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XXX Academic Council - Annexure 2.8
Department of Computer Science & Applications
Minutes of 6th Board of Studies Meeting

The Department of Computer Science & Applications called for the 6th Board of Studies (BOS) meeting, scheduled to take place on the 23rd June 2020, starting from 10:00 a.m. onwards.

The following BOS Members attended:

1. Dr.M S R Prasad, Professor, HOD-BCA, KLEF.
2. Dr. Raghuveer, Dean Academics, KLEF.
3. Mr. Bhukya. Jabber, Asst. Professor, KLEF.
4. Dr Satya Prasad R., Professor, Acharya Nagarjuna University.
5. Dr M Babu Reddy, Professor, Krishna University.
6. Mr Sai Satish, CEO, Indian Servers.
7. Dr. Amaralingeswara Rao Kaka,Program Director,IBM, Hyderabad.
8. Mr.C. Rajesh Kumar, Academic In charge , INurture.
9. Dr. M.R. Narasinga Rao, Professor & R-PAC KLEF.
10. Dr.K. Bhanu Prakash, Professor KLEF.
11. Dr D. Veerabhadra Babu, Assoc.Professor, BCA KLEF.
12. Mr Abdul Mannan, Asst Professor, KLEF.
13. Mr.G. Akhilesh, Asst Professor, KLEF.
14. Ms. Surabhi Saxena, Asst Professor, KLEF.
15. Mr.K. Vishal Raj, Asst Professor, KLEF.
16. Mr.S. Shanmukh, Alumni, KLEF.
17. Ms. G. Vamsi Priya , Alumni, KLEF.

Opening Remarks

Dr.M S R Prasad, Professor, HOD-BCA opened the meeting, welcoming all attendees.

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Agenda 1:

Proposed to review the approvals of previous meeting minutes.

Discussion

- Confirm the accuracy of the documented action items from the last meeting.
- Allow participants to share any additional comments or concerns related to the previous meeting minutes.
- Encourage suggestions from attendees on how to improve the documentation and approval process of meeting minutes.

Action taken:

- The minutes of the previous meeting were reviewed and approved unanimously.

Agenda 2:

Proposal to introduce professional elective courses for specialization Data Science in AY:2020-21 based on the feedback received from Stakeholders.

Discussion

- As per the recommendations of Industry expert Mr. K. Tarun, CEO, Glocal Tech, Bangalore suggested introducing the course "Introduction to Data Science with R programming" for data analysis and visualization.
- Faculty Member Dr. Bindu Suggested to introduce the "Linear Algebra" for solving the real time problems using machine learning, deep learning using the basics of Linear Algebra.
- Industry expert Mr. K. Srinivas, CEO, Indian Servers, recommended to introduce "Sampling Methods & Exploratory Data Analysis" with fundamental techniques in statistics and data science.
- Academic peer Dr. P. Suresh Varma, Professor, Adikavi Nanayya University, suggested introducing "Design and Analysis of Algorithms", to analyze the time and space complexity of the problems with high performance capabilities.
- Alumni member Ms. L. Swathi Shireen suggested introducing the courses "Artificial Intelligence" and "Machine Learning" which have a wide range of career opportunities are in high demand.
- Faculty member Mr. C. Rajesh Kumar suggested to introduce the course "Big Data Analytics" based on the industry requirements.
- Industry expert Dr. Amaralingeswara Rao Kaka, Program Director, IBM suggested to introduce the course "Data Visualization Tools and Techniques" for generating the reports using graphical representation of information and data.

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- Industry expert Ms. M. Sravani, Software engineer, Wipro, suggested to introduce "Data Warehousing and Mining" for extracting the useful information from large set of data.
- Academic Peer Dr Satya Prasad R. from Acharya Nagarjuna University, suggested to introduce "Optimization Techniques" to manage the enterprise resources.
- Alumni member Ms. G.Vamsi Priya suggested introducing the course "Soft Computing" to understand how samples can be used to produce the finest result and genetic algorithms can be used for solving the real world problems.
- Industry person Mr. Goutham, Software consultant, suggested to introduce "DevOPS with Cloud" to understand the continuous integration and continuous delivery to deploy the products into the cloud.
- Faculty Member Ms.Surabhi Saxena suggested to introduce the course "Technology Management" course for the benefits would be the management of the use of technology for human advantage.

List of Courses Introduced as per suggestions and feedback provided by stakeholders to meet industry requirements:

S.No	Course code	Course Title	Course Type	Remarks
1	20CA2132	Introduction to Data Science with R Programming	Professional Elective	Newly Introduced Course
2	20CA2133	Linear Algebra	Professional Elective	Newly Introduced Course
3	20CA2134	Sampling Methods & Exploratory Data Analysis	Professional Elective	Newly Introduced Course
4	20CA2135	Design and Analysis of Algorithms	Professional Elective	Newly Introduced Course
5	20CA2236	Big Data Analytics	Professional Elective	Newly Introduced Course
6	20CA2237	Artificial Intelligence	Professional Elective	Newly Introduced Course
7	20CA2238	Data Visualization Tools & Techniques	Professional Elective	Newly Introduced Course
8	20CA2239	Data Warehousing & Mining	Professional Elective	Newly Introduced Course
9	20CA3140	Optimization Techniques	Professional Elective	Newly Introduced Course
10	20CA3141	Soft Computing	Professional	Newly Introduced Course

23/6/20
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			Elective	
11	20CA3142	Devops with Cloud	Professional Elective	Newly Introduced Course
12	20CA3143	Machine Learning	Professional Elective	Newly Introduced Course
13	20CA3244	Technology Management	Core	Introduced in place of Configuration Management on Cloud based on stakeholder's feedback.

The detailed syllabus is shown in **ANNEXURE-1.**

Resolutions:

- A resolution is taken to add the following courses as per discussions and recommendations or suggestions provided by industrial faculty and external members to meet the industry standards.

Action taken

- Dr. M S R Prasad, Professor, HOD-BCA will be responsible for circulating the newly introduced courses for final approval from the Academic Committee.
- Courses have been added based on extensive discussions and recommendations from industrial faculty and external members, aiming to meet the ever-evolving industry standards.

Agenda 3:

Proposed to add course "Technical skills" with LTPS 0-0-0-8 in all the semesters.

Discussion:

As per the recommendations of Alumni and parents Technical Skills Course is introduced in all the semesters with LPTS structure 0-0-0-8.

Sl#	Course Code	Course Title	L	T	P	S	Cr	CH
1	20CA1105	Technical Skills-1	0	0	0	8	2	2
2	20CA1210	Technical Skills-2	0	0	0	8	2	2
3	20CA2117	Technical Skills-3	0	0	0	8	2	2
4	20CA2223	Technical Skills-4	0	0	0	8	2	2
5	20CA3131	Technical Skills-5	0	0	0	8	2	2

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Resolutions:

- A proposal has been put forth to enrich the academic offerings of the University by introducing new courses in response to the evolving needs of students and industry demands.
- The Board of Studies authorizes the respective Heads of Departments and Academic Deans to undertake essential measures for the implementation of new course as "Technical Skills" to be introduced in all semesters.

Action taken

- The Board of Studies has granted authorization to the respective Heads of Departments and Academic Deans to initiate essential measures for the successful implementation of the new course titled "Technical Skills" in all semesters.

Agenda 4:

Proposed to Combine the Courses "Digital Logic Design" and "Computer Organization and Architecture" and add as a revised course as "Digital Logic Design & Computer Organization".

Discussion:

Faculty Member Dr D. Veerabhadra Babu, suggested to combine the courses "Digital Logic Design" and "Computer Organization and Architecture" into "Digital Logic Design & Computer Organization" as the concepts in the courses are interrelated and collectively used for the designing of Combinational and Sequential circuits using flipflops, micro-operations.

- The comparison table of old syllabus and revised syllabus is shown in Annexure **II.**

Resolutions:

- Revised versions of the following courses were accepted with major modifications suggested during the meeting and added as Newly Introduced Courses.

- The Department of Computer Science Applications will continue to monitor and enhance its curriculum to align with industry standards.

23/6/20

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Actions taken:

- The revised versions of courses, along with the approved major changes to existing courses, are in the process of being implemented.
- Following a comprehensive review, the revised versions of several courses have been accepted, with significant modifications recommended during the meeting.

BCA Program Structure for 2020-2021 Batch:

Course Code	Course Name	Course Category	L	T	P	S	CR	Pre-Requisite	New Course/Revised Course/ Retained Course	Changes Proposed by	Justification
20UC1101	Integrated Professional English	HSS	0	0	4	0	2	NA	Retained	NA	Covering communication skills for employability
20MT1105	Fundamentals of Mathematics	HSS	3	0	2	0	4	NA	Retained	NA	Enhance Mathematical skills for employability
20CA1101	Programming in C	PC	3	0	2	0	4	NA	Retained	NA	Enhance Programming skills for employability
20CA1102	Operating Systems	PC	3	1	0	0	4	NA	Retained	NA	Provide basic understanding of operating through for employability
20CA1103	Software Engineering	PC	3	0	0	0	3	NA	Retained	NA	Provide the entire knowledge of software engineering for employability
20CA1104	Digital Logic & Computer Organization	PC	3	0	0	0	3	NA	Newly Intro Course	Faculty	Enhance the knowledge of architecture of computer for employability
20UC0009	Ecology & Environment	HSS	2	0	0	0	2	NA	Retained	NA	Enhance the awareness of environment.

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20CA1105	Technical Skills-1	Skill	0	0	0	8	2	NA	**Newly Introduced Course**	Alumni and Parents	Enhance the skilling and knowledge of coding
20UC1202	English Proficiency	HSS	0	0	4	0	2	NA	Retained	NA	Covering communication skills for employability
20CA1206	Object Oriented Programming Using Java	PC	2	0	2	0	3	20CA1101	Retained	NA	Enhance Programming skills for employability
20CA1207	Data Structures	PC	2	0	2	0	3	20CA1101	Retained	NA	Enhance data structure knowledge for employability
20CA1208	Computer Networks	PC	3	1	0	0	4	NA	Retained	NA	Enhance networking knowledge for employability and Entrepreneurship
20CA1209	Computer Oriented Statistics	PC	3	0	2	0	4	NA	Retained	NA	Enhance knowledge for statistics in term of computer and Entrepreneurship
20UC0010	Universal Human Values & Professional Ethics	H&S	2	0	0	0	2	NA	Retained	NA	Enhance knowledge for human values and professional ethics
20CA1211	Technical Skills-2	Skill	0	0	0	8	2	NA	**Newly Introduced Course**	Alumni and Parents	Enhance the skilling and knowledge of coding
20UC1102	Design Thinking & Innovation-1	HSS	1	0	0	4	2	NA	Retained	NA	Enhance the knowledge of thinking in respect of start-up

29/5/20
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20CA1211	Database Management System	PC	**3**	**0**	**2**	**0**	**4**	NA	Retained	NA	Enhance database knowledge for employability and Entrepreneurship
20CA2116	Client-Side Scripting	PC	**3**	**0**	**2**	**0**	**4**	20CA1206	Retained	NA	Enhance scripting knowledge for employability and Entrepreneurship
20UC1203	Design Thinking & Innovation-1	HSS	**1**	**0**	**0**	**4**	**2**	NA	Retained	NA	Enhance the knowledge of thinking in respect of start-up
20CA2117	Technical Skills-3	Skil l	**0**	**0**	**0**	**8**	**2**	NA	**Newly Introduced Course**	Alumni and Parents	Enhance the skilling and knowledge of coding
20CA2118	Internship	PC	**0**	**0**	**4**	**0**	**2**	NA	Retained	NA	Enhance the knowledge of software development
20CA2112	Linux Administration	PE	**2**	**0**	**2**	**0**	**3**	NA	Retained	NA	Enhance the knowledge of LINUX operating system for employability and Entrepreneurship
20CA2113	Information Storage and Management	PE	**2**	**1**	**0**	**0**	**3**	NA	Retained	NA	Enhance the knowledge of Information storage for employability and Entrepreneurship
20CA2114	Principles of Virtualization	PE	**2**	**0**	**2**	**0**	**3**	NA	Retained	NA	Gain the knowledge of Principals of virtualization for

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											employability and Entrepreneurship
20CA2115	Network & Information Security	PE	**3**	**0**	**0**	**0**	**3**	NA	Retained	NA	Enhance the knowledge of network security for employability and Entrepreneurship
20CA2132	Introduction to Data Science with R Programming	PE	2	0	2	0	3	NA	Newly Introduced Course	Industry Person	Enhance the knowledge of web development for employability and Entrepreneurship
20CA2133	Linear Algebra	PE	2	1	0	0	3	NA	Newly Introduced Course	Faculty Member	Enhance Knowledge on Algebra for extracting the information
20CA2134	Sampling Methods & Exploratory Data Analysis	PE	2	0	2	0	3	NA	Newly Introduced Course	Industry	Enchance Knowledge on Data using sampling methods and Data analysis
20CA2135	Design and Analysis of Algorithms	PE	3	0	0	0	3	NA	Newly Introduced Course	Academic Peer	Enhance Knowledge on performance of programming by analyzing the algorithms.
20UC2103	Professional Communication Skills	HSS	**0**	**0**	**4**	**0**	**2**	NA	Retained	NA	Covering communication skills for employability
20CA2219	Python Web	PC	**3**	**0**	**2**	**0**	**4**	NA	Retained	NA	Enhance the knowledge of Python

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	Developme nt										programming for employability and Entrepreneurship
20CA222 3	Technical Skills-4	PC	**0**	**0**	**0**	**8**	**2**	NA	**Newly Introduce d Course**	Alumni and Parents	Enhance the skilling and knowledge of coding
20CA221 8	Installation and Configurati on of Server	PE	**2**	**0**	**2**	**0**	**3**	NA	Retained	NA	Enhance the knowledge of Configuration Management on Cloud for employability
20CA222 0	Introductio n to Cloud Computing	PE	**2**	**0**	**2**	**0**	**3**	NA	Retained	NA	Enhance the knowledge of cloud computing for employability and Entrepreneurship
20CA222 1	Ethical Hacking	PE	**2**	**0**	**2**	**0**	**3**	NA	Retained	NA	Enhance the knowledge of ethical hacking for employability and Entrepreneursh ip
20CA222 2	Cloud Web Services	PE	**2**	**0**	**2**	**0**	**3**	20C A21 14	Retained	NA	Enhance the knowledge of cloud web services for employability and Entrepreneursh ip
20CA223 6	Big Data Analytics	PE	2	0	2	0	3	20C A22 22	Newly Introduced Course	Faculty Member	Enhance knowledge on analysing the huge amount

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											of data for Employability
20CA2237	Artificial Intelligence	PE	2	0	2	0	3	NA	Newly Introduced Course	Alumni	Enhance Knowledge on Artificial intelligence for Employability
20CA2238	Data Visualization Tools & Techniques	PE	2	0	2	0	3	20CA2222	Newly Introduced Course	Industry Person	Enhance knowledge on visualizing the data helps in employability
20CA2239	Data Warehousing & Mining	PE	2	0	2	0	3	NA	Newly Introduced Course	Industry Person	Enhance knowledge on mining algorithms helps to extract data for employability
20UC3005	Aptitude Builder	HSS	**0**	**0**	**4**	**0**	**2**	NA	Retained	NA	Enhance Skilling Knowledge to solve the problems in Competitive exams
20CA3128	Malware Analysis	PE	**2**	**0**	**2**	**0**	**3**	NA	Retained	NA	Enhance the knowledge of Malware r employability
20CA3130	Internship-2	PR	**0**	**0**	**4**	**0**	**2**	NA	Retained	NA	Enhance the knowledge of thinking in respect of start- up

23/6/20
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20CA3131	Technical Skills-5	PC	**0**	**0**	**0**	**8**	**2**	NA	**Newly Introduced Course**	Alumni and Parents	Enhance the skilling and knowledge of coding
20CA3124	Cloud Information Security	PE	**2**	**1**	**0**	**0**	**3**	NA	Retained	NA	Enhance the knowledge cloud information security for employability
20CA3125	Windows Azure	PE	**2**	**0**	**2**	**0**	**3**	NA	Retained	NA	Enhance the knowledge of Windows Azure for employability
20CA3126	Digital Forensics	PE	**2**	**0**	**2**	**0**	**3**	NA	Retained	NA	Enhance the knowledge of Digital Forensics for employability
20CA3127	Design and Development of Cloud Application	PE	**2**	**0**	**2**	**0**	**3**	NA	Retained	NA	Enhance the knowledge of Development of Cloud for employability
20CA3140	Optimization Techniques	PE	2	1	0	0	3	NA	Newly Introduced Course	Academic Peer	Enhance Knowledge to solve problems optimally
20CA3141	Soft Computing	PE	2	0	2	0	3	NA	Newly Introduced Course	Alumni	Enhance Knowledge on the Neural networks & Genetic Algorithms

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20CA3142	Devops with Cloud	PE	2	0	2	0	3	NA	Newly Introduced Course	Industry Person	Enhance the knowledge of Configuration Management on Cloud for employability
20CA3143	Machine Learning	PE	2	0	2	0	3	NA	Newly Introduced Course	Alumni	Enhance Knowledge on Machine Learning Algorithm types.
20CA3244	Technology Management	PC	3	0	0	0	3	NA	Newly Introduced Course	Faculty Member	Enhance knowledge on managing the technology as a team leader
20CA3245	Secure Software Engineering	PC	3	0	0	0	3	NA	Retained	NA	Enhance the knowledge of Software Engineering for employability
20CA3246	Major Project /Internship	PR	0	0	24	0	12	NA	Retained	NA	Enhance the knowledge project for Skill Development and Entrepreneurship

Percentage of Syllabus Revision = 34.54 % (19 Out of 53)
Percentage of Courses focusing on Employability= 86.79% (46 Out of 53)

Percentage of Courses focusing on Entrepreneurship= 34.54% (19 Out of 53)

Percentage of Courses focusing on Skill Development = 22.64% (12 Out of 53)

23/6/20
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ANNEXTURE-II

20CA3244: Technology Management

L-T-P-S:3-0-0-0 **Credits: 3** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO. No	Course Outcome	Mapped PO	BTL
CO 1	Understand Technology management and development	PO1, PO6	2
CO 2	Understand technology absorption and assessment	PO1, PO6	2
CO 3	Apply Technology diffusion and Information system	PO3, PO6	3
CO 4	Apply Technology at Enterprise level and Global IT strategies	PO1, PO6	3

Syllabus:

Technology Management: Technology IT alignment, benefits, stages, management of technology change, creating condition for ongoing change **Technology development** : classification of technology, technological forecasting, future oriented technology analysis, methods of technological forecasting, evaluation of quality of technological forecasting methods, choosing of a forecasting **Technology absorption**: concepts, benefits and constraints of technology absorption, Indian experience, issues involved **Technology Assessment**: methods, implication, technology evaluation, real time assessment. **Technology diffusion**: concepts, why diffusion?, implications, development of diffusion strategy **Information system**: content and sources of technology, benefits of technology information, important aspects of technology information **Technology at Enterprise level**: Technical strategy, technical gap and enterprise, technology transfer and absorption, technology transfer process and resource management, development and training of human resource **Strategy for Global IT management**: concepts of global IT strategy, managing strategy and organization

Text Books:

1. *Management of Technology* by CSG Krishnamacharyulu and Lalitha Ramakrishnan, Himalaya Publishing House, 2010
2. *Technology Management-Text and International Cases*, Norma Harrison, Danny Samson, McGraw-Hill Education, 2001 Technology Management – JNU Press, 2013

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20CA2132: Introduction to Data Science with R Programming

L-T-P-S: 2-0-2-0 **Credits: 3** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO#	Course Outcome	PO/PSO	BTL
CO1	To understand the overview of Data Science, Understand the fundamental syntax of R	PO 1	2
CO2	To understand the importance of mathematics & Statistics in Data Science	PO2, PO7	3
CO3	To understand the role of machine learning techniques, Analyze a data set in R and present findings using the appropriate R packages	PO 1	3
CO4	To know the integrated role of computers and its components in Data Science	PO 2	3
CO5	Ability to write R Scripts	PO 2	3

Syllabus:

Mathematics and Statistics in Data Science: Role of mathematics in Data Science, importance of probability and statistics in Data Science, important types of statistical measures in Data Science : Descriptive, Predictive and prescriptive statistics, introduction to statistical inference and its usage in Data Science, application of statistical techniques in Data Science, overview of linear algebra : matrix and vector theory. **Machine Learning in Data Science:** Role of machine learning in Data Science, different types of machine learning techniques and its broad scope in Data Science : Supervised, unsupervised, reinforcement and deep learning, different machine learning techniques, brief introduction to machine learning algorithms, difference between machine learning classification and prediction. **R Programming**: Installing and loading Packages , Setting up your working directory, Downloading and importing data, Working with missing data. **Computers in Data Science:** Role of computer science in Data Science, various components of computer science being used for Data Science, role of relation data base systems in Data Science: SQL, NoSQL, role of data warehousing in Data Science, terms related with data warehousing techniques, importance of operating concepts and memory management. Various freely available software tools used in Data Science : R, Python, important proprietary software tools, different business intelligence tools and its crucial role in Data Science project presentation. **R Programming**: Extracting a subset of a data frame , Writing R scripts , Adding comments and documentation, Creating reports , Measures of central tendency, Measures of variability, Skewness and kurtosis Summary functions, describe functions, and descriptive statistics by group Correlations.

Text books:

1. Data Science from Scratch: First Principles with Python 1st Edition by JoelGrus
2. Principles of Data Science by Sinan Ozdemir, (2016) PACKT.

23/6/20

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20CA2133: Linear Algebra

L-T-P-S: 2-1-0-0 **Credits: 3** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO	Course Outcome	PO/PSO	BTL
1	Identify the types of random variables and apply discrete distributions to analyze various real-world situations	PO1, PO5,	2
2	Construct the linear equations of a continuous random variable based on a real-world problems, and also predict the linear and non-linear relationship between the two variables	PO1, PO5,	2
3	Apply statistical tests for large and small samples to test the hypothesis.	PO1, PO5,	3
4	Testing the hypothesis to analyze the variance by applying suitable design.	PO1, PO5	3

Syllabus:

Introduction to matrix, different types of matrix, matrix operation, determinant of matrix, Cramer's rule, volume and linear transformation, properties of determinant of matrix, adjoint of matrix, inverse of a matrix, characterization of invertible matrix, matrix factorization, rank of matrix, application of inverse matrix in analytics, The Leontief Input–Output Model, Perron–Frobenius Theory, positive and non-negative matrices. **Linear Equations** Introduction to system of linear equations, row reduction and echelon forms in matrix representation of linear equations, vector equations, matrix equations. Solution sets of linear systems, application of linear systems, linear independence, matrix of linear transformations linearly independent sets, coordinate system, homogeneous system of linear equation and its application in solving unknowns, application of Markov chains, application of linear systems in business, science and engineering. **Eigen values and Eigen Vectors**: Introduction to Eigen values and Eigen vectors, characteristic equation of matrix, properties of characteristic equation of matrix, characteristic polynomial and Caley – Hamilton theorem, importance of Eigen values and Eigen vectors in data dimensionality reduction, diagonalization, Eigen vectors and linear transformations, application to differential equations. **Linear Transformation**: Introduction of linear transformation, matrices and linear transformation, linear combinations, pre-images, injective linear transformation, examples of injective linear transformation, surjective linear transformation, composition of surjective linear transformation, invertible linear transformation, invertibility, structure and isomorphism, rank and nullity of linear transformation. **Orthogonality and least squares:** Introduction to inner product, length and Orthogonality, orthogonal sets and orthogonal projections, Cosines and projections onto lines, orthogonal bases and The Gram–Schmidt orthonormalization Process, problems on least squares, application to linear models, inner product spaces, application of inner product spaces, the fast Fourier Transform.

Text books:

1. Ronald E. Walpole, Sharon L. Myers and Keying Ye, *Probability and Statistics for Engineers and Scientists,* 8th Edition, Pearson Pub.

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20CA2134: Sampling Methods & Exploratory Data Analysis

L-T-P-S: 2-0-2-0 **Credits: 3** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO No	Course Outcome	PO/PSO	BT L
CO1	To understand importance of data and its types in Exploratory Data Analysis.	PO1 ,PO5	2
CO2	To understand difference between EDA and summary statistics in context of interpretation	PO2, PO5	2
CO3	To understand the importance of data pre-processing for Exploratory Data Analysis.	PO1, PO5	2
CO4	To understand the significance of missing value imputations in better EDA interpretations	PO1, PO5	2
CO5	To understand the importance measure of central tendency in describing the quick view of data set	PO1, PO5	2

Syllabus:

Introduction to Data and its types : Definition and importance of data, classification of data : based on observation – Cross Sectional, times series and panel data, based on measurement – ratio, interval, ordinal and nominal, based on availability – primary, secondary, tertiary, based on structural form – structured, semi structured and unstructured, based on inherent nature – quantitative and qualitative, concepts on sample data and population, small sample and large sample, statistic and parameter, types of statistics and its application in different business scenarios, frequency distribution of data. **Introduction to Exploratory Data Analysis (EDA):** Definition of EDA, difference between EDA with classical and Bayesian Analysis, comparison of EDA with Classical data summary measures, goals of EDA, Underlying assumptions in EDA, importance of EDA in data exploration techniques, introduction to different techniques to test the assumptions involved in EDA, role of graphics in data exploration, introduction to unidimensional, bidimensional and multidimensional graphical representation of data. **Data Preparation :** Introduction to data exploration process for data preparation, data discovery, issues related with data access, characterization of data, consistency and pollution of data, duplicate or redundant variables, outliers and leverage data, noisy data, missing values, imputation of missing and empty places, with different techniques, missing pattern and its importance, handling non numerical data in missing places. **Univariate Data Analysis:** Description and summary of data set, measure of central tendency – mean: Arithmetic, geometric and harmonic mean – Raw and grouped data, confidence limit of mean, median, mode, quartile and percentile, interpretation of quartile and percentile values, measure of dispersion, concepts on error, range, variance, standard deviation, confidence limit of variance and standard deviation, coefficient of variation, mean absolute deviation, mean

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Koneru Lakshmaiah Education Foundation
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deviation, quartile deviation, interquartile range, concepts on symmetry of data, skewness and kurtosis, robustness of parameters, measures of concentration. **Bivariate Data Analysis:** Introduction to bivariate distributions, association between two nominal variables, contingency tables, Chi-Square calculations, Phi Coefficient, scatter plot and its causal interpretations, correlation coefficient, regression coefficient, relationship between two ordinal variables – Spearman Rank correlation, Kendall's Tau Coefficients, measuring association between mixed combination of numerical, ordinal and nominal variables.

Text Books

1. Exploratory Data Analysis – John W Tukey, Addison Wesley Publishing Company
2. Exploratory Data Analysis in Business and Economics - An Introduction Using SPSS, Stata and Excel – Thomas Cleff, Springer Publication

Reference Books

1. Graphical Exploratory Data Analysis - S.H.C. du Toit A.G.W. Steyn R.H. Stumpf, Springer Publication
2. Hand book of Data Visualization – Chun-houh Chen, Wolfgang Härdle, Antony Unwin, Springer Publication.

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20CA2135: Design and Analysis of Algorithms

L-T-P-S: 3-0-0-0 **Credits: 3** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO No	Course Outcome	PO/PSO	BTL
CO1	Understand time and space complexity, analyze complexity for problems solvable by divide and conquer technique	PO1	2
CO2	Apply greedy and dynamic algorithm design methodologies to solve problems.	PO1	3
CO3	Apply state space tree methods for solving searching problems.	PO2	3
CO4	Distinguish between P and NP classes of problems and solve complex problems.	PO1	4
CO5	Choose the appropriate algorithm design techniques to solve any real-world problems.	PO3	4

Syllabus:

Introduction: Definition of an Algorithm- Algorithm Specification - Analysis of Algorithm. **Divide and Conquer:** Merge Sort-Quick Sort- Strassen's Matrix Multiplication – Convex Hull. **Greedy Method:** The General Method-Job Sequencing with Deadlines- Knapsack Problem-Minimum Cost Spanning Trees- Huffman Codes -Single Source Shortest Path Method. **Dynamic Programming:** The General Method- Multistage graphs- Optimal Binary Search Tree- 0/1 Knapsack-Traveling Salesperson Problem. Ford Fulkerson. **Backtracking:** The Eight Queens Problem - Sum Of Subset Problem - Graph Coloring - Knapsack Problem. **Branch and Bound:** 0/I Knapsack Problem- Traveling Salesperson Problem- **NP Hard and NP Complete Problems:** Basic Concepts- Cook's Theorem-NP Hard Graph Problems- CDP, NCDP, AOG. **PRAM Algorithms:** Merging-Sorting. **String Algorithms:** The naïve string-matching algorithm, Robin – karp algorithm, The Knuth Morris Pratt algorithm. Approximate Algorithms.

Text Books:

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", 2nd Edition, University Press, 2008.
2. Cormen, Leizerson & Rivest, "Introduction to algorithms", 3rd Edition, Prentice-Hall, 2002.

Reference Books:

1. Robert Sedgewick and Kevin Wayne," Algorithms", 4th edition, Addison Wesley Prof., (2011).
2. Anny Levitin, "Introduction to Design and Analysis of Algorithms", 2rd Edition, Person Education Press. (2007).
3. Michael T.Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis and Internet Examples, Second Edition, Wiley-India, (2006).

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20CA2236: BIG DATA ANALYTICS

L-T-P-S: 2-0-2-0 **Credits: 3** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO No	Course Outcome	PO/PSO	BTL
CO1	To understand the basic concept of BigData, different types of Data	PO1	1
CO2	To understand architecture of Hadoop and YARz	PO3	2
CO3	To understand about Processing and Storage Layer of Hadoop, internal concept of MapReduce	PO5	3
CO4	You will understand the concept of Master and Slave Architecture	PO5	3
CO5	You will learn about cluster management using YARN	PO5	3

Syllabus:

Understanding BigData: Defining Data, Types of Data, Structured Data, Semi Structured Data, Unstructured Data, How data being Generated, Different source of Data Generation, Rate at which Data is being generated, Different V's, Volume, Variety, Velocity, Veracity, Value, How single person is contributing towards BigData, Significance for BigData, Reason for BigData, Understanding RDBMS and why it is failing to store BigData. Future of BigData, BigData use cases for major IT Industries. **Introduction to Hadoop:** What is Hadoop, Apache Community, Cluster, Node, Commodity Hardware, Rack Awareness, History of Hadoop, Need for Hadoop, How is Hadoop Important, Apache Hadoop Ecosystem, Different Hadoop offering, Hadoop 1.x Architecture, Apache Hadoop Framework, Master- Slave Architecture, Advantages of Hadoop. **Storage Unit:** Hadoop Distributed File System, Design of HDFS, HDFS Concept, How files are stored in HDFS, Hadoop File system, Replication factor, Name Node, Secondary Name Node, Job Tracker, Task tracker, Data Node, FS Image, Edit-logs, Check-pointing Concept, HDFS federation, HDFS High availability Architectural description for Hadoop Cluster, When to use or not to use HDFS, Block Allocation in Hadoop Cluster, Read operation in HDFS, Write operation in HDFS, Hadoop Archives, Data Integrity in HDFS, Compression & Input Splits. **Processing Unit** : What is MapReduce, History of MapReduce, How does MapReduce work, Input files, Input Format types Output Format Types, Text Input Format, Key Value Input Format, Sequence File Input Format, Input split, Record Reader, MapReduce overview, Mapper Phase, Reducer Phase, Sort and Shuffle Phase, Importance of MapReduce. Data Flow, Counters, Combiner Function, Partition Function, Joins, Map Side Join, Reduce Side Join, MapReduce Web UI, Job Scheduling, Task Scheduling, Fault Tolerance, Writing MapReduce Application, Driver Class, Mapper Class, Reducer Class, Serialization, File Based Data Structure, Writing a simple MapReduce program to Count Number of words, MapReduce Work Flows **YARN &Hadoop Cluster:** YARN, YARN Architecture, YARN Components, Resource Manager, Node Manager, Application Master, Concept of Container, Difference between Hadoop 1.x and 2.x Architecture, Execution of Job in Yarn Cluster, Comparing and Contrasting Hadoop with Relational Databases. Cluster Specification, Cluster Setup and Installation, Creating Hadoop user, Installing Hadoop,

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SSH Configuration, Hadoop Configuration, Hadoop daemon properties, Different modes of Hadoop, Standalone Mode, Pseudo Distributed Mode, Fully Distributed Modes,

Text Books:

1. Hadoop: The Definitive Guide, By: Tom White, O'REILLY

Reference Books:

1. Hadoop for Dummies, By: Dirk deRoos, Paul C. Zikopoulos, Bruce Brown, Rafael Coss, and Roman B. Melnyk, A Wiley brand
2. Hadoop in Action, Writer: Chuck Lam Published By: Manning Publications

MSR 23/6/20
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20CA2237: Artificial Intelligence

L-T-P-S: 2-0-2-0 **Credits: 3** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO. No	Course Outcome	PO/PSO	BTL
CO1	Understand different types of AI agents	PO1,3	2
CO2	Know various AI search algorithms	PO1	3
CO3	Understand the fundamentals of knowledge representation (logic-based, frame-based, semantic nets), inference and theorem proving	PO2,4	3
CO4	Know how to build simple knowledge-based systems	PO1	4

Syllabus:

General Concept of AI: Defining AI: AI what and what not?- Basic principle and concept of AI-The intellectual History of AI -Foundations of AI-Frontiers of artificial intelligence-Parallel and distributed AI--AI and the programming platform-Uses and application of AI. Introduction to agent-Agent performance –Example of Agents- Agent Faculties- Can machine think?: 'Turning and testing-The Chinese room. Computation and representation-Applications eras of AI-Computationalism-Ethics of AI-Impacts of AI. The impact of AI in human labor-AI and the social equality-Technology that precursors to AI era -The concept of bot-AI and Automation-Super intelligence and AI-paths to super intelligence-Forms of super intelligence-Future impacts of AI-AI programming platforms ,State space search- Goal Directed Agent- Search Problem- illustration of search process- eight queens problem-tic tac toe - General state space search-Search Tree-Terminology of search tree-Informed search -Best-first Search-A* search-Hill climbing search-Simulated Annealing-Tabusearch-Introduction to constraint satisfaction problem- Backtracking Search for constraint satisfaction problem- Local Search for Constraint Satisfaction Problems- The Structure of Problems-Constraint propagation- forward checking-Arc consistency. **Adversarial Search:** Introduction to Games- Two player game-Optimal Decisions in Games- Optimal strategies- The minimax algorithm- min max with Tic-Tac-Toe-Optimal decisions in multiplayer games- Alpha-Beta Pruning- min max with Alpha-Beta pruning-Imperfect. Real-Time Decisions-classical AI: checkers-Chess-Othello-Go-Backgammon-Application of AI algorithm in Video Game. **Uninformed search:** Search and AI -Define Uninformed Search- Depth first search (DFS)-Example of DFS-Depth Limited Search-algorithm with example-(BFS) Breadth first search – Example of Breadth first search-Properties of BFS-Pros and Cons of BFS-Low Cost First Search-example of low cost first search- Iterative deepening Search-Bidirectional search-Time and space complexities-Uniform cost search.

Text Books:

1. Artificial Intelligence A Modern Approach, Stuart J. Russell and Peter Norvig, , Second Edition,Pearson Education, Inc., Upper Saddle River; New Jersey 07458
2. Artificial Intelligence: The Basics By Kevin Warwick, Professor of Cybernetics Kevin, First published 2012 by Routledge
3. Artificial intelligence A systems approach - by M.Tim Jones, INFINITY SCIENCE PRESS LLC ,2008

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References:

1. D. Poole, Artificial Intelligence: Foundations Of Computational Agents, Cambridge University Press, 2010.
2. "Artificial Intelligence and Intelligent Systems",byPadhy N.P, 4th impression , Oxford University Press, 2007.
3. Super intelligence paths, Dangers and Strategies by Nick Bostrom, Oxford University Press.

23/6/20
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20CA2238: Data Visualization Tools & Techniques

L-T-P-S: 2-0-2-0 **Credits: 3** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO No	Course Outcome	PO/PSO	BTL
CO1	Understand the need of visualization techniques	PO1	2
CO2	To explain Static Graphical Techniques	PO2	2
CO3	To apply Multivariate Graphical Techniques	PO4	3
CO4	To explain the concept of Graphical Validation and customization	PO3	3
Co5	Demonstrate and practice programs on data visualization	PO2, PO3	3

Syllabus:

Introduction to Data Visualization: Brief history of data visualization, scientific design choices in data visualization- choice of graphical form, grammar of graphical techniques of large amount of data, crucial need of visualization techniques, challenges in visualization techniques, classification of visualization techniques for qualitative and quantitative data, power of visualization techniques, introduction to different visualization techniques. **Static Graphical Techniques – 1:** Introduction to bar graph, basic understanding of making basic bar graph, grouping bars together, bar graphs on counts, customization of bar graphs by changing colour, size, title, axis units, changing width and spacing of the bar chart, adding labels to bar graph, application of bar graph in business. **Multivariate Graphical Techniques:** Introduction to correlation matrix, application of correlation matrix in the multivariate analysis, network graph, basics of heat map, difference between heat map and tree map, introduction to higher dimensional scatter plot, axis adjustment in the higher dimensional scatter plot, addition of prediction surface of higher dimensional scatter plot. **Graphical Validation:** Basics of multivariate statistical visual representations and its results, dendrogram, importance of dendrogram in grouping (cluster analysis), Scree Plot, importance of Scree Plot, application of Scree Plot in determining number of clusters and factors, QQ plot, importance of QQ plot in distribution of data for the further quantitative analysis, PP plot, applications and usage of PP Plot for distribution detection. **Customization** : Introduction to annotations – adding : text, mathematical expression , lines, arrows, shaded shapes, highlighting the texts and items, adding error bars, introduction to axis, swapping x and y axis, changing the scaling ration in the axis, positioning of axis and arranging tick marks and labels, changing the appearance of axis labels, circular graphs, using themes, changing the appearance of theme elements, creating the own themes, legends : removing the legends, position of legends, legend title, labels in legends.

Text Books:

1. Munzner, Visualization Analysis and Design, 2014, ISBN 1466508914
2. Ware, Information Visualization: Perception for Design, 3rd ed. Morgan Kaufmann, 2012, ISBN 0123814642 (available electronically through the Clemson University libraries)

Reference Books:

Visualizing Data. O'Reilly Media, 2008, ISBN 0596514557

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20CA2239: Data Warehousing & Mining

L-T-P-S: 2-0-2-0 **Credits: 3** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO No	Course Outcome	PO/PSO	BTL
CO1	Understand stages in building a Data Warehouse	PO1,PO2	1
CO2	Apply pre-processing techniques for data cleansing Analyze multi-dimensional modelling techniques	PO3	3
CO3	Analyze and evaluate performance of algorithms for Association Rules.	PO1, PO4,	4
CO4	Analyze Classification and Clustering algorithms	PO3, PO4,	4
CO5	Evaluate mining techniques like classification, clustering, and association rules on data objects	PO5	4

Syllabus:

KDD Process, Introduction to Data Warehouse, Data Pre-processing- Data Cleaning methods, Descriptive Data Summarization, Data Reduction, Data Discretization and Concept hierarchy generation, Overview of ETL and OLAP OLTP integration – comparison of OLAP with OLTP systems, ROLAP, MOLAP and DOLAP, Data Cube Computation methods, Advanced SQL support for OLAP, multi-dimensional modelling, Attribute-oriented Induction, Data Warehouse architecture and implementation - Parallel execution, Materialized views. Data Mining Techniques: Basic concepts of Association Rule Mining, Frequent Item set mining, Mining various kinds of association rules, Classification by decision tree induction, Bayesian Classification, Rule-based Classification, Classification Back-propagation, Associative Classification, Lazy Learners, Rough set approach, Clustering methods, Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Measuring Data Similarity and Dissimilarity Partitioning-Based Clustering Methods; Hierarchical Clustering Methods; Density Based and Grid-Based Clustering Methods

Text Books:

1. Han J &Kamber M, "Data Mining: Concepts and Techniques", third Edition, Elsevier, 2011.
2. Pang-Ning Tan, Michael Steinback, Vipin Kumar, "Introduction to Data Mining", Pearson Education, 2008

Reference Books:

1. M.Humphires, M.Hawkins, M.Dy,"Data Warehousing: Architecture and Implementation", Pearson Education, 2009.
2. Anahory, Murray, "Data Warehousing in the Real World", Pearson Education, 2008.

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20CA3140: Optimization Techniques

L-T-P-S: 2-1-0-0 **Credits: 3** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO No	Course Outcome	PO/PSO	BTL
CO1	To design algorithms, the repetitive use of which will lead reliably to finding an approximate solution.	PO1	2
CO2	Evaluate and measure the performance of an algorithm.	PO3	2
CO3	Understand optimization techniques using algorithms.	PO5	3
CO4	Investigate, study, develop, organize, and promote innovative solutions for various applications.	PO5, PO8	3

Syllabus:

Static and Dynamic Optimization : Unconstrained Optimization and Efficient Algorithms, e.g. steepest orgradient descent methods, Constrained Optimization with Lagrange Multipliers (First-OrderNecessary Conditions) and Second-Order Conditions **Calculus of Variations :** Motivation Examples, Hamiltonian Formalism and Mechanics, First and Second-Order Conditions, Specification of Performance Indices **Optimal Control of Discrete-Time Systems :**Solution Concept, Linear Quadratic Regulator (LQR) and Matrix Equations , Steady-State Closed-Loop Control , Advanced Topics **Control of Continuous-Time Systems :**Solution Concept , LQR and Matrix Equations ,Steady-State Closed-Loop Control ,Advanced Topics **Extensions of LQR :**Cross Terms in the Cost Functional , Servo and Tracking Problems **Final- Time-Free and Constrained Input Control :** Constrained Minimum-Time Problem (Bang-Bang Control), Constrained Minimum-Fuel Problem (Bang-Off-Bang Control), Constrained Minimum-Energy Problem **Dynamic Programming :** Bellman's Principle of Optimality , Continuous versus Discrete-Time , Hamilton- Jacobi-Bellman (HJB) Equation , Brief Remarks on Viscosity Solutions

Text Books:

1. F. L. Lewis, D. Vrabie, and V. L. Syrmos. Optimal Control, John Wiley & Sons, 2012 , (ISBN: 978-0-470-63349-6)
2. D. Liberzon, Calculus of variations and optimal control theory: a conciseintroduction, Princeton University Press, 2012 (ISBN: 978-0-691-15187-8) **(goodreference on calculus of variations).**

References:

1. Vrabie, K. G. Vamvoudakis, F. L. Lewis, Optimal Adaptive Control andDifferential Games by Reinforcement Learning Principles, Control EngineeringSeries, IET Press, 2012 (ISBN: 978-1-84919-489-1) **(good reference on RL andoptimal control)**

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20CA3141: Soft Computing

L-T-P-S: 2-0-2-0 **Credits: 3** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO No	Course Outcome	PO/PSO	BTL
CO1	Understand the extensions from intelligent systems to soft computing through knowledge representation.	PO1	2
CO2	Understand and apply fuzzy concepts, fuzzification, defuzzification and Fuzzy Inference Systems	PO2	3
CO3	Apply the working of various types of Nueral Networks and applications	PO1, PO2	3
CO4	Apply the biological and nature inspired evolutionary algorithms	PO2	3
CO5	Develop and implement neuro, fuzzy and genetic concepts learnt using open-source tools	PO5	3

Syllabus:

Introduction to Intelligent systems and soft computing: Intelligence systems, Knowledge -based systems, knowledge representation and processing, soft computing. Fuzzy Logic and Control System: Crisp Vs Fuzzy Sets Operations, Fuzzification methods, Defuzzification Methods, Extension Principle and Fuzzy Relations , Fuzzy Inference Systems. Fundamentals of Artificial neural networks: Fundamentals of connectionist modeling Major classes of neural networks: The multi-layer perceptrons, radial basis function networks, Kohonen's self-organizing network, The Hopfield network, industrial and commercial application of ANN. Evolutionary computing: Overview of Evolutionary Computing, Genetic algorithms and optimization, Genetic Algorithm operators and algorithm, Partical Swarm Optimization, Hybrid Systems-Neuro, Fuzzy, Genetic.

Text Books:

1. Fakhreddine O. Karry, Clarence De Silva, "Soft Computing and Intelligent systems Design Theory, Tools and Applications", Pearson, (2009).

Reference Books:

1. J.S.R.Jang, C.T. Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI / Pearson Education, (2015).
2. S N. Sivanandam, S. N. Deepa, "Principles of Soft Computing", Second Edition, Wiley India(2011).

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20CA3142 – DevOps with Cloud

L-T-P-S: 2-0-2-0 **Credits: 3** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO No	Course Outcome	PO/PSO	BTL
CO1	Understand the Emergence of DevOps	PO1	2
CO2	Understand DevOps Principles and Aspects of IT DevOps Agile Skills Association	PO2	3
CO3	Apply the Cultural Aspects of a DevOps Team	PO1, PO2	3
CO4	Understand Emergence of Cloud Technology and Principles	PO2	3

Syllabus:

DevOps INTRODUCTION Emergence of DevOps: Digital Transformation and DevOps Why organizations should do DevOps? Business Case for DevOps, DevOps History, Benefits of DevOps Core Concepts of DevOps: DevOps Definitions, Culture of High-Performance IT, How DevOps is tightly intertwined with Agile and Lean IT? DevOps Principles and Aspects of IT DevOps Agile Skills Association (DASA): DevOps Skills Areas, Knowledge Areas, and Competency Framework, DASA Qualification Scheme, Mission, and Vision CULTURE Introduction to a DevOps Culture: Build Around Teams: Facilitated Lean Product 'Companies', The Boston Consultancy Group (BCG) Matrix, The Three Horizons Model 12. What is DevOps culture? Cultural Aspects of a DevOps Team DevOps Environment: Service Mindset and Quality at the Source, What context to provide to facilitate growth areas for teams? Key Elements of DevOps: What is a team?, Intrinsically Motivated Teams, Collaboration: A Success Factor of a Team, Visual Management: A Key Tool of Team building, Importance of Quality at the Source, Cost of Accumulating Technical Debt, Role of Continuous Improvement in Solving Problems, Structured Problem-Solving The emergence of Cloud Technology and Principles: Emergence of Cloud Computing, Cloud Services, Self Service Infrastructure, Platform, and Software, National Institute of Standardization (NIST) Cloud Principles Cloud Service Concepts in a DevOps Organization: Cloud Principles in DevOps Organizations, Different Conversations Between Development and Operations in a Traditional Organization, Different Conversations Between Development and Operations in a DevOps Organization, DevOps Platform Teams as a "Cloud" Service Provider, DevOps Business System Product and Platform Product Teams, Different Types of Clouds to Operate Automated Provisioning Concepts: Pets Versus Cattle, Desired State Configuration to Automate Environments, Automated Provisioning with Mutable Infrastructure and Immutable Infrastructure

Text Book :

1. The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations Paperback – October 6, 2016, by Gene Kim.

Reference Books:

2. Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale 1st Edition, by Jennifer Davis.

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20CA3143: Machine Learning

L-T-P-S: 2-0-2-0 **Credits: 3** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO#	Course Outcome	PO/PSO	BTL
CO1	To understand the basic concepts of statistical learning methods and models	PO1	1
CO2	To understand the importance of supervised learning in classifying class labels for prediction	PO3	2
CO3	To understand the different algorithms related to classification techniques	PO5	3
CO4	To understand the assumptions in estimating regression coefficients using OLS method	PO 4	3
CO5	To understand the concepts of hypothesis testing in parametric and nonparametric classification techniques	PO5	3

Syllabus:

Introduction to Machine Learning Algorithms: Introduction to Machine learning – Statistical Learning – types of Machine Learning –learning models: geometric, probabilistic and logistic models, introduction to supervised, unsupervised and reinforcement learning – model evaluation – model implementation – model accuracy indicators. **Supervised Learning – Simple Linear Regression Analysis:** Introduction to parametric machine learning method, assumptions of parametric machine learning methods, linear model and its assumptions, simple linear regression, scatter diagram, Simple linear Regression parameter estimation, properties of regression parameters, testing the significance of regression parameters using ANOVA and t test, estimation of σ^2, Interval Estimation of the Mean Response, R Square, Adjusted R Square, Normality of response variable, prediction of new observations, Confidence interval for β_0, β_1 and σ^2. **Supervised Learning – Multiple Linear Regression Analysis I:** Multiple linear regression model, assumptions of Multiple linear regression variables – multicollinearity, homoscedasticity, autocorrelation, effects of multicollinearity, effect of homoscedasticity and auto autocorrelation in parameter estimation, Least - Squares Estimation of the Regression Coefficients, Geometrical Interpretation of Least Squares, Properties of the Least - Squares Estimators, Estimation of σ^2, Inadequacy of Scatter Diagrams in Multiple Regression. **Supervised Learning – Multiple Linear Regression Analysis II:** testing the general linear hypothesis, Test for Significance of Regression, Tests on Individual Regression Coefficients and Subsets of Coefficients, Special Case of Orthogonal Columns in X, Confidence Intervals on the Regression Coefficients, CI Estimation of the Mean Response, Simultaneous Confidence Intervals on Regression Coefficients, predicting new observations, residual analysis, model adequacy and validation. **Supervised Learning – Non Linear Regression Analysis** Introduction to non-linear regression models, non-linear least square method to estimating the regression parameters, transformation of non-linear model to linear model, linearization, other parameter estimation methods, starting values, statistical inference in non-linear regression models

Text Books:

1. Introduction to Linear Regression Analysis, Fifth Edition - DOUGLAS C. MONTGOMERY, ELIZABETH A. PECK, G. GEOFFREY VINING, A JOHN WILEY & SONS, INC., PUBLICATION
2. Introduction to Machine Learning - EthemAlpaydm, The MIT Press.

Reference Books:

3. Python Machine Learning - Sebastian Raschka, PACKT Publishing.
4. Using Multivariate Statistics - Barbara G. Tabachnick, Linda S. Fidell, Pearson Education Inc.

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20CA1105: Technical Skill-1

L-T-P-S: 0-0-0-8 **Credits: 3** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO NO	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO1	Develop Solutions to solve real world Problems using Data Types, storage classes, control statements	PO1,PO2	3
CO2	Develop Solutions to solve real world problems using Functions and Pointers	PO2,PO1	3
CO3	Develop Solutions and debug to solve real world problems using Struct and Union	PO1,PO2	3
CO4	Develop Solutions for real world problems by using stacks, queues and linked Lists and debug.	PO1,PO2	3

Syllabus:

Overview of Programming: Introduction, Program design and implementation, Flowcharts & Algorithms, Programming environment – Machine language, assembly language, high level languages, Assemblers, Compilers, Interpreters. Fundamentals of C programming: Overview of C, Data Types, Constants & Variables, Operators & Expressions, Control constructs-if then.

Basic I/O-formatted and Unformatted I/O, Type modifiers and storage class specifiers, Type casting, type conversion. Advanced programming techniques: Control constructs- for, while, Do while, Switch statement, break and continue, exit() function, go to and label , Functions, Scope rules, call by value and reference, calling functions with arrays, argc and argv, recursion- basic concepts, Arrays- single & multidimensional arrays.Pointers- Pointer expression, Pointer operations, malloc vs calloc, arrays of pointers, pointers to pointers,pointers to functions, function retuning pointers, Structures- Basics, referencing structure elements, array of structures, passing structures to functions, structure pointers, arrays and structures within structures,Unions,enumerated data-types, typedef.Additional features: File Handling – The file pointer, file accessing functions, C Preprocessor commands, Conditional compilation directives,C standard library and header files: Header files, string functions.

Text Books:

1. The complete reference Java –2: V Edition By Herbert Schildt Pub. TMH.

Reference Books:

1. Programming with Java, by E. Balagurusamy, McGraw Hill Education 2. SAMS teach yourself Java – 2: 3rd Edition by Rogers Cedenhead and Leura Lemay Pub. Pearson Education.

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20CA1210: Technical Skills-2

L-T-P-S: 0-0-0-8 **Credits: 2** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO NO	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO1	Develop Solutions to solve real world Problems using Data Types.	PO1,PO2	3
CO2	Develop Solutions to solve real world problems using Functions and classes.	PO2,PO1	3
CO3	Develop Solutions for real world problems by using stacks, queues and linked Lists and debug.	PO1,PO2	3
CO4	Develop Solutions for real world problems in java data base connectivities.	PO1,PO2	3

Syllabus:

Classes and objects Class Fundamentals, Declaring objects, constructors, "this" keyword, finalize ( ) method, Over loading methods, using objects as parameters, Argument passing, Returning objects, Recursion, Access control, Introducing final, understanding "static", Nested and Inner classes, command line arguments. Inheritance: Inheritance basics, Using super, method overriding, using abstract classes, using final with Inheritance.JavaPackages:Definition, Access protection importing packages, Interfaces: Definition implementing interfaces. Exception Handling: Fundamental, Exception types, Using try and catch, Multiple catch clauses, Nested try Statements, throw, throws, finally. Multithreaded Programming : Creating a thread, Creating multiple threads, Thread - Priorities, Synchronization, Inter thread communication, suspending, resuming and stopping threads, JAVA Database Connectivity (JDBC) : Database connectivity: JDBC architecture, loading a driver, connecting to a database, Handling SQL exceptions, Accessing result sets.

Text Books:

1. The complete reference Java –2: V Edition By Herbert Schildt Pub. TMH.

Reference Books:

1. Programming with Java, by E. Balagurusamy, McGraw Hill Education 2. SAMS teach yourself Java – 2: 3rd Edition by Rogers Cedenhead and Leura Lemay Pub. Pearson Education.

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20CA2117: Technical Skills-3

L-T-P-S: 0-0-0-8 **Credits: 2** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO NO	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO1	To apply and Develop Solutions to solve real world Problems using Data Types, storage classes, control statements	PO1,PO2	3
CO2	Develop Solutions to solve real world problems using Functions and Pointers	PO2,PO1	3
CO3	Develop Solutions and debug to solve real world problems using Struct and Union	PO1,PO2	3
CO4	Develop Solutions for real world problems by using stacks, queues and linked Lists and debug.	PO1,PO2	3

Syllabus:

R AS CALCULATOR APPLICATION a. Using with and without R objects on console b. Using mathematical functions on console c. Write an R script, to create R objects for calculator application and save in a specified location in disk. DESCRIPTIVE STATISTICS IN R a. Write an R script to find basic descriptive statistics using summary, str, quartile function on mtcars& cars datasets. b. Write an R script to find subset of dataset by using subset (), aggregate () functions on iris dataset. READING AND WRITING DIFFERENT TYPES OF DATASETS a. Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location. b. Reading Excel data sheet in R. c. Reading XML dataset in R. VISUALIZATIONS a. Find the data distributions using box and scatter plot. b. Find the outliers using plot. c. Plot the histogram, bar chart and pie chart on sample data. CORRELATION AND COVARIANCE a. Find the correlation matrix. b. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data. c. Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data. REGRESSION MODEL Import a data from web storage. Name the dataset and now do Logistic Regression to find out relation between variables that are affecting the admission of a student in a institute based on his or her GRE score, GPA obtained and rank of the student. Also check the model is fit or not. Require (foreign), require (MASS). MULTIPLE REGRESSION MODEL Apply multiple regressions, if data have a continuous Independent variable.Apply on above dataset REGRESSION MODEL FOR PREDICTION Apply regression Model techniques to predict the data on above dataset. CLASSIFICATION MODEL a. Install relevant package for classification. b. Choose classifier for classification problem. c. Evaluate the performance of classifier. CLUSTERING MODEL a. Clustering algorithms for unsupervised classification. b. Plot the cluster data using R visualizations. Create a web page that displays your bio-data showing your professional and personal details. Create a web page that displays basic

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department information like department description, programs offered, list of courses and class time table. Design the following static web pages required for an online book store web site. 1) HOME PAGE 2) Books Page 3) Details Page Continuation of experiment No.2 with login and registration forms for online book store. Registration form should have the following fields . 1) Name (Text field) 2) Password (password field) 3) E-mail id (text field) 4) Phone number (text field) 5) Gender (radio button) 6) Date of birth (3 select boxes) 7) Languages known (check boxes – English, Telugu, Hindi, Tamil) 8) Address (text area) 9) Books of interest (select options) Write a program illustrating various methods in cascading style sheets. 1) Use different font, styles 2) Control the repetition of the image 3) Work with layers Write a script to check whether entered Number/string is Palindrome or not.And generate prime numbers between two given numbers Extend the forms created in experiment-3 by validating the login and registration form elements. Write a Script Program that finds the smallest element of several elements.Assume that the first value read specifies the number of values to be input from the user. Draw line, rectangle, circle, polygon(star) and rounded rectangle using HTML5

Text Books:

1. Data Science from Scratch: First Principles with Python 1st Edition by JoelGrus 2. Principles of Data Science by SinanOzdemir, (2016) PACKT.

Reference Books:

2. Data Science For Dummies by Lillian Pierson (2015)
3. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking by Foster Provost, Tom Fawcett
4. Data Smart: Using Data Science to Transform Information into Insight 1st Edition by John W. Foreman. (2015) Wiley Publication.

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20CA2223: Technical Skills-4

L-T-P-S: 0-0-0-8 **Credits: 2** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO NO	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO1	To apply and Develop Solutions to solve real-world Problem using Data Types, storage classes, control statements	PO1,PO2	3
CO2	Develop solutions to solve real-world problems using Functions .	PO2,PO1	3
CO3	Develop Solutions and debug to solve real-world problems using statistical methods and functions.	PO1,PO2	3
CO4	Develop Solutions for real-world problems by using python modules.	PO1,PO2	3

Syllabus:

Calculating Mean and Median, Calculating Mode, Data Operations in Numpy, Data Operations in Pandas, Pandas DataFrame, Pandas Panel, When and Why Is Data Missed? Handling Missing Values(say NA or NaN) Using Pandas, Check for Missing Values, Cleaning / Filling Missing Data , Fill NA Forward and Backward, Drop Missing Values, Replace Missing (or) Generic Values, How Python - Processing CSV Data, Reading Specific Rows, Reading Specific Columns, Reading Specific Columns and Rows, Reading Specific Columns for a Range of Rows , Python - Processing JSON Data , Read the JSON File , Reading Specific Columns and Rows using JSON, Reading JSON file as Records, Python - Processing XLS Data, Input as Excel File, Reading an Excel File, Reading Specific Columns and Rows, Reading Multiple Excel Sheets , Python - Relational Databases, Installing SQLAlchemy, .Reading Relational Tables, Inserting Data to Relational Tables, Deleting Data from Relational Tables, Python - NoSQL Databases, Inserting Data, Updating Data, Deleting Data, Python - Date and Time, Date Time Representation, Date Time Arithmetic, Date Time Comparison, Python - Data Wrangling, How to Merging Data, Grouping Data, Concatenating Data, Python - Data Aggregation , Applying Aggregations on DataFrame, Apply Aggregation on a Whole Data frame, Apply Aggregation on a Single Column of a Dataframe ,Apply Aggregation on Multiple Columns of a DataFrame, Python - Reading HTML Pages Install Beautifulsoup, Reading the HTML file, Extracting Tag Value, Extracting All Tags, Python - Processing Unstructured Data, Reading Data, Counting Word Frequency, Python - Word Tokenization Tokenizing Sentences, Python - Stemming and Lemmatization, data visualization using python, how to Create a Chart, Labeling the Axes, Formatting Line type and Colour, Saving the Chart File, Python - Chart Styling , Adding Annotations, Adding Legends, Chart presentation Style, Python - Box Plots Drawing a Box Plot, Python - Heat Maps, Python - Scatter Plots, Drawing a Scatter Plot, Python - Bubble Charts, Drawing a Bubble Chart, Python - 3D Charts , Python - Time Series, Sample Data, Creating Time Series, Python - Geographical Data, Python - Graph Data, Graph Representations, Statistical Data Analysis, Python - Measuring

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Central Tendency, Calculating Mean and Median, Calculating Mode Python - Measuring Variance, Measuring Standard Deviation, Measuring Skewness, Python - Normal Distribution, Python - Binomial Distribution, Python - Poisson Distribution, Python - Bernoulli Distribution, Python - P-Value, Python – Correlation, Python - Chi-Square Test, Python - Linear Regression.

Text Books:

1. Data Science from Scratch: First Principles with Python 1st Edition by JoelGrus
2. Principles of Data Science by SinanOzdemir, (2016) PACKT.

Reference Books:

1. Data Science For Dummies by Lillian Pierson (2015)
2. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking by Foster Provost, Tom Fawcett
3. Data Smart: Using Data Science to Transform Information into Insight 1st Edition by John W. Foreman. (2015) Wiley Publication.

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20CA3131: Technical Skills-5

L-T-P-S: 0-0-0-8 **Credits: 2** **Prerequisite: Nil**

Mapping of Course outcomes (CO) with program outcomes (PO):

CO NO	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO1	To apply and Develop Solutions to solve real-world Problems using Tableau	PO1,PO2	3
CO2	Develop solutions to solve real-world problems using Functions and calculations	PO2,PO1	3
CO3	Develop Solutions to solve real-world problems and analysing the data using filters, sorting and chats	PO1,PO2	3
CO4	Applying and develop to created business requirement documents and plans for creating dashboards.	PO1,PO2	3

Syllabus:

INTRODUCTION to TABLEAU: BI Concepts, what is TABLEAU? Why Data Visualization? Unique Features compared to Traditional BI Tools, TABLEAU Overview & Architecture, File Types & Extensions. TABLEAU PRODUCTS:DESKTOP, SERVER, PUBLISHER, PUBLIC, READER. instruction to tableau, environment setup, getset, design flow, file types, data types, show me, terminals. Tableau Data source: data sources, custom data view, extracting data, fields operation, Editing Meta data, data joining, data blending. Tableau worksheet: Add worksheets, rename worksheet, save delete worksheet, Record work sheet, paged workbook. Tableau calculations: operators, functions, numeric calculations, string calculation, date calculation, table calculation, LOD expressions. Tableau filter and sorting: basic sorting, basic filters, quick filters, context filters, condition filter, top filter, filter operations Table charts: bar charts, line charts, pie chart, cross tab, scatter plot, bubble chart, bullet graph, box plot, tree map, bump chart, Gantt chart, histogram, motion chart, waterfall charts. Table advanced: dashboard, formatting, forecasting, tread lines, case study of Covid-19 other similar Tools

Text Books:

1. Mastering Tableau 2021: Implement advanced business intelligence techniques and analytics with Tableau, 3rd Edition Paperback – 31 May 2021 by Marleen Meier
2. Visual Analytics with Tableau Paperback – 31 May 2019 by Alexander Loth

Reference Books:

1. Tableau Desktop Pocket Reference First Edition by Ryan Sleeper

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ANNEXURE-II

Comparison of Existing and New syllabus for Revised courses of AY: 2020-21

S. No	Course Code	Course Title	Existing Syllabus	New Syllabus	Topics added/removed/ replaced	Changes in Course Outcome(s)	Justification for no change in percentage of change in syllabus	Revision Percentage
1	20CA1104	Digital Logic Design & Computer Organization	**Logic Simplification and Combinational Logic Design**: Number Systems, Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Karnaugh maps, Binary codes, Code Conversion, Integrated Circuit Logic Gates. **Combinational Logic Functions:** Adder and Substractor, Decoders, Encoders, Multiplexers, Demultiplexers, Magnitude Comparators, Parity Generators and Checkers, BCD to seven segment decoders. Verilog HDL design for Combinational Logic Functions. **Sequential**	**Basic Computer Organization:** Peripheral devices, Input – Output interface, CPU, Memory, Instruction Codes, Computer Registers: Common bus system, Computer Instructions: Instruction formats, Instruction Cycle: Fetch and Decode, Flowchart for Instruction cycle, Register reference instructions, Introduction of Multiprocessors: Characteristics of multi-processors. **Logic Simplification and Combinational Logic Design:** Number Systems, Review of	**Basic Computer Organization:** Peripheral devices, Input – Output interface, CPU, Memory, Instruction Codes, Computer Registers: Common bus system, Computer Instructions: Instruction formats, Instruction Cycle: Fetch and Decode, Flowchart for Instruction cycle, Register reference instructions, Introduction of Multiprocessors: Characteristics of multi-processors. **Logic Simplification and Combinational Logic Design:** Number Systems, Review of Boolean Algebra and De Morgan's Theorem, SOP	Few topics added to all CO's	Faculty Member	50

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			NAND/NOR Latches Gated Latches, Edge-Triggered Flip-flops. Registers and Counters: Shift register, Universal Shift Register, Design of	De Morgan's Theorem, SOP & POS forms, Karnaugh maps, Binary codes, Code Conversion, Integrated Circuit Logic Gates.	maps, Binary codes, Code Conversion, Integrated Circuit Logic Gates.			

23/6/20

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S.No	Course Code	CourseTitle	Existing Syllabus	New Syllabus	Topics added/removed/ replaced	Changes in Course Outcome (s)	Justification for no change in percentage of change in syllabus	Revision Percentage
			Synchronous and Asynchronous Counters, Modulus counters.Mealy and Moore machines, State diagrams and Tables, FSM, Introduction to ASM charts. Verilog HDL design for Sequential Logic Functions. **Programmable Logic Devices:** Programmable Logic Array (PLA), Programmable Array Logic (PAL), Logic implementation using Programmable Devices. Complex Programmable Logic Devices, Field Programmable Gate Arrays, Applications of CPLDs and FPGAs.	**Combinational Logic Functions:** Adder and Substractor, Decoders, Encoders, Multiplexers, Demultiplexers, Magnitude Comparators, Parity Generators and Checkers, BCD to seven segment decoders. Verilog HDL design for Combinational Logic Functions. **Computer Arithmetic** Introduction, Addition and Subtraction, Multiplication Algorithms (Booth algorithm), Division Algorithms	**Combinational Logic Functions:** Adder and Substractor, Decoders, Encoders, Multiplexers, Demultiplexers, Magnitude Comparators, Parity Generators and Checkers, BCD to seven segment decoders. Verilog HDL design for Combinational Logic Functions. **Computer Arithmetic** Introduction, Addition and Subtraction, Multiplication Algorithms (Booth algorithm), Division Algorithms			

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S.No	CourseCode	CourseTitle	Existing Syllabus	New Syllabus	Topics added/removed/ replaced	Changes in Course Outcome(s)	Justification for no change in percentage of change in syllabus	Revision Percentage
			Basic Computer Organization Peripheral devices, Input – Output interface, CPU, Memory, s Instruction Codes, Computer Registers: Common bus system, Computer Instructions: Instruction formats, Instruction Cycle: Fetch and Decode, Flowchart for Instruction cycle, Register reference instructions, Introduction of Multiprocessors: Characteristics of multi-processors. **Computer Arithmetic** Introduction, Addition and Subtraction, Multiplication Algorithms (Booth algorithm), Division Algorithms.	**Register Transfer and Micro-operation** Register Transfer Language, Register Transfer, Bus and Memory Transfer: Three state bus buffers, Memory Transfer. Arithmetic Micro-operations: Binary Adder, Binary Adder-Subtractor, Binary Incrementor, Logic Micro-operations: List of Logic micro-operations, Shift Micro-operations (excluding H/W implementation), Arithmetic Logic Shift Unit.	**Register Transfer and Micro-operation** Register Transfer Language, Register Transfer, Bus and Memory Transfer: Three state bus buffers, Memory Transfer. Arithmetic Micro-operations: Binary Adder, Binary Adder-Subtractor, Binary Incrementor, Logic Micro-operations: List of Logic micro-operations, Shift Micro-operations (excluding H/W implementation), ALU Unit.			

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S.No	Course Code	CourseTitle	Existing Syllabus	New Syllabus	Topics added/removed/ replaced	Changes in Course Outcome(s)	Justification for no change in percentage of change in syllabus	Revision Percentage
			Register Transfer and Micro-operation Register Transfer Language, Register Transfer, Bus and Memory Transfer: Three state bus buffers, Memory Transfer. Arithmetic Micro-operations: Binary Adder, Binary Adder-Subtrator, BinaryIncrementor, Logic Micro-operations: List of Logic micro operations, Shift Micro-operations (excluding H/W implementation),Arithmetic Logic Shift Unit.**Micro Programmed Control Unit** Control Memory, Address Sequencing, Conditional branching, Mapping of instruction, Subroutines, Design of Control Unit, Central Processing Unit: Introduction, General Register Organization, Stack Organization: Register stack, Memory stack; Instruction Formats, Add					

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Computer Science and Applications
Koneru Lakshmaiah Education Foundation
(K.L. Deemed to be University)
Green Fields, Vaddeswaram-522502
Guntur District, Andhra Pradesh

S.No	Course Code	CourseTitle	Existing Syllabus	New Syllabus	Topics added/removed/ replaced	Changes in Course Outcome(s)	Justification for no change in percentage of change in syllabus	Revision Percentage
			Modes of Data Transfer and Memory Organization Modes of Data Transfer: Priority Interrupt, Direct Memory Access, Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.					

23/8/19

Head of the Department
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Accredited by **NAAC** as '**A++**' ❖Approved by AICTE ❖ ISO 21001:2018 Certified
Campus: Green Fields, Vaddeswaram - 522 302, Guntur District, Andhra Pradesh, INDIA.
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Department of Computer Science & Applications
Minutes of the DAC meeting held on 20-05-2020

Agenda Items

1. To discuss any proposals for modifications to the existing curriculums of the department.
2. To formulate the eligibility criteria for admissions into BCA with Specializations
3. To Analyze the feedback towards curriculum improvement.

This meeting is chaired by Dr. M.S.R Prasad, HOD, Department of Computer Applications.

Members Present

S.No	FULL NAME	POSITION
1	Dr.M S R Prasad	Professor, HOD-BCA
2	Dr. Raghuveer	Dean Academics, KLEF
3	Mr.Bhukya. Jabber	Asst. Professor, KLEF
4	Mr.C.Rajesh Kumar	Academic Incharge, iNurture
5	Dr. M.R.Narasinga Rao	Professor & R-PAC, KLEF
6	Dr.K. Bhanu Prakash	Professor, KLEF
7	Dr D.Veerabhadra Babu	Assoc. Professor, BCA, KLEF
8	Mr Abdul Mannan	Asst Professor, KLEF

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9	Mr.G.Akhilesh	Asst Professor, KLEF
10	Ms.Surabhi Saxena	Asst Professor, KLEF
11	Mr.K.Vishal Raj	Asst Professor, KLEF

Minutes of the Meeting:

1. It is recommended to set the eligibility criteria for admission into all the four programs of BCA as "minimum 50% marks in core subjects of intermediate or equivalent study".

2. It is recommended to allow students who studied intermediate or equivalent without mathematics subjects. However, for such students a strong bridge course is proposed before the commencement of graduation program.

3. It is recommended to follow the existing curriculum for Y18 and Y19 batches without any changes.

4. As per the recommendations of Industry Person Mr. K. Tarun, CEO, Glocal Tech, Bangalore suggested introducing the course "Introduction to Data Science with R programming for data analysis and visualization.

5. Faculty Member Dr. Bindu Suggested to introduce the "Linear Algebra" for solving the real time problems using machine learning, deep learning using the basics of Linear Algebra.

6. Industry Person Mr. K. Srinivas, CEO, Indian Servers, recommended to introduce "Sampling Methods & Exploratory Data Analysis" with fundamental techniques in statistics and data science.

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7. Academic Peer Dr. P. Suresh Varma, Professor, Adikavi Nanayya University, suggested introducing "Design and Analysis of Algorithms", to analyze the time and space complexity of the problems with high performance capabilities.

8. Alumni Member Ms. L. Swathi Shireen suggested introducing the courses "Artificial Intelligence" and "Machine Learning" which have a wide range of career opportunities are in high demand.

9. Faculty Member Mr. C. Rajesh Kumar suggested to introduce the course "Big Data Analytics" based on the industry requirements.

10. Industry Person Dr. Amaralingeswara Rao Kaka, Program Director, IBM suggested to introduce the course "Data Visualization Tools and Techniques" for generating the reports using graphical representation of information and data.

11. Industry Person Ms. M. Sravani, Software engineer, Wipro, suggested to introduce "Data Warehousing and Mining" for extracting the useful information from large set of data.
12. Academic Peer Dr Satya Prasad R. from Acharya Nagarjuna University, suggested to introduce "Optimization Techniques" to manage the enterprise resources.

13. Alumni Member Ms. G.Vamsi Priya suggested introducing the course "Soft Computing" to understand how samples can be used to produce the finest result and genetic algorithms can be used for solving the real world problems.

14. Industry Person Mr. Goutham, Software consultant, suggested to introduce "DevOPS with Cloud" to understand the continuous integration and continuous delivery to deploy the products into the cloud.

15. Faculty Member Ms.Surabhi Saxena suggested to introduce the course "Technology Management" course for the benefits would be the management of the use of technology for human advantage.

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16. As per the recommendations of Alumni and parents Technical Skills Course is introduced in all the semesters with LPTS structure 0-0-0-8.

17. As per the recommendations of Faculty Member Dr D. Veerabhadra Babu, suggested to combine the courses "Digital Logic Design" and "Computer Organization and Architecture" into "DLD&CO" as the concepts in the courses are interrelated and collectively used for the designing of Combinational and Sequential circuits using flipflops, micro-operations.

28/8/19

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