SARDAR PATEL UNIVERSITY
Vallabh Vidyanagar, Gujarat
(Reaccredited with 'A' Grade by NAAC (CGPA 3.25)
Syllabus with effect from the Academic Year 2022-2023

PROGRAMME STRUCTURE
MCA Semester: III

Programme Outcome (PO) - For MCA Programme	The objective of the MCA programme is to prepare post-graduates for software industry, corporate sector, government organizations and academics by providing skill-based education in the core and emerging areas of computer applications. The programme emphasizes on giving the students a sound background in theoretical and skill-oriented courses relevant to the latest trends in software development.
Programme Specific Outcome (PSO) - For MCA Semester - III	The objective of the MCA programme is to prepare post-graduates for software industry, corporate sector, government organizations and academics by providing skill-based education in the core and emerging areas of computer applications. The programme emphasizes on giving the students a sound background in theoretical and skill-oriented courses relevant to the latest trends in software development.

To Pass	(i) At least 40% Marks in the University Examination in each paper and (ii) At least 40% Marks in the total of Internal and the University Examination in each paper.

Course Type	Course Code	Name Of Course	Theory/ Practical	Credit	Exam Duration in hrs	Component of Marks		
						Internal Total	External Total	Total
Core Course	PS03CMCA51	Web Application Frameworks	T	4	3	30	70	100
	PS03CMCA52	Mobile Application Development	T	4	3	30	70	100
	PS03CMCA53	Artificial Intelligence	T	4	3	30	70	100
	PS03CMCA54	Computer Graphics	T	4	3	30	70	100
	PS03CMCA55	Practicals based on PS03CMCA51 & PS03CMCA52	P	3	3	30	70	100
	PS03CMCA56	Project Work (In-house)	=	2	3	30	70	100
Elective Course (Any One)	PS03EMCA57	Cloud Computing and Distributed Systems	T	4	3	30	70	100
	PS03EMCA58	Machine Learning	T	4	3	30	70	100
	PS03EMCA59	Data Science & Big Data Analytics	T	4	3	30	70	100
	PS03EMCA60	Advanced Java Programming	T	4	3	30	70	100

MCA (Master of Computer Applications)
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Course Code	PS03CMCA51	Title of the Course	WEB APPLICATION FRAMEWORKS
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To learn the fundamentals of the Python programming language. 2. To study development of procedural as well as object-oriented Python programs. 3. To learn GUI program development using Python. 4. To understand how to access files and databases from Python. 5. To learn client-side web application frameworks. 6. To learn server-side web application frameworks.

Course Content

Unit	Description	Weightage* (%)
1.	**Basic Web Application Development Tools** – Introduction to HTML5, CSS3 – Interactive web pages using JavaScript – The JQuery library – JavaScript user interface library	25
2.	**Web Frameworks for Python** – Introduction to web frameworks – Popular full-stack frameworks and non full-stack frameworks (microframeworks) – Working with Flask and Django frameworks.	25
3.	**Client-side Web Application Frameworks** – Setting up Project, project organization and management – Templates – MVC Architecture – Data binding – Dependency injection – Routing	25

4.	**Server-side Web Application frameworks** – Application structure – MVC Architecture – Routing – Helpers – Libraries – Form validation – Session management – Active record	25

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to

1.	develop websites using Django Framework.
2.	manipulate different Python data types.
3.	develop object-oriented programs using Python.
4.	understand the Python package system.
5.	create basic GUI programs as well as Python programs with file handling and database access.

Suggested References:	
Sr. No.	References
1.	Dane Cameron, "HTML5, JavaScript and jQuery", Wrox publication.
2.	David Sawyer McFarland, "CSS3", O'reilly.
3.	Brad Green and Syham Seshadri, "AngularJS", O'Reilly.
4.	Python Web Frameworks by Carlos de la Guardia, O'Reilly Media, Inc., March 2016.
5.	Jake Spurlock, "Bootstrap", O'Reilly.
6.	Thomas Myer, "Professional CodeIgniter", Wrox Professional Guides.
7.	Karl Swedberg, Jonathan Chaffer, "jQuery 1.4 Reference Guide", PACKT publishing.
8.	Valeri Karpov, Diego Netto, "Professional AngularJS", Wrox publication.
9.	Zak Ruvalcaba, Anne Boehm, "HTML5 and CSS3", Murach.
10.	Bear Bibeault, Yehuda Katz, "jQuery in action", 2nd edition, Dreamtech press.

On-line resources to be used if available as reference material	
1.	Python documentation.

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Course Code	PS03CMCA52	Title of the Course	MOBILE APPLICATION DEVELOPMENT
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. Understanding of Components and Working of Mobile Applications. 2. Gain Knowledge of Designing, Coding and Deployment of Mobile Applications using Android Studio IDE

Course Content		
Unit	Description	Weightage* (%)
1.	**Introduction** – Introduction to Prominent Mobile Application Development Platforms: Android, iOS, Windows – Overview and Evolution of Android, Features of Android – Android System Architecture – Key Android concepts – SDK, API, AVD, DVM – Types of Android Applications – Android Application Components: Intent, Activity, Service, Broadcast Receiver, Content Provider, Synch Adapters – The Android Activity Life Cycle – Introduction to Android Application Development Environment: Android Studio – Anatomy of the Android Project	25
2.	**Android User Interface Design** – Views: Basic, Picker, Lists – Toast, Alert Dialog – Layouts – Handling Events of UI Components – Units of Measurement: dp, sp, px, pt – Intents: Explicit and Implicit – Adapters: Array and Cursor – Menu: Options and Context – Notifications	25

3.	**Data Persistence** – Understanding of Data Persistence in Android – Shared Preferences – File System Access – Introduction to the SQLite Database and DB Browser – Creating and Managing the SQLite Database – Using Different Types of Content Providers	25
4.	**Advanced Android Programming** – Multimedia: Images, Audio, Video – Accessing the Camera Using Intent – Broadcast Receivers – Services – Text Messages(SMS) – Accessing Files and Data From a Remote Server, Web Services – Location Based Services	25

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	• To develop Mobile Applications for Android Platform.
2.	To understand Components and Working of Mobile Applications.

Suggested References:	
Sr. No.	References
1.	Lee Wei-Meng : Beginning Android Appilcation Development, Wiley Publishing, Inc., 2011.
2.	Meier Reto : Professional Android Application Development, Wiley Publishing, Inc., 2010
3.	Darwin I. A. : Android Cookbook, O'Reiley Media, Inc., 2012

On-line resources to be used if available as reference material	
1.	https://developer.android.com

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MCA (Master of Computer Applications)
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Course Code	PS03CMCA53	Title of the Course	ARTIFICIAL INTELLIGENCE
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To learn the fundamental concepts of traditional Artificial Intelligence (AI) systems. 2. To get awareness regarding various application areas in the field of AI. 3. To learn various AI techniques such as expert systems, fuzzy logic, neural network and genetic algorithms and their applications.

Course Content

Unit	Description	Weightage* (%)
1.	**Artificial Intelligence (AI) and Knowledge Based Systems (KBS)** – Natural and Artificial Intelligence – Testing intelligence with Turing test, and Chinese room experiment, Application areas of Artificial Intelligence, Data pyramid – Production systems and AI based searches like Hill climbing and Heuristic search – KBS structure, Components of KBS, Categories of KBS, Knowledge-Based Shell, Advantages, Limitations and Applications of KBS – Knowledge acquisition, Knowledge update – Factual and procedural knowledge representations – Knowledge management cycle	25
2.	**Fuzzy Logic** – Fuzzy logic, Fuzzy sets, Membership functions – Fuzzification and Defuzzification – Operations on fuzzy sets – Fuzzy functions and Linguistic variables – Fuzzy relations, Propositions and Connectives – Fuzzy rules and Fuzzy rule based systems – Fuzzy control system.	25
3.	**Connectionist Models** – Introduction to ANN, Biological neuron and Artificial neuron – Hopfield model of ANN, Parallel relaxation – Linearly separable problems, Single perceptron – Non linearly separable problems, Fixed increment perceptron learning	25

	– Multi layer perceptron, Backpropagation in multi layer perceptron – General Learning Paradigms: Supervised and Unsupervised Learning – Applications of ANN and Cases	
4.	**Genetic Algorithms** – Introduction to Genetic Algorithm (GA), – Fundamental concepts of GA: Gene, Population, Fitness Functions, Generations – Encoding Strategies, Genetic operators, Fitness functions – Typical Genetic algorithm cycle – Function optimization, – Designing special operators and Edge recombination, travelling salesman problem – Schema	25

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understanding of fundamental concepts related to artificial intelligence.
2.	Understanding of the applications of artificial intelligence in various domains.

Suggested References:	
Sr. No.	References
1.	Rushell and Norvig, Modern Approach to Artificial Intelligence, Prentice Hall of India Ltd., 2009.
2.	Elaine Rich, Artificial Intelligence, Tata McGraw Hill Publishing Co. Ltd., 3rd Edition (Sie), 2019.
3.	Vijyalaxmi Pai and Rajasekaran, Neural Networks, Fuzzy Systems and Evolutionary Algorithms: Synthesis and Applications, Prentice Hall of India, Pvt Ltd., 2017.
4.	Akerkar RA and Sajja P S, Knowledge-Based Systems, Jones & Bartlett Publishers, Sudbury, MA, USA, 2009.
5.	Peter Jackson, Introduction to Applied Expert systems, Pearson Education Ltd., Second Indian Reprint, 2001.
6.	David E.Goldberg, Genetic Algorithms in Search, Optimization & Machine Learning, Pearson Education, 2006Dane Cameron, "HTML5, JavaScript and jQuery", Wrox publication.

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MCA (Master of Computer Applications)
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Course Code	PS03CMCA54	Title of the Course	COMPUTER GRAPHICS
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To learn the fundamental concepts of Computer Graphics 2. To understand algorithms of output primitives such as line, circle, and characters generation 3. To get awareness regarding various 2D and 3D Geometric Transformations 4. To learn various digital image processing and analysis techniques. 5. To get awareness about Multimedia concept including of 2D and 3D animation.

Course Content

Unit	Description	Weightage* (%)
1.	**Introduction, Output Primitives and 2D Geometric Transformations** – Introduction and applications of Computer Graphics, – Graphics Software Standards – Display devices (Random scan-raster scan monitors, Flat Panel Display) – Algorithms for output primitives (Line, Circle, Character Generation) and attributes of output primitives – 2D Geometric Transformations: Translation, Rotation, Scaling, Reflection and Shear – Matrix representation of basic transformations and representation in homogeneous coordinates – Applications of Basic Transformations	25
2.	**Clipping and 3D Concepts** – 2D Viewing pipeline – Window to view port transformation – Clipping Algorithms for Point, Line, Polygon and Text – 3D coordinate systems – 3D display methods: Parallel Projection, Perspective Projection – Introduction of 3D Object representations. – 3D Geometric Transformations (Translation, Rotation and Scaling) – 3D Viewing pipeline – Visible Surface detection methods: Back face detection methods and the Z- Buffer algorithm	25

	– Introduction and need of Illumination models and surface-rendering methods	
3.	**Image Operations** – Image Representation: Graphics Formats - Graphics Interchange Format (GIF), Microsoft Windows Bitmap (BMP), JPEG File Interchange Format (JPEG) , Tag Image File Format(TIFF), Portable Network Graphic Format(PNG) – Introduction, applications and components of Image processing system, Human vision system – Digitization: Sampling & Quantization – Image Enhancement with Examples: Contrast Intensification, smoothing, Sharpening, and Noise Reduction – Introduction to Image restoration, Image compression (Lossy & Loss-less compression), Image Registration – Multi-Valued Image processing – Image analysis: Segmentation, Edge & Line Detection, Feature Extraction, Image Description, Image Recognition – Color models (RGB, CMY, YIQ, YCbCr and HSI) and conversion between different models	25
4.	**Virtual Reality using Multimedia** – Introduction to Multimedia with its applications – Facets of multimedia: Audio, Text, Graphics, Video, Animations – Multimedia hardware & software – Introduction to digital medium – Digital Audio- Audio cards, Audio playback, Audio recording, Audio Editing – Digital Text- Designing Text & Hypermedia – Graphics – Purpose, Types of Graphics storage, Graphics Software, Graphics editing & Introduction of Scanner – Digital Video- Need, Digitization of Video – Animation- Need, Types of animations, 2D & 3D animation techniques & software – Multimedia project design / development concepts – Multimedia authoring, characteristics of authoring tools, authoring methodologies and multimedia programming	25

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the basics of Computer Graphics and Digital Image Processing & Analysis.
2.	Applications of 2D and 3D Geometric Transformations.
3.	Hands on practice of audio tools and 2D Animation Tools.

Suggested References:	
Sr. No.	References
1.	Donald Hearn & M. Pauline Baker: "Computer Graphics",PHI, 2011.
2.	Rafael C. Gonzalez & Richard E. Woods: "Digital Image Processing", Third Edition, Addision-Wesley Publishing Company, 2012.
3.	B. Chanda, D. Dutta Majumder: "Digital Image Processing and Analysis", PHI, 2011.
4.	S. Gokul: Multimedia Magic, BPB Publication, 2006.

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Course Code	PS03CMCA55	Title of the Course	PRACTICALS BASED ON PS03CMCA31 & PS03CMCA32
Total Credits of the Course	3	Hours per Week	6

Course Objectives:	1. To provide practical experience of working with web application frameworks. 2. To train students to work with Python framework. 3. To lean client-side web application frameworks, 4. To lean server-side web application frameworks, 5. To understand components and working of Mobile applications. 6. To gain knowledge of designing, coding and deployment of Mobile applications using Android Studio IDE.

Course Content		
Unit	Description	Weightage* (%)
1.	Practical based on PS03CMCA31	50%
2.	Practical based on PS03CMCA32	50%

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	gain familiarity with using web application frameworks.
2.	develop mobile applications using Android Studio.
3.	acquire knowledge for creating web application using Flask and Django frameworks.
4.	develop application using popular client-side and server-side web application frameworks.

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Course Code	PS03CMCA56	Title of the Course	PROJECT WORK (IN-HOUSE)
Total Credits of the Course	2	Hours per Week	4

Course Objectives:	1. To provide practical experience of software development. 2. To train students to develop software product. 3. To gain knowledge of software development life cycle.

Course Content		
Unit	Description	Weightage* (%)
1.	Training on In-house Project Work	100

Teaching-Learning Methodology	Project-based learning approach in which students acquire skills on design, development, analysis, critical thinking, decision making, evaluation and testing of software systems.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	develop an application for solving real-life problems.
2.	gain knowledge of software development process.

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MCA (Master of Computer Applications)
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Course Code	PS03EMCA57	Title of the Course	CLOUD COMPUTING & DISTRIBUTED SYSTEMS
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To understand the basic concepts of cloud computing and distributed systems 2. To acquire basic information about various cloud platforms. 3. To learn various applications and benefits of cloud computing. 4. To study design issues, system models and processor allocation algorithms for distributed systems.

Course Content

Unit	Description	Weightage* (%)
1.	**Introduction to cloud computing** – Definition and characteristics of cloud computing – Benefits and challenges of cloud computing – Overview of cloud architecture – Applications of cloud computing – Cloud service delivery models (IaaS, PaaS, SaaS)	25
2.	**Deployment Model, Virtualization and Security** – Cloud deployment models: Public, Private, Community & Hybrid – Architecture for traditional versus cloud applications – Fundamental requirements for cloud application architecture – Service Oriented Architecture(SOA) for cloud applications – Virtualization – Categorization of cloud security issues – Introduction to open source and commercial clouds	25
3.	**Distributed Systems – I** – Basic concepts – Advantages and disadvantages of distributed systems – Tightly coupled and loosely coupled systems, – Hardware and Software Requirements – True Distributed Systems – Design Issues – Distributed file system design	25

4.	**Distributed Systems – II** – System models for organizing processors in a distributed system : the workstation model, the processor pool model and the hybrid model. – Using idle workstations – Design and implementation issues for processor allocation algorithms – Processor Allocation Models – Synchronization Aspects	25

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	understand concepts of cloud computing and distributed systems.
2.	understand the cloud service models & deployment models.
3.	gain knowledge of concept related to virtualization.
4.	gain basic understanding of the design issues, system models and processor allocation strategies for distributed.

Suggested References:	
Sr. No.	References
1.	Fundamentals of cloud computing, A. Kannammal, CENGAGE Learning
2.	Kailash Jayaswal, Jagannath Kallakurchi, Donald J Houde, Dr. Deven Shah : Cloud Computing :Black Book Dreamtech Publications
3.	Tanenbaum A. S. and Herbert Bos, Modern Operating Systems, 4th Edition, Pearson, 2014.
4.	Tanenbaum Andrew S.: Distributed Operating Systems, Pearson Education India, 1995.
5.	RajkumarBuyya, James Broberg, Andrzej M Goscinski: Cloud Computing: Principles and Paradigms, Wiley Publication.
6.	RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi: Mastering Cloud Computing: Foundations and applications programming, Elsevier Morgan Kaufmann.
7.	Anthony T. Velte, Toby J. Velte, Robert Elsenpeter: Cloud Computing – A Practical Approach, Tata McGraw Hill Education.
8.	Rishabh Sharma: Cloud Computing Fundamentals, Industry Approach and Trends: Wiley Publication.
9.	Barrie Sosinsky, Cloud Computing Bible,Willey Publication.

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Course Code	PS03EMCA58	Title of the Course	MACHINE LEARNING
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To learn the fundamental issues and challenges of traditional artificial intelligence systems and the need for machine learning. 2. To learn the strengths and weaknesses of many popular machine learning approaches. 3. TO learn various machine learning algorithms, paradigms of supervised and unsupervised learning, and hybrid computational intelligence techniques. 4. To be able to learn applications of machine learning in various real-life systems.

Course Content		
Unit	Description	Weightage* (%)
1.	**Introduction to Machine Learning** – Types of learning: Human and machine learning – Types of machine learning – Applications of machine learning – Tools for machine	25
2.	**Supervised Learning** – Introduction and examples of supervised learning – Classification model and classification learning steps – Training data sets and validation data sets – Deep learning in artificial neural network, Deep Vs. shallow learning – Introduction to deep learning	25
3.	**Unsupervised Learning** – Introduction to Clustering – Self Organizing map/Kohenon neural network – K nearest neighborhood – K-means and its variations – Applications of unsupervised learning – Introduction to hybrid	25
4.	**Hybrid Computational Intelligence** – Constituents of computational intelligence	25

	– Possible hybridization of constituents of computational intelligence – Neuro-Fuzzy Systems, Neuro-Genetic Systems and Neuro-Fuzzy-Genetic systems – Applications of computational intelligence system in real	

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	• To understand the fundamental concepts related to machine learning techniques.
2.	• To understanding the application of modern intelligent systems in solving real-life problems.

Suggested References:	
Sr. No.	References
1.	Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, "Machine Learning", Pearson Education, 2018.
2.	Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.
3.	Sajja P S, Illustarted computational Intellignce:Examples and Applications, Springer International Publishing, 2020.
4.	Christopher M. Bishop, Pattern recognition and machine learning, Spinger, 2006.
5.	Ethem Alpaydın, Introduction to Machine Learning, Second Edition, 2010.

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Course Code	PS03EMCA59	Title of the Course	DATA SCIENCE AND BIG DATA ANALYSIS
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To impart knowledge of data science, big data and data analytics 2. To teach and demonstrate techniques and technologies used by data science practitioners

Course Content		
Unit	Description	Weightage* (%)
1.	**Introduction to Data Science Data Analytics** – Data Science Definition – Need and features – Importance of Data Science in Modern Business – Current Trends in Data Science – Analytical Techniques	25
2.	**Introduction to Big Data and Big Data Analytics** – Types of Digital Data: Unstructured, Semi-structured and Structured – Working with Unstructured Data – Evolution and Definition of Big Data – Characteristics and Need of Big Data – Meaning and Characteristics of Big Data Analytics – Need of Big Data Analytics – Classification of Analytics – Importance of Big Data Analytics	25
3.	**Data Visualization and Analysis using Python Packages** – Using Matplotlib for data visualization – Using NumPy for data analysis – Using pandas for data analysis – Introduction to SciPy – Case Studies	25
4.	**Data Visualization and Analysis using R and Hadoop** – The R programming language and environment for statistical computing – Introduction to R Studio	25

	– Using Hadoop and MapReduce for big data analysis – Case studies	

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	demonstrate knowledge of data science, big data and data analytics.
2.	understand and apply techniques and technologies used by data science practitioners.

Suggested References:	
Sr. No.	References
1.	Davy Cielen, Arno D.B. Meysman, Mohamed Ali, Introducing Data Science: Big Data, Machine Learning and More, Using Python Tools.
2.	Seema Acharya, Subhashini Chellappan, Big Data and Analytics, Wiley.
3.	Vignesh Prajapati, Big Data Analytics with R and Hadoop – Packrt.
4.	Wes McKinney, "Python for Data Analysis", O'Reilly, 2013.
5.	Robert I. Kabacoff, "R in Action: Data Analysis and Graphics with R", Manning, 2011.

6.	Akerkar R.A. and Sajja, P.S. "Intelligent Techniques for Data Science", Springer International Publishing, Switzerland, August 2016.
7.	Minelli, Chambers, Dhiray, Big Data Big Analytics, Wiley.
8.	Bart Baesens, Analytics in a Big Data World , Wiley.
9.	Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drives, and Techniques, , Pearson India Education Services Pvt. Ltd., 2016.
10.	Roger D. Peng and Elizabeth Matsui, The Art of Data Science: A Guide for Anyone Who Works with Data, LeanPub, 2016.
11.	Brian Caffo, Roger D. Peng and Jeffrey Leek, Executive Data Science A Guide to Training and Managing the Best Data Scientists, LeanPub, 2016.
12.	Sridhar Alla, Big Data Analytics with Hadoop 3, Ingram, 2018.
13.	Benjamin Bengfort, Data Analytics with Hadoop: An Introduction for Data Scientists, O'Reilly, 2016.
14.	Tom White, Hadoop: The Definitive Guide, O'Reilly, 2009.

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MCA (Master of Computer Applications)
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Course Code	PS03EMCA60	Title of the Course	ADVANCED JAVA PROGRAMMING
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To introduce the students to enterprise Java application development using Jakarta EE 2. To enable students to develop dynamic web pages using Java Servlets and the JSP technology 3. To train the students in using the Hibernate ORM 4. To teach the students the Spring Framework and Spring Boot 5. To introduce the students to the EJB techology 6. To familiarize the students with software design patterns

Course Content		
Unit	Description	Weightage* (%)
1.	**Java Servlets and the Java Sever Page (JSP) Technology** – Introduction to Jakarta EE – Introduction to Java Servlet – Life cycle of Servlet – Database access using Servlets and JDBC – Introduction to JSP, Architecture of JSP – Developing simple JSP page – JSP expressions, directives, declarations – JSP implicit objects – Introduction to internationalization in JSP	25
2.	**The Hibernate ORM** – Object-relational mapping (ORM) – Introduction to the Hibernate ORM and JPA – Hibernate entities – HQL (Hibernate Query Language) – Hibernate annotations – Hibernate named queries and query parameters – CRUD operations using Hibernate – Relationships between entities in Hibernate	25
3.	**The Spring Framework and Spring Boot** – Introduction to the Spring framework	25

	– Inversion of Control (IoC) and Dependency Injection (DI) – Data access framework – Spring MVC – Developing Spring applications using Spring Boot	
4.	**Enterprise Java Beans (EJB) and Java EE Design Patterns** – Introduction to the Enterprise Java Beans (EJB) technology – Entity beans – Session beans – Message driven beans – Introduction to design patterns – Common design patterns	25

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	understand and describe enterprise Java application development using Jakarta EE.
2.	develop dynamic web pages using Java Servlets and the JSP technology.
3.	use the Hibernate ORM for object-relational mapping and data access.
4.	develop Jakarta EE enterprise web applications using the Spring Framework and Spring Boot.
5.	use the EJB technology in Jakarta EE applications.
6.	describe software design patterns.

Suggested References:	
Sr. No.	References
1.	Eric Jendrock, et. al., The Java EE 7 Tutorial: Volume 1, 5th Edition, Addison-Wesley Professional, 2014.
2.	Eric Jendrock, et. al., The Java EE 7 Tutorial: Volume 2, 5th Edition, Addison-Wesley Professional, 2014.
3.	Luciano Manelli, Beginning Jakarta EE Web Development, 3rd Edition, Apress, 2020.
4.	Antonio Goncalves, Beginning Java EE 7, Apress, 2013.
5.	Jim Koegh, The Complete Reference J2EE, McGraw Hill Education, 2017.
6.	Christian Bauer, Gavin King, and Gary Gregory, Java Persistence with Hibernate, 2nd Edition, Manning Publications, 2015.
7.	Debu Panda, Reza Rahman, Ryan Cuprak, and Michael Remijan, EJB 3 in Action, 2nd Edition, Manning Publication, 2014.
8.	Kathy Sierra and Bert Bates, Head First EJB, O'Reilly, 2003.
9.	Rod Johnson, et. al., Professional Java Development with the Spring Framework, O'Reilly, 2005.
10.	Felipe Gutierrez, Introducing Spring Framework, Apress, 2014.
11.	K. Siva Prasad Reddy, Beginning Spring Boot 2, Apress, 2017.
12.	Craig Walls, Spring Boot in Action, Manning Publication, 2016.
13.	Murat Yener and Alex Theedom, Professional Java EE Design Patterns, Wrox Publications, 2014.

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MCA (Master of Computer Applications)
MCA (Master of Computer Applications) Semester III

Course Code	PS03CMCA54	Title of the Course	COMPUTER GRAPHICS
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To learn the fundamental concepts of Computer Graphics 2. To understand algorithms of output primitives such as line, circle, and characters generation 3. To get awareness regarding various 2D and 3D Geometric Transformations 4. To learn various digital image processing and analysis techniques. 5. To get awareness about Multimedia concept including of 2D and 3D animation.

Course Content

Unit	Description	Weightage* (%)
1.	**Introduction, Output Primitives and 2D Geometric Transformations** – Introduction and applications of Computer Graphics, – Graphics Software Standards – Display devices (Random scan-raster scan monitors, Flat Panel Display) – Algorithms for output primitives (Line, Circle, Character Generation) and attributes of output primitives – 2D Geometric Transformations: Translation, Rotation, Scaling, Reflection and Shear – Matrix representation of basic transformations and representation in homogeneous coordinates – Applications of Basic Transformations	25
2.	**Clipping and 3D Concepts** – 2D Viewing pipeline – Window to view port transformation – Clipping Algorithms for Point, Line, Polygon and Text – 3D coordinate systems – 3D display methods: Parallel Projection, Perspective Projection – Introduction of 3D Object representations. – 3D Geometric Transformations (Translation, Rotation and Scaling) – 3D Viewing pipeline – Visible Surface detection methods: Back face detection methods and the Z- Buffer algorithm	25

	– Introduction and need of Illumination models and surface-rendering methods	
3.	**Image Operations** – Image Representation: Graphics Formats - Graphics Interchange Format (GIF), Microsoft Windows Bitmap (BMP), JPEG File Interchange Format (JPEG) , Tag Image File Format(TIFF), Portable Network Graphic Format(PNG) – Introduction, applications and components of Image processing system, Human vision system – Digitization: Sampling & Quantization – Image Enhancement with Examples: Contrast Intensification, smoothing, Sharpening, and Noise Reduction – Introduction to Image restoration, Image compression (Lossy & Loss-less compression), Image Registration – Multi-Valued Image processing – Image analysis: Segmentation, Edge & Line Detection, Feature Extraction, Image Description, Image Recognition – Color models (RGB, CMY, YIQ, YCbCr and HSI) and conversion between different models	25
4.	**Virtual Reality using Multimedia** – Introduction to Multimedia with its applications – Facets of multimedia: Audio, Text, Graphics, Video, Animations – Multimedia hardware & software – Introduction to digital medium – Digital Audio- Audio cards, Audio playback, Audio recording, Audio Editing – Digital Text- Designing Text & Hypermedia – Graphics – Purpose, Types of Graphics storage, Graphics Software, Graphics editing & Introduction of Scanner – Digital Video- Need, Digitization of Video – Animation- Need, Types of animations, 2D & 3D animation techniques & software – Multimedia project design / development concepts – Multimedia authoring, characteristics of authoring tools, authoring methodologies and multimedia programming	25

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the basics of Computer Graphics and Digital Image Processing & Analysis.
2.	Applications of 2D and 3D Geometric Transformations.
3.	Hands on practice of audio tools and 2D Animation Tools.

Suggested References:	
Sr. No.	References
1.	Donald Hearn & M. Pauline Baker: "Computer Graphics",PHI, 2011.
2.	Rafael C. Gonzalez & Richard E. Woods: "Digital Image Processing", Third Edition, Addision-Wesley Publishing Company, 2012.
3.	B. Chanda, D. Dutta Majumder: "Digital Image Processing and Analysis", PHI, 2011.
4.	S. Gokul: Multimedia Magic, BPB Publication, 2006.

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MCA (Master of Computer Applications)
MCA (Master of Computer Applications) Semester III

Course Code	PS03CMCA55	Title of the Course	PRACTICALS BASED ON PS03CMCA31 & PS03CMCA32
Total Credits of the Course	3	Hours per Week	6

Course Objectives:	1. To provide practical experience of working with web application frameworks. 2. To train students to work with Python framework. 3. To lean client-side web application frameworks, 4. To lean server-side web application frameworks, 5. To understand components and working of Mobile applications. 6. To gain knowledge of designing, coding and deployment of Mobile applications using Android Studio IDE.

Course Content		
Unit	Description	Weightage* (%)
1.	Practical based on PS03CMCA31	50%
2.	Practical based on PS03CMCA32	50%

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	gain familiarity with using web application frameworks.
2.	develop mobile applications using Android Studio.
3.	acquire knowledge for creating web application using Flask and Django frameworks.
4.	develop application using popular client-side and server-side web application frameworks.

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MCA (Master of Computer Applications)
MCA (Master of Computer Applications) Semester III

Course Code	PS03CMCA56	Title of the Course	PROJECT WORK (IN-HOUSE)
Total Credits of the Course	2	Hours per Week	4

Course Objectives:	1. To provide practical experience of software development. 2. To train students to develop software product. 3. To gain knowledge of software development life cycle.

Course Content		
Unit	Description	Weightage* (%)
1.	Training on In-house Project Work	100

Teaching-Learning Methodology	Project-based learning approach in which students acquire skills on design, development, analysis, critical thinking, decision making, evaluation and testing of software systems.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	develop an application for solving real-life problems.
2.	gain knowledge of software development process.

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MCA (Master of Computer Applications)
MCA (Master of Computer Applications) Semester III

Course Code	PS03EMCA57	Title of the Course	CLOUD COMPUTING & DISTRIBUTED SYSTEMS
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To understand the basic concepts of cloud computing and distributed systems 2. To acquire basic information about various cloud platforms. 3. To learn various applications and benefits of cloud computing. 4. To study design issues, system models and processor allocation algorithms for distributed systems.

Course Content

Unit	Description	Weightage* (%)
1.	**Introduction to cloud computing** – Definition and characteristics of cloud computing – Benefits and challenges of cloud computing – Overview of cloud architecture – Applications of cloud computing – Cloud service delivery models (IaaS, PaaS, SaaS)	25
2.	**Deployment Model, Virtualization and Security** – Cloud deployment models: Public, Private, Community & Hybrid – Architecture for traditional versus cloud applications – Fundamental requirements for cloud application architecture – Service Oriented Architecture(SOA) for cloud applications – Virtualization – Categorization of cloud security issues – Introduction to open source and commercial clouds	25
3.	**Distributed Systems – I** – Basic concepts – Advantages and disadvantages of distributed systems – Tightly coupled and loosely coupled systems, – Hardware and Software Requirements – True Distributed Systems – Design Issues – Distributed file system design	25

4.	**Distributed Systems – II** – System models for organizing processors in a distributed system : the workstation model, the processor pool model and the hybrid model. – Using idle workstations – Design and implementation issues for processor allocation algorithms – Processor Allocation Models – Synchronization Aspects	25

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	understand concepts of cloud computing and distributed systems.
2.	understand the cloud service models & deployment models.
3.	gain knowledge of concept related to virtualization.
4.	gain basic understanding of the design issues, system models and processor allocation strategies for distributed.

Suggested References:	
Sr. No.	References
1.	Fundamentals of cloud computing, A. Kannammal, CENGAGE Learning
2.	Kailash Jayaswal, Jagannath Kallakurchi, Donald J Houde, Dr. Deven Shah : Cloud Computing :Black Book Dreamtech Publications
3.	Tanenbaum A. S. and Herbert Bos, Modern Operating Systems, 4th Edition, Pearson, 2014.
4.	Tanenbaum Andrew S.: Distributed Operating Systems, Pearson Education India, 1995.
5.	RajkumarBuyya, James Broberg, Andrzej M Goscinski: Cloud Computing: Principles and Paradigms, Wiley Publication.
6.	RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi: Mastering Cloud Computing: Foundations and applications programming, Elsevier Morgan Kaufmann.
7.	Anthony T. Velte, Toby J. Velte, Robert Elsenpeter: Cloud Computing – A Practical Approach, Tata McGraw Hill Education.
8.	Rishabh Sharma: Cloud Computing Fundamentals, Industry Approach and Trends: Wiley Publication.
9.	Barrie Sosinsky, Cloud Computing Bible,Willey Publication.

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MCA (Master of Computer Applications)
MCA (Master of Computer Applications) Semester III

Course Code	PS03EMCA58	Title of the Course	MACHINE LEARNING
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To learn the fundamental issues and challenges of traditional artificial intelligence systems and the need for machine learning. 2. To learn the strengths and weaknesses of many popular machine learning approaches. 3. TO learn various machine learning algorithms, paradigms of supervised and unsupervised learning, and hybrid computational intelligence techniques. 4. To be able to learn applications of machine learning in various real-life systems.

Course Content		
Unit	Description	Weightage* (%)
1.	**Introduction to Machine Learning** – Types of learning: Human and machine learning – Types of machine learning – Applications of machine learning – Tools for machine	25
2.	**Supervised Learning** – Introduction and examples of supervised learning – Classification model and classification learning steps – Training data sets and validation data sets – Deep learning in artificial neural network, Deep Vs. shallow learning – Introduction to deep learning	25
3.	**Unsupervised Learning** – Introduction to Clustering – Self Organizing map/Kohenon neural network – K nearest neighborhood – K-means and its variations – Applications of unsupervised learning – Introduction to hybrid	25
4.	**Hybrid Computational Intelligence** – Constituents of computational intelligence	25

	– Possible hybridization of constituents of computational intelligence – Neuro-Fuzzy Systems, Neuro-Genetic Systems and Neuro-Fuzzy-Genetic systems – Applications of computational intelligence system in real	

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	• To understand the fundamental concepts related to machine learning techniques.
2.	• To understanding the application of modern intelligent systems in solving real-life problems.

Suggested References:	
Sr. No.	References
1.	Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, "Machine Learning", Pearson Education, 2018.
2.	Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.
3.	Sajja P S, Illustarted computational Intellignce:Examples and Applications, Springer International Publishing, 2020.
4.	Christopher M. Bishop, Pattern recognition and machine learning, Spinger, 2006.
5.	Ethem Alpaydın, Introduction to Machine Learning, Second Edition, 2010.

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MCA (Master of Computer Applications)
MCA (Master of Computer Applications) Semester III

Course Code	PS03EMCA59	Title of the Course	DATA SCIENCE AND BIG DATA ANALYSIS
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To impart knowledge of data science, big data and data analytics 2. To teach and demonstrate techniques and technologies used by data science practitioners

Course Content		
Unit	Description	Weightage* (%)
1.	**Introduction to Data Science Data Analytics** – Data Science Definition – Need and features – Importance of Data Science in Modern Business – Current Trends in Data Science – Analytical Techniques	25
2.	**Introduction to Big Data and Big Data Analytics** – Types of Digital Data: Unstructured, Semi-structured and Structured – Working with Unstructured Data – Evolution and Definition of Big Data – Characteristics and Need of Big Data – Meaning and Characteristics of Big Data Analytics – Need of Big Data Analytics – Classification of Analytics – Importance of Big Data Analytics	25
3.	**Data Visualization and Analysis using Python Packages** – Using Matplotlib for data visualization – Using NumPy for data analysis – Using pandas for data analysis – Introduction to SciPy – Case Studies	25
4.	**Data Visualization and Analysis using R and Hadoop** – The R programming language and environment for statistical computing – Introduction to R Studio	25

	– Using Hadoop and MapReduce for big data analysis – Case studies	

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	demonstrate knowledge of data science, big data and data analytics.
2.	understand and apply techniques and technologies used by data science practitioners.

Suggested References:	
Sr. No.	References
1.	Davy Cielen, Arno D.B. Meysman, Mohamed Ali, Introducing Data Science: Big Data, Machine Learning and More, Using Python Tools.
2.	Seema Acharya, Subhashini Chellappan, Big Data and Analytics, Wiley.
3.	Vignesh Prajapati, Big Data Analytics with R and Hadoop – Packrt.
4.	Wes McKinney, "Python for Data Analysis", O'Reilly, 2013.
5.	Robert I. Kabacoff, "R in Action: Data Analysis and Graphics with R", Manning, 2011.

6.	Akerkar R.A. and Sajja, P.S. "Intelligent Techniques for Data Science", Springer International Publishing, Switzerland, August 2016.
7.	Minelli, Chambers, Dhiray, Big Data Big Analytics, Wiley.
8.	Bart Baesens, Analytics in a Big Data World , Wiley.
9.	Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drives, and Techniques, , Pearson India Education Services Pvt. Ltd., 2016.
10.	Roger D. Peng and Elizabeth Matsui, The Art of Data Science: A Guide for Anyone Who Works with Data, LeanPub, 2016.
11.	Brian Caffo, Roger D. Peng and Jeffrey Leek, Executive Data Science A Guide to Training and Managing the Best Data Scientists, LeanPub, 2016.
12.	Sridhar Alla, Big Data Analytics with Hadoop 3, Ingram, 2018.
13.	Benjamin Bengfort, Data Analytics with Hadoop: An Introduction for Data Scientists, O'Reilly, 2016.
14.	Tom White, Hadoop: The Definitive Guide, O'Reilly, 2009.

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MCA (Master of Computer Applications)
MCA (Master of Computer Applications) Semester III

Course Code	PS03EMCA60	Title of the Course	ADVANCED JAVA PROGRAMMING
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To introduce the students to enterprise Java application development using Jakarta EE 2. To enable students to develop dynamic web pages using Java Servlets and the JSP technology 3. To train the students in using the Hibernate ORM 4. To teach the students the Spring Framework and Spring Boot 5. To introduce the students to the EJB techology 6. To familiarize the students with software design patterns

Course Content		
Unit	Description	Weightage* (%)
1.	**Java Servlets and the Java Sever Page (JSP) Technology** – Introduction to Jakarta EE – Introduction to Java Servlet – Life cycle of Servlet – Database access using Servlets and JDBC – Introduction to JSP, Architecture of JSP – Developing simple JSP page – JSP expressions, directives, declarations – JSP implicit objects – Introduction to internationalization in JSP	25
2.	**The Hibernate ORM** – Object-relational mapping (ORM) – Introduction to the Hibernate ORM and JPA – Hibernate entities – HQL (Hibernate Query Language) – Hibernate annotations – Hibernate named queries and query parameters – CRUD operations using Hibernate – Relationships between entities in Hibernate	25
3.	**The Spring Framework and Spring Boot** – Introduction to the Spring framework	25

	– Inversion of Control (IoC) and Dependency Injection (DI) – Data access framework – Spring MVC – Developing Spring applications using Spring Boot	
4.	**Enterprise Java Beans (EJB) and Java EE Design Patterns** – Introduction to the Enterprise Java Beans (EJB) technology – Entity beans – Session beans – Message driven beans – Introduction to design patterns – Common design patterns	25

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	understand and describe enterprise Java application development using Jakarta EE.
2.	develop dynamic web pages using Java Servlets and the JSP technology.
3.	use the Hibernate ORM for object-relational mapping and data access.
4.	develop Jakarta EE enterprise web applications using the Spring Framework and Spring Boot.
5.	use the EJB technology in Jakarta EE applications.
6.	describe software design patterns.

Suggested References:	
Sr. No.	References
1.	Eric Jendrock, et. al., The Java EE 7 Tutorial: Volume 1, 5th Edition, Addison-Wesley Professional, 2014.
2.	Eric Jendrock, et. al., The Java EE 7 Tutorial: Volume 2, 5th Edition, Addison-Wesley Professional, 2014.
3.	Luciano Manelli, Beginning Jakarta EE Web Development, 3rd Edition, Apress, 2020.
4.	Antonio Goncalves, Beginning Java EE 7, Apress, 2013.
5.	Jim Koegh, The Complete Reference J2EE, McGraw Hill Education, 2017.
6.	Christian Bauer, Gavin King, and Gary Gregory, Java Persistence with Hibernate, 2nd Edition, Manning Publications, 2015.
7.	Debu Panda, Reza Rahman, Ryan Cuprak, and Michael Remijan, EJB 3 in Action, 2nd Edition, Manning Publication, 2014.
8.	Kathy Sierra and Bert Bates, Head First EJB, O'Reilly, 2003.
9.	Rod Johnson, et. al., Professional Java Development with the Spring Framework, O'Reilly, 2005.
10.	Felipe Gutierrez, Introducing Spring Framework, Apress, 2014.
11.	K. Siva Prasad Reddy, Beginning Spring Boot 2, Apress, 2017.
12.	Craig Walls, Spring Boot in Action, Manning Publication, 2016.
13.	Murat Yener and Alex Theedom, Professional Java EE Design Patterns, Wrox Publications, 2014.

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MCA (Master of Computer Applications)
MCA (Master of Computer Applications) Semester III

Course Code	PS03EMCA57	Title of the Course	CLOUD COMPUTING & DISTRIBUTED SYSTEMS
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To understand the basic concepts of cloud computing and distributed systems 2. To acquire basic information about various cloud platforms. 3. To learn various applications and benefits of cloud computing. 4. To study design issues, system models and processor allocation algorithms for distributed systems.

Course Content

Unit	Description	Weightage* (%)
1.	**Introduction to cloud computing** – Definition and characteristics of cloud computing – Benefits and challenges of cloud computing – Overview of cloud architecture – Applications of cloud computing – Cloud service delivery models (IaaS, PaaS, SaaS)	25
2.	**Deployment Model, Virtualization and Security** – Cloud deployment models: Public, Private, Community & Hybrid – Architecture for traditional versus cloud applications – Fundamental requirements for cloud application architecture – Service Oriented Architecture(SOA) for cloud applications – Virtualization – Categorization of cloud security issues – Introduction to open source and commercial clouds	25
3.	**Distributed Systems – I** – Basic concepts – Advantages and disadvantages of distributed systems – Tightly coupled and loosely coupled systems, – Hardware and Software Requirements – True Distributed Systems – Design Issues – Distributed file system design	25

4.	**Distributed Systems – II** – System models for organizing processors in a distributed system : the workstation model, the processor pool model and the hybrid model. – Using idle workstations – Design and implementation issues for processor allocation algorithms – Processor Allocation Models – Synchronization Aspects	25

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	understand concepts of cloud computing and distributed systems.
2.	understand the cloud service models & deployment models.
3.	gain knowledge of concept related to virtualization.
4.	gain basic understanding of the design issues, system models and processor allocation strategies for distributed.

Suggested References:	
Sr. No.	References
1.	Fundamentals of cloud computing, A. Kannammal, CENGAGE Learning
2.	Kailash Jayaswal, Jagannath Kallakurchi, Donald J Houde, Dr. Deven Shah : Cloud Computing :Black Book Dreamtech Publications
3.	Tanenbaum A. S. and Herbert Bos, Modern Operating Systems, 4th Edition, Pearson, 2014.
4.	Tanenbaum Andrew S.: Distributed Operating Systems, Pearson Education India, 1995.
5.	RajkumarBuyya, James Broberg, Andrzej M Goscinski: Cloud Computing: Principles and Paradigms, Wiley Publication.
6.	RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi: Mastering Cloud Computing: Foundations and applications programming, Elsevier Morgan Kaufmann.
7.	Anthony T. Velte, Toby J. Velte, Robert Elsenpeter: Cloud Computing – A Practical Approach, Tata McGraw Hill Education.
8.	Rishabh Sharma: Cloud Computing Fundamentals, Industry Approach and Trends: Wiley Publication.
9.	Barrie Sosinsky, Cloud Computing Bible,Willey Publication.

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MCA (Master of Computer Applications)
MCA (Master of Computer Applications) Semester III

Course Code	PS03EMCA58	Title of the Course	MACHINE LEARNING
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To learn the fundamental issues and challenges of traditional artificial intelligence systems and the need for machine learning. 2. To learn the strengths and weaknesses of many popular machine learning approaches. 3. TO learn various machine learning algorithms, paradigms of supervised and unsupervised learning, and hybrid computational intelligence techniques. 4. To be able to learn applications of machine learning in various real-life systems.

Course Content		
Unit	Description	Weightage* (%)
1.	**Introduction to Machine Learning** – Types of learning: Human and machine learning – Types of machine learning – Applications of machine learning – Tools for machine	25
2.	**Supervised Learning** – Introduction and examples of supervised learning – Classification model and classification learning steps – Training data sets and validation data sets – Deep learning in artificial neural network, Deep Vs. shallow learning – Introduction to deep learning	25
3.	**Unsupervised Learning** – Introduction to Clustering – Self Organizing map/Kohenon neural network – K nearest neighborhood – K-means and its variations – Applications of unsupervised learning – Introduction to hybrid	25
4.	**Hybrid Computational Intelligence** – Constituents of computational intelligence	25

	– Possible hybridization of constituents of computational intelligence – Neuro-Fuzzy Systems, Neuro-Genetic Systems and Neuro-Fuzzy-Genetic systems – Applications of computational intelligence system in real	

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to

1.	• To understand the fundamental concepts related to machine learning techniques.
2.	• To understanding the application of modern intelligent systems in solving real-life problems.

Suggested References:

Sr. No.	References
1.	Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, "Machine Learning", Pearson Education, 2018.
2.	Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.
3.	Sajja P S, Illustarted computational Intellignce:Examples and Applications, Springer International Publishing, 2020.
4.	Christopher M. Bishop, Pattern recognition and machine learning, Spinger, 2006.
5.	Ethem Alpaydın, Introduction to Machine Learning, Second Edition, 2010.

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MCA (Master of Computer Applications)
MCA (Master of Computer Applications) Semester III

Course Code	PS03EMCA59	Title of the Course	DATA SCIENCE AND BIG DATA ANALYSIS
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To impart knowledge of data science, big data and data analytics 2. To teach and demonstrate techniques and technologies used by data science practitioners

Course Content		
Unit	Description	Weightage* (%)
1.	**Introduction to Data Science Data Analytics** – Data Science Definition – Need and features – Importance of Data Science in Modern Business – Current Trends in Data Science – Analytical Techniques	25
2.	**Introduction to Big Data and Big Data Analytics** – Types of Digital Data: Unstructured, Semi-structured and Structured – Working with Unstructured Data – Evolution and Definition of Big Data – Characteristics and Need of Big Data – Meaning and Characteristics of Big Data Analytics – Need of Big Data Analytics – Classification of Analytics – Importance of Big Data Analytics	25
3.	**Data Visualization and Analysis using Python Packages** – Using Matplotlib for data visualization – Using NumPy for data analysis – Using pandas for data analysis – Introduction to SciPy – Case Studies	25
4.	**Data Visualization and Analysis using R and Hadoop** – The R programming language and environment for statistical computing – Introduction to R Studio	25

	– Using Hadoop and MapReduce for big data analysis – Case studies	

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	demonstrate knowledge of data science, big data and data analytics.
2.	understand and apply techniques and technologies used by data science practitioners.

Suggested References:	
Sr. No.	References
1.	Davy Cielen, Arno D.B. Meysman, Mohamed Ali, Introducing Data Science: Big Data, Machine Learning and More, Using Python Tools.
2.	Seema Acharya, Subhashini Chellappan, Big Data and Analytics, Wiley.
3.	Vignesh Prajapati, Big Data Analytics with R and Hadoop – Packrt.
4.	Wes McKinney, "Python for Data Analysis", O'Reilly, 2013.
5.	Robert I. Kabacoff, "R in Action: Data Analysis and Graphics with R", Manning, 2011.

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7.	Minelli, Chambers, Dhiray, Big Data Big Analytics, Wiley.
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10.	Roger D. Peng and Elizabeth Matsui, The Art of Data Science: A Guide for Anyone Who Works with Data, LeanPub, 2016.
11.	Brian Caffo, Roger D. Peng and Jeffrey Leek, Executive Data Science A Guide to Training and Managing the Best Data Scientists, LeanPub, 2016.
12.	Sridhar Alla, Big Data Analytics with Hadoop 3, Ingram, 2018.
13.	Benjamin Bengfort, Data Analytics with Hadoop: An Introduction for Data Scientists, O'Reilly, 2016.
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MCA (Master of Computer Applications)
MCA (Master of Computer Applications) Semester III

Course Code	PS03EMCA60	Title of the Course	ADVANCED JAVA PROGRAMMING
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To introduce the students to enterprise Java application development using Jakarta EE 2. To enable students to develop dynamic web pages using Java Servlets and the JSP technology 3. To train the students in using the Hibernate ORM 4. To teach the students the Spring Framework and Spring Boot 5. To introduce the students to the EJB techology 6. To familiarize the students with software design patterns

Course Content		
Unit	Description	Weightage* (%)
1.	**Java Servlets and the Java Sever Page (JSP) Technology** – Introduction to Jakarta EE – Introduction to Java Servlet – Life cycle of Servlet – Database access using Servlets and JDBC – Introduction to JSP, Architecture of JSP – Developing simple JSP page – JSP expressions, directives, declarations – JSP implicit objects – Introduction to internationalization in JSP	25
2.	**The Hibernate ORM** – Object-relational mapping (ORM) – Introduction to the Hibernate ORM and JPA – Hibernate entities – HQL (Hibernate Query Language) – Hibernate annotations – Hibernate named queries and query parameters – CRUD operations using Hibernate – Relationships between entities in Hibernate	25
3.	**The Spring Framework and Spring Boot** – Introduction to the Spring framework	25

	– Inversion of Control (IoC) and Dependency Injection (DI) – Data access framework – Spring MVC – Developing Spring applications using Spring Boot	
4.	**Enterprise Java Beans (EJB) and Java EE Design Patterns** – Introduction to the Enterprise Java Beans (EJB) technology – Entity beans – Session beans – Message driven beans – Introduction to design patterns – Common design patterns	25

Teaching-Learning Methodology	Blended learning approach incorporating traditional classroom teaching as well as online / ICT-based teaching practices

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	understand and describe enterprise Java application development using Jakarta EE.
2.	develop dynamic web pages using Java Servlets and the JSP technology.
3.	use the Hibernate ORM for object-relational mapping and data access.
4.	develop Jakarta EE enterprise web applications using the Spring Framework and Spring Boot.
5.	use the EJB technology in Jakarta EE applications.
6.	describe software design patterns.

Suggested References:	
Sr. No.	References
1.	Eric Jendrock, et. al., The Java EE 7 Tutorial: Volume 1, 5th Edition, Addison-Wesley Professional, 2014.
2.	Eric Jendrock, et. al., The Java EE 7 Tutorial: Volume 2, 5th Edition, Addison-Wesley Professional, 2014.
3.	Luciano Manelli, Beginning Jakarta EE Web Development, 3rd Edition, Apress, 2020.
4.	Antonio Goncalves, Beginning Java EE 7, Apress, 2013.
5.	Jim Koegh, The Complete Reference J2EE, McGraw Hill Education, 2017.
6.	Christian Bauer, Gavin King, and Gary Gregory, Java Persistence with Hibernate, 2nd Edition, Manning Publications, 2015.
7.	Debu Panda, Reza Rahman, Ryan Cuprak, and Michael Remijan, EJB 3 in Action, 2nd Edition, Manning Publication, 2014.
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9.	Rod Johnson, et. al., Professional Java Development with the Spring Framework, O'Reilly, 2005.
10.	Felipe Gutierrez, Introducing Spring Framework, Apress, 2014.
11.	K. Siva Prasad Reddy, Beginning Spring Boot 2, Apress, 2017.
12.	Craig Walls, Spring Boot in Action, Manning Publication, 2016.
13.	Murat Yener and Alex Theedom, Professional Java EE Design Patterns, Wrox Publications, 2014.

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