrams	Cognitive level- Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1		1					
LO2	1	1					2
LO3					1	2	2
LO4		2		1	1	1	2
LO5	1	2	2	1	3	1	3

Evaluation scheme will comprise of:

i)   50 Marks for continuous assessment
ii)   50 marks for a written report after the completion of the project

25-251-0601 PROJECT III – MAIN PROJECT & VIVA-VOCE (DURATION–80 DAYS)

Course Description

The objective of Major Project is to provide students with practical exposure to the real world of analytics whereby they get an opportunity to apply the knowledge and skill acquired through the course. The students are required to undertake this project in a Business Analytics firm. The project will be of 80 working days duration. Each student will be allotted to a faculty guide for the project.

Course Learning Outcomes

Learning Outcomes		Cognitive Level
CLO1	Apply essential career skills including communication skills, time management and resource management skills	Apply
CLO2	Apply analytical thinking and methodological approaches based on previous course inputs on research methods.	Apply
CLO3	Use theoretical analytics methods and models in solving business analytics problems	Apply
CLO4	Design organizational interventions integrating management, statistical and analytics concepts and real-world requirements of organizations	Analyse
CLO5	Prepare a comprehensive project report complying with standard analytics project reporting norms learned from associated courses and present it for expert evaluation	Create

Mapping of course outcomes with programme outcomes: Low=1, medium=2, High=3

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
LO1	2	2	3	3	3	1	2
LO2	2	2	3	3	3	1	2
LO3	2	2	3	3	3	1	2
LO4	2	2	3	3	3	1	2
LO5	2	2	3	3	3	1	2

Evaluation scheme will comprise of:

Continuous assessment–100 marks

Final report – 100 marks

Regulations for B.Voc in Business Process and Data Analytics Programme offered in DDU KAUSHAL Kendra under the Faculty of Social Sciences from the Academic year 2025-26

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I. Introduction

The **Bachelor of Vocation (B.Voc)** programme has been launched by the UGC to promote vocational education at higher education institutions to produce industry ready, employable graduates under the National Skill Qualification Framework (NSQF) with multiple entry/exit options during the programme. The contents of the vocational courses are to be designed by providing a judicious mix of skill component relating to a profession (60%) and appropriate content of General education (40%) to ensure that the students are getting equipped in terms of knowledge and skills to be employable at each exit point of the programme.

B.Voc in Business Process and Data Analytics is a vocational graduate programme designed to be offered under the DDU KAUSHAL Kendra, CUSAT and designed according to the UGC guide lines based on NSQF with multiple entry/exit options, leading to various job roles at each level of exit. Course contents shall be aligned with the norms of the concerned Sector Skill Councils (SSC) for enabling the students to obtain skill certifications from SSC concerned at various exit points.

II. Duration and Nature of the Course

B Voc in Business Process and Data Analytics is a Bachelor level vocational programme which spans over a period of six semesters (three years) with multiple entry and exit options. Multiple entry and exit options imply that the students have exit options at the end of each year of the course and are eligible for varying certifications as shown below and such candidates who exit the course can rejoin to the course on a later stage and can complete the course.

1. Students who successfully complete the first two semesters and take exit option will be eligible for **Diploma in Business Process and Data Analytics**

2. Students those who successfully complete the first four semesters and take exit option will be eligible for **Advanced Diploma in Business Process and Data Analytics** and

3. Students who successfully complete all six semesters will be eligible for Bachelor of Vocation (B.Voc.) **Degree in Business Process and Data Analytics.**

Such students with Diploma/Advanced Diploma will be eligible for lateral entry to the third/fifth semester of B Voc Programme later if they wish to do so. Students with Diploma in Business Process and Data Analytics will be eligible for lateral entry to third semester and those with Advanced Diploma in Business Process and Data Analytics will be eligible for lateral entry to the fifth semester of this course. In such cases the students must surrender their Diploma/Advanced Diploma for obtaining the Advance Diploma/B Voc Degree certificate as they are not eligible for multiple certifications and such lateral entry shall be permitted only within five years of their original admission to the B Voc programme.

III.   Centre and Faculty

B.Voc in Business Process and Data Analytics shall be offered at DDU KAUSHAL KENDRA and the degree shall be awarded under the Faculty of Social Sciences.

IV.   Eligibility for Admission

Minimum Qualification Required

- Students with a total of 50% mark or equivalent CGPA in Plus Two or any equivalent examination conducted by recognized Boards with Mathematics / Statistics /Economics as one of the Subjects.
- Candidates belonging to Kerala Scheduled Caste (KSC) and Kerala Scheduled Tribe (KST) communities are eligible for applying, if they have minimum pass marks in the qualifying examination.
- SEBC candidates of Kerala State who are certified as belonging to non-creamy layer are eligible for 5% relaxation in the minimum required marks for qualifying examination.

NB: While calculating the percentage of marks for Plus two or any equivalent examination, the marks of Mathematics/Statistics/Economics shall necessarily be included.

V.   Selection and Intake of the Programme

5.1 Selection of candidates will be based on the following criteria:

The eligible students shall be admitted to the course from a rank list prepared by the university based on the marks secured by candidate in an Aptitude Test (CAT) conducted by the university.

5.2 Intake of the programme shall be as per the decision of the university from time to time, taking into consideration the facilities available in the centre offering the programme. Seats are reserved for SC/ST and Other Backward Communities as per Government of Kerala rules in this regard.

VI.   Programme structure

6.1 Since the Programme is vocational in character, the curriculum is designed in such a way that 60 per cent of the subjects are in the vocational domains (Business Process and Data Analytics) and 40 per cent in the general domains such as English language, communication skills, professional skills, IT skills, entrepreneurship and Functional Management. The curriculum has been designed to meet the requirements laid out in the UGC Guidelines for curriculum design for B Voc programmes under the National Skill Qualification Framework (NSQF). The total credit requirements for the course is 180 out of which skill components will carry 108 and general education components will carry 72 credits. The credit distribution will be in the following pattern:

	NSQF Level	Skill Component Credits	General Education Credits
Year I Diploma	5	36	24
Year II Advanced Diploma	6	36	24
Year III B Voc	7	36	24
Total		108	72

6.2 The number of credits (total) in I, II, III, IV, V and VI semesters shall be 30, 30, 30, 30, 34 and 26 respectively. The total number of credits required for a pass in the programme shall be 180, in which minimum credit required for the core courses and electives shall be 172 and 8 respectively.

6.3 Students shall have the freedom to opt for one elective each in semester IV and semester V of the programme.

6.4 Students will have to undertake an Organisational study of minimum 15 working days as part of their Project-I at the end of semester II. Project II at the end of Semester IV will be of 15 working days on Business Process Mapping. Semester VI is fully devoted for Project

III – (Main Project) of not less than 80 working days and the same will be on a data analytics project in any organisation. Each student shall be assigned to a faculty guide for all the projects. A written report must be submitted at the end of the Project-I, II and III in a format prescribed by the Centre.

6.5 Students are required to attend single/multiple Training Programme/s with the total duration of which shall amount to 5 days each in Semester I and Semester III and 10 days in Semester VI. These training programmes shall be in the general domain to improve the personal effectiveness, professional skills and career planning of the students. The ten days workshop programme proposed in fourth semester will help students to build personal branding and to prepare career planning along with building awareness about current trends and developments in Industry and Economy. Students shall be encouraged to participate in training programmes organized by state/national level institutes/Centres or Departments of Universities including DDUKK/Professional bodies such as AIMA or ISTD, etc. to satisfy the requirements for acquiring credits for the aforementioned training programmes in various semesters.

In order to attend such training programmes, students have to obtain prior permission from the Centre by submitting the details of the institution offering the training programme and the proposed course. The credits for the participation in such training programme shall be awarded only based on the evaluation of the report submitted by the students along with the participation Certificates.

VII. Method of Teaching and Training

The teaching and training for the B Voc programme shall focus on developing skills and enhancing employability of the students so as to make them industry-ready graduates. Hence the teaching and training pedagogy of the programme will be mostly through "Activity oriented Class Room (AOC)", and the same will comprise of case studies, games, simulation techniques, presentations, Industry internships, training labs, both individual and group projects, interaction with industry experts, etc. Live analytics projects and internship training in organisations shall also form part of the training for the programme.

VIII. Mode of Evaluation and Eligibility for Pass

8.1 Mode of Evaluation will be 100 per cent internal for all papers out of which 50 % marks are for continuous assessment throughout the semester and 50 % marks are for End-

semester examination. In the case of the following subject namely Managerial Skills Development and Design Thinking (Semester III), the entire 100 marks will be awarded through continuous assessment by the teachers through case analysis, group discussion, team building tasks, leadership role, problem solving exercises, personal improvement, report writing, presentations etc.

For Project I and Project II, 50 % marks will be awarded through continuous assessment and 50% marks will be awarded based on the evaluation of the report submitted by the student. In case of the Project III (Main Project) 100 marks each will be awarded for Continuous Assessment, Project Report and Viva Voce. Viva-Voce examination at the end of the sixth semester shall be carried out by a board with at least three examiners.

Evaluation for programming-based subjects in various semesters shall be in practical mode.

8.2 A minimum of 75% attendance is compulsory for each student to appear for End-Semester examination and also to progress to the subsequent semester. But the Vice-Chancellor shall have the power to condone the shortage of attendance up to 10% on medical grounds on the recommendations of the HOD. However, such condonation for shortage of attendance shall be given to a particular student only once during the entire programme of study.

8.3 Internal marks will be awarded on the basis of class tests, assignments, viva-voce, practical assignments, term-papers, mini-projects etc. as decided by the teacher concerned, considering the relevance of each component with respect to the paper he/she handles. However, the student shall be evaluated continuously throughout the semester and marks shall be awarded as per the following guidelines:

   a) A minimum of 50 per cent weightage shall be given for internal tests/lab exams/practical assignments

   b) A maximum of 20 per cent weightage shall be given for written assignments

   c) A maximum of 20 per cent weightage shall be given for class room presentations, Viva –voce and mini projects

   d) A maximum of 20 per cent weightage shall be given for other items such as attendance or activities that the teacher of the concerned course believes as relevant for the course and assigned to the students.

   The total Internal Marks awarded will be 50.

However, Department/Centre Council can change the guidelines for the distribution of internal marks given above, as and when required.

8.4 The question paper for the End-Semester examination shall be set by the concerned teacher in advance which shall be scrutinized by the respective Centre/Department Council or by a committee consisting of the HOD and faculty members offering courses in that semester to ensure that questions are within the scope of the syllabus and that the entire syllabus of the course is fairly covered in the question papers. Modifications can be suggested by the council if necessary and such suggestions shall be incorporated in the final version of the question paper.

There shall be only a single evaluation for the End-Semester examination. Immediately after the examination is over, the Head of the Department/Centre shall make arrangements to complete the evaluation and finalise the results within 10 working days after the last examination. In case of Semester II, Semester IV and Semester VI where Projects are included, the results shall be finalised within ten working days after the submission of the report/ conduct of Viva-Voce examination, which ever applicable as the case may be. The marks and grade in all courses obtained by the students will be displayed in the notice board and the answer scripts can be shown to the students for scrutiny on written request by the student addressed to the Director of the Centre. (Viva-voce marks are exempted from this clause as it is awarded by a board of examiners).

8.5 For each course there shall be a separate passing minimum of 40% marks for the End-Semester examination and the student has to secure an aggregate of 40% when End-Semester examination and Internal Marks are taken together for every course in all the semesters for passing the programme. In case of the course Managerial Skills Development and Design Thinking in Semester III, students should acquire a minimum of 40% marks in Continuous Assessment. In case of Projects, candidate has to acquire aggregate 50% marks in each projects- Project I, II and III, for the successful completion.

8.6 The department shall publish the marks obtained by the students, in the continuous assessment and End-Semester examination. If the student has any grievance, he/she can approach the concerned teacher and submit his/her grievance with supporting documents/arguments. The teacher and the HOD will examine the case and decide on his/her grievance. If the student is not convinced with the decision, he/she can approach the appellate authority, which is the department council, in writing and the council shall

examine the same and take a final decision which has to be intimated to the student. The decision of the appellate authority shall be final.

8.7 The final marks and grades obtained by the students shall be published in the notice board. Those who could not obtain at least Grade D in total for a course will be declared as failed in that course.

8.8 For Semester I, III, and V, the results of the examinations shall be finalized and published within 30 working days from the date of last end semester by the centre/department council, which will act as the passing board and the minutes shall be sent to the Controller of Examinations of the university for the issue of grade cards. In case of Semester II, Semester IV and Semester VI where Project I, II and III are included respectively, the results shall be finalized and published within ten working days after the submission of the report/ conduct of Viva-Voce examination, which ever applicable as the case may be.

8.9 A student shall complete his/her B Voc programme within six years from the date of admission by acquiring the total credit requirements as specified for the award of the degree. In case of candidates who take lateral entry to Semester III or V of the course shall complete his/her B Voc programme within five years or four years respectively from the date of admission.

8.10 For Diploma in Business Process and Data Analytics, a student shall complete the passing requirements within three years of securing admission to the course. And the same will be four years in the case of Advanced Diploma.

8.11 For Advanced Diploma in Business Process and Data Analytics, a student shall complete the passing requirements within five years of securing admission to the course.

IX. Passing Criteria, Special Supplementary and Improvement

1. For each course the pass requirement is **40% of the aggregate marks (continuous assessment marks + semester end exam marks) with a separate requirement of minimum 40% for the semester end examination** and those who fail in the semester end examination of any course may repeat the semester end examination of that course in the next available chance.

   Also, a Special "Save an Year" supplementary examination will be conducted for students who fail in their final two semesters (5th and 6th semester for 3 year UG).

Special supplementary examination for final semester will be conducted after the publication of that semester results and the exam will be conducted for all courses of that semester. The student will be awarded the actual grade he/she obtains in the special supplementary examination and those who fail in the end-semester examination/special supplementary examination of any course may repeat the semester end examination of that course in the next available chances.

2. The students of UG programmes are permitted to improve their marks in the end semester examination on certain conditions.

   a) The student can write the improvement exam only for courses where he/she secured P grade or above in the regular chance.

   b) The number of courses where a student can register for improvement exam is restricted to a maximum of 2 course per semester.

   c) The improvement exam is not permitted for courses offered in the final two semesters of the programme.

   d) The improvement exam should be written in the next available chance with the immediate following batch.

   e) There will no improvement for internal examinations/ practical examinations.

   f) The higher of the marks (original marks or improvement marks will be treated as the final end semester marks for grade calculations.

X.   Grading and Classification

The following 10-point grading system shall be adopted for all the programmes. The grades will be awarded for each course based on the aggregate marks (continuous assessment marks + semester end exam marks) obtained subject to the requirement of minimum 40% for the semester end examination.

% Marks (Range)	Grade point (G)	Letter Grade	Description
95 - 100	10	O	(Outstanding)
85 – 94.99	9	A+	(Excellent)
75 – 84.99	8	A	(Very Good)
65 – 74.99	7	B+	(Good)
55 – 64.99	6	B	(Above Average)

45 – 54.99	5	C	(Average)
40 – 44.99	4	P	(Pass)*
Below 40	F	0	Fail
Absent	Ab	0	Absent

Overall performance at the end of the semester will be indicated by Grade Point Average (GPA) calculated as follows.

$$GPA = \frac{G1C1+G2C2+G3C3+\dots\dots\dots\dots\dots\underline{GnCn}}{C1+C2+C3+\dots\dots\dots\dots\dots\dots\dots\dots Cn}$$

'G' ' refers to the grade point and 'C' refers to the credit value of corresponding course undergone by the student. At the end of the final semester Cumulative Grade Point Average (CGPA) will be calculated based on the above formula, considering the Credits and Grades earned during the entire programme of study.

Accordingly, the pass requirements shall be as follows:-

1. For each course, 40% of the aggregate marks (continuous assessment marks plus end semester marks) with a separate minimum requirement of 40% for the end semester examination.

2. Minimum aggregate CGPA required for successful completion of the programme will be 4.0.

3. The CGPA to percentage conversions shall be done using the following formula
   %marks = CGPA * 10

Classification for the Degree/Diploma will be given as follows based on the CGPA:

First Class with Distinction (FCD)	CGPA 7.5 and above
First Class	CGPA 6 to 7.499
Second Class	CGPA 5 to 5.999

XI.   Revision of Regulations and Curriculum

The University may from time to time, revise, amend or change the Regulations, Schemes of Examinations and Syllabus. The date of effect of such changes will be as decided by the university.

XII.   Structure of the Question Paper of End-Semester Examinations

The End-Semester question paper shall have three parts (except for practical examinations), namely Part-A, Part-B and Part C. The maximum marks for End-Semester Examinations will be 50.

In Part A, there will be 5 compulsory questions which will be of short answer. Each question in Part A carries two marks.

Part-B will consist of seven questions out of which students must answer four questions. Each question will carry five marks in this part.

In Part-C, student will have to answer two questions of 10 marks each from a group of three questions. One case study would be preferred among the three questions in this section.

In case of practical exams, this pattern need not be followed. The number of questions can be varied according to the nature of the subject and the same will be decided by the examiners concerned based on the norms set by the Centre/Department council.

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