PRESIDENCY UNIVERSITY
Presidency University Act, 2013 of the Karnataka Act No. 41 of 2013 | Established under Section 2(f) of UGC Act, 1956
Approved by AICTE, New Delhi

SCHOOL OF INFORMATION SCIENCE

CURRICULUM STRUCTURE

based on Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

Program: BACHELOR OF SCIENCE

B.Sc. [DATA SCIENCE]

(Computer Science Statistics, Mathematics)

2021-2024

Regulations No. : PU/AC-20.4/SOIS02/BSD/2021-24

Resolution No. 4 of the 20th Meeting of the Academic Council held on 15th February 2023, and ratified by the Board of Management in its 21st Meeting held on 22nd February 2023.

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February – 2023

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Name of the Program: B.Sc. [BACHELOR OF SCIENCE - DATA SCIENCE]

I. Program Code: BSD

II. Program Needs:

B.Sc. Data Science is a three-year full-time, interdisciplinary program that combines the fields of Computer Science, Mathematics and Statistics, aims at producing students with a sound understanding of the theory and practice of Statistics, Artificial Intelligence, Machine Learning and Data Science. The objective of this program is to prepare students to become industry ready and knowledgeable for a new world where Data Science is transforming business and society, build and deploy solutions to take data-driven decisions. Artificial Intelligence and DS are likely to replace the current mode of technology. With the evolution of Deep Learning, Artificial Intelligence, and the Internet of Things, Data Science future demand has grown by leaps and bounds.

This program enables the students to build intelligent machines, software/ applications with a combination of state of the art artificial intelligence, machine learning, data analytics and visualization tools to generate actionable insights, necessary for making data-driven decisions.

The department offers Industry oriented curriculum. The primary focus of the curriculum is to impart technical know-how to students, promote their problem solving skills and innovation of new technologies. Introduced various skill development programs and Industrial training to equip the students with hands on training in the fields knowledge discovery, Machine learning, Artificial Intelligence, Deep Learning, Natural Language Processing, MATLAB and Python programming and visualization tools. The students will be given strong foundation on Math and Statistical methods. Department offers large number of optional courses for providing wide spectrum of opportunities to the students to pursue their interest. The course contents are periodically updated for introducing new courses.

Students may have career opportunities in healthcare, business, ecommerce, social networking companies, climatology, biotechnology, genetics, and other important areas. They can work as Business Analyst, Data Analyst, Intelligence Analyst, Data Scientist, Data Manager, Information Security Analyst, Risk Analyst, Machine Learning Engineer, Big Data Engineer/Architect, Data Engineer Etc.,

Firms like Facebook, Google are investing a hefty amount in AI to get the desired outcome at a relatively lower computational time. Many multinational companies and organizations hire

graduates in data science and artificial intelligence. Amazon, Microsoft, Adobe, Uber, Samsung, Intel, Accenture, Facebook, Netflix, and Lenovo have been some of the top recruiters in the data science and artificial arena.

There is a huge scope in the field of Data Science. Student can go for higher studies or Job after the completion of course. They can get Hottest and attractive offers. A very promising and growing sector all over the world.

III. Program Educational Objectives [PEOs]: After three years of successful completion of the program, the graduates shall be:

PEO 01: Demonstrate as a Professional in Data Science

PEO 02: A Teaching and Research Professional in the area of Data Science through lifelong learning

PEO 03: A Freelancing consultant to the Data Science Industry.

PEO 04: An entrepreneur in Data Science and other related areas of specialization.

IV. Program Outcome [POs]: On successful completion of the Program, the students shall be able to:

PO 1: Application of Domain Knowledge: Apply the domain knowledge such as mathematics, science and software engineering fundamentals into the Computer Application related professions.

PO 2: Problem Solving & Analysis: Identify, Formulate, Analyze and Solve Complex Scenarios related to Computer Applications.

PO 3: Design/development of Activities: Conceive, Design and develop various activities of Computer Applications.

PO 4: Conduct Investigations of Events: Carry out Investigation of an event and draw logical conclusions based on critical thinking and analytical reasoning.

PO 5: Modern Tool usage: Effectively apply relevant ICT Tools and digital tools to carry out Computer Application Attributes.

PO 6: Research: Identify suitable Research Methods and report the findings.

PO 7: Profession and Society: Apply the knowledge of the values and beliefs of multicultural society and a global perspective in the profession.

PO 8: Ethics: Identify ethical issues and embrace ethical values in conduct of Profession.

PO 9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Express thoughts and ideas effectively in writing and oral communication

PO 11: Project Management and Finance: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.

PO 12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of societal and technological change.

V. Program Specific Outcomes [PSOs]: On successful completion of the Program, the students shall be able to:

PSO 01: Apply the knowledge of mathematics, science, software engineering, structured and object oriented programming concepts to provide efficient solutions.

PSO 02: Identify, formulate and apply appropriate techniques in the areas related to machine learning, IoT and data analytics of varying complexities in real-time applications.

PSO 03: Apply relevant resources, design and develop Web and Cloud based solutions for real-time applications

VI. Curriculum Structure: The curriculum structure is composed of the following baskets:

1] Core (Common & Compulsory to all the B.C.A programs of the School consists of 30 Credits)

2] Program Core (Specific to the B.Sc.[Data Science] Program, consists of 72 credits).

3] Discipline Electives (Specific to the B.Sc. [Data Science] Program and categorized under various specialized groups, the minimum number of credits to be earned in this basket is 12)

4] Open Electives (Consists of courses from various schools to provide an opportunity for multi-disciplinary learning and the minimum number of credits to be earned from this basket is 6)

Table 1: Summary of Minimum Credit Contribution from various Baskets

Baskets	Credit Contribution
School Core	30
Program Core	72
Discipline Elective	12
Open Elective	6
Total Credits	**Min. 120**

The curriculum structure is designed as per the CBCS and incorporating OBE Principles. The students are provided with at most flexibility in selection of the courses of their choice. The students are free to prepare their own Course grid for every semester from the Basket of courses subject to satisfying the pre-requisites for the courses selected and adhering to the Minimum and Maximum Credit requirement as per the Program Regulations.

The students have an option to decide the pace of his/ her learning [The number of semesters to complete the program]. The slot time table system provides the opportunity to the students to

decide the time slot of the course and to select the faculty member among those who are offering the course.

The curriculum provides an opportunity to the students to obtain a specific specialization in the basic degree of **BACHELOR OF COMPUTER APPLICATIONS - BACHELOR OF SCIENCE - DATA SCIENCE by choosing discipline electives courses [Minimum of 6 credits] exclusively from Immersive Media Basket.**

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VII. Basket wise courses:

A] SCHOOL CORE)- Minimum Credits to be earned from this basket

Minimum Credits to be earned from this basket = 30 Credits

Sl. No.	Course Code	Course Name	L	P	C	Type of Skill/ Focus	Course Caters to	Pre-requisites/ Co-requisites	Anti-requisites	Future Courses that need this as a Pre-requisite	List of POs to which Course Caters to											
											PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
					21																	
1	BSD1007	Programming in Python	1	4	3	S/ EM/ EN	-						□	□	□	□			□	□		□
2	CSA3001	Capstone Project	-	-	4	S/ EM/ EN																
3	MAT1007	Introduction to Statistics	3	0	3	S	HP/ GS				□	□	□	□	□	□			□	□		
4	MAT2007	Applied Mathematics	3	0	3	F	-				□	□	□	□	□	□			□			
5	CSA3008	Internship	-	-	8	S/ EM/ EN																
English and Foreign Languages Basket																						
Minimum credits to be earned from this basket =					**4**																	
1	ENG1003	Communicative English	2	0	2	S	-	-				□	□	□	□	□				□		

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2	ENG1005	Technical Written Communication	2	0	2	S/ EM	-	ENG1004	-	Profession		☐	☐	☐	☐	☐			☐				
3	FRL1001	Basic Spanish	2	0	2	S/ EM		ENG1004	-	Profession									☐				
4	FRL1002	Basic French	2	0	2	S/ EM			-	Profession									☐				
5	FRL1003	Basic German	2	0	2	S/ EM			-	Profession									☐				
Kannada Basket																							
Minimum credits to be earned from this basket =					**1**																		
1	KAN1001	Kali Kannada	1	0	**1**	**S**		Non-Karnataka	-	-									☐				
2	KAN2001	Thili Kannada	1	0	**1**	**S**		From Karnataka	-	-									☐				
Soft Skills Basket																							
Minimum credits to be earned from this basket =					**4**																		
1	PPS1001	Introduction to soft skills	0	2	**1**	S	HP	-	-	PPS2001		☐				☐			☐	☐			
2	PPS1006	Employability for Young Professionals	0	2	**1**	S/EM	HP	PPS1001	-	PPS2002		☐				☐		☐	☐	☐			
3	PPS2001	Reasoning and Employment Skills	0	2	**1**	S/EM	HP/GS	PPS1006	-	PPS3001		☐				☐		☐	☐	☐			☐
4	PPS3001	Problem Solving through Aptitude	0	2	**1**	S		PPS2001	-	Profession		☐							☐	☐			
Non-Credit Pass/Fail Type Courses					**0**																		
1	CHE1018	Environment Science	1	2	0	**-**	P/F	ES	-	-		☐		☐	☐		☐	☐		☐			
Co/ Extra-Curricular Basket					**0**																		
Student is expected to enroll and serve in any one university wide, school level or department level club/ student chapter in at least one semester during program duration. List of University wide clubs, school level clubs, department level clubs/ student chapters are attached separately as an annexure.																							

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B] Program Core: Minimum Credits to be earned from this basket = 72 Credits-99

Sl. No.	Course Code	Course Name	L	P	C	Type of Skill/ Focus	Course Caters to	Pre-requisites/ Co-requisites	Anti-requisites	Future Courses that need this as a Pre-requisite	List of POs to which Course Caters to											
											PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	BSD1004	Elements of Computing Systems	3	0	3	4	-			-			–	–	–	–			–	–		–
2	BSD1006	Fundamentals of Data Science	2	2	3	S/ EM/ EN		BCA1005		-			–	–	–	–			–			–
3	MAT1010	Fundamental Calculus	3	0	3	S/ EM/ EN	-			-			–	–	–	–			–	–		
4	MAT1008	Probabilty and Inferential Statistics	3	0	3	S/ EM/ EN	-			-			–	–	–	–			–	–		
5	BSD1002	Programming in C	1	4	3	S/EM	HP			-				–	–	–			–	–		
6	BCA2002	Datastructures and Algorithms	3	2	4	S/ EM/ EN	HP/ GS	BSD1002		-			–	–	–	–			–	–		–
7	BSD2002	Data Modeling and vizualization	2	2	3	S/ EM/ EN	HP	BSD1002, BSD1006		-	–	–	–	–	–	–			–	–	–	
8	BCA2011	Web Design and Development	1	4	3	F	HP/ GS	CSA1005		-			–	–	–	–			–			
9	CSA2003	Relational Database Management systems	2	4	4	S/ EM/ EN	HP/ GS			-			–	–	–	–			–			
10	MAT2023	Matrix Computations for Data Science	3	0	3																	
11	CSA1006	Operating Systems and Unix Programming	2	2	3																	
12	CSA1005	Object Oriented Programming Using Java	1	4	3	S/ EM/ EN		BSD1002														

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13	CSA2019	R Programming for Datascience	2	2	3			BCA1005, BSD1006															
14	MAT2028	Graph Theory	3	0	3																		
15	CSA2020	Artificial Intelligence	3	0	3			BCA1005															
16	CSA2021	Data Warehousing and Data mining	3	0	3			BCA1005, BSD1006															
17	CSA2006	Fundamentals of Software Engineering	3	0	3																		
18	CSA3002	Machine Learning Algorithms	2	2	3			BCA1005															
19	CSA3004	Big data analytics	2	2	3			BSD1006															
20	CSA3003	Android Mobile Applications Development	1	4	3			BCA1005															
21	CSA3014	Natural Language Processing	1	2	2																		
22	CSA2008	Essentials of Cloud Computing	3	0	3																		
23	CSA3005	Internet of Things	1	4	3			CSA2008															
24	CSA3017	Information Retrieval	1	2	2																		

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C] Discipline Electives: Minimum Credits to be earned from this basket = 12 Student has to select at least 1 course each from a minimum of 6 baskets

Sl. No.	Course Code	Course Name	L	P	C	Type of Skill/ Focus	Course Caters to	Pre-requisites/ Co-requisites	Anti-requisites	Future Courses that need this as a Pre-requisite	List of POs to which Course Caters to											
											PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
DISCIPLINE ELECTIVE -																						
1	CSA3068	Predictive Analytics	1	4	3	S/EM		MAT1008	-													
2	CSA3069	Data Management using Cloud	2	2	3	S/ EM		CSA2008	-													
3	CSA3074	Reinforcement earning							-													
4	CSA3070	Time Series Analysis	3	0	3				-													
5	CSA3071	Deep Learning	2	2	3			CSA3002	-													
6	CSA3072	Web Application Security	3	0	3	S/EM	HP	BCA2011	-													
7	CSA3048	Cloud Storage Applications	3	0	0	S/EM/ EN		CSA2008	-													
8	CSA3073	Data Security and Privacy	3	0	3	S/ EM		CSA2008	-													
Mathematics Basket																						
1	MAT2024	Matlab and Simulink	1	4	3	S/EM	HP	MAT1009					□	□	□	□	□	□	□	□	□	□
2	MAT2026	Scientific Computation	2	2	3	S/EM							□	□	□	□	□	□	□	□	□	□

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3	MAT2027	Multivariable Calculus	3	0	3	S		MAT1010					□	□	□	□	□	□	□	□	□	□
4	MAT2061	Discrete Mathematics	3	0	**3**	S		-					□	□	□	□	□					□
5	MAT 2062	Optimization Techniques for Data Science	3	0	3								□	□	□	□	□	□	□	□	□	□
Statistics Basket																						
1	MAT2033	Statistical Analysis using R	2	2	3	S/EM	HP	MAT1007		-			□	□	□	□	□	□	□	□	□	□
2	MAT2034	Nonparametric tests	3	0	3	S		MAT1007					□	□	□	□	□	□	□	□	□	□
3	MAT2035	Sampling Techniques	3	0	3	S/EM		MAT2020					□	□	□	□	□	□	□	□	□	□
4	MAT2036	Design of Experiments	3	0	3	S/EM							□	□	□	□	□	□	□	□	□	□
5	MAT2037	Statistical Quality Control	3	0	3	S/ EM							□	□	□	□	□	□	□	□	□	□
6	MAT2038	Linear programing	3	0	3	S							□	□	□	□	□	□	□	□	□	□

D] Open Electives: Minimum Credits to be earned from this basket = 6 Credits

Sl. No.	Course Code	Course Name	L	P	C	Type of Skill/ Focus	Course Caters to	Pre-requisites/ Co-requisites	Anti-requisites	Future Courses that need this as a Pre-requisite	List of POs to which Course Caters to											
											PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Chemistry Basket																						
1	CHE1003	Sensor technology	3	0	3	S	ES	-	-	-	□	□	□		□	□	□					
2	CHE1004	Smart materials for IOT	3	0	3	S	ES	-	-	-	□	□	□		□	□	□					□
3	CHE1005	Computational Chemistry	2	0	2	S	ES	-	-	-	□	□	□		□	□	□					

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4	CHE1006	Introduction to Nano technology	3	0	3	S	ES	-	-	-	☐	☐	☐		☐	☐	☐					☐
5	CHE1007	Biodegradable electronics	2	0	2	S	ES	-	-	-	☐	☐	☐		☐	☐	☐					☐
6	CHE1008	Energy and Sustainability	2	0	2	EM	ES	-	-	-	☐	☐	☐	☐	☐	☐	☐	☐	☐			☐
7	CHE1009	3D printing with Polymers	2	0	2	S	ES	-	-	-	☐	☐	☐	☐	☐	☐	☐					
8	CHE1010	Bioinformatics and Healthcare IT	2	0	2	S	ES	-	-	-	☐	☐	☐	☐	☐	☐	☐	☐	☐			☐
9	CHE1011	Chemical and Petrochemical catalysts	3	0	3	S	ES	-	-	-	☐	☐	☐		☐	☐	☐		☐			
10	CHE1012	Introduction to Composite materials	2	0	2	S	ES	-	-	-	☐	☐	☐	☐	☐	☐			☐			
11	CHE1013	Chemistry for Engineers	3	0	3	S	ES	-	-	-	☐	☐	☐		☐	☐	☐		☐			
12	CHE1014	Surface and Coatings technology	3	0	3	S	ES	-	-	-	☐	☐	☐		☐	☐	☐	☐	☐			☐
13	CHE1015	Waste 2 Fuels	2	0	2	F	ES	-	-	-	☐	☐	☐		☐	☐	☐	☐	☐			☐
14	CHE1016	Forensic Science	3	0	3	S/EM	HP	-	-	-	☐	☐	☐		☐	☐	☐					

Sl. No.	**Course Code**	**Course Name**	**L**	**P**	**C**	**Type of Skill/ Focus**	**Course Caters to**	**Pre-requisites/ Co-requisites**	**Anti-requisites**	**Future Courses that need this as a Pre-requisite**	**List of POs to which Course Caters to**											
											PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
Civil Engineering Basket																						
1	CIV1001	Disaster management and mitigation	3	0	3	S	ES/ HP	-	-	-	☐	☐	☐		☐	☐	☐	☐		☐		☐
2	CIV1002	Environment Science and Disaster Management	3	0	3	F	ES	-	-	-	☐					☐	☐	☐				☐
3	CIV2001	Sustainability Concepts in Engineering	3	0	3	S	ES	-	-	-	☐	☐	☐		☐	☐	☐	☐		☐		☐
4	CIV2002	Occupational Health and Safety	3	0	3	S		-	-	-	☐	☐	☐	☐		☐	☐	☐	☐	☐		☐

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5	CIV2003	Sustainable Materials and Green Buildings	3	0	3	S/EM	ES	-	-	-	☐	☐	☐			☐	☐	☐		☐		☐
6	CIV2004	Project Management	3	0	3	S/EM/ EN	HP/GS	-	-	-	☐	☐				☐		☐		☐	☐	☐
7	CIV2005	Environmental Impact Assessment	3	0	3	EM/EN	ES	-	-	-	☐					☐	☐	☐		☐		☐
8	CIV2006	Infrastructure Systems for Smart Cities	3	0	3	EM/EN	ES	-	-	-	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
9	CIV2044	Geospatial Applications for Engineers	2	2	3	S/EM	ES	-	-	-	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Commerce Basket																							
1	COM2001	Introduction to Human Resource Management	2	0	2	F	HP/GS	-	-	-								☐	☐	☐		
2	COM2002	Finance for Non-Finance	2	0	2	S		-	-	-										☐	☐	☐
3	COM2003	Contemporary Management	2	0	2	F		-	-	-		☐	☐	☐					☐	☐		
4	COM2004	Introduction to Banking	2	0	2	F		-	-	-										☐	☐	☐
5	COM2005	Introduction to Insurance	2	0	2	F		-	-	-										☐	☐	☐
6	COM2006	Fundamentals of Management	2	0	2	F		-	-	-		☐	☐	☐					☐	☐		
7	COM2007	Basics of Accounting	2	0	2	F		-	-	-		☐	☐	☐	☐				☐	☐		

Sl. No.	**Course Code**	**Course Name**	**L**	**P**	**C**	**Type of Skill/ Focus**	**Course Caters to**	**Pre-requisites/ Co-requisites**	**Anti-requisites**	**Future Courses that need this as a Pre-requisite**	**List of POs to which Course Caters to**											
											PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
Computer Science Basket																						
1	CSE2002	Programming in Java	2	2	3	S/ EM		-	-	-	☐	☐	☐	☐	☐				☐	☐		☐
2	CSE2003	Social Network Analytics	3	0	3	S	GS	-	-	-	☐	☐	☐	☐					☐	☐		☐
3	CSE2004	Python Application Programming	2	2	3	S/ EM		-	-	-	☐	☐	☐	☐	☐				☐	☐		☐
4	CSE2005	Web design fundamentals	2	2	3	S/EM/ EN		-	-	-	☐	☐	☐	☐	☐				☐	☐		☐
Design Basket																						

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1	DES1001	Sketching and Painting	0	2	1	S		-	-	-			☐	☐	☐				☐			
2	DES1002	Innovation and Creativity	2	0	2	F		-	-	-		☐	☐	☐		☐	☐					
3	DES1003	Serviceability of Fashion Products	1	2	2	F	ES	-	-	-		☐	☐	☐			☐	☐	☐	☐		
4	DES1004	Choices in Virtual Fashion	1	2	2	F	ES/GS/ HP	-	-	-	☐		☐			☐	☐	☐	☐	☐	☐	☐
5	DES1005	Fashion Lifestyle and Product Diversity	1	2	2	F	ES/GS/ HP	-	-	-	☐		☐		☐	☐	☐	☐	☐	☐	☐	☐
6	DES1006	Colour in Everyday Life	1	2	2	F	ES	-	-	-	☐		☐			☐	☐	☐	☐	☐	☐	☐
7	DES2001	Design Thinking	3	0	3	S	-	-	-	-	☐		☐		☐	☐	☐	☐	☐	☐	☐	☐
Electrical and Electronics Engineering Basket																						
1	EEE1002	IoT based Smart Building Technology	3	0	3	S/EM/ EN					☐	☐	☐	☐		☐	☐					
2	EEE1003	Basic Circuit Analysis using NI LAB View	2	2	3	S/EM/ EN					☐	☐	☐	☐								☐
3	EEE1004	Programmable Logic Controllers	3	0	3	S/EM/ EN					☐	☐	☐	☐	☐				☐	☐		☐
4	EEE1005	Fundamentals of Sci Lab Programming	3	0	3	S/EM/ EN					☐	☐	☐	☐	☐				☐	☐		☐
5	EEE1006	Smart Sensors for Engineering Applications	2	2	3	S/EM/ EN					☐	☐					☐			☐		

Sl. No.	**Course Code**	**Course Name**	**L**	**P**	**C**	**Type of Skill/ Focus**	**Course Caters to**	**Pre-requisites/ Co-requisites**	**Anti-requisites**	**Future Courses that need this as a Pre-requisite**	**List of POs to which Course Caters to**											
											PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
Electronics and Communication Engineering Basket																						
1	ECE1002	Artificial Neural Networks	2	0	2	S	EM	-	-	-	☐	☐			☐	☐			☐	☐		☐
2	ECE1003	Joy of Electronics Engineering	2	0	2	F		-	-	-	☐	☐				☐				☐		
3	ECE1004	Microprocessor based systems	3	0	3	F		-	-	-	☐	☐	☐		☐				☐	☐	☐	☐
4	ECE1005	Journey of Communication Systems	2	0	2	F		-	-	-	☐				☐			☐		☐		
English Basket																						
1	ENG1008	Indian Literature	2	0	2		GS/HP	-	-	-												
2	ENG1009	Reading Advertisement	1	2	2	S		-	-	-												

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3	ENG1010	Verbal Aptitude for Placement	2	2	3	S		-	-	-													
4	ENG1011	English for Career Development	3	0	3	S		-	-	-													
5	ENG1012	Gender and Society in India	2	0	2		GS/HP	-	-	-													
6	ENG1013	Indian English Drama	3	0	3			-	-	-													
Fitness and Wellness Basket																							
1	DSA2001	Spirituality for Health	2	0	2	F	HP	-	-	-								☐	☐	☐			
2	DSA2002	Yoga for Health	2	0	2	S	HP	-	-	-								☐	☐	☐			
3	DSA2003	Stress Management and Well Being	2	0	2	F		-	-	-								☐	☐	☐			
Kannada Basket																							
1	KAN2002	Sahithya Vimarshe	2	0	2			-	-	-										☐			
2	KAN2003	Pradharshana Kale	1	2	2	S		-	-	-										☐			
Law Basket																							
1	LAW1001	Introduction to Sociology	2	0	2	F	HP	-	-	-		☐	☐	☐		☐		☐	☐	☐			
2	LAW2001	Indian Heritage and Culture	2	0	2	F	HP/GS	-	-	-						☐		☐	☐	☐			
3	LAW2002	Introduction to Law of Succession	2	0	2	F	HP/GS	-	-	-						☐		☐	☐	☐			
4	LAW2003	Introduction to Company Law	2	0	2	F	HP	-	-	-		☐	☐	☐		☐		☐	☐	☐			
5	LAW2004	Introduction to Contracts	2	0	2	F	HP	-	-	-		☐	☐	☐		☐		☐	☐	☐			

Sl. No.	Course Code	Course Name	L	P	C	Type of Skill/ Focus	Course Caters to	Pre-requisites/ Co-requisites	Anti-requisites	Future Courses that need this as a Pre-requisite	List of POs to which Course Caters to											
											PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
6	LAW2005	Introduction to Copy Rights Law	2	0	2	F	HP	-	-	-		☐	☐	☐		☐		☐	☐	☐		
7	LAW2006	Introduction to Criminal Law	2	0	2	F	HP	-	-	-		☐	☐	☐		☐		☐	☐	☐		
8	LAW2007	Introduction to Insurance Law	2	0	2	F	HP	-	-	-		☐	☐	☐		☐		☐	☐	☐		
9	LAW2008	Introduction to Labour Law	2	0	2	F	HP	-	-	-		☐	☐	☐		☐		☐	☐	☐		
10	LAW2009	Introduction to Law of Marriages	2	0	2	F	HP/GS	-	-	-						☐		☐	☐	☐		
11	LAW2010	Introduction to Patent Law	2	0	2	F	HP	-	-	-		☐	☐	☐		☐		☐	☐	☐		

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12	LAW2011	Introduction to Personal Income Tax	2	0	2	F	HP	-	-	-		☐	☐	☐		☐		☐	☐	☐		
13	LAW2012	Introduction to Real Estate Law	2	0	2	F	HP	-	-	-		☐	☐	☐		☐		☐	☐	☐		
14	LAW2013	Introduction to Trademark Law	2	0	2	F	HP	-	-	-		☐	☐	☐		☐		☐	☐	☐		
15	LAW2014	Law on Sexual Harassment	2	0	2	F	HP/GS	-	-	-		☐	☐	☐		☐		☐	☐	☐		
16	LAW2015	Media Laws and Ethics	2	0	2	F	HP/GS	-	-	-		☐	☐	☐		☐		☐	☐	☐		
Mathematics Basket																							
1	MAT2001	Introduction to Mathematical Modelling	3	0	3	S		-	-	-	☐	☐	☐	☐	☐					☐		☐
2	MAT2002	Essential Statistics	3	0	3	S		-	-	-	☐	☐	☐	☐	☐					☐		☐
3	MAT2003	Mathematical Economics	3	0	3	F		-	-	-	☐	☐	☐	☐	☐					☐		☐
4	MAT2004	Mathematical Finance	3	0	3	F		-	-	-	☐	☐	☐	☐	☐					☐		☐
5	MAT2005	Mathematical Reasoning	3	0	3	S		-	-	-	☐	☐	☐	☐						☐		☐
6	MAT2008	Fourier Series & Complex Variables	3	0	3	F		-	-	-	☐	☐	☐	☐	☐					☐		☐
7	MAT2009	Integral Transforms	3	0	3	F					☐	☐	☐	☐	☐					☐		☐
8	MAT2010	Graph Theory and Combinatorics	3	0	3	F					☐	☐	☐	☐	☐					☐		☐
9	MAT2011	Probability and Random Signals	3	0	3	F					☐	☐	☐	☐	☐					☐		☐
10	MAT2012	Advanced Statistics	3	0	3	F					☐	☐	☐	☐	☐					☐		☐
11	MAT2013	Advanced Business Mathematics	3	0	3	S					☐	☐	☐	☐	☐					☐		☐
12	MAT2014	Bio-Statistics and Bio-Modelling	3	0	3	S					☐	☐	☐	☐						☐		☐
Sl. No.	**Course Code**	**Course Name**	**L**	**P**	**C**	**Type of Skill/ Focus**	**Course Caters to**	**Pre-requisites/ Co-requisites**	**Anti-requisites**	**Future Courses that need this as a Pre-requisite**	**List of POs to which Course Caters to**												
											PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
Mechanical Engineering Basket																							
1	MEC1001	Fundamentals of Automobile Engineering	2	0	2	F		-	-	-	☐	☐	☐	☐	☐		☐		☐	☐	☐	
2	MEC1002	Introduction to Matlab and Simulink	3	0	3	S/EM		-	-	-	☐	☐	☐	☐	☐		☐		☐	☐	☐	
3	MEC1003	Engineering Drawing	1	4	3	S		-	-	-	☐	☐	☐	☐	☐		☐		☐	☐	☐	

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4	MEC2001	Renewable Energy Systems	3	0	3	F	ES	-	-	-	☐	☐	☐	☐	☐		☐		☐	☐	☐	
5	MEC2002	Operations Research & Management	3	0	3	F		-	-	-	☐	☐	☐	☐	☐		☐		☐	☐	☐	
6	MEC2003	Supply Chain Management	3	0	3	S/ EM/ EN		-	-	-	☐	☐	☐	☐	☐		☐		☐	☐	☐	
7	MEC2004	Six Sigma for Professionals	3	0	3	S/EM		-	-	-	☐	☐	☐	☐	☐		☐		☐	☐	☐	
8	MEC2005	Fundamentals of Aerospace Engineering	3	0	3	F		-	-	-	☐	☐	☐	☐	☐		☐		☐	☐	☐	
9	MEC2006	Safety Engineering	3	0	3	S/EM	ES	-	-	-	☐	☐	☐	☐	☐		☐		☐	☐	☐	
10	MEC2007	Additive Manufacturing	3	0	3	F/EM		-	-	-	☐	☐	☐	☐	☐		☐		☐	☐	☐	
11	MEC3001	Electric Vehicles & Battery Technology	3	0	3	F/EM	ES	-	-	-	☐	☐	☐	☐	☐		☐		☐	☐	☐	
12	MEC3068	Engineering Optimization	3	0	3	S/EM		-	-	-	☐	☐	☐	☐	☐				☐	☐	☐	
13	MEC1005	Electronics Waste Management	3	0	3	F/S	ES	-	-	-	☐	☐	☐	☐	☐		☐		☐	☐	☐	
14	MEC3069	Hybrid Electric Vehicle Design	3	0	3	S/EM	ES	-	-	-	☐	☐	☐	☐	☐		☐		☐	☐	☐	
15	MEC3070	Thermal Management of Computer Appliances	3	0	3	S/EM		-	-	-	☐	☐	☐	☐	☐				☐	☐	☐	
Petroleum Engineering Basket																							
1	PET2022	Computational Fluids Dynamics	3	0	3	S / EN		-	-	-	☐	☐	☐	☐	☐				☐	☐	☐	☐
2	PET2023	Petroleum Corrosion Technology	3	0	3	F/S/EM		-	-	-	☐	☐	☐		☐	☐	☐	☐		☐		☐
3	PET2024	Polymer Technology	3	0	3	F / S		-	-	-	☐	☐	☐				☐			☐		☐
4	PET2025	Oil and Gas Quality Management	3	0	3	F / S		-	-	-	☐	☐	☐				☐	☐	☐	☐	☐	☐
5	PET2026	Health, Safety and Environment	2	2	3	S/ EM/ EN	ES	-	-	-	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
6	PET2027	Material Science and Engineering	3	0	3	F/S/EM		-	-	-	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐		☐
7	PET2028	Petroleum Economics	3	0	3	S / EM	ES	-	-	-	☐	☐	☐					☐	☐	☐	☐	☐

Sl. No.	**Course Code**	**Course Name**	**L**	**P**	**C**	**Type of Skill/ Focus**	**Course Caters to**	**Pre-requisites/ Co-requisites**	**Anti-requisites**	**Future Courses that need this as a Pre-requisite**	**List of POs to which Course Caters to**											
											PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
Physics Basket																						
1	PHY1003	Mechanics and Physics of Materials	3	0	3	F/S		-	-	-	☐	☐		☐	☐				☐			

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2	PHY1004	Astronomy	3	0	3	F		-	-	-						☐		☐				☐
3	PHY1005	Game Physics	0	2	1	F/S		-	-	-	☐	☐			☐				☐			☐
4	PHY1006	Statistical Mechanics	2	0	2	F		-	-	-		☐	☐									☐
5	PHY1007	Physics of Nanomaterials	3	0	3	F		-	-	-			☐			☐						
6	PHY1008	Adventures in Nano world	2	0	2	F		-	-	-	☐			☐	☐		☐		☐	☐		
7	PHY2001	Medical Physics	2	0	2	F	ES	-	-	-	☐	☐			☐	☐	☐	☐	☐	☐		
8	PHY2002	Sensor Physics	1	2	2	F/S		-	-	-	☐	☐	☐	☐	☐				☐			☐
9	PHY2003	Computational Physics	1	2	2	F		-	-	-	☐	☐		☐	☐							☐
10	PHY2004	Laser Physics	3	0	3	F	ES	-	-	-	☐					☐		☐				
11	PHY2005	Science and Technology of Energy	3	0	3	F	ES	-	-	-	☐	☐					☐		☐	☐		
12	PHY2006	Composite Materials-ASTM Standards	2	2	3	F/S		-	-	-	☐	☐		☐		☐						
Management Basket																						
Minimum credits to be earned from this basket =					**6**																	
1	MGT1001	Introduction to Psychology	2	0	2	F	HP									☐		☐	☐	☐		
2	MGT1002	Business Intelligence	2	0	2	EN													☐	☐	☐	
3	MGT1003	NGO Management	2	0	2	S												☐	☐	☐	☐	☐
4	MGT1004	Essentials of Leadership	2	0	2	EM/EN	GS/ HP									☐		☐	☐	☐		☐
5	MGT1005	Cross Cultural Communication	2	0	2	S/EM/ EN	HP												☐	☐		
6	MGT2001	Business Analytics	3	0	3	S/EM/ EN						☐	☐		☐				☐	☐	☐	
7	MGT2002	Organizational Behavior	3	0	3	F	HP											☐	☐	☐	☐	
8	MGT2003	Competitive Intelligence	3	0	3	S							☐		☐				☐	☐		
9	MGT2004	Development of Enterprises	3	0	3	S/EM/ EN						☐	☐	☐		☐	☐	☐	☐	☐	☐	
10	MGT2005	Economics and Cost Estimation	3	0	3	S/EM		-	-	-		☐	☐	☐	☐				☐	☐	☐	
11	MGT2006	Decision Making Under Uncertainty	3	0	3	S							☐	☐		☐	☐	☐	☐	☐		
12	MGT2007	Digital Entrepreneurship	3	0	3	S/EM/ EN									☐	☐	☐	☐	☐	☐		
13	MGT2008	Econometrics for Managers	2	0	2	S						☐	☐	☐	☐			☐	☐	☐		
14	MGT2009	Management Consulting	2	0	2	S/EM/ EN		-	-	-		☐	☐	☐					☐	☐		
15	MGT2010	Managing People and Performance	2	0	2	S/EM/ EN	HP/GS	-	-	-								☐	☐	☐		

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16	MGT2011	Personal Finance	2	0	2	F		-	-	-													
17	MGT2012	E Business for Management	2	0	2	S/EM		-	-	-													
18	MGT2013	Project Management	3	0	3	EN / EM	GS/HP/ ES	-	-	-													
19	MGT2014	Project Finance	3	0	3	EN / EM	HP	-	-	-													
20	MGT2015	Engineering Economics	3	0	3	S		-	-	-													
21	MGT2016	Business of Entertainment	3	0	3	EM/EN		-	-	-													
22	MGT2017	Principles of Management	3	0	3	S/EM/ EN		-	-	-													
23	MGT2018	Professional and Business Ethics	3	0	3	S/EM/ EN	HP	-	-	-													
24	MGT2019	Sales Techniques	3	0	3	S/EM/ EN	HP	-	-	-													

Research Project (Students are required to carry out research work under the guidance of a faculty member/ research scholar and the same shall be evaluated and credit will be granted as per the academic regulations)																							
1	URE2001	University Research Experience	-	-	**3**	S/ EM/ EN	-	-	-	=													

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Type of Course	No. of Courses	Credits	Level of Course				Type of Skill				Course Caters to			Course Credits			
			First Level	Second Level	Third Level	Fourth Level	Foundation	Skill Development	Employability	Entrepreneurship	Gender Sensitization	Environment and sustainability	Human values and Professional Ethics	1 Credit	2 Credits	3 Credits	4 Credits
Theory Based Courses	30	78	14	17	12	3	1	20	12	3	1	0	2	2	5	22	0
Lab Based Courses	4	4	3	1	1	0	0	4	2	0	1	0	3	4	0	0	0
Theory and Lab Embedded Courses	21	198	13	13	14	4	4	18	15	11	3	1	7	1	1	22	4
Grand Total	**55**	**280**	**30**	**31**	**27**	**7**	**5**	**42**	**29**	**14**	**5**	**1**	**12**	**7**	**6**	**44**	**4**

Apart from the above list, the student is free to enroll for any course offered by any school and earn credits for Open elective provided the student has not completed an ant requisite and the student fulfils the prerequisite if any for the course he wishes to enroll.

Type of Skill
F - Foundation
S - Skill Development
EM - Employability
EN - Entrepreneurship

Course Caters to
GS - Gender Sensitization
ES - Environment and sustainability
HP - Human values and Professional Ethics

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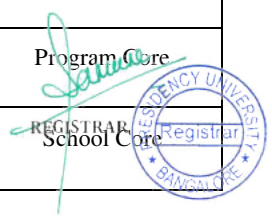
Sl. No.	Course Code	Course Name	L	P	Credits	Basket
Semester 1					**19**	
1	MAT1007	Introduction to Statistics	3	0	3	School Core
2	BSD1004	Elements of Computing Systems	3	0	3	Program Core
3	BSD1006	Fundamentals of Data Science	2	2	3	Program Core
4	BSD1007	Programming in Python	1	4	3	School Core
5	MAT1010	Fundamental Calculus	3	0	3	Program Core
6	ENG1003	Communicative English	2	0	2	School Core
7	KAN1001/ KAN2001	Kali Kannada / Tili Kannada	1	0	1	School Core
8	PPS1001	Introduction to soft skills	0	2	1	School Core
Semester 2					**22**	
1	MAT2007	Applied Mathematics	3	0	3	School Core
2	MAT1008	Probability and Inferential Statistics	3	0	3	Program Core
3	BSD1002	Programming in C	1	4	3	Program Core
4	BCA2002	Data structures and Algorithms	3	2	4	Program Core
5	BSD2002	Data Modelling and visualization	2	2	3	Program Core
6	BCA2011	Web Design and Development	1	4	3	Program Core
7	ENG1005	Technical Written Communication	2	0	2	School Core
8	PPS1006	Employability for Young Professionals	0	2	1	School Core
Semester 3					**20**	
1	CSA2003	Relational Database Management systems	2	4	4	Program Core
2	MAT2023	Matrix Computations for Data Science	3	0	3	Program Core
3	CSA1006	Operating Systems and Unix Programming	2	2	3	Program Core
4	CSA1005	Object oriented Programming Using Java	1	4	3	Program Core
5	CSA2020	Artificial Intelligence	3	0	3	Program Core
6	CSA2019	R Programming for Data science	2	2	3	Program Core
7	PPS2001	Reasoning and Employment Skills	0	2	1	School Core
Semester 4					**20**	
1	MAT2028	Graph Theory	3	0	3	Program Core
2	CSAXXXX	Discipline elective – I	3	0	3	Discipline Elective
3	CSA2021	Data Warehousing and Data mining	3	0	3	Program Core
4	CSAXXXX	Discipline elective – II	3	0	3	Discipline Elective
5	CSA2006	Fundamentals of Software Engineering	3	0	3	Program Core
6	CSA3001	Capstone Project	-	-	4	School Core



7	CHE1018	Environment Science	1	2	0	School Core
8	PPS3001	Problem Solving through Aptitude	0	2	1	School Core
Semester 5					**20**	
1	CSA3002	Machine Learning Algorithms	2	2	3	Program Core
2	CSA3004	Big data analytics	2	2	3	Program Core
3	CSA3003	Android Mobile Application Development	1	4	3	Program Core
4	CSA3014	Natural Language Processing	1	2	2	Program Core
5	CSA2008	Essentials of Cloud Computing	3	0	3	Program Core
6	CSAXXXX	Discipline elective – III	3	0	3	Discipline Elective
7	XXX XXXX	Open Elective – I	3	0	3	Open Elective
Semester 6					**19**	
1	CSA3005	Internet of Things	1	4	3	Program Core
2	CSA3017	Information Retrieval	1	2	2	Program Core
3	XXX XXXX	Open Elective – II	3	0	3	Open Elective
4	CSAXXXX	Discipline Elective 4: Deep Learning	2	2	3	Discipline Elective
5	CSA3008	Internship	-	-	8	School Core

Total Credits	**120**	**Type of Course**	**Credits**
		School Core	**30**
		Program Core	**72**
		Discipline Elective	**12**
		Open Elective	**6**

Semester	**Credits**	**No. of Courses**	**No of Class Hours**
Semester 1	**19**	**8**	23
Semester 2	**22**	**8**	29
Semester 3	**20**	**8**	29
Semester 4	20	**7**	15
Semester 5	20	8	27
Semester 6	19	4	15
Total	**120**	43	138

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VIII. Course Catalogues:

Each course shall have a course catalogue with the following details:

i) Pre –Requisites of the course
ii) Course Description
iii) Course Outcome
iv) Course Content
iv) Reference Resources.

The Course Catalogues for the Courses offered in each basket are attached below:

Course Code: CSA2003	**Course Title: Relational Database Management Systems** **Type of Course: Integrated**	**L- P-C**	**2**	**4**	**4**
Version No.	1.0				
Course Pre-requisites	**NIL**				
Anti-requisites	**NIL**				
Course Description	This course offers detailed concept on principles and techniques required in the design and implementation of database systems. It helps the students to learn and practice data modelling using the entity-relationship diagrams. It covers relation database management (RDBMS) concepts and also provides detail knowledge on how to design, maintain and retrieve the information effectively and efficiently. The corresponding laboratory is intended to implement database design using MYSQL. All the experiments will focus on the fundamentals of database creation, populating, interactive querying which includes use of various data definition, data manipulation commands, functions, joins, sub-queries, views, set operations, procedures, triggers and executing database transactions.				
Course Objective	This Course is designed to improve the learner's EMPLOYABILITY SKILLS by using PROBLEM SOLVING methodologies.				
Course Out Comes	**On successful completion of this course the students shall be able to:** 1. Understand the basic concepts of database and ER modeling in designing the database. [**Knowledge**] 2. Apply Relational Algebra and Database Querying concepts in designing the database. [**Application**] 3. Analyze various normalization techniques for designing a robust database. [**Analysis**] 4. Understand the Transaction control and concurrency control mechanisms.[**Comprehension**]				
Course Content:					
Module 1	Introduction				**10 Sessions**
Topics:					

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Introduction to Database: Database Management System, Characteristics of Database Approach, Types of Database users, DBA, Data Models, Schema, Instance, Three-Schema Architecture, Data Independence, Disadvantages in traditional file system, advantages of database over traditional file systems.

Conceptual Modeling: Data Modeling Using Entity Relationship (ER) Model, ER Model to Table Conversion, Examples on ER model.

Module 2	Query Languages			**12 Sessions**

Topics:

Relational Algebra: selection, projection, rename, set operations, Cartesian product, joins and division operator. Examples on Relational Algebra Operations.

Database Querying: DDL, DML, Constraints, Operators- BETWEEN, IN, LIKE, where clause, orderby command, Set Operators, Aggregate Functions, having clause, Views, Procedures, Cursors and Triggers.

Module 3	Designing and Refining Database Schema			**10 Sessions**

Topics:

Schema Design: Problems in schema design, redundancy and anomalies

Schema refinement*:* Functional Dependencies, Normalization and forms - First, Second, Third, Dependency Preservation – Boyce/Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form, **Rules and Types of Decomposition.**

Module 4	Transaction Management and Concurrency Control			**13 Sessions**

Topics:

Transaction: ***Transactions****:* Introduction to Transaction Processing, Transaction and System concepts, Desirable properties (ACID) of Transactions, Simultaneous Transactions and their problems like dirty read, lost update and incorrect summary, Serializability, Conflict Serializability, View Serializability. Transaction Support in SQL

Concurrency Control: Need for Concurrency, Locking and Time-stamping concurrency schemes.

List of Laboratory Experiments:

Create Student, Employee, Banking and Library Management databases and populate with necessary data. Perform the following various experiments on those databases.

Labsheet-1[4 Practical Sessions]

Experiment No 1: [2 Sessions]

To study and implement Data Definition Language (DDL) commands and Data Manipulation Language (DML) commands of MySQL.

Level 1: Perform basic operations using Data Definition Language (Create, Alter, Drop, Truncate & Rename) and Data Manipulation Language commands on Student Database.

Experiment No. 2: [2 Sessions]

To study and implement different types of constraints, relational, logical, pattern matching, BETWEEN, IS NULL, IN and NOT IN Special Operators.

Level 1: Create tables on Employee database using PRIMARY KEY, NOT NULL, UNIQUE, FOREIGN KEY and demonstrate the working of relational, logical, pattern matching, BETWEEN, IS NULL, IN and NOT IN Special Operators on Employee Database.

Labsheet-2[4 Practical Sessions]

Experiment No. 3: [2 Sessions]

To study and implement for aggregation of data in to groups and sub-groups using GROUP BY, HAVING clauses and sort data using ORDER BY clause.

Level 1: Implementing GROUP BY, HAVING, ORDER BY and aggregate functions on Employee Database**.**

Experiment No. 4: [2 Session]

To study and implement various Set and Join Operations.

Level 1: Demonstrate different types of Set Operations (UNION, UNION ALL, INTERSECT, MINUS) and Join Operations (INNER JOINs, OUTER JOINS, CROSS JOIN, NATURAL JOIN) on two or more tables of Employee Database.

Labsheet-3 [2 Practical Sessions]

Experiment No. 5: [2 sessions]

To study and implement Views, Procedures and Functions in MySQL.

Level 1: Implement MySQL Views and Procedures in MySQL on Banking database.

Labsheet-4 [2 Practical Sessions]

Experiment No. 6: [2 Sessions]

To study and implement Cursors and Triggers in MySQL.

Level 1: Implement MySQL Cursors and Triggers in MySQL on Employee database.

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

1] Constructing E-R diagrams.
2] Implementation on a given scenario.

Text Book

1. Elmasri R and Navathe S B, "Fundamentals of Database System", 7th Edition, Pearson Publication, 2017.

References

1. Hector Garcia Molina, Jeffery D Ullman, Jenniffer Widom, "Database systems: The Complete Book", 2nd edition, Pearson Publication,2013.

2. Avi Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", 7th Edition, McGraw-Hill, 2019.

Catalogue prepared by	Ms. Namrata Das
Recommended by the Board of Studies on	16th BoS dated 23-07-2022
Date of Approval by the Academic Council	17th Academic Council Meeting dated 03-08-2022

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Course Code: CSA 1006	**Course Title: OPERATING SYSTEM AND UNIX PROGRAMMING** **Type of Course: Integrated**	**L- P-C**	2	2	3
Version No.	1.0				
Course Pre-requisites	The prerequisites for this course are Data Structures and Computer Organization. You are expected to have a working knowledge of C / C++, including a familiarity with its basic data types and control structures, and an understanding of computer organization.				
Anti-requisites	Nil				
Course Description	The main objective of this course is to cover basic concepts of operating systems. Operating Systems functions, Basic Concepts, Notion of a process, Concurrent processes, Problem of mutual exclusion, Deadlock, Process Scheduling, Memory management, Multiprogramming, File systems; time sharing systems and their design consideration. This course will prepare students to develop software in and for Linux/UNIX environments. Also this course helps the students in UNIX operating system and their effective use for problem solving.				
Course Objectives	This course is designed to improve the learners' **SKILLS** by using EXPERIENTIAL LEARNING techniques				
Course Outcomes	1. Describe the fundamental concepts of operating Systems and Apply various CPU scheduling algorithms. 2. Recognize the classic synchronization problems and Compare methods for handling deadlocks 3. Discuss various memory management techniques. 4. Describe file systems				
Course Content:					
Module 1	**Introduction to OS Structure and process management**	Assignment			**7 Sessions**
Topics: **Introduction:** What Operating Systems Do? OS Services, System Calls, types of system calls, os **Structure** Processes**:** Process Concept, process Scheduling, operations on process, Scheduling Criteria, Scheduling Algorithms.					
Module 2	**Process coordination**	Assignment			**11 Sessions**
Topics: The Critical-Section Problem, Synchronization Hardware, Semaphores, Monitors, Synchronization Examples, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.					
Module 3	**Memory-Management**	Case Study			**7 Sessions**

Topics:
Memory Management: Introduction to Memory Management, Swapping, Contiguous and Non-Contiguous Memory Allocation, Segmentation, Paging - Structure of the Page Table – Demand Paging – Page Replacement, Allocation of Frames – Thrashing.

Module 4	**Storage Management.**	Case Study and Project		**5 Sessions**

Topics: File Concept, Access Methods, Directory and Disk Structure, Overview of Mass-Storage, Disk Structure, Structure, Disk Scheduling.

Targeted Application & Tools that can be used:

Linux / Vi Editor

Project work/Assignment:

Assignment:

Lab Experiments

Experiment 1

Level 1 : To study of Basic UNIX Commands and various UNIX editors such as vi
Level 2 : To study the File manipulation Commands

Experiment 2

Level 1 : Programs using the following system calls of UNIX operating system fork, exec, getpid, exit,wait
Level 2 : Programs using the following system calls of UNIX operating system close, stat, opendir, readdir

Experiment 3

Level 1 : Program For Simulation Of Ls Unix Commands
Level 2 : : Program For Simulation Of Ls Unix Commands

Experiment 4

Level 1 : Write a Shell program to check the given number is even or odd
Level 2 : Write a Shell program to check the given year is leap year or not

Experiment 5

Level 1 : Write a Shell program to find the factorial of a number
Level 2 : Write a Shell program to swap the two integers

Experiment 6

Level 1 : Implementation of Priority scheduling algorithms. With total and average waiting time
Level 2 : Implementation of Priority scheduling algorithms. With total and average turnaround time

Experiment 7

Level 1 : Write a Shell program to display a given Message
Level 2 : Write a Shell Program to find the roots of the quadratic equation.

Experiment 8

Level 1 : Write a shell program to find the smallest digit of a value
Level 2 : Write a shell script to perform integer arithmetic operations

Experiment 9

Level 1 : Write a shell program to reverse a number.
Level 2 : Write a shell program to find the sum of even and odd numbers in an array

Experiment 10

Level 1 : Write a Simple Shell script to print the sum of n natural numbers
Level 2 : Write a shell program to count the number of digits of a value.

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1. Study of Linux commands – System Information, Files and Directories, Process, Text Processing and Scripting, Programming.

2. Creating Child process (using fork), Zombie, Orphan. Displaying system information using C.
3. Shell scripting (I/O, decision making, looping)
4. IPC (Threads, Pipes)
5. CPU Scheduling Algorithms (FCFS, SJF, RR, Priority)
6. Deadlock Avoidance Algorithm (Bankers algorithm)
7. Process synchronization (Producer Consumer / Reader Writer/Dining Philosopher using semaphores)
8. Page Replacement Algorithms. (FIFO, LRU, Optimal)
9. Dynamic Memory Allocation Algorithms (First fit, Best fit, Worst fit)
10. Disk Scheduling Algorithms

Text Books

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne-Operating System Concepts, Wiley, 10th Edition, 2019.
2. Tanenbaum, Andrew S., and Albert S. Woodhull. Operating systems: design and implementation. Vol. 68. Englewood Cliffs: Prentice Hall, 1997

Reference Books

1. The Unix programming Environment by Brain W. Kernighan & Rob Pike, Pearson.
2. Introduction to Unix Shell Programming by M.G.Venkateshmurthy, Pearson
3. Unix and shell programming by B.M. Harwani, OXFORD university press.
4. Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau, Operating Systems, Three Easy Pieces,Arpaci-Dusseau Books, Inc, 2015
5. Dhamdhere, Dhananjay M. Operating systems: a concept-based approach, 2E. Tata McGraw-Hill Education, 2006.
6. Deitel, Harvey M., Paul J. Deitel, and David R. Choffnes. Operating systems. Delhi. Pearson Education: Dorling Kindersley, 2004.
7. Milenkovič, Milan. Operating systems: concepts and design. McGraw-Hill, Inc., 1987.

Web References

1. **https://nptel.ac.in/courses/106108101**
2. **https://nptel.ac.in/courses/106106144**
3. **https://nptel.ac.in/courses/117106113**
4. **https://www.udemy.com/course/unix-getting-started/**
5. **https://www.coursera.org/learn/unix**

Catalogue prepared by	**Dr.R.Chinnaiyan**
Recommended by the Board of Studies on	16th BoS dated 23-07-2022
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Course Code: CSA2020	**Course Title: Artificial Intelligence** **Type of Course: Program Core & Theory only**	**L- P-C**	3	0	3
Version No.	1.0				
Course Pre-requisites	**NIL**				
Anti-requisites	**NIL**				
Course Description	**This course explores the intelligent system structure and various levels of Knowledge representation. The students can learn about how to identify, differentiate, and categorize a wide range of intelligent system, as well as to evaluate how AI contribute to the design and development of intelligent system design. The Students can also evaluate the role and contribution of Artificial intelligence in various fields through interactive lectures, in-class and online assignments, and group projects. With the good knowledge of AI, students can learn how to regulate the models which are best suited for achieving an intended system result, and they can judge whether the Intelligent systems have been implemented successfully or not.**				
Course Outcomes	**On successful completion of the course, the students shall be able to:** **1]** Define the basic of local search algorithms, various optimization techniques for a given AI algorithm. **2]** Identify the smart intelligent way to represent the knowledge Engineering. **3]** Illustrates the key aspects of planning models of artificial intelligence. **4]** Understand the expert based intelligent system.				
Course Content:					
Module 1	Introduction to intelligent systems	Assignment	Research Assignment	**12 Sessions**	
Topics: **Basic Concepts and definitions of AI. Searching: Searching for solutions, Uniformed Search Strategies, Informed Search Strategies, Heuristic Functions. Local Search Algorithms and Optimization Problems: Hill climbing, Simulated annealing, Local beam, Genetic algorithms, Constraint Satisfaction Problems, Backtracking Search for CSPs. searching in solution tree- case study: water jug problem. Adversial Search: Games, Optimal Decision in Games, Alpha Beta Pruning, Evaluation Functions, Cutting off search, Games that include an Element of chance, Game programs.**					
Module 2	Knowledge representations	Case Study	Knowledge Engineering Process	**10 Sessions**	
Topics: **First Order Logic: Syntax and Semantics, Using First Order Logic, Knowledge Engineering, Inference in First Order Logic: Propositional vs. First Order Inference, Unification and Lifting, Resolution, Forward and Backward Chaining.**					

Module 3	Planning	Assignment	Statistical learning methods	**11 Sessions**
Topics: **Planning: Classical planning problem, Language of planning problems, Partial Order planning, Planning Graphs, Planning with Propositional Logic. Learning: Forms of learning, Introduction learning, Learning Decision Tree, Statistical learning methods, learning with complete data, Instance based learning, Neural networks.**				
Module 4	Expert system	Project	Neural Network	**10 Sessions**
Topics: **Expert Systems: Introduction, Advantages, Languages, Elements, Production Systems, Procedural and Nonprocedural Paradigms, Artificial Neural Systems. Design of Expert Systems: Selecting the Appropriate Problem, Stages in the Development of an Expert System, The Expert System Life Cycle. Detailed life cycle model, Decision trees.**				
Project work/Assignment:				
Assignment: 1] Research a popular game and identify its intelligent component contributing to its popularity. Understand the implementation of intelligent component in the game. **Project Assignment: 1] Model any intelligent application to improvise traditional system.**				
Text Books **1. E. Rich and K. Knight," Artificial Intelligence", Tata McGraw Hill, 2013** **2. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", PHI, 2013.**				
References **1. M.Timjones "Artificial Intelligence a Systems Approach" University Science Press 2010.** **2. E. Charnaik and D.McDermott," Introduction to artificial Intelligence", Pearson Education, 2012.**				
Catalogue prepared by	Dr. Nihar Ranjan Nayak, Assistant professor , Department of Computer Science and Engineering, Presidency University			
Recommended by the Board of Studies on	16th BoS dated 23-07-2022			
Date of Approval by the Academic Council	17th Academic Council Meeting dated 03-08-2022			

Course Code: CSA2006	**Course Title: FUNDAMENTALS OF SOFTWARE ENGINEERING** **Type of Course: Program Core - Theory**	**L- P- C**	3 0	3
Version No.	1			

Course Pre-requisites	Object Oriented Concepts, Basic programming knowledge, basic understanding of algorithms
Anti-requisites	NIL
Course Description	The course covers software process models, software requirement engineering processes, system analysis, design, implementation and testing aspects of software system development. The course also covers project evaluation, planning, effort estimation and risk management aspects in software project planning. Topics include: Introduction to Software Engineering, Process Life Cycle Models, Requirement Analysis and Specification, User Interface Analysis and Design, Software Testing, Project Management, Project Planning, Effort Estimation Techniques, Project Scheduling, Project Metrics & Evaluation, Risk Management.
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using participative learning techniques
Course Outcomes	On successful completion of this course the students shall be able to: 1) Describe the software engineering principles, ethics and process models. 2) Identify the requirements and appropriate design models for a given application. 3) Discuss the various types of testing methods and Quality Assurance. 4) Apply project planning, scheduling, evaluation and risk management principles for a given project.
Course Content:	

Module 1				08 Sessions

Introduction to Software Engineering & Process Models

Software and Software Engineering: Nature of Software, Software Engineering Practice,Software Myths, SDLC, Software Processes: Generic Model, Prescriptive Process Model, Unified Process Model, Agile Development: Extreme Programming, SCRUM.

Module 2				09 Sessions

Software Requirements and Design

Requirements Engineering: Eliciting requirements, Functional and non- Functional requirements, SRS, Requirements modelling: Developing Use Cases, Developing Activity diagram and Swimlane diagram, Design : Design concepts, Architectural design, Component based design, User interface design.

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Module 3		Assignment		8 Sessions

Software Testing and Quality

Introduction to Software Testing: verification and validation, Test Strategies for conventional

Software, Validation Testing, White box Testing: Basis path testing, Black box Testing. Software Quality Assurance : Elements of software quality assurance, SQA Tasks, Goals and Metrics,

Software configuration management : SCM process

Module 4				13 Sessions

Software Project Management

Project Management Concepts, Project Planning, Overview of metrics, Estimation for Software

projects, Project Scheduling, Risk Management, Maintenance and Reengineering, Software

Process Improvement (SPI): CMM Levels.

Targeted Application & Tools that can be used:

Apply project planning, scheduling, evaluation and risk management principles for a given project.

Project work/Assignment:

Project Assignment:
Assignment 1: Module 3
Assignment 2: Module 3

Textbooks:

1.Roger S. Pressman, "Software Engineering – A Practitioner's Approach", VII Edition, McGraw Hill, 2017.

2. Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management", VI Edition, McGrawHill, 2018.

References:

Ian Sommerville, "Software Engineering", IX Edition, Pearson Education Asia, 2011.

2. Rajib Mall, "Fundamentals of Software Engineering", VI Edition, PHI learning private limited, 2014.

Web references:
https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2233842&site=ehost-live
https://nptel.ac.in/courses/105106053

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Topics relevant to "Employability":

Agile Development, Software Testing,White box Testing,Black box Testing

Topics relevant to "Environment and Sustainability":	
Catalogue prepared by	Ms.B.Bhavya
Recommended by the Board of Studies on	BOS NO: 2nd BOS held on 22/12/22
Date of Approval by the Academic Council	20th Academic Council Meeting held on 15th February2023

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