School of CSA

B.Sc (Research)
(Computer Science - Cloud Computing and Big Data)

HANDBOOK
2018-2019

REVA UNIVERSITY
Bengaluru, India

10 YEARS OF UNIVERSITY RECOGNITION
20 YEARS OF ACADEMIC EXCELLENCE

SCHOOL OF COMPUTER SCIENCE AND APPLICATIONS

Bachelor of Science (Research) Computer Science-Cloud Computing and Big Data

HANDBOOK

2018

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Chancellor's Message

"Education is the most powerful weapon which you can use to change the world."- Nelson Mandela.

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when 'intellectual gratification' has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. The difference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of 'Knowledge is power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I'm always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said 'A University should be a place of light, of liberty and of learning'. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVA University to join hands in laying the foundation of your future with values, wisdom and knowledge.

Dr. P. Shyama Raju

The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor's Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.

A strong believer and practitioner of the dictum "Knowledge is Power", REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this 'temple of learning' has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of Reva University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE

and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft-skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, "Intelligence plus character –that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to provide premium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS".

Welcome to the portals of REVA University!

Dr. S. Y. Kulkarni
Vice-Chancellor, REVA University

Director –Message

Welcome note to students

It's my pleasure to welcome you to the School of Computer Science and Applications. Computer, being considered as most significant and revolutionary invention of mankind has metamorphosed the planet earth completely. Predominantly School of Computer Science and Applications have acquired the control of the modern life in a myriad way.

The Bachelor of Science with specialization in Cloud Computing & Big Data program is designed keeping in view the current situation and possible future developments, both at national and global levels. This program is designed to give greater emphasis on Cloud Computing and Big Data analytics. This program on Cloud computing & Big Data will teach both the fundamental concepts of how and why Cloud systems works, as well as Cloud technologies such as Amazon AWS, Microsoft Azure, and Open Stack. Students will learn concepts like virtualization, private & public clouds. They will also become proficient in "Big Data" on various platforms. Besides a hands-on project, this program will include knowledge transfer by Industry experts. The lab sessions cover cloud application development and deployment, use of cloud storage, creation and configuration of virtual machines and data analysis on cloud using data mining tools. A variety of activities such as mini projects, seminars, interaction with industries, cultural activities and social activities are in place to shape the all-round development of students.

Students after successful completion of Bachelor of Science with specialization in Cloud Computing & Big Data program:

- Can design cloud-based Solutions/Architecture
- Can develop and deploy cloud application using popular cloud platforms
- Can build private cloud, Public Cloud & Hybrid Cloud
- Can design and develop highly scalable cloud-based applications by creating and configuring virtual machines on the cloud
- Can perform big data analysis in cloud

The curriculum caters to and has relevence to local, reginal, natinal and global development needs. All courses are focussed on building skill, employability and entrepreneurship of students. Maximum number of courses are integrated with cross cutting issues with relevant to professional ethics, gender, human values, environment and sustainability.

I am sure the students choosing Bachelor of Science (Cloud Computing & Big Data) in REVA University will enjoy the curriculum, teaching and learning environment, the vast infrastructure and the experienced teachers involvement and guidance. We will strive to provide all needed comfort and congenial environment for their studies. I wish all students pleasant stay in REVA and grand success in their career.

Dr. S. Senthil
Director, School of Computer Science and Applications

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. **Rukmini Educational Charitable Trust** (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notched educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 13,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette No. 80 dated 27thFebruary, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 45 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-built teaching facilities, fully air-conditioned library and central computer centre, the well planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

The University is presently offering 23 Post Graduate Degree programs, 20 Degree and PG Degree programs in various branches of studies and has 12000+ students studying in various branches of knowledge at graduate and post graduate level and 302 Scholars pursuing research leading to PhD in 18 disciplines. It has 800+ well qualified, experienced and committed faculty members of whom majority are doctorates in their respective areas and most of them are guiding students pursuing research leading to PhD.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty

supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Censor Networks, Computer Networks, IOT, MEMS, Nano- Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nana Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much required skills through variety of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor & Dean, and supported by well experienced Trainers, Counselors and Placement Officers.

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other

unemployed students. The University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Okalahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc, to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitates students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

The University has also given greater importance to quality in education, research, administration and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works on planning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms. To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N R Narayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. Balaram, Former Director IISc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of Defence Dr. Sathish Reddy, Scientific Advisor, Ministry of Defence, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

As a part of our effort in motivating and inspiring youth of today, REVA University also has instituted awards and prizes to recognize the services of teachers, researchers, scientists, entrepreneurs, social workers and such others who have contributed richly for the development of the society and progress of the country. One of such award instituted by REVA University is 'Life

Time Achievement Award' to be awarded to successful personalities who have made mark in their field of work. This award is presented on occasion of the "Founders' Day Celebration" of REVA University in presence of dignitaries, faculty members and students gathering and the first "REVA Life Time Achievement Award" for the year 2015 has been awarded to Shri. Kiran Kumar, Chairman ISRO on the occasion of Founder's Day Celebration, 6th January, 2016 and the second "REVA Life Time Achievement Award" for the year 2016 has been awarded to Shri. Shekhar Gupta, Renowned Journalist on the occasion of Founder's Day Celebration, 6th January, 2017.

REVA organises various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of such cultural events is REVAMP conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges. During three days of this mega event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is Shubha Vidaaya, - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective spheres of activities. During this occasion, the students who have achieved top ranks and won medals and prizes in academic, cultural and sports activities are also recognised by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga classes everyday to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Recognizing the fast growth of the university and its quality in imparting higher education, the BERG (Business Excellence and Research Group), Singapore has awarded BERG Education Award 2015 to REVA University under Private Universities category. The University has also been honoured with many more such honors and recognitions.

REVA University Vision

''REVA University aspires to become an innovative university by developing excellent human resources with leadership qualities, ethical and moral values, research culture and innovative skills through higher education of global standards''.

Mission

- To create excellent infrastructure facilities and state-of-the-art laboratories and incubation centers
- To provide student-centric learning environment through innovative pedagogy and education reforms
- To encourage research and entrepreneurship through collaborations and extension activities
- To promote industry-institute partnerships and share knowledge for innovation and development
- To organize society development programs for knowledge enhancement in thrust areas
- To enhance leadership qualities among the youth and enrich personality traits, promote patriotism and moral values.

Objectives

- Creation, preservation and dissemination of knowledge and attainment of excellence in different disciplines
- Smooth transition from teacher - centric focus to learner - centric processes and activities
- Performing all the functions of interest to its major constituents like faculty, staff, students and the society to reach leadership position
- Developing a sense of ethics in the University and Community, making it conscious of its obligations to the society and the nation
- Accepting the challenges of globalization to offer high quality education and other services in a competitive manner

ABOUT SCHOOL OF COMPUTER SCIENCE AND APPLICATIONS

The School of Computer Science and Applications is shouldered by well qualified, experienced and highly committed faculty. The state-of-the-art infrastructure digital classrooms, well equipped advanced computer laboratory, conference rooms and the serene academic atmosphere at REVA University will enhance the transfer as well as creation of knowledge. The School offers BCA, B. Sc. (R) Computer Science-Cloud Computing and Big Data, MCA and MS (Computer Science) programs. The School also has research program leading to doctoral degree. The curriculum of both graduate and post graduate degree programs have been designed to bridge the gap between industry – academia and hence they are industry oriented. These programs provide ample scope to enter into a wide range of business opportunities, entrepreneurship ventures and as well as job opportunities in different sectors. This is reflected in various core subjects / courses offered within the program. Further the school provides an interactive, collaborative peer tutoring environment that encourages students to break down complex problems and develop strategies for finding solutions across a variety of situations and disciplines. The school aims to develop a learning community of critical thinkers who serve as models of innovative problems solving in the university environment to enrich their academic and professional careers.

VISION

To transform students into good human beings, responsible citizens and competent professionals, focusing on assimilation, generation and dissemination of knowledge in the area of Computer Applications.

MISSION

- To impart quality education to meet the needs of profession and society, and achieve excellence in teaching-learning and research in the area of Computer Applications;

- To attract and develop talented and committed human resource, and provide an environment conducive to innovation, creativity, team-spirit and entrepreneurial leadership in Computing field;

- To facilitate effective interactions among faculty and students of the School of Computer Applications, and foster networking with alumni, industries, institutions and other stake-holders; and

- To practice and promote high standards of professional ethics, transparency and accountability.

OBJECTIVES

- To impart programs at graduate, post-graduate and doctoral levels in the field of computer applications;

- To adopt innovative methods of teaching and promote student centric learning process;

- To create infrastructure of international standard and facilitate and create conducive environment for teaching, learning and research;

- To promote faculty development and encourage faculty members and students to organize and participate in national and international level conferences, seminars, symposia and such others;

- To encourage teachers and students to take-up interdisciplinary studies and research;

- To promote students participation in co-curricular and extension activities and develop their personality traits and team spirit

ADVISORY BOARD

SL. No	Name and Affiliation
1	Dr. Anand Kumar Professor and Dean-Academics, MCA Department, M.S Engineering College
2	Dr. Muralidhar B.L Professor and Coordinator, MCA Programme, Bangalore University
3	Dr. Dharani Dhamre Professor, Dept of MCA, RVCE
4	Mr. Manikantan Mohanavelu Head Training Tower-India, HP
5	Mr. Madusudan R Practice Lead, Engagement & System Operations-IBM
6	Mr. Dharshan Maheshbhai Project Lead- Cognizant Technology Pvt Ltd
7	Mr. Ashish Tanwar, University Relations Manager-India, Dell

Programme Overview

The Bachelor of Science (Research) Computer Science-Cloud Computing and Big Data programme is designed keeping in view the current situation and possible future developments, both at national and global levels. This programme is designed to give greater emphasis on Cloud Computing and Big Data analytics. This programme on Cloud computing & Big Data will teach both the fundamental concepts of how and why Cloud systems works, as well as Cloud technologies such as Amazon AWS, Microsoft Azure, and Open Stack. Students will learn concepts like virtualization, private & public clouds. They will also become proficient in "Big Data" on various platforms. Besides a hands-on project, this program will include knowledge transfer by Industry experts. The lab sessions cover cloud application development and deployment, use of cloud storage, creation and configuration of virtual machines and data analysis on cloud using data mining tools. A variety of activities such as mini projects, seminars, interaction with industries, cultural activities and social activities are in place to shape the all-round development of students.

There is a dearth for cloud engineers, data scientists, data analysts, cloud architects. This programme aims in fulfilling the demand by sending graduates equipped for the industry.

The School of Computer Science and Applications at REVA UNIVERSITY has designed to offer B.Sc(R) (Computer Science-Cloud Computing and Big Data) programme as an undergraduate degree programme to create motivated, enthusiastic, thinking and creative graduates to fill the roles as computer algorithm developers, computer programmers, computer application developers, professors, scientists, professionals and administrators.

The B.Sc(R) (Computer Science-Cloud Computing and Big Data) programme at **School of Computer Science and Applications** has been designed and developed by industry experts. The cloud related subjects are handled by corporate trainers and it is in par with the industry standards.

The curriculum is outcome based and it imbibes required theoretical concepts and practical skills in the domain. By undergoing this programme, students develop critical, analytical thinking and problem solving abilities for a smooth transition from academic to real-life work environment. In addition, students are trained in communication skills and interdisciplinary topics to enhance their scope. The above mentioned features of the programme, advanced

teaching and learning resources, and experience of the faculty members with their strong connections with industry and research organizations makes this programme unique.

Program Educational Objectives (PEO's)

The programme acts as a foundation degree and helps to develop critical, analytical and problem solving skills at first level. The foundation degree makes the graduates employable in IT industries, scientific organisations and also to assume administrative positions in various types of organisations. With further acquisition of higher level degrees help the graduates to pursue a career in academics or scientific organisations as a researcher.

The Programme Educational Objectives are to prepare the students to:

PEO-1	Be cloud engineers , data analysts, data scientists and cloud architects and Operate various cloud related commercial software tools to solve scientific and business problems.
PEO-2	Be computer Application Developers, Algorithm developers, Computer Programmers and to Work alongside engineering, medical, ICT professionals and scientists to assist them in setting up a cloud in their area of domain.
PEO-3	Adopt lifelong learning philosophy for continuous improvement to which qualifies them to become professionals in various levels as administrators in public, private organisations or as scientists in research establishments
PEO-4	Understand environmental, legal, cultural, social, ethical, public safety issues and Work as a member of a team and communicate effectively across team members to set his/her own enterprise with further training

Program Outcomes for B.Scs (Research) In Computer Science- Cloud Computing And Big Data

After undergoing this programme, a student will be able to:

- **PO 1: Disciplinary knowledge**: Capable of demonstrating comprehensive knowledge and understanding of computer science with specialization in Cloud computing and Big data analytics that form a part of B.Sc(Honors) in Computer Science –Cloud Computing and Big Data

- **PO 2: Scientific reasoning**: Ability to analyse, and understand concepts in computer science, critically evaluate ideas, logical reasoning and experiences in programming, algorithm development and application development.

- **PO 3: Problem solving**: Capacity to extrapolate and apply competencies to solve different kinds of non-familiar problems, such as design cloud-based Solutions/Architecture,

develop and deploy scalable cloud application using popular cloud platforms, build private cloud, Public Cloud & Hybrid.

- **PO 4: Environment and Sustainability**: Understand the issues of environmental contexts and **sustainable development and provide solutions for the same using domain knowledge in Cloud computing**.

- **PO 5: Research-related skills**: Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation in data analytics.

- **PO 6: Ethics**: Conduct as a responsible citizen by recognizing different value systems and understand the **moral dimensions** of decisions, and **accept responsibility** for them.

- **PO 7: Cooperation/Team work**: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.

- **PO 8: Communication Skills**: Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups

- **PO 9: Self-directed and Life-long Learning**: Acquire the ability to engage in independent and **life-long learning** in the broadest context socio-technological changes.

Programme Specific Outcomes (PSO)

1. Design cloud-based Solutions or Architecture, and use the popular cloud platforms to develop and deploy cloud applications.
2. Provide computer based solutions for real life problems by developing specific software products.
3. Design and develop a highly scalable cloud-based applications by configuring virtual machines on the cloud.

Bachelor of Science in Computer Science with specialization in Cloud Computing and Big Data
Scheme of Instructions

(effective from Academic Year 2018-19)

FIRST SEMESTER

SL. NO	Code	Title	HC/ SC/ FC	Credit Pattern			Credits	Working Hrs
				L	T	P		
1	B18BS1010	Mathematics	HC	4	0	0	4	4
2	B18BS1020	Programming in C	HC	2	1	0	3	4
3	B18BS1030	Linux Foundation	HC	2	1	0	3	4
4	B18BS1040	Digital Logic Design &Computer Organization	HC	4	0	0	4	4
5	B18BS1050	Environmental Studies	FC	2	0	0	2	2
6	B18BS1060	Technical English	FC	2	0	1	3	4
7	B18BS1070	Sports/Music/Yoga/Dance	RULO	2	0	0	2	2
Practical Courses								
8.	B18BS1080	C Programming Lab	HC	0	0	2	2	4
9	B18BS1090	Linux Lab	HC	0	0	2	2	4
Total Credits				**18**	**2**	**5**	**25**	**32**

SECOND SEMESTER

SL. NO	Code	Title	HC/ SC/ FC	Credit Pattern			Credits	Working Hrs
				L	T	P		
1	B18BS2010	Operating systems	HC	4	0	0	4	4
2	B18BS2020	Data Structures using C	HC	2	1	0	3	4
3	B18BS2030	Advanced Linux	HC	2	1	0	3	4
4	B18BS2040	Probability and statistics	HC	4	0	0	4	4
5	B18BS2050	Constitution of India & Professional Ethics	FC	2	0	0	2	2
Practical Courses								
6	B18BS2060	Data Structures Lab	HC	0	0	2	2	4
7	B18BS2070	Advanced Linux Lab	HC	0	0	2	2	4
Total Credits				**16**	**2**	**4**	**20**	**26**

THIRD SEMESTER

Sl.NO	Code	Title	HC /SC/ FC	Credit Pattern			Credits	Working Hrs
				L	T	P		
1	B18BS3010	Cloud Computing and Virtualization Foundation	HC	3	0	1	4	5
2	B18BS3020	Object Oriented Programming with JAVA	HC	2	1	0	3	4
3	B18BS3030	Relational Database Management Systems	HC	2	1	0	3	4
4	B18BS3040	Data mining & Data warehousing	HC	4	0	0	4	4
5	B18BS3050	Computer Networks	HC	4	0	0	4	4
6	B18BS3061	Numerical methods	SC	2	1	0	3	4
	B18BS3062	Discrete Mathematical Structures						
7	B18BS3070	Soft skills	RULO	2	0	0	2	2
Practical Courses								
8	B18BS3080	Object Oriented Programming with JAVA Lab	HC	0	0	2	2	4
9	B18BS3090	RDBMS Lab	HC	0	0	2	2	4
Total Credits				**19**	**3**	**5**	**27**	**35**

FOURTH SEMESTER

Sl. No.	Code	Title	HC/SC/FC	Credit Pattern			Credits	Working Hrs
				L	T	P		
1	B18BS4010	Cloud Computing Architecture and Design	HC	2	1	0	3	4
2	B18BS4020	Object Oriented Modelling and Design	HC	2	1	0	3	4
3	B18BS4030	Design and Analysis of Algorithms	HC	4	0	0	4	4
4	B18BS4040	Operations Research	HC	4	0	0	4	4
5	B18BS4051	Advanced Computer Networks	SC	2	1	0	3	4
	B18BS4052	Introduction to Data Science						
6	B18BS4060	Mooc/Swayam	RULO	4	0	0	4	4
7	B18BS4070	Soft skills	RULO	2	0	0	2	2
Practical Courses								
8	B18BS4080	Cloud Computing Architecture and Design Lab	HC	0	0	2	2	4
9	B18BS4090	Object Oriented Modelling and Design LAB	HC	0	0	2	2	4
Total Credits				**20**	**3**	**4**	**27**	**34**

FIFTH SEMESTER

Sl. No	Code	Title	HC/ SC/ FC	Credit Pattern			Credits	Working Hrs
				L	T	P		
1	B18BS5010	Public Cloud platforms	HC	2	1	0	3	4
2	B18BS5020	Big Data Analytics using Hadoop	HC	3	0	1	4	5
3	B18BS5030	Programming with Python	HC	2	1	0	3	4
4	B18BS5041	Mobile Networks &Computing	SC	2	1	0	3	4
	B18BS5042	Information Security and Cryptography						
5	B18BS5051	Introduction to Web programming	SC	2	0	1	3	4
	B18BS5052	Data Science using Tableu						
6	B18BS5061	Cloud Databases	SC	2	1	0	3	4
	B18BS5062	Enterprise Resource Planning						
7	B18BS5070	Soft skills	RU LO	2	0	0	2	2
Practical Courses								
8	B18BS5080	AWS and Azure Public Cloud lab	HC	0	0	2	2	2
9	B18BS5090	Programming with Python lab	HC	0	0	2	2	2
Total Credits				**15**	**4**	**6**	**25**	**31**

SIXTH SEMESTER

Sl. No.	Code	Title	HC/SC/FC	Credit Pattern			Credits	Working Hrs
				L	T	P		
1	B18BS6010	Automation Tools for Cloud Deployment	HC	3	0	1	4	5
2	B18BS6020	Building Private Cloud with Openstack	HC	2	1	0	3	4
3	B18BS6030	Big Data and Hadoop on AWS and Azure	HC	2	1	0	3	4
4	B18BS6040	Software Engineering	HC	4	0	0	4	4
5	B18BS6051	Wireless Sensor Networks	SC	2	1	0	3	4
	B18BS6052	Cyber security & Big data Security						
6	B18BS6061	Advanced Web Programming using Ruby	SC	2	0	1	3	4
	B18BS6062	Data Analytics using R						
7	B18BS6070	Soft Skills	RULO	2	0	0	2	2
Practical Courses								
8	B18BS6080	Big Data and Hadoop on AWS and Azure lab	HC	0	0	2	2	2
9	B18BS6090	Building Private Cloud with Openstack lab	HC	0	0	2	2	2
Total Credits				**17**	**3**	**6**	**26**	**31**

SEVENTH SEMESTER

S.NO	Code	Title	HC/ SC/ FC	Credit Pattern			Credits	Working Hrs
				L	T	P		
1	B18BS7010	Deployment &Management of Private Cloud	HC	2	1	0	3	4
2	B18BS7020/ M18MS1010	Big Data Technologies on Google Cloud	HC	3	0	1	4	5
3	B18BS7030	Devops	HC	2	1	0	3	4
4	B18BS7040	Project Work – Phase-1	Others	0	2	2	4	8
5	B18BS7051	Software Project Management	SC	2	1	0	3	4
	B18BS7052/ M18MS1062	Advanced DBMS						
6	B18BS7061	Software Testing	SC	2	0	1	3	4
	B18BS7062	Machine Learning						
7	B18BS7071	Fundamentals of Cloud Computing*	OE	4	0	0	4	4
	B18BS7072	Basics of Data Analytics*	OE					
Practical Courses								
8	B18BS708	Deployment &Management of Private Cloud lab	HC	0	0	2	2	2
9	B18BS709	Devops lab	HC	0	0	2	2	2
Total Credits				**15**	**5**	**8**	**28**	**37**

Note: The Open Elective Courses offered are for students of other Schools: The students of School of Computer Science and Applications shall have to choose ONE Open Elective Course offered by any other School

Open Elective Courses offered to other Schools

Sl. No	Code	Title	HC/ SC/OE	Credit Pattern			Credits	Working Hrs
				L	T	P		
1	B18BS7071	Fundamentals of Cloud Computing	OE	4	0	0	4	4
	B18BS7072	Basics of Data Analytics						

EIGHTH SEMESTER

Sl. No	Code	Title	HC/SC/ FC	Credit Pattern			Cred its	Worki ng Hrs
				L	T	P		
1	B18BS8011	Cloud Storage using Open Stack Swift	SC	2	0	1	3	4
	B18BS8012/ M18MS2020	Linear Algebra						
2	B18BS8021	Internet of Things	SC	2	1	0	3	4
	B18BS8022/ M18MS2041	System Simulation and Modeling						
3	B18BS8030	Project Work– Phase-2	HC	0	4	4	8	16
Total Credits				**4**	**5**	**5**	**14**	**24**

Credit Summary

Semester	Credits
First	22
Second	26
Third	28
Fourth	28
Fifth	24
Sixth	24
Seventh	25
Eighth	15
Total	192

CREDIT DISTRIBUTION

Semester	Hard Core (HC)	Fundamental Core(FC)	Soft Core(SC)	Open Elective(OE)	Others	Project	Total Credits
I	18	5	-	-	2	-	25
II	18	2	-	-	-	-	20
III	22	-	3	-	2	-	27
IV	18	-	3	-	6	-	27
V	14	-	9	-	2	-	25
VI	18	-	6	-	2	-	26
VII	14	-	6	04	4		28
VIII		-	6	-	-	08	14
Total	122	7	33	04	18	08	
Total Credits for the Programme							**192**

Bachelor of Science in Computer Science with specialization in Cloud Computing and Big Data

DETAILED SYLLABUS

(effective from Academic Year 2018-19)

FIRST SEMESTER

B18BS1010	MATHEMATICS	L	T	P	C
Total Hours: 60		4	0	0	4

COURSE OBJECTIVES:

- To understand the concepts of Linear algebra and its applications in various fields of engineering and Technology.
- To understand the concepts of differential calculus and its applications.
- To familiarize with partial differentiation and its applications in various fields.
- To understand the concepts of Integral calculus, differential equations and its applications.

COURSE OUTCOMES:

After the completion of the course the student will be able to:

- Apply the knowledge of Linear Algebra in Image processing and digital signal processing
- Apply the knowledge of differential calculus in the field of wave theory and communication systems.
- Apply the knowledge of partial differential equations in the field of signals and systems, control systems.
- Apply the knowledge of Integral calculus differential equations to perform integration and other operations for certain types of functions and carry out the computation fluently.

COURSE CONTENT:

UNIT I Linear Algebra   **15 Hours**

Rank of matrix, Echelon form, (*reference-Normal form: one example), Solution of a system of linear equations by Gauss elimination, LU decomposition, Diagonalization of a matrix, Rayleigh Power method to find the largest Eigen value and corresponding Eigen vector.

UNIT II Differential Calculus 15Hours

Successive differentiation-nth derivatives (proof and problems), Leibnitz Theorem (without proof) and problems, Taylor's series and McLaren's series expansion for one variable (only problems), Partial Differentiation: Partial derivatives-Euler's theorem-problems, Total derivative and chain rule.

UNIT III Integral Calculus 15Hours

Reduction formulae for the integrals, and evaluation of these integrals with standard limits (direct result) – Problems, Multiple Integrals – Double integrals, change of order of integration (simple problems).

UNIT IV Differential Equations 15 Hours

1st order Differential Equation, Definition Exact equation and reducible to exact form (1. Close to expression M or N and find IF, 2. $y = f(x)\ dx + x\ g(y)\ dy$),2nd order Linear Differential Equations: Definitions, Complete solution, Operator D, Rules for finding the complementary function, Inverse operator, Rules for finding the particular integral Method of variation of parameters(simple problems).

Text Books:
1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th edition, 2013.

Reference Books:
1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th Reprint edition, 2013.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 4th edition, 2014.

B18BS1020	PROGRAMMING IN C	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:

- Explain the basic programming concepts.
- Illustrate the importance of Algorithm to write the Program(in small steps).
- Divide a problem into its logical set of components.
- Describe how a good program design can reduce coding and debugging time.
- State the Problem Definition clearly.
- Introduce the concepts of Files for application data maintenance
- Provide detailed understanding of control statements, function and arrays.
- Illustrate the use of pointers and Strings.

At the end of the course students will be able to

- Design Algorithms and Flowcharts to solve real world problems.
- List various data types and operators and develop programs to evaluate arithmetic expressions and mathematical functions.
- Identify the suitable control statements and implement the solution for any problem.
- Design programs to handle list of data and strings using arrays.
- Apply the categories of user defined functions to implement the concept of modularity also implement program using Structures and Unions.
- Explore pointers in implementing programs, especially in memory management and file handling.

COURSE CONTENT:

UNIT I Computer Problem-Solving& Fundamental Algorithms   15 Hours

Computer Basics, Introduction To Computer Problem-Solving, Fundamental Algorithms: Introduction, Exchanging the Values of Two variables, Counting, Summation of a Set of Numbers, Factorial Computation, Generation of the Fibonacci Sequence. Basics of C Programming: History of C, Importance of C, Basic Structure of C Programs, Introduction, Character Set, C Tokens, Keywords and Identifiers, Constants, Variables, Data Types, Declaration of Variables, Declaration of Storage Class, Assigning Values to Variables.

UNIT II Operators And Expressions   15 Hours

Introduction, Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional Operator, Bitwise Operators, Special Operators, Arithmetic Expressions, Evaluation of Expressions, Precedence of Arithmetic Operators. Structured Constructs**:** Decision Making and Branching, Decision Making and Looping.

UNIT III Arrays & Functions   15 Hours

Introduction, One-Dimensional Arrays, Initialization of One-Dimensional Arrays, Two Dimensional Arrays, Initializing Two Dimensional Arrays, Multi Dimensional Arrays, Character Arrays and Strings: Introduction, Declaring and Initializing String Variables, Reading Strings from Screen, Writing Strings to Screen, String-Handling Functions. User-Defined Functions: Introduction, Need for User-Defined Functions Elements of User-Defined Functions, Definition of Functions, Return Values and their types, Function Calls, Function Declaration, Category of Functions, No arguments and No return values, Arguments but No return values, Arguments with return values, No arguments but returns a value, Recursion.

UNIT IVUser Defined Data Types, Structures and Unions   15 Hours

Introduction, Defining a Structure, Declaring Structure Variables, Accessing Structure Members, Structure Initialization, Copying and Comparing Structure Variables, Operations on Individual Members, Arrays of Structures, Arrays with Structures, Structures within Structures, Unions. Introduction to Pointers: Introduction and Understanding pointers, Accessing the address of a variable, Declaring pointer variables, Initialization of pointer

variables, Accessing a variable through its pointer. File Management in C: Introduction, Defining and Opening a File, Closing a File, Input/ Output Operations on Files.

Text Books:
1. V. Rajaraman, Neeharika Adabala, "Fundamentals of Computers", 6th Edition, PHI, 2015. (Chapter 1)
2. R.F Dromey, "How to Solve it by Computer" Pearson, Fourteenth Impression, 2013. (Chapter 1 & 2)
3. E. Balaguruswamy, "Programming In ANSI C", 3rd edition, McGraw Hill Education , 2006.(Chapter 1 to 12).

References Books:
1. Mahapatra, "Thinking in C", PHI Publications, 1998.
2. YashwantKanetkar, "Let Us C", 13th Edition, PHP, 2013.
3. Ashok N. Kamthane, "Programming with ANSI and Turbo C", Pearson Education, 6th Impression , 2009
4. Anami, Angadi, and Manvi, "Computer Concepts and C Programming – A Holistic approach", PHI 2008,

B18BS1030	**LINUX FOUNDATION**	**L**	**T**	**P**	**C**
Total Hours: 60		**2**	**1**	**0**	**3**

COURSE OBJECTIVES:
- Provide Storage foundational knowledge of Linux
- Provide understanding of Linux operating file system
- Understand and work multiple Linux operating System (RHEL and Ubuntu)

COURSE OUTCOMES:
A student who successfully completes the course will have the ability to:

- Install and configure Redhat Linux Enterprise server 7
- Install and configure Ubuntu 14.04 LTS server.Work on file directories
- Install and Configure services like SSH,Web, DNS,NFS ,Proxy Server
- Basic Linux Security (SElinux)

COURSE CONTENT:

UNIT I Introduction To Linux   **15 Hours**
Introduction and Installing of Red Hat and Ubuntu Linux Operating System, Interfaces basics like Login, Desktop and Help

UNIT II Interacting With Shell And Desktop   **15Hours**

Introduction, Environment, Introduction to Shell , Shell configuration, Secure shell, GNOME, KDE.

UNIT III Basic Linux Administration   **15 Hours**

Basic System administration, Managing users, Software Management, File System Management, RAID and LVM, Devices and modules, Kernel administration, virtualization, Backup Management, dump/restore.

UNIT IV Linux Network, Security And Services Configuration   **15 Hours**

Install and configure apache web server, NFS, Mail server, Proxy server, Selinux, firewall, App Armor, NIS, Domain Name System, Samba.

Text books:

1. Red Hat Fedora Core 7 And Red Hat Enterprise Linux: The Complete Reference Books, McGraw-Hill Education

2. Ubuntu: The Complete Reference Books , Richard Petersen , McGraw-Hill Education

Reference Book:

1. A Book by Mark G. Sobell A Practical Guide to Fedora and Red Hat Enterprise Linux, Seventh Edition

B18BS1040	DIGITAL LOGIC DESIGN AND COMPUTER ORGANIZATION	L	T	P	C
Total Hours: 60		4	0	0	4

COURSE OBJECTIVES:

- To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
- To prepare students to perform the analysis and design of various digital electronic circuits.

COURSE OUTCOMES:

After studying this course the students would gain enough knowledge about:

- Have a thorough understanding of the fundamental concepts and techniques used in Digital electronics.
- Analyze various combinational and sequential Logic Circuits. Design various combinational and sequential Logic Circuits.
- Identify basic requirements for a design application and propose a cost Effective solution.
- Understand basic structure of computer and control unit operations. Perform computer arithmetic operations.

UNIT I Number systems, Operations, codes and Logic Gates   15 Hours
Decimal numbers, Binary numbers, Number Base Conversions: Decimal-to-Binary conversion, Binary Arithmetic, 1's and 2's Complements of Binary Numbers, Hexadecimal Numbers, Octal numbers, Binary Coded Decimal (BCD).The Inverter, the AND Gate, the OR gate, the NAND Gate, the NOR Gate, the Exclusive-OR and Exclusive-NOR Gates, Basics of Digital Integrated Circuits

UNIT II Boolean Algebra, Logic Simplification   15Hours
Boolean Operations and Expressions, Laws and Rules of Boolean Algebra, DeMorgan's Theorems, Boolean Analysis of Logic Circuits, Simplification Using Boolean Algebra, Standard Forms of Boolean Expressions, Boolean Expressions and Truth Tables, The Karnaugh Map, SOP Minimization, POS Minimization.

UNIT III Combinational Logic, Sequential Logic and Basic Structure of Computers
**   15Hours**

Combinational Logic: Introduction, Design Procedure, Adders, Sequential Logic: Introduction, Flip-Flops.Basic Structure of Computers: Computer types, Functional Units, Basic Operational Concepts, Bus Structures, and Performance and Historical Perspective

UNIT IV Machine Instructions and INPUT/OUTPUT Organization   15 Hours
Memory Locations and Address, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes. INPUT/OUTPUT Organization: Interrupts, Direct Memory Access and Buses.

Text Books:
1. Tokheim "Digital Electronics Principles and Applications', 6th Edition, McGRAW-HILL, 2015. Chapter 1 (1.1, 1.2, 1.3)
2. THOMOS L. FLOYD, "Digital Fundamentals", TENTH EDITION, PEARSON, 2014. Chapters (2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10 and 2.11). Chapters (3.1 to 3.7) and (4.1 to 4.9)
3. M. Morris Mano " Digital Logic and Computer Design", PEARSON, 2013. Chapters (4.1 to 4.4, 6.1 to 6.2 and 7.1 to 7.3)
4. Hamacher, Vranesic and Zaky, "Computer Organization", FIFTH EDITION, TATA McGRAW-HILL, 2015. Chapters (1.1, 1.2, 1.3, 1.4 and 1.6) Chapters (4.2, 4.4 and 4.5) Chapters (5.1 to 5.3)

B18BS1050	ENVIRONMENTAL STUDIES	L	T	P	C
Total Hours: 30		2	0	0	2

COURSE OBJECTIVE:

- To familiarize students with environmental issues as how to conserve, preserve our environment.

COURSE OUTCOMES:

- Students will be able to develop concern for environment and its related aspects.

COURSE CONTENT :

UNIT I Introduction   07 Hours

Multidisciplinary nature of environmental studies – Definition -Scope and importance -Need for public awareness.

UNIT II Natural Resources   08 Hours

Renewable and non-renewable -Problems associated - Forest resources-Water resources-Mineral resources- Food resources-Energy resources-Land resources and their conservation.

UNITIII Environmental Pollution   07 Hours

Definition- Causes - Effects and control measures of air - Water-Soil-Marine-Noise-Thermal – Nuclear Pollutions -Solid waste management-Prevention of pollution.

UNIT IV Social Issues and the Environment   08 Hours

Unsustainable to sustainable development, Environmental ethics, Climate changes, global warming, Wildlife protection act, Public awareness- Human Population and the Environment- Population growth-Population explosion - Human rights - Value education - Role of information technology in environment and human health - HIV/Aids -Women and child welfare - Case studies.

Text Books:
1. Desai R.G. - Environmental studies, Himalaya Publication House.
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd.,
4. Jadhav, H &Bhosale, V.M. 1995, Environmental Protection and Laws, Himalaya Pub. House, Delhi.
5. Rao M N. &Datta, A.K. 1987. Waste Water treatment, Oxford & IBH Publ. Co. Pvt. Ltd.

B18BS1060	TECHNICAL ENGLISH	L	T	P	C
Total Hours: 30		2	0	1	3

COURSE OBJECTIVES:

- To develop basic communication skills in English for the learners of BS Cloud Computing.
- To prioritize listening and reading skills among learners of BS Cloud Computing.
- To simplify writing skills needed for academic as well as workplace context.
- To examine that the learners use the electronic media such as internet and supplement the learning materials used in the classroom.

COURSE OUTCOMES :

On completion of the course, learners will be able to:
- Interpret audio files and comprehend different spoken discourses/ excerpts in different accents (Listening Skills).
- Demonstrate speaking ability with clarity, confidence and comprehension and communicate with one or many listeners using appropriate communicative strategies (Speaking Skills).
- Make use of reading different genres of texts adopting various reading strategies (Reading Skills).
- Develop the ability to write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic (Writing Skills).

COURSE CONTENT:

UNIT I Functional English   07 Hours

Grammar: Prepositions; Verbs, **Listening:** Listening to audio (verbal & sounds), Speaking**:** Debating Skills, **Reading:** Skimming a reading passage; Scanning for specific information **Writing:** Email communication

UNIT II Interpersonal Skills   08 Hours

Grammar: Tenses; Active & Passive Voice, **Listening & Speaking:** Listening and responding to video lectures / Talks, **Reading:** Reading Comprehension, **Writing:** Letters

UNIT III Multitasking skills   07 Hours

Grammar: Idioms; Phrasal Verbs, **Listening & Speaking:** Listening to specific task; focused audio tracks and responding, **Reading:** Reading and interpreting visual material, **Writing:** Types of paragraph (cause and effect / compare and contrast / narrative / analytical); Note Taking/ Note Making

UNIT IV Communication skills **08 Hours**

Grammar: Direct and indirect speech,**Listening & Speaking:** Watching videos / documentaries and responding to questions based on them; Role plays, **Reading:** Making inference from the reading passage; predicting the content of a reading passage, **Writing:** Cover Letter & CV

Reference Books:

1. Green, David. Contemporary English Grammar Structures and Composition. New Delhi: MacMillan Publishers, 2010.
2. Thorpe, Edgar and Showick Thorpe. Basic Vocabulary. Pearson Education India, latest.
3. Leech, Geoffrey and Jan Svartvik. A Communicative Grammar of English. Longman, 2003.
4. Murphy, Raymond. Murphy's English Grammar with CD. Cambridge University Press, 2004.
5. Rizvi, M. Ashraf. Effective Technical Communication. New Delhi: Tata McGraw-Hill, 2005.
6. Riordan, Daniel. Technical Communication. New Delhi: Cengage Publications, 2011.
7. Sen et al. Communication and Language Skills. Cambridge University Press, 2015.
8. Bansal, R.K. and J.B. Harrison. Spoken English. Orient Blackswan, 2013.
9. Raman, Meenakshi and Sangeeta Sharma. Technical Communication. Oxford University Press, 2015.
10. Thorpe, Edgar and Showick Thorpe. Objective English. Pearson Education, 2013.
11. Dixson, Robert J. Everyday Dialogues in English. Prentice Hall India Pvt Ltd., 1988.
12. Turton, Nigel D. ABC of Common Errors. Mac Millan Publishers, 1995.
13. Samson, T. (ed.) Innovate with English. Cambridge University Press, 2010.
14. Kumar, E Suresh, J. Savitri and P Sreehari (ed). Effective English. Pearson Education, 2009.
15. Goodale, Malcolm. Professional Presentation. Cambridge University Press, 2013.

B18BS1070	SPORTS/ YOGA/ MUSIC /DANCE/ THEATRE	L	T	P	C
Total Hours: 30		2	0	0	2

Note: Music, Dance, and Theater courses are offered by the School of Performing Arts, whereas the Sports and Yoga courses are offered by the Department of Physical Education. The students have to choose any **ONE** of these courses.

A. YOGA FOR HEALTH

COURSE   OBJECTIVES:

Following are the Course Objectives.

- To prepare the students for the integration of their physical, mental and spiritual faculties;
- To enable the students to maintain good health;
- To practice mental hygiene and to attain higher level of consciousness;
- To possess emotional stability, self-control and concentration; and
- To inculcate among students self-discipline, moral and ethical values.

COURSE OUTCOMES :

On completion of the course learners will be able to:

- Practice yoga for strength, flexibility, and relaxation.
- Learn techniques for increasing concentration and decreasing anxiety
- Become self-disciplined and self-controlled
- Improve physical fitness and perform better in studies
- Gain self-confidence to face the challenges in the society with commitment to serve the society

COURSE CONTENT:

UNIT I

   Yoga: Introduction, Tips from Sage Patanjali's Yoga Sutras
   Surya Namaskara:- 10 counts,12 counts,16 counts

UNIT II

   Asanas: Sitting-Vajrasana, Dandasana, Padmasana, Matsyasana, Ardha Matsyendrasana, Suptavajrasana, Paschimottasana, Bakasana, Simhasana, Shirasasana.
   Asanas: Standing-Tadasana, Trikonasana, Parshwa konasana, Veerabadrasana, Parivrutta trikonasana.

UNIT III

   Asanas:Prone Position-Bhujangasana, Dhanurasana, Shalabhasana.
   Asanas: Supine Position-Sarvangasana, Sethubandha sarvangasana, Halasana, Karnapeedasana.
   Mudras- Dhyana mudra, Chinmaya mudra, Namaste mudra, Nasika mudra

UNIT IV

Pranayams:- Ujjayi, Nadi Shodhana, Anuloma – Viloma, Basthrika, Bhramari, Sheethali

Dhyana & its types

Competition format, Rules and their interpretations

A. VOLLEYBALL

COURSE OBJECTIVES :

- To learn the rules, fundamental skills, and strategies of volleyball.
- To develop skills in passing, setting, serving, spiking, and blocking.
- To learn basic offensive and defensive patterns of play.
- To develop a positive attitude towards volleyball as a lifetime sport and to improve physical fitness through participation in volleyball.

COURSE OUTCOMES :

On completion of the course learners will be able to:

- Learn basic skills and knowledge associated with volleyball.
- Apply these skills while playing volleyball and exhibit improved performance
- Improve physical fitness and practice positive personal and lifestyle.
- Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

COURSE CONTENT :

UNIT I

- Introduction about Volleyball
- Players Stance, Receiving and passing
- The Volley (Overhead pass), The Dig (Underhand pass), Service Reception

UNIT II

- Service- Under Arm Service, Tennis Service, Side Arm Spin Service, Round Arm Service, High spin service, Asian serve / American serve (floating)
- Setting the ball- Set for attack, Back set, Jump set

UNIT III

- Smash/Spike- Straight smash, Body turn smash, Wrist outward smash, Wrist inward smash
- Block- Single block, Double block, Three-man block
- Rolls- Overhead pass & back rolling, One hand underhand pass with side rolling, Forward dive

UNIT IV

- Attack Combination, Defense Systems, Libero play
- Court marking, Rules and their interpretations and Duties of officials

B. BASKETBALL

- To learn the rules, fundamental skills, and strategies of Basketball
- To develop technical skills in passing, in ball handling, individual offense, individual defense, rebounding, screen, team offense, team defense and fast break.
- To learn basic offensive and defensive strategies of play.
- To develop a positive attitude towards Basketball as a lifetime sport and to improve physical fitness through participation in Basketball.
- To develop positive understanding and appreciation of the basketball game.

COURSE OUTCOMES :

On completion of the course learners will be able to:

- Learn basic skills and knowledge associated with basketball.
- Apply these skills while playing basketball and exhibit improved performance
- Improve physical fitness and practice positive personal and lifestyle.
- Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

COURSE CONTENT :

UNIT I

- Basketball: Introduction
- Grip; Player stance- Triple threat stance and Ball handling exercises
- Passing (Two hand/one hand)- Chest pass, Bounce Pass, Over head pass, Underhand pass, Hook Pass, Behind the back pass, Baseball pass, Side arm pass and passing in running.
- Receiving-Two Hand receiving, One hand receiving, Receiving in stationary position, Receiving while jumping, Receiving while running.

UNIT II

- Dribbling- How to start dribble, How to stop dribble, High / Low dribble with variations
- Shooting- Layup shot and its variations, One hand set shot, One hand jump shot, Free throw, Hook shot, Tip-in shot.
- Stopping- Stride/Scoot, Pivoting and Faking /Feinting footwork.

UNIT III

- Rebounding- Defensive rebound, Offensive rebound, Box out, Rebound Organization.
- Individual Defensive- Guarding the man with the ball and without the ball.
- Offensive drills, Fast break drills, Team Defense/Offense, Team Tactics

UNIT IV

- Court marking, Rules and their interpretations.

C. FOOTBALL

- To learn the rules, fundamental skills, and strategies of football.
- To develop skills in passing, receiving, controlling the ball, dribbling, shielding, shooting, tackling, beating a defender and heading in football.
- To learn basic offensive and defensive patterns of play
- To use different parts of the body in utilizing the above skills while playing football
- To develop a positive attitude towards football as a lifetime sport and to improve physical fitness through participation in football.

COURSE OUTCOMES :

On completion of the course learners will be able to:

- Learn basic skills and knowledge associated with football.
- Apply these skills while playing football and exhibit improved performance
- Use the knowledge and understanding to perform, refine and adapt the above skills and related skills with precision, accuracy, fluency and clarity in any situation.
- Improve physical fitness and practice positive personal and lifestyle.Gain an understanding of the value of sports in attaining wellness, maintaining good health.

COURSE CONTENT :

UNIT I

Football: Introduction

- Kicks- Inside kick, Instep kick, Outer instep kick, Lofted kick, Chipping, Volley, Half Volley
- Trapping- Trapping rolling the ball, Trapping bouncing ball with sole

UNIT II

- Dribbling- With instep and outer instep of the foot.
- Heading- From standing, running and jumping.
- Feinting- With the lower limb and upper part of the body.

UNIT III

- Tackling- Simple tackling, Slide tackling.
- Throw-in- Standing and Sliding
- Goal Keeping- Collection of balls, Ball clearance, throwing and deflecting.

UNIT IV

- Ground marking, Rules and their interpretations

D. ATHLETICS (TRACK AND FIELD)

COURSE OBJECTIVES :

- To teach students the skilled techniques in sprints, relay running, hurdles, long jump, high jump, and shot put and practice them.
- To develop competence among students in demonstrating all the techniques covered in the course.

- To make students understand some of the scientific and empirical principles and their rationale underlying the development of skilled performance.
- To inculcate among students the habit of team work and cooperative learning and develop competence in detecting / correcting technique errors.
- To develop a positive attitude towards sports in general and athletics in particular and to improve physical fitness through participation in various athletic games / sports activities.

COURSE OUTCOMES :

On completion of the course learners will be able to:

- Display competencies in executing basic techniques and skills associated with select track and field events.
- Develop basic skills and techniques to improve one's running posture and take-off position for different jumps.
- Learn regular practice of select track and field events and improve physical fitness
- Appreciate track and field events by applying sports science knowledge to explain the execution of the events.

COURSE CONTENT :

UNIT I

- Athletics: Introduction
- Track Events - Steeple Chase, Race Walking, Middle and Long distance races
- Race walking - Technique, Faults and Officiating.
- Middle and Long distance races – Technique and Training

UNIT II

- Jumping Events - High Jump and Triple Jump: Basic Skills and techniques
- High Jump - Straddle Roll & Flop Technique, Approach, Take-off, Technique in the air, Clearance over the bar & Landing
- Triple Jump – Hop, Step and Jump Technique, Approach, Take-off & Landing

UNIT III

- Throwing Events - Discus Throw and Hammer Throw: Basic Skills and techniques
- Discus Throw -Standing and Rotatory techniques, Grip, Stance, Rotation Technique, Power stance, Release and Reverse (Follow through)
- Hammer Throw - Grip, Swings, Rotation foot work, Release and Follow through

UNIT IV

- Rules, Officiating and Marking - Ground / Sector Marking, Interpretation of Rules.

Reference Books :
1. Arthur E. Ellison (ed) (1994). Athletic Training and Sports Medicine.
2. Ballisteros, J.M. (1998). Hurdles Basic Coaching Manual, IAAF.
3. Bosen K.O. (1993). Teaching Athletics Skills and Technique.
4. Bosen K.O. (1990). Study Material on Hurdles for the Regular Course Students.

5. Doherty K. (1995). Track and Field Omni book.
6. Martin, David E. Peter N. Coe (1991). Training Distance Runner.
7. Howard S. (1981). Science of Track and Field Athletics.
8. Briggs Graeme (1987). "Track and field coaching Manual", Australian Track and Field
9. Coaches Association. Rothmans Foundation National Sports Division.
10. Carr, Gerry (1999). "Fundamentals of Track and Field. Track Athletics 1 Title G.V. 1060 5.e. 368.
11. I.A.A.F. Level-II (2001). Text Book on Jumping Event.
12. Jarver, Jesse (1987). "The Jumps", Track and Field Coaching Manual Australia.

B18BS1080	C PROGRAMMING LAB	L	T	P	C
Total Hours: 30		0	0	2	2

LAB EXPERIMENTS:

1. Program to read and print the size of variables of different data type.
2. A person has deposited some amount in bank. Write a program to calculate simple interest and compound interest on amount for a period.
3. In Delhi, four wheelers run on the basis of even or odd number. Write a program to identify whether vehicle registration number is even or odd.
4. People frequently need to calculate the area of things like rooms, boxes or plots of land where quadratic equation can be used. Write a program to find the coefficients of a quadratic equation and compute its roots.
5. Consider the age of 3 persons in a family, Write a program to identify the eldest person among three of them.
6. Consider student's marks in Computer Test. Write a Program display the grade obtain by student in Computer Test based on range.
7. Calculator allows you to easily handle all the calculations necessary for everyday life with a single application. Write a program to design a basic calculator that performs the basic operations and you want to give choice to user to perform
   a. Addition of two numbers
   b. Subtraction of two numbers
   c. Multiplication of two numbers.
   d. Division of two numbers.
   e. Wrong choice
8. In a stock market at the end of the day we do the summation of all the transactions.
   a. Write a program to display numbers (transactions) from 1 to n.
   b. Write a program to find the sum of n natural numbers.

9. Read your ATM Pin Number. Write a program to identify your Pin Number is palindrome or not.

10. Read your Landline Number. Write a program to print the reverse of it and also find sum of digits of your Landline Number.

11. Create a Contact list of n friends, Write a program to read and print the Phone number of your friend's.

12. In computer based applications, matrices play a vital role in the projection of three dimensional image into a two dimensional screen, creating the realistic seeming motions. Write a program to perform matrix Multiplication and check compatibility of matrix.

13. You have joined a startup company of N employees; Write a program is to sort all employee id.

14. A student has taken 10 books from the library. Every time he take's the book, Librarian read's its ISBN Number. Write a program to identify whether book is issued to him or not based on ISBN Number.

15. Suppose students have registered for workshop, and their record is maintained in ascending order based on student id. Write a program to find whether a particular Student has registered for that particular workshop or not

16. In a CCP test you scored less marks compared to your friend, Write a program to swap your marks with your friend.

17. Assume you went to mall to watch movie with your friend. Write a program to interchange your place with a person who is sitting next to your friend.

18. In a memory game, you first enter a string wait for a time and again enter second string, Write a program to check both sting were same or not.

19. Read your first and last name in two different strings; Write a program to combine these two strings into third string.

20. Assume a person has entered a Password, Write a program so that he can know the length of his password.

B18BS1090	LINUX LAB	L	T	P	C
Total Hours: 30		0	0	2	2

LAB EXPERIMENTS:

1. Learn installation procedure of Ubuntu and Red hat Linux server.

2. Create files and directories

3. Change or modify permission on files and directories

4. Install and configure nfs server

5. Configure nfs client and work on mount points

6. Work on Linux desktop interface

7. Configure DNS server

8. Install and configure web server

SECOND SEMESTER

S.NO	Code	Title	HC/SC/FC	Credit Pattern			Credits	Working Hrs
				L	T	P		
1	B18BS2010	Operating systems	HC	4	0	0	4	4
2	B18BS2020	Data Structures using C	HC	2	1	0	3	4
3	B18BS2030	Advanced Linux	HC	2	1	0	3	4
4	B18BS2040	Probability and statistics	HC	4	0	0	4	4
5	B18BS2050	Constitution of India & Professional Ethics	FC	2	0	0	2	2
Practical Courses								
6	B18BS2060	Data Structures Lab	HC	0	0	2	2	4
7	B18BS2070	Advanced Linux Lab	HC	0	0	2	2	4
Total Credits				**16**	**2**	**4**	**20**	**26**

B18BS2010	OPERATING SYSTEMS	L	T	P	C
Total Hours: 60		4	0	0	4

COURSE OBJECTIVES:

- Enabling Knowledge: the operation, implementation and performance of modern operating systems, and the relative merits and suitability of each for complex user applications

- Critical Analysis: Ability to compare, contrast, and evaluate the key trade-offs between multiple approaches to operating system design, and identify appropriate design choices when solving real-world problems

- Throughout the course, practical aspects that pertain to the most popular operating systems such as Unix/Linux and Windows, and some instructional operating systems will be studied.

COURSE OUTCOMES:

On completion of this course, students will be able to describe the basic principles used in the design of modern operating systems. Specifically, you should be able to:

- Describe the important computer system resources and the role of operating system in their management policies and algorithms.

- Understand the process management policies and scheduling of processes by CPU.

- Describe and analyze the memory management and its allocation policies.

- Identify use and evaluate the storage management policies with respect to different storage management technologies.

COURSE CONTENT:

UNIT I Introduction   15Hours

Batch Systems, Multiprogramming and Time Sharing, Parallel, Distributed and real time Systems, Operating System Structures, Components & Services, and System calls, System programs, Virtual machines.**Process Management:** Process Concept, Process Scheduling, Co – Operating process, Threads, Inter process communication, CPU Scheduling Criteria, Scheduling algorithm, Multiple Processor Scheduling, Algorithm evolution.

UNIT II Process Synchronization and deadlocks   15Hours

The Critical Section Problem, Synchronization hardware, Semaphores, Classical problems of synchronization, Critical regions, monitors, Dead locks – system model, Characterization,

Dead lock prevention, avoidance and detection, Recovery from dead lock, Combined approach to deadlock handling.

UNIT III Memory Management **15 Hours**

Logical and Physical address space, Swapping, Contiguous allocation, Paging, Segmentation, Virtual memory-Demand paging and it's performance, Page replacement algorithms, Allocation of frames, thrashing, page size and other considerations. File management: File Concepts, Access methods, Directory Structure, Protection and consistency, File system structure, Allocation methods, Free space management, Directory Implementation, Recovery.

UNIT IV Disk Management (Structure, Disk Scheduling Methods) **15 Hours**

Disk Structure & Scheduling methods, Disk management, Swap – Space management. Protection and Security: Goals of protection, Domain Protection, Access matrix, Security Problem, Authentication, One time password, program threats, System threads. Case Study of Windows and Linux Operating System

Text Books:

1. Abraham Silberschatz and Peter Baer Galvin, "Operating System Concepts", 7th Edition, Pearson Education, 2002.
2. " Operating System" by Gary Nutt, Pearson/Addison Wesley – 2004.

Reference Books:

1. H.M.Deitel, "Operating Systems", Pearson Learning Solutions, 3rd Edition, 2003.
2. William Stallings, "Operating Systems", 6th Edition, Pearson Education, 2010.
3. Stuart, "Operating systems: Principles, Design and Implementation", 1st Edition 2008, Cengage Learning India

B18BS2020	**DATA STRUCTURES USING C**	**L**	**T**	**P**	**C**
Total Hours: 60		**2**	**1**	**0**	**3**

COURSE OBJECTIVES:

- Assess how the choice of data structures and algorithm design methods.
- Choose the appropriate data structure and algorithm design method for a specified application.
- Write programs using function-oriented design principles.
- Solve problems using data structures such as linear lists, stacks, queues, binary trees, heaps, binary search trees, and graphs and writing programs for these solutions.

On successful completion of this course, the student is expected to be able to:

- Design or select an appropriate data structures for a particular problem,
- Package a set of data structures and algorithms as an abstract data type,
- Apply their knowledge of data structures in writing more efficient programs in a programming language,
- Understands the importance of Data structures. Develop Applications using Linear and Non-Linear Data Structures.

COURSE   CONTENT:

UNIT I Basics of Data Structures   **15 Hours**

Data Structures, Classifications (Primitive & Non Primitive), Data structure Operations, Review of Arrays-Inserting and deleting operations, String operations, Structures, Unions, Pointers and Dynamic Memory Allocation Functions.

UNIT II Linear Data Structures   **15 Hours**

Stack: Definition, Array representation, Linked list representation, Operations, Recursion, Towers of Hanoi, Applications of stack (Infix to postfix conversion, evaluation of expression). Queue: Definition, Array representation, Linked list representation, Operations, Applications; Types of queues: Simple queue, Circular queue, Double ended queue, Priority queue.

UNIT III Linked List   **15 Hours**

Definition, Singly linked list: Representation in memory, Traversing, Insertion, Deletion and Searching; Memory allocation; Garbage collection; Doubly linked list; Header linked list; Circular linked list. **Searching**: Linear and Binary Search.**Sorting:** Insertion, Selection, Bubble, Quick, Merge.**Hashing**: Hash Table organizations, Hashing Functions, Static and Dynamic Hashing.

UNIT IV Non Linear Data Structures: **15 Hours**

Need for non-linear structures, Trees and its representation, Binary Tree, Types of Binary Trees, Binary tree traversals , applications of trees , Binary Search Tree, Introduction to Graph, Graph Traversal Techniques.

Text Books:

1. Ashok N Kamthane, "Introduction to Data Structures in C", Pearson Education (S) Pvt Ltd., New   Delhi: 2005. – (Chapter 1to 11)

2. YedidyahLangsam and Moshe J. Augenstein and Aaron M Tenanbanum, "Data Structures Uisng C and C++", 2nd Edition, Pearson Education Asia, 2002. – (Chapter 1 to 8)

Reference Books:

1. Jean-Paul Tremblay and Paul G Sorenson, "An Introduction to Data Structures with Applications", Second Edition, Tata McGraw-Hill Publishing Company Lt., New Delhi: 1995.

2. Horowitz, Ellis, Sahni, Sartaj, Anderson-Freed, Susan (2008), Fundamentals of Data Structure in C, 2nd Edition, University Press, India.

3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education.

4. E. Balaguruswamy, "Data Structures using C", McGraw Hill Edition India Pvt. Ltd, 2013

B18BS2030	ADVANCED LINUX	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:

The objective of this course is to:

- Understand advanced topics of Linux operating system
- Understand Linux troubleshooting
- Automating Linux common and advanced tasks using scripting

COURSE OUTCOMES:

A student who successfully completes the course will have the ability to:

- Demonstrate a basic knowledge of working with Linux and Communicate using multiple modes of communication
- Evaluate and apply technology resources by installing, configuring, and managing a Linux server and relevant services and applications.
- Understand the importance of maintaining a secure Linux server
- Ability to understand troubleshooting steps in Linux, write scripts and execute them.

UNIT I Configuring Server on Linux   **15 Hours**

Configure web server and securing your web traffic using SSL, troubleshooting web server, Configure FTP server and ftp client, configure windows file sharing Samba server, Configuring NFS Server

UNIT II Linux scripting   **15 Hours**

The Bourne Again Shell (bash), background of scriptingWriting Simple Shell Scripts, Executing and debugging shell scripts Understanding shell variables , Special shell positional parameters ,Reading in parameters ,Parameter expansion in bash ,Performing arithmetic in shell scripts ,Using programming constructs in shell scripts ,The "if . . . then" statements ,The case command ,The "for . . . do" loop ,The "while . . . do" and "until . . . do" loops, Trying some useful text manipulation programs ,The general regular expression parser ,Remove sections of lines of text (cut) ,Translate or delete characters (tr) The stream editor (sed) ,Using simple shell scripts ,setting up CRON job, Backup script

UNIT III Linux Networking and Linux advanced administration   **15 Hours**

Network Administration Ubuntu and Centos (Configure DNS,DHCP, routes, work with network interface and network files, Linux Administration (Starting and stopping services, understand working with logs, working with LVM , Software package management like apt-get on Ubuntu and yum for centos. Monitoring (understanding and working logs, centralizing the logs)

UNIT IV Linux troubleshooting and security   **15 Hours**

Security (understand basic security in linux, securing user accounts, securing passwords, securing the file system, monitoring user accounts and fiel system, introduction to implementing Linux security with cryptography , Enhanced linux security, securing Linux on network . Troubleshooting (Bios setup troubleshooting, troubleshooting init process, rescue mode and troubleshooting memory issues. Managing Processes (listing processes, background foreground process, killing processes, introduction PID Namespaces)

Text Books:

1.   Your Unix the ultimate Guide by Sumitabha Das

2.   Linux Bible, 8th Edition Christopher Negus, Christine Bresnahan (Contributions by) ISBN: 978-1-118-21854-9

3.   Practical Guide to Ubuntu Linux ,A, 4/E by Mark G. Sobell

B18BS2040	PROBABILITY AND STATISTICS	L	T	P	C
Total Hours: 60		4	0	0	4

COURSE   OBJECTIVES:

To help students understand the basics of probability & statistics

- To acquaint students with various statistical methods.

- To cultivate statistical thinking among students.

- To prepare students for future courses having quantitative components.

COURSE OUTCOMES:

Upon successful completion of the course one should be able to

- Understand and appreciate descriptive statistics.

- Understand the concepts of probability and random variables.

- Understand and apply statistical theory to analytics field.

COURSE CONTENT:

UNIT I Introduction   15 Hours

Meaning of Statistics and its definition-Functions-Scope/Characteristics-limitations. Collection of data Classification of data , preparation of frequency distribution and tabulation of data. Diagrammatic representation of bar and pie diagrams, Graphical representation of median and mode by - histograms, smoothed frequency curve, frequency polygon, Cumulative frequency curves (ogives).Measure of Central Tendency - Arithmetic Mean (Average), Partition values – Median, quartiles, deciles, percentile and Mode and its applications.

UNIT II Measures of Dispersion, and Skewness   15 Hours

Methods of Dispersion Range, Quartile deviation, Mean deviations: Standard deviations and Coefficient of Variation and its applications. Measure of skewness: Meaning, uses and problems on Karl Pearson's coefficient of skewness and Bowley's co-efficient of skewness and its applications.

UNIT III Probability   15Hours

Random experiments, trial, sample space, events. Approaches to probability- classical, empirical, subjective and axiomatic.Theorems on probabilities of events. Addition rules of

probability. Conditional probability, independence of events and multiplication rule of probability. Bayes theorem (no proof any theorem) and its applications.

UNIT IV Random variables and Expectations   **15 Hours**

Definition, Random Variable, Discrete and continuous random variables, Distribution function probability mass and density function problems. Mathematical expectation - discrete random variable and its problems. Joint probability function for pdf, pmf and marginal distribution function of Discrete and Continuous Random Variable simple problems

Text Books:

1. Gupta. S.C and Kapoor V.K. Fundamentals of Mathematical Statistics, Sultan Chand and sons, (2001)

2. Freund J.E., Mathematical Statistics, Prentice hall, (2001)

Reference Books:

1. Berenson and Levine, Basic Business Statistics, Prentice- Hall India (1996, 6th edition)

2. S.P.Gupta, "Statistical methods"- Sultan Chand & Sons, New Delhi, latest Edition

3. Ross Sheldon, A First Course in Probability, Macmillan , (6th edition)

4. Medhi.J, "Statistical methods - An introductory text", new age publications, 2009 edition.

5. D.C. Montogomery and G.C.Runger, "Applied Statistics and Probability for engineers", New Jersey,John Wiley and Sons, 3rd edition, 2003.

6. P K Srimani and M Vinayaka Murthy, "Probability and Statistics", Subhas Stores, 2000

B18BS2050	CONSTITUTION OF INDIA AND	L	T	P	C
Total Hours: 60	PROFESSIONAL ETHICS	2	0	0	2

COURSE OBJECTIVES:

- To provide and gain knowledge on Constitution of India
- To know and understand about the Fundamental Rights, Duties and other Rights which is been given by our law.
- To prepare students in the practicality of Constitution perspective and make them face the world as abona fide citizen.
- To attain knowledge about ethics and also know about professional ethics.
- To explore ethical standards followed by different companies.

COURSE OUTCOMES:

On successful completion of this course; the student shall be able to:

- Strengthen the knowledge on Indian constitutional law and make the practical implementation of it.
- Understand the fundamental rights and human rights.
- Get the knowledge to explain the duties and more importantly practise it in a right way.
- Adopt the habit of raising their voice against a non constitutionality of any laws and upon any legal discrimination as we have session of debates on Constitutional validity.
- Get exposed about professional ethics and know about etiquettes about it.
- Know about ethical standards of different companies which will increase their professional ability.

COURSE CONTENT:

UNIT I Constitution of India   12 Hours

Definition, Making of Indian Constitution, Preamble to the Constitution of India, Fundamental Rights under Part III; Rights to Equality, Right to Freedom, Right against Exploitation, Rights to Freedom of Religion, Cultural and Educational Rights, Constitutional Remedies. Fundamental Duties of the Citizen, Significance and Characteristics. Elements of National Significance; National Flag, National Anthem, National Emblem.

UNIT II Union and State   10 Hours

Organs of the Government; Legislature, Executive and Judiciary .Union and State Executives: President Vice President, Prime Minister, Supreme Court, Cabinet, Governor, Council of Ministers, Electoral process, Election Commission. Right to Information (RTI), Consumer and Consumer Protection.

UNIT III Ethics   12 Hours

Meaning, Definition, Evolution, Need of ethics, Aristotle an Ethics, Utilitarianism, Kantianism, Professional ,Ethics, Personal Ethics and Business Ethics, Ethical Standards, Duties of Employers and Employees.

UNIT IV Engineering Ethic   10 Hours

Definition Scope and needs, Ethics in Consumer Protection, Due Care theory, Environmental Ethics, Ethical Code of Conduct in ethics. Best Ethical Companies in India and Abroad; Corporate Social Responsibilities, Code of Conduct and Ethical Excellence.

Text Book:
1. M V Pylee, An introduction to Constitution of India

B18BS2060		L	T	P	C
	DATA STRUCTURES LAB				
Total Hours: 30		**0**	**0**	**2**	**2**

LAB EXPERIMENTS:

1. Design, Develop and Implement a menu driven Program in C for the following Array operations
   a. Creating an Array of N Integer Elements
   b. Display of Array Elements with Suitable Headings
   c. Inserting an Element (ELEM) at a given valid Position (POS)
   d. Deleting an Element at a given valid Position(POS)
   e. Exit.
 Support the program with functions for each of the above operations.

2. Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX)
a.   Push an Element on to Stack
b.   Pop an Element from Stack
c.   Demonstrate how Stack can be used to check Palindrome
d.   Demonstrate Overflow and Underflow situations on Stack
e.   Display the status of Stack
f.   Exit
Support the program with appropriate functions for each of the above operations

3. Design, Develop and Implement a menu driven Program in C for the following operations on QUEUE of Integers (Array Implementation of Stack with maximum size MAX)
   a.   Insert an Element on to queue
   b.   Delete an Element from queue
   c.   Demonstrate Overflow and Underflow situations on Queue.
   d.   Display the status of Queue.
   e.   Exit

Support the program with appropriate functions for each of the above operations.

4. Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, %(Remainder), ^(Power) and alphanumeric operands.

5. Design, Develop and Implement a Program in C for the following Stack Applications
    a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^

    b. Solving Tower of Hanoi problem with n disks

6. Design, Develop and Implement a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX)
    a. Insert an Element on to Circular QUEUE
    b. Delete an Element from Circular QUEUE
    c. Demonstrate Overflow and Underflow situations on Circular QUEUE
    d. Display the status of Circular QUEUE
    e. Exit
Support the program with appropriate functions for each of the above operations
7. Design, Develop and Implement a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name, Branch, Sem, PhNo
    a. Create a SLL of N Students Data by using front insertion.
    b. Display the status of SLL and count the number of nodes in it.
    c. Perform Insertion / Deletion at Front of SLL(Demonstration of stack)
    d. Perform rear insertion/ deletion at front of SLL(Demonstration of Queue)
    e. Exit
8. Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation, Sal, PhNo
    a.   Create a DLL of N Employees Data by using end insertion.
    b.   Display the status of DLL and count the number of nodes in it
    c.   Perform Insertion and Deletion at End of DLL
    d.   Perform Insertion and Deletion at Front of DLL
    e.   Exit
9. Simulate the working of a circular linked list providing the following operations
a. Delete from the beginning
b. Delete from the end
c. Delete a given element
d. Display
e. exit
Insert is mandatory.
10. Implement quick sort.

11. Implement the search techniques of
     a. Linear Search using iteration
     b. Binary Search using recursion.

12. Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers
   a.   Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2
   b.   Traverse the BST in Inorder, Preorder and Post Order
   c.   Search the BST for a given element (KEY) and report the appropriate message
   d.   Exit

13. Write a C program to traverse the nodes in a graph using i. Breadth First Search. ii. Depth First Search.

14. Write a Program to
     a) Create AVL Tree
     b) Insert element to AVL tree
     c) Find the height of the AVL tree

PART – B

1. Programs may be decided by External and Internal examiners.

B18BS2070	ADVANCED LINUX LAB	L	T	P	C
Total Hours: 30		0	0	2	2

LAB EXPERIMENTS:

1. Configure web server security for access over https
2. Configure ftp server
3. Configure samba server
4. Write a workable scripts to install web server
5. Write scripts to install MySQL- database server
6. Write scripts to check if ,if else based parameters
7. Setup cron job
8. Work with system logs and service logs
9. Manage system processes
10. Troubleshooting issues with memory and init process

THIRD SEMESTER

S.NO	Code	Title	HC /SC/ FC	Credit Pattern			Credits	Working Hrs
				L	T	P		
1	B18BS3010	Cloud Computing and Virtualization Foundation	HC	3	0	1	4	5
2	B18BS3020	Object Oriented Programming with JAVA	HC	2	1	0	3	4
3	B18BS3030	Relational Database Management Systems	HC	2	1	0	3	4
4	B18BS3040	Data mining & Data warehousing	HC	4	0	0	4	4
5	B18BS3050	Computer Networks	HC	4	0	0	4	4
6	B18BS3061	Numerical methods	SC	2	1	0	3	4
	B18BS3062	Discrete Mathematical Structures						
7	B18BS3070	Soft skills	RUL O	2	0	0	2	2
Practical Courses								
8	B18BS3080	Object Oriented Programming with JAVA Lab	HC	0	0	2	2	4
9	B18BS3090	RDBMS Lab	HC	0	0	2	2	4
Total Credits				**19**	**3**	**5**	**27**	**35**

B18BS3010	CLOUD COMPUTING AND	L	T	P	C
Total Hours: 60	VIRTUALIZATION FOUNDATION	3	0	1	4

COURSE OBJECTIVES:

The objective of this course is to:

- Provide storage foundation knowledge on Cloud Computing concepts
- Demystify cloud and virtualization
- Understand multiple Hypervisors/Virtualization technologies used in cloud data centre with hands on experience
- Ability to Install and configure Microsoft hyper infrastructure
- Ability to Install and manage Windows server 2016

COURSE OUTCOMES :

A student who successfully completes the course will have the ability to:

- Understand basics of virtualization
- Understand the benefits and limitations of Cloud Computing
- Understand what is Private ,Public ,and Hybrid Cloud Computing. Understand what is IaaS, PaaS and SaaS
- Understand how to choose a right service provider. Design and implement Microsoft virtualization on windows 2016 server

COURSE CONTENTS :

UNIT I Virtualization basics   **15 Hours**

Evolution of virtualization, Virtualization basics, types of virtualization Full virtualization and Para virtualization, Virtual box installation and create virtual machine, install Ubuntu and centos Linux in virtual machine, KVM Installation and create virtual machines on KVM hypervisor.

UNIT II Cloud Computing foundation   **15 Hours**

Understanding cloud computing, characteristics of Cloud computing, basic concepts and terminologies, benefits and limitations of Cloud computing, Cloud infrastructure framework, the business case of going cloud.

UNIT III Cloud Computing Service & Deployment Models   **15 Hours**

Understand cloud computing service models Infrastructure-As-A-Service, Platform-As-A-Service, Software-As-A-Service, Storage-As-A-Service and also Understand Cloud Deployment models like Private cloud, Public Cloud, Hybrid cloud, and community cloud, Introduction to Cloud Computing Security whitepaper "Nine Notorious threats in Cloud Computing Cloud Security Alliance .

UNIT IV Microsoft Windows server latest with Hyper-v Virtualization   15 Hours

 Microsoft 2016 server Introduction and installing web server, nfs, cifs ,dns role, Active directory ,iSCSI role on windows server, Learning Power shell, Hyper-V Basics , Hyperv-v virtual machine operations, Hyper Networking, Hyper storage, Building a Failover Cluster.

Text books:

1. Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More by Kris Jamsa
2. Mastering Windows Server 2016 Jordan Krause by October 2016.

Reference Book:

1**.** Windows Server 2016 Hyper-V Cookbook - Second Edition, Charbel Nemnom, Patrick Lownds.

LAB EXPERIMENTS

Lab 1 Amazon EC2- Win server latest and Red hat linux (RHEL)   (Hands on lab by students)
- Launch Windows server latest Instance
- connect to the EC2 Windows latestand RHEL instance
- Terminate the Windows server latest and RHEL Instance

Lab 2 : Amazon Elastic Block Store (Hands on lab by students)
- Create Standard Volume
- Create and delete snapshots
- Create Provisioned I/o Volume
- Assign volumes to Windows server latest and Ubuntu 14.04 server
- Disassociate and Delete volumes

Lab 3 : Amazon Elastic Load Balancing (ELB)   (Hands on lab by students)
- Lab 3.1
    1. Launch Two Ubuntu EC2 Instances- apache web servers with user data
    2. Edit HTML files to both the servers
    3. Test your web Servers through internet
- Lab 3.2
    1. Create Elastic Load Balancer
    2. Add both the Ubuntu servers to ELB
    3. Test your Elastic Load Balancer
    4. Delete your Elastic Load Balancer

Lab 4 : AWS s3 (Hands on lab by students)
- AWS s3- Overview and pricing
- Create Bucket and Folder
- Upload, download, share and delete object
- Delete Bucket

Lab 5 : Create ,connect delete Win server latest on Microsoft Azure cloud

Lab 6 : Create a block storage volume attach to win and Linux server of azure cloud

Lab 7 : Create a load balancer and attach 2 web servers

Lab 8 : Install windows server latest/2016

Lab 9 : Install hyper role on windows server

Lab 10 : Create a virtual machine and install guest operating system
Lab 11 : Install discs role on win server
Lab 12 : Configure failover cluster of two hyper hosts
Lab 13 : Test failover

B18BS3020	OBJECT ORIENTED PROGRAMMING WITH JAVA	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES :
The objectives of this course are to:
- Understand fundamentals of object-oriented programming in Java, including defining Classes, invoking methods, using class libraries, exception handling etc.
- Solve problems using object-oriented paradigm
- Develop applications using threads and applet programming.
- Understand Java Database Connectivity.

COURSE   OUTCOMES:
On successful completion of this course, the student will be able to:
- Implement Java classes from specifications.
- Effectively create and use objects from predefined class libraries.
- Use interfaces, inheritance, and polymorphism as programming techniques.
- Use exceptions and multithreading.
- Use applets and GUI based controls

COURSE CONTENTS :
UNIT I Introduction to JAVA Programming   **15 Hours**
An overview of Java, Internal Details of JVM Difference between JDK, JRE and JVM, Data types, variables, type conversion, casting, arrays, operators, arithmetic, bitwise, relational, Boolean, precedence, Control Statements.

UNIT II Introduction to classes in java and members of the class   **15 Hours**
Classes, abstract classes – the Object class, methods, constructors, Java static Method, this, Super and final keyword, dynamic binding overloading, inheritance, Packages, interfaces, String handling.

UNIT III AWT and Applets   **15 Hours**
Exception handling - Input/output Java streams - Threads - Abstract Windowing Toolkit - Overview, Working with Windows, Graphics, Text, Images - AWT Controls - Applets – Programs.

UNIT IV Swings and JDBC   **15 Hours**
Laying out components - Introducing Java Foundation Classes - Swing Packages – Swing – Introduction to JDBC- Type of Drivers- connecting and performing different operation on

database .Java –Data structures, Collections, Generics, networking, Java sending email, java multi-threading , Java DB connection ,Java Scripting

Text Books:
1. Patrick Naughton and Herbert Schildt, ''Java: The Complete Reference", Tata McGraw-Hill, New Delhi, 1997. (Unit 1- chapter 1,2,3,4,5   Unit 2 – chapter 6, 7,8,9,15   Unit 3- Chapter 10, 11, 13, 21, 23 Unit 4- 24, 30)
2. Oracle® Database JDBC Developer's Guide and Reference 10g Release 2 (10.2) B14355-04 (Unit 4 – Part 1)

Reference Books:
1. Aaron Walsh and John Fronckowick, "Java Bible, Programming Version 2", IDG Books Worldwide, Inc. 2000. (Refer)
2. Balagurusamy E, "Programming with JAVA", TMG, 2007

B18BS3030	RELATIONAL DATABASE MANAGEMENT SYSTEMS	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:

- To introduce the basic concepts in Database Systems and Relational Databases.
- To expose the students to the steps in building E-R Diagrams and Normalization.
- To train the students in the practical skills using Oracle9i software to develop and alter tables.
- To equip the students with skills to manipulate tables using updation, deletion and arithmetic operations.
- To provide the basic understanding to group data using built-in functions and join multiple tables.

COURSE OUTCOMES :

- Students will understand all basic terminologies in Database Systems and Relational Databases.
- Students will be skilled in building E-R Diagrams and performing Normalization.
- Students will be trained to use Oracle9i software to develop and alter tables, and to manipulate tables using updation, deletion and arithmetic operations.
- Students will have a basic understanding to group data using built-in functions and join multiple tables.

UNIT I Introduction **15 Hours**

Database System Applications – Purpose of Database Systems – View of Data – Database Languages – Relational Databases – Databases Design – Data Storage and Querying – Transaction Management – Database Architecture – Database Users and Administrator. Relational Model: Structure of Relational Databases – Database Schema – Keys – Schema Diagrams – Relational Query Languages – Relational Operations.

UNIT II Database Design **15 Hours**

Overview – Entity-Relationship Model – Constraints – Removing Redundant Attributes – E-R Diagrams – Reduction to Relational Schemas – E-R Design Issues – Extended E-R Features.

Relational Database Design: Features of Good Relational Designs – Atomic Domains and First Normal Form – Decomposition using Functional Dependencies – Functional-Dependency Theory – Algorithms for Decomposition – Decomposition using Multivalued Dependencies – More Normal Forms.

UNIT III Oracle9i **15 Hours**

Overview, Personal Databases – Client/Server Databases – Oracle9i an introduction – SQL *Plus Environment – SQL – Logging into SQL *Plus - SQL *Plus Commands – Errors & Help – Alternate Text Editors - SQL *Plus Worksheet - iSQL *Plus.

Oracle Tables: DDL: Naming Rules and conventions – Data Types – Constraints – Creating Oracle Table – Displaying Table Information – Altering an Existing Table – Dropping, Renaming, Truncating Table – Table Types – Spooling – Error codes.

UNIT IV Working with Table **15 Hours**

Data Management and Retrieval: DML –adding a new Row/Record – Customized Prompts – Updating and Deleting an Existing Rows/Records – retrieving Data from Table – Arithmetic Operations – restricting Data with WHERE clause – Sorting – Revisiting Substitution Variables – DEFINE command – CASE structure.

Functions and Grouping: Built-in functions – Grouping Data. Multiple Tables: Join – Set operations.

Text Books:
1. Database System Concepts – Abraham Silberschatz, Henry F. Korth and S. Sudarshan, 6th Edition, McGraw-Hill. (Units 1 and 2)
2. Database Systems Using Oracle – Nilesh Shah, 2nd edition, PHI. (Units 3 and 4)

Reference Books:
1. Database Management Systems – ArunMajumdar&Pritimoy Bhattacharya, 2007, TMH.
2. Database Management Systems – Gerald V. Post, 3rd edition, TMH.

B18BS3040	DATA MINING & DATA WAREHOUSING	L	T	P	C
Total Hours: 60		4	0	0	4

- To understand Data Mining principles and techniques and introduce Data Mining as a cutting edge business intelligence.
- To discover interesting patterns, to analyze supervised and unsupervised models and estimate the accuracy of the algorithms.
- To identify Applications and Trends of Data mining.
- To expose the students to the concepts of Data Warehousing Architecture and Implementation.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to,

- Discover and measure interesting patterns from different kinds of databases.
- Evolve Multidimensional Intelligent model from typical system.
- Discover the knowledge imbibed in the high dimensional system.
- Evaluate various mining techniques on complex data objects.

COURSE CONTENTS :

UNIT I   **15 Hours**
Data Mining – Introduction - Basic data mining tasks – data mining versus knowledge discovery in databases – Data mining issues – Data mining metrics – Social implications of data mining – Data mining from a database perspective. Data Mining Techniques**:** Introduction – A Statistical Perspective on data mining – Similarity Measures – Decision Trees.

UNIT II   **15 Hours**
Classification: Introduction – Issues in Classification - Statistical – based algorithms - Distance – based algorithms – Decision tree - based algorithms. **Clustering:** Introduction – Similarity and Distance Measures – Outliers – Hierarchical Algorithms: Agglomerative Algorithms – Divisive Algorithms - Partitional Algorithms: Minimum Spanning Tree – Squared Error Clustering algorithm – K-Means Clustering – Nearest neighbour algorithm – PAM algorithm – Bond Energy algorithm.

UNIT III   **15 Hours**
Association rules: Introduction - Large item sets - Basic algorithms: Apriori algorithm – Sampling Algorithm – Partitioning - Advanced Association Rules Techniques – Measuring the quality of rules. **Data Mining Applications:** Data Mining for Financial Data Analysis - Data Mining for the Retail Industry - Data Mining for the Telecommunication Industry - Data Mining for Intrusion Detection.

Data Warehouse Basic concepts : What is a Data Warehouse – Differences between operational database systems and Data Warehouses – Multi-tiered Architecture – Data Warehouse models – Extraction, Transformation and Loading – Metadata repository. Data Warehouse modelling: Data Cube and OLAP – Data cube: A Multidimensional Data model – Schemas for multidimensional data models – Dimensions: The role of concept hierarchies – Measures: Their categorization and computation – Typical OLAP operations.

Text Books:

1. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2011.
2. Daniel. T. Larose Knowledge discovery, An Introduction to Data Mining, Wiley Publishers, 2014
3. Margaret H.Dunham, "Data mining introductory and advanced topics", Pearson education, 2003.
4. G. K. Gupta: Introduction to Data Mining with Case Studies, 3rd Edition, PHI, New Delhi, 2009.

B18BS3050	**COMPUTER NETWORKS**	L	T	P	C
Total Hours: 60		**4**	**0**	**0**	**4**

COURSE OBJECTIVES :

After successful completion of this course students will be able to
- Identify the different components and their respective roles in a communication System
- Design an enterprise network employing the common LAN technologies and be able to evaluate the advantages and disadvantages
- Describe the importance and functions of the OSI layers Physical, data link, network and transport layer.

COURSE OUTCOMES :

- To master the fundamentals of data communications and networks by gaining knowledge of data transmission concepts.
- Understanding the operation of physical and data link layer.
- Learning the algorithms used to design data networks.
- Understanding the principles of transport and application layers.

UNIT I Introduction   **15 Hours**
Uses of computer networks, Network Hardware, Network Software, Reference Models, Network Standardization. The Physical Layer: Guided Transmission Media, Wireless Transmission, Digital modulation and multiplexing, Switching: Circuit switching, packet switching. Mobile telephone system.

UNIT II The Data Link Layer   **15 Hours**
Data link layer design issues, Error Detection and Correction, Sliding window protocol, Example Data link protocols. MAC sub layer: channel allocation problem, Multiple Access Protocols, Ethernet, Wireless LANs, data link layer switching,

UNIT III The Network Layer   **15 Hours**
Network layer design issues, Routing algorithms, Congestion control algorithms, Quality of Service, The network layer in the internet.
UNIT IV Transport Layer   **15 Hours**
Elements of Transport protocols, UDP, TCP, Performance issues. **Application Layer:** Domain Name system, Electronic Mail, WWW.

Text Book:
1. Andrew S Tanenbaim, David J Wetherall "Computer Networks", Pearson Education, 5th Edition, Elsevier Inc, 2014. Chapter-1, 2, 3, 4, 5, 6, 7

Reference Books:
1. Data Communications and computer Network, Prakash C Guptha, Second Edition, PHI learning Pvt Ltd, Nov 2014.
2. "Introduction to Data Communication & Networking" BehrouzFerouzan, 5th Edition, Mc Graw Hill Education Pvt Ltd 2013
3. Larry &Peterson & Bruce S Davis; Computer networks-A System Approach, 5th Edition, Elsevier Inc, 2014.

B18BS3061	NUMERICAL METHODS	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES :

At the end of the course, the students would be acquainted with the basic concepts in numerical methods and their uses are summarized as follows:

- The roots of nonlinear (algebraic or transcendental) equations, solutions of large system of linear equations and Eigen value problem of a matrix can be obtained numerically where analytical methods fail to give solution.
- When huge amounts of experimental data are involved, the methods discussed on interpolation will be useful in constructing approximate polynomial to represent the data and to find the intermediate values.

COURSE OUTCOMES:

- Demonstrate understanding of common numerical methods and how they are used to obtain approximate solution to otherwise intractable mathematical problems.
- Apply numerical methods to obtain approximate solutions to mathematical problems.
- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyse and evaluate the accuracy of common numerical methods.

COURSE CONTENTS:

UNIT I Solution of Equations and Eigen value Problems   **15 Hours**

Solution of equation –Fixed point iteration: Bisection method – Newton's method – Solution of linear system by Gaussian elimination and Gauss-Jordon method– Iterative method – Gauss-Seidel method – Inverse of a matrix by Gauss Jordon method – Eigen value of a matrix by power method and by Jacobi method for symmetric matrix.

UNIT II Interpolation and Approximation   **15 Hours**

Lagrangian Polynomials – Divided differences – Interpolating – Newton's forward and backward difference formulas.

UNIT III Numerical Differentiation and Integration   **15 Hours**

Differentiation using interpolation formulae Numerical integration by trapezoidal and Simpson's1/3 and 3/8 rules – Weddle's rule –Double integrals using trapezoidal and Simpsons' rules.

UNIT IV Initial and Boundary Value Problems for Ordinary Differential Equations
15 Hours

Single step methods: Taylor series method – Euler method for first order equation – Fourth order Runge–Kutta method for solving first and second order equations – Multistep methods: Milne's and Adam's predictor and corrector methods.

Text Books:
1. Veerarjan, T and Ramachandran, T., "Numerical methods with programming in C", Tata McGraw-Hill Publishing.Co.Ltd.
2. Sankara Rao K, "Numerical Methods for Scientists and Engineers", Prince Hall of India Private Ltd, New Delhi.

Reference Books:
1. Chapra, S. C and Canale, R. P., "Numerical Methods for Engineers, Tata McGraw-Hill, New Delhi.
2. Gerald, C. F. and Wheatley, P.O., "Applied Numerical Analysis", Pearson Education, Asia, New Delhi.
3. Grewal, B.S. and Grewal, J.S., "Numerical methods in Engineering and Science", Khanna Publishers, New Delhi.
4. P K Srimani and M Vinayaka Murthy, "Computer Oriented Numerical Methods & Linear Programming", Subhas Stores, Bengaluru, 2011

B18BS3062	DISCRETE MATHEMATICAL STRUCTURES	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:
- To reflect on the concepts and operations of mathematical logic needed for computer science.
- To Examine and apply the class of functions which transform a finite set into another finite set which relates to input output functions in computer science.
- To interpret discrete knowledge in Computer Science through graph theory and its applications.

COURSE OUTCOMES:
On completion of this course the student will be able to:
- Acquire the basic knowledge of set theory, functions and relations concepts needed for designing and solving problems.
- Acquire the knowledge of logical operations and predicate calculus needed for computing skill.
- Able to design and solve Boolean functions for defined problems.

- Apply the acquired knowledge of graph theory, design discrete problems to solve by computers.

COURSE CONTENTS:

UNIT I Set Theory, Properties of Integers   15 Hours
Sets and its different types of sets, Set Operations and the Laws of Set Theory, Counting and Venn Diagrams, Principles of Inclusion and Exclusion, Permutations and Combinations with repetition and Mathematical Induction.

UNIT II Fundamentals of Logic   15 Hours
Basic Connectives and Truth Tables, Logic Equivalence: The laws of Logic, Logical Implications: Rules of Inference, The use of Quantifiers and Quantifier Definitions.

UNIT III Relations and Functions   15 Hours
Cartesian products and Relations, Properties of Relations, Computer recognition-Zero One Matrices and Directed Graphs, Composite relations. Functions-Plain and One-to-One, Onto Functions, Sterling Numbers and the Second Kind, Special functions, The Pigeon-hole principle, Function composition and inverse functions.

UNIT IV Graph Theory   15 Hours
Terminology, Definitions, Properties and Examples, Connectivity and Adjacency, Euler and Hamilton, Representation and Isomorphism, Planarity and Chromatic Number, Directed Graphs and Weighted Graphs, Trees and its properties and types.

Text Books:
1. Ralph P Grimaldi, B.V.Ramana, "Discrete & Combinatorial Mathematics, An Applied Introduction" 5th Edition, Pearson Education, 2004.
2. Eric Gosset "Discrete Mathematics with Proof" Wiley India, 2nd Edition, 2010.

Reference Books:
1. Kenneth H Rosen, "Discrete Mathematics & its Applications" 7th edition, McGraw-Hill, 2010
2. Tremblay and Manohar R, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill, New Delhi, 2003.
3. Y N Singh "Discrete Mathematical Structures" Wiley India, 1st edition, 2010
4. JayantGanguly: A Treatise on Discrete Mathematical Structures" Pearson, 2010
5. D.S. Malik & M.K Sen: Discrete Mathematical Structures: Theory & Applications, Cengage Learning, 2004.
6. NarsinghDeo, Graph Theory with Applications to Engineering and Computer Science, PHI Learning Pvt. Ltd., 2004.
7. Thomas Koshy: Discrete Mathematics with Applications, Elsevier, 2005, Reprint 2008.
8. Dr.D.S.C, "Discrete Mathematical Structures", Fourth Edition, 2014 – 2015.

9. K S Deshikachar, M Vinayaka Murthy and Udaya Rani, " Discrete Mathematical Stuctures with Application to Computer Science", Subhas Stores, Bengaluru, latest

B18BS3070	SOFT SKILLS	L	T	P	C
Total Hours: 60		2	0	0	2

*** COURSE CONTENTS will be provided by Placement ****

B18BS3080	OBJECT ORIENTED PROGRAMMING WITH JAVA LAB	L	T	P	C
Total Hours: 30		0	0	2	2

LAB EXPERIMENTS:

PART-A

1. Program to define a structure of a basic JAVA program
2. Program to define the data types, variable, operators, arrays and control structures.
3. Program to define class and constructors. Demonstrate constructors.
4. Program to define class, methods and objects. Demonstrate method overloading.
5. Program to define inheritance and show method overriding.
6. Program to demonstrate Packages.
7. Program to demonstrate Exception Handling.
8. Program to demonstrate Multithreading.
9. Program to demonstrate I/O operations
10. Program to demonstrate Applet structure and event handling.
11. Program to demonstrate Layout managers.

PART-B

1. Install java on windows
2. Install and configure java on centos7
3. Install and configure java on Ubuntu server
4. Write a web application server and connect to mysql database
5. Use maven to build compile and package
6. Deploy your package web application

B18BS3090	RDBMS LAB	L	T	P	C
Total Hours: 30		0	0	2	2

LAB EXPERIMENTS:

Practical List - 1

1. Create the following Tables and Insert the below data.

Salesmen

```
SNUM    SNAME        CITY        COMMISSION
--------------------------------------------------------
1001    Piyush       London        12 %
1002    Sejal        Surat        13 %
1004    Miti         London        11 %
1007    Rajesh       Baroda        15 %
1003    Anand        New Delhi      10 %
```

SNUM   : A unique number assigned to each salesman.
SNAME   : The name of salesman.
CITY   : The location of salesmen.
COMMISSION: The Salemen's commission on orders.

Customers

```
CNUM    CNAME          CITY     RATING  SNUM

---------------------------------------------------------

2001    Harsh          London    100    1001
2002    Gita           Rome      200    1003
2003    Lalit          Surat    200    1002
2004    Govind          Bombay    300    1002
2006    Chirag         London    100    1001
2008    Chinmay         Surat    300    1007
2007    Pratik          Rome    100    1004
```

CNUM : A unique number assigned to each customer.
CNAME : The name of the customer.
CITY   : The location of the customer.
RATING : A level of preference indicator given to this customer.
SNUM   : The number of salesman assigned to this customer.
Orders

70

```
   ONUM     AMOUNT       ODATE      CNUM     SNUM

   -------------------------------------------------------

   3001     18.69       10/03/97    2008     1007
   3003     767.19      10/03/97    2001     1001
   3002     1900.10     10/03/97    2007     1004
   3005     5160.45     10/03/97    2003     1002
   3006     1098.16     10/03/97    2008     1007
   3009     1713.23     10/04/97    2002     1003
   3007     75.75       10/04/97    2004     1002
   3008     4723.00     10/05/97    2006     1001
   3010     1309.95     10/06/97    2004     1002
   3011     9891.88     10/06/97    2006     1001
```

ONUM   : A unique number assigned to each order.

AMOUNT : The amount of an order.

ODATE : The date of an order.

CNUM   : The number of customer making the order.

SNUM   : The number of salesman credited with the sale.

Practical List - 2

1)Alter salesman table by setting snum as primary key.

2)Alter customer table by setting cnum as primary key.

3)Alter orders table by setting onum as primary key.

4)Alter orders table by adding snum and cnum as foreign keys

5)Alter customer table by adding snum as foreign keys

6) Insert any five records in customers table.

7) Update the name of the customer in the customers table from Lalit to Girish

8)Remove all orders from customer Chirag from the orders table.

Practical List - 3

1. Produce the order no, amount and date of all orders.

2. Give all the information about all the customers with salesman number 1001.

3. Display the following information in the order of city, sname,snum and commission.

4. List of rating followed by the name of each customer in Surat.

5. List of all orders for more than Rs. 1000.

6. List all customers whose names begins with letter 'A' to 'G'.

7. List of names and cities of all salesmen in London with commission above 10%.

8. List all customers excluding those with rating <= 100 unless they are located in Rome.

9. List all orders for more than Rs.1000 except the orders of snum<1006 of 10/03/97.

10. List all orders with zero or NULL amount.

Practical List - 4

1) Display cnum, cname, city from customer details table.

2) Display all snum without duplicates from all orders.

3) Display names and commissions of all salespeople in london.

4) All customers who were either located in Rome or had a rating above 200.

5) All customers with NULL values in city column.

6) All orders taken on Oct 3Rd and Oct 4th 1997.

7) Largest order taken by each salesperson with order value more than $3000.

8) Select each customer's smallest order.

9) Count the number of salespeople currently listing orders in the order table.

10) All customers serviced by Piyush or Miti.

Practical List - 5

Solve the following using PL/SQL Block.

1) Reverse of a Number

2) Factorial of a number

3) Write a PL/SQL to update the rate field by 20% more than the current rate in inventory table which has the following fields: Prono, ProName and Rate. After updating the table a new field (Alter) called for Number of item and place for values for the new field without using PL/SQL block.

4) Write a PL/SQL to split the student table into two tables based on result (One table for ―Pass‖ and another for ―Fail‖). Use cursor for handling records of student table. Assume necessary fields and create a student details table

FOURTH SEMESTER

Sl. No.	Code	Title	HC/SC/FC	Credit Pattern			Credits	Working Hrs
				L	T	P		
1	B18BS4010	Cloud Computing Architecture and Design	HC	2	1	0	3	4
2	B18BS4020	Object Oriented Modelling and Design	HC	2	1	0	3	4
3	B18BS4030	Design and Analysis of Algorithms	HC	4	0	0	4	4
4	B18BS4040	Operations Research	HC	4	0	0	4	4
5	B18BS4051	Advanced Computer Networks	SC	2	1	0	3	4
	B18BS4052	Introduction to Data Science						
6	B18BS4060	Mooc/Swayam	RULO	4	0	0	4	4
7	B18BS4070	Soft skills	RULO	2	0	0	2	2
Practical Courses								
8	B18BS4080	Cloud Computing Architecture and Design Lab	HC	0	0	2	2	4
9	B18BS4090	Object Oriented Modelling and Design LAB	HC	0	0	2	2	4
Total Credits				**20**	**3**	**4**	**27**	**34**

B18BS4010	CLOUD COMPUTING	L	T	P	C
Total Hours: 60	**ARCHITECTURE AND DESIGN**	**2**	**1**	**0**	**3**

The objective of this course is to:

- Get understanding of Cloud Data center Infrastructure framework

- Understand components which help achieve cloud infrastructure

 COURSE OUTCOMES:

- Identify the architecture, infrastructure and delivery models of cloud computing
- Apply suitable virtualization concept.
- Choose the appropriate cloud player, Programming Models and approach.
- Address the core issues of cloud computing such as security, privacy and interoperability and design Cloud Services and Set a private cloud.

 COURSE CONTENTS:

UNIT I Cloud Enabling and Datacenter /VMware ESXi Technology: 15 Hours
Internet service Providers, technical and business considerations, virtualization, standardization, automation, remote operations and management, High availability, security-aware design ,operation, and Management ,computing hardware, storage hardware, network hardware, virtualization technology, Multi-tenant technology, service technology .VMware ESXi 5.5 or above (Exploring VSphere 5.5, Planning and installing VMware ESXi 5.5 , Install and configure vcentre Server, setup Vsphere web application for management, creating and configuring virtual networks, creating and configuring shared storage (iSCSI SAN or NFS) for storing VM's , Configure Vsphere high availability and test VM failover, VM snapshots and restore, VM clone

UNIT II Fundamentals of cloud architecture: 15 Hours
 Introduction to UML and TOGAF, workload Distribution Architecture, resource pooling architecture, Dynamic scalability architecture, Elastic resource capacity architecture, server load balancing architecture, cloud bursting architecture, elastic disk provisioning architecture, redundant storage architecture, case study example

UNIT-III Advanced cloud architecture and Virtualization with Citrix Xen Server:
                                                                                       15 Hours

Hypervisor clustering architecture, load balanced virtual server instances, non-disruptive service relocation architecture, zero downtime architecture, cloud balancing architecture, resource reservation architecture, dynamic failure detection and recovery architecture, bare-

metal provisioning architecture, rapid provisioning architecture, storage workload management architecture, case study example . Citrix xen (Installing and configure Xen Server, install xen centre client, configuring xen server networking, Xen server storage overview and components.)

UNIT IV Security, SLA Management and Disaster recovery planning :   15 Hours
Data in cloud, and how much security is required, responsibilities of each service models, security strategies, areas of focus on security, define SLA's and factors that impact SLA, Disaster recovery approach for your cloud, disaster recovery strategies for IaaS, PaaS, SaaS and hybrid clouds , case study .

Text Books:
1. Cloud Computing: Concepts, Technology & Architecture (The Prentice Hall Service Technology Series from Thomas Erl) Hardcover – May 20, 2013 ,by Thomas Erl (Author)
2. Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS) Hardcover – January 28, 2014 by Michael J. Kavis (Author)
3. Mastering Citrix® XenServer® by Martez Reed
4. VMware vsphere 5.5 or above official documentation

B18BS4020	OBJECT ORIENTED MODELING AND DESIGN	L	T	P	C
Total Hours: 60		**2**	**1**	**0**	**3**

COURSE OBJECTIVES:

- To introduce the concept of Object-oriented design
- Acquire knowledge of Basic UML Concepts, Life Cycle of Object oriented Development, Modeling Concepts
- Produce conceptual models for solving operational problems in software and IT environment using UML

COURSE OUTCOMES:

- Analyze the development of Object Oriented Software models

- Develop a working understanding of formal object-oriented analysis and design processes, Ability to abstract object-based views for generic software systems.
- Ability to analyze and model software specifications.
- Ability to abstract object-based views for generic software systems

COURSE CONTENTS:

UNIT I Modeling Concepts & Class Modeling   15 Hours

Introduction to OO development, OO themes; Evidence for usefulness of OO development, OO modeling history. Modeling as Design Technique: Modeling; abstraction; The three

75

models. Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model; Navigation of class models; Practical tips. Advanced object and class concepts; Association ends; N-array associations; Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived data; Packages;

UNIT II State Modeling and Interaction Modeling   15 Hours

State Modeling: Events, States, Transitions and Conditions; State diagrams; State diagram behavior; Practical tips. Advanced State Modeling: Nested state diagrams; Nested states; Signal generalization; Concurrency; A sample state model; Relation of class and state models; Interaction Modeling: Use case models; Sequence models; Activity models. Use case relationships; Procedural sequence models; Special constructs for activity models

UNIT III System Conception and Analysis System Conception   15 Hours

Devising a system concept; elaborating a concept; preparing a problem statement. Overview of analysis; Domain class model; Domain state model; Domain interaction model; Iterating the analysis. Application Analysis: Application interaction model; Application class model; Application state model; adding operations.

UNIT IV   15 Hours

System Design and Class Design Overview of system design; Estimating performance; Making a reuse plan; Breaking a system in to sub-systems; Identifying concurrency; Allocation of sub-systems; Management of data storage; Handling global resources; Choosing a software control strategy; Handling boundary conditions Class Design: Overview of class design; Bridging the gap; Realizing use cases; Designing algorithms; Recording downwards, Refactoring; Design optimization; Reification of behavior.

Text Books:

1. Michael Blaha, James Rumbaugh, "Object-Oriented Modeling and Design with UML", 2nd Edition, Pearson Education / PHI, 2005. (Chapters 1 to 9, 11 to 14.10,15.1 to 15.8)
2. Frank Buschmann, RegineMeunier, Hans Rohnert, Peter Sommerlad, Michael Stal, "Pattern-Oriented Software Architecture, A System of Patterns", Volume 1, John Wiley and Sons, 2006. (Chapters 1, 2.4, 3)
Reference Books:
1. Grady Booch et al, "Object-Oriented Analysis and Design with Applications", 3rd Edition, Pearson,2007.
2. Mark Priestley, "Practical Object-Oriented Design with UML", 2nd Edition, Tata McGraw-Hill, 2003.
3. K. Barclay, J. Savage, "Object-Oriented Design with UML and JAVA", Elsevier, 2008.
4. Booch, G., Rumbaugh, J., and Jacobson, I., "The Unified Modeling Language User Guide", 2 nd Edition,Pearson, 2005.
5. E. Gamma, R. Helm, R. Johnson, J. Vlissides, "Design Patterns-Elements of Reusable Object- Oriented Software", Addison-Wesley, 1995.

6. Michael R Blaha, James R Rumbaugh, "Object Oriented Modeling and Design with UML", 2nd Edition, Prentice Hall, 2004.

B18BS4030	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
Total Hours: 60		4	0	0	4

COURSE OBJECTIVES:

Analyze the asymptotic performance, prove the correctness and to analyze the running time of the basic algorithms.

- To design algorithms using the dynamic programming; greedy method and recite algorithms that employ this Strategy.
- Demonstrate Tree and graph traversal techniques.
- Evaluation of Backtracking algorithms.

COURSE OUTCOMES:

Upon completion of this course, students should be able to:
- Analyse the fundamental principles underlying algorithm analysis and design and be able to apply them in   specific instances
- Validate algorithms asymptotically and compute the performance analysis of algorithms with the same functionality.
- Design an efficient algorithm for a problem using a specified paradigm along with a proper data structure.
- Realise essential algorithm design techniques such as divide-and conquer, dynamic programming and the greedy methods and many of its applications
- Implement various algorithms on graph data structures, including finding the minimum spanning tree and shortest path.

COURSE CONTENTS:

UNIT I Introduction and Divide & Conquer technique   15 Hours

Definition of algorithm, Characteristics of algorithm, Important problem types, Fundamentals of Algorithmic Problem Solving using flow chart, Different methods to find the GCD of two integers, Order of Growth, Basic efficiency classes, Asymptotic Notations, Time and space complexity of an algorithms. **Divide and Conquer**: General Method, Binary Search, Merge Sort and Quick Sort.

UNIT II Greedy Method   15 Hours

General method, Fractional Knapsack Problem, Job Sequencing with deadline, Spanning trees, Minimum cost spanning trees: Prim's algorithm, Kruskal's Algorithm, Single Source Shortest Paths problems-Dijkstra's algorithm

UNIT III Dynamic Programming   **15 Hours**

Introduction to Graphs, Types of graphs, Representation of graphs, Terms related to graph, General Method, Multistage Graphs, Warshall's Algorithm for Transitive Closure, All pair Shortest Paths, 0/1–knapsack, Flow Shop Scheduling.

UNIT IV Basic Traversal & Search techniques: **15 Hours**

Traversal techniques for Trees: Binary Tree, Properties of Binary Tree, Types of Binary Tree, Binary Tree Traversal Techniques: Pre-order traversal, In-order traversal and post-order traversal. Search techniques for graphs: Breadth First Search (BFS), Depth First Search (DFS). **Backtracking:** General method, 4-Queens Problem, Sum of Subset Problem, Graph Coloring, Hamiltonian Circuit Problem.

Text Books:
1. SaraBaase, Allen Van Gelder, ComputerAlgorithms ,Introduction to design and Analysis, 3rdedition Pearson Publication, 2006 (Chapters 4, 5, 7, 8 and 9).
2. Horowitz E., Sahani S., Rajasekharan S, "Fundamentals of Computer Algorithms", Galgotia Publication 2005(Chapters 1, 3- 6 and 7).
3. Fundamentals ofComputer algorithm – Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran., 2005 (Chapters 1, 3, 4, 5, 6 and 7).

Reference Books:
1. A. M Padma Reddy , " Design and Analysis of Algorithms ", Sri nandi Publications, 2017(Chapters 1-9).
2. Srikanth S, "" Design and Analysis of Algorithms", Skyward Publishers, 2015 (Chapter 1-8).
3. Chitra Ravi, " Design and Analysis of Algorithms", Subhas Publishers, 2015 (Chapter 1-8).

B18BS4040	OPERATION RESEARCH	L	T	P	C
Total Hours: 60		4	0	0	4

COURSE OBJECTIVES:

Introduce students to the techniques of operations research in mining operations
- Provide students with basic skills and knowledge of operations research and its application in mineral industry
- Introduce students to practical application of operations research in big mining projects.

COURSE OUTCOMES:

Formulate and solve problems as networks and graphs.
- Develop linear programming (LP) models for shortest path, maximum flow, minimal spanning tree, critical path, minimum cost flow, and transshipment problems.

- Solve the problems using special solution algorithms.
- Use CPM and PERT techniques, to plan, schedule, and control project activities.
- Construct linear integer programming models and discuss the solution techniques.
- Formulate pure, mixed, and binary integer programming models.

COURSE CONTENTS:

UNIT I Introduction and Linear Programming Problems (LPP)   15 Hours
Introduction to OR Modeling Approach and Various Real Life Situations, Basic LPP and Applications; Various Components of LP Problem Formulation, Solving LPP: Using Simultaneous Equations and Graphical Method; Simplex Method.

UNIT II Solving Linear Programming Problems and Transportation Problems
                                                                                          15 Hours

Big – M Method.Two-Phase Method, Duality Theory; Transportation Problems and Assignment Problems.

UNIT III Network Analysis   15 Hours
Shortest Path: Dijkstra Algorithm; PERT-CPM problems (Cost Analysis, Crashing, Resource Allocation excluded).

UNIT IV Game Theory and Queuing Theory: 15 Hours
Introduction ; 2- person Zero – sum Game; Saddle Point ; Mini-Max and Maxi-Min Theorems(statement only); Games without saddle point ; Graphical Method ; Principle of Dominance. Introduction, Basic Definitions and Notations; Axiomatic Derivation of the Arrival & Departure (Poisson Queue). Poisson Queue Models: M/M/1: ∞/FIFO and M/M/1: N/ FIFO.

Text Book:
1. H.A. Taha, "Operations Research", Fifth Edn. Macmillan Publishing Company,.

Reference Books :
1. V.K. Kapoor – "Operations Research" problem & Solutions, fourth revised edition, Sultan Chand & Sons Educational Publishers, New Delhi.
2. KantiSwaroop – " Operations Research"
3. Hadley G., "Linear Programming" Narosa Publishers, 1987
4. Hillier F. & Liebermann G.J., "Introduction to Operations Research" 7/e , THM
5. Mustafi : Operations Research, New Age International
6. Shenoy : Operations Research for Management , New Age International
7. Mahapatra : Introduction to System Dynamics Modelling, Universities PressRao : Engineering Optimization , New Age International
8. Schaum Outline Series – "Operations Research" ,TMH
9. P K Srimani and M Vinayaka Murthy, "Computer Oriented Numerical Methods & Linear Programming", Subhas Stores, Bengaluru, 2011

B18BS4051	ADVANCED COMPUTER NETWORKS	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:

In this course students will be able to
- Identify and work on different routing protocols
- Propose knowledge of Internetworking
- Describe different types of routing mechanisms
- Describe the Transport layer protocols and its functionality.

COURSE OUTCOMES:
- Understand motivation, parameters and Functions of Quality of service.
- To master the fundamentals of data communications and networks by gaining knowledge of data transmission concepts.
- Analyze the computer network with suitable network protocols and routing algorithms.
- Analyze different routing protocols and traffic engineering methods deployed in networking.

COURSE CONTENTS :

UNIT I Transmission Networks   **15 Hours**

Introduction, PDH Networks, SONET/SDH Networks, DWDM Network, Wireless Transmission: Wireless media, Wireless Systems, Spread Spectrum Technology.

UNIT II Routing And Internet Protocol   **15Hours**

Routing, Static routing, Dynamic routing, Distance Vector Routing Algorithm, Link State Routing, Open Shortest Path First Routing protocol. Address types of the TCP/IP stack, IP Address format, IPv4 Packet Format, Hierarchical Addressing, Sub netting, ICMP, IPv6, Introduction to SDN, VXLAN, GRE and VPN.

UNIT III End-To-End Protocols   **15Hours**

Simple De-multiplexer(UDP), Reliable Byte Stream(TCP), Remote Procedure Call, Congestion Control and Resource Allocation-Issues in Resource Allocation, Queuing Disciplines, TCP Congestion Control.

UNITIV Quality Of Service   **15 Hours**

Motivation for QoS, Parameters, Functions required for supporting QoS, Traffic Control, Leaky Bucket algorithm, Token Bucket Algorithm, Explicit Congestion Notification (ECN), Resource Reservation Protocol(RSVP).

Text Books:

1. Computer Networks, Natalia Olifer, Victor Olifer, First Edition, John Wiley, 2015, UNIT-1: Chapter 10, 11

2. Larry &Peterson & Bruce S Davis; Computer networks-A System Approach, 5th Edition, Elsevier Inc, 2014. Chapter 4,5,6.

3. Data Communications and computer Network, Prakash C Guptha, Second Edition, PHI learning Pvt Ltd, Nov 2014. Chapter 23.

Reference Books:

1. "Introduction to Data Communication & Networking" BehrouzFerouzan, 5th Edition, Mc Graw Hill Education Pvt Ltd 2013

2. Andrew S Tanenbaim, "Computer Networks", Pearson Education, 5th Edition, Elsevier Inc, 2014.

B18BS4052	INTRODUCTION TO DATA SCIENCE	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:

- To understand the basics of Big Data
- To know the role and use of Big Data in various relevant industries
- Utilize a variety of data analysis tools
- Create flexible data aggregations using pivot tables
- Represent data visually using pivot charts

COURSE OUTCOMES:

Able to use multiple files,

- Link these with formulae and work with three dimensional ranges,
- Calculate margins and other common ratios using calculation on pivot table
- Filter data using slicers in multiple pivot tables
- Create aggregate reports using formula based techniques

COURSE CONTENTS:

UNIT I Introduction 15 Hours

Data science definition, Evaluation of Data Science, Application of data science, Big data v/s data science, Business analytics v/s data science, type of business analytics, Machine learning definition and it's types, Visualization in data science ,tools in Data Science , certification in Data Science, Statistics in data science introduction

UNIT II Data pre-processing   15 Hours

Why data pre-processing is required, How to load data and understanding the data, Divide the data, Independent and dependent variable, How to handle missing values, How to handle categorical values, Splitting the data, Feature scaling, data pre-processing libraries

UNIT III Introduction to machine learning   15 Hours

What is Machine learning and how it works, Types of machine learning algorithms: supervised and unsupervised, Regression and classification, Simple Linear regression, multiple linear regression, Polynomial regression, SVR, decision tress, random forest, Logistics regression

UNIT IV   15 Hours

SVM, KNN, NAIVE BAIYES, decision tress classification, Random Forest classification, Visualization of Data, Statistical concepts

Text Books:
1. Microsoft Excel 2013 Inside Out by Mark Dodge and Craig Stinson
2. Microsoft Excel 2013 Data Analysis and Business Modeling: Data Analysis and Business Modeling by Wayne Winston

Introduction to Data Science using MS Excel (Labs)
- Execute SUM, AVERAGE, MIN, MAX & COUNT Functions
- Create & Modify a Pivot Table
- Create Pivot Charts
- Create Pivot Tables from Data Models
- Perfom a t-test, on the basis of Hypothesis Testing
- Perform a z-test, on the basis of Hypothesis Testing

B18BS4060	MOOC/SWAYAM	L	T	P	C
Total Hours: 60		4	0	0	4

COURSE CONTENTS:

MOOC / SWAYAM Online Courses: Globally, MOOC (Massive Open Online Course) platforms are gaining much popularity. Considering the popularity and relevance of MOOCs, Government of India has also launched an indigenous platform, SWAYAM. SWAYAM (Study Webs of Active Learning for Young Aspiring Minds) is basically an integrated MOOCs platform for distance education that is aimed at offering all the courses from school level (Class IX) to post-graduation level. The platform has been developed collaboratively by MHRD (Ministry of Human Resource Development) and AICTE (All India Council for Technical Education) with the help of Microsoft and is capable of hosting 2,000 courses.

A student shall register and successfully complete any of the courses available on SWAYAM / MOOC. Student shall inform the MOOC / SWAYAM coordinator of the school about the course to which he/she has enrolled. The duration and credits of the course shall vary depending upon the agency offering MOOC / SWAYAM courses. The student should submit the certificate issued by the agency offering SWAYAM / MOOC courses to the Coordinator of the school, the grades obtained in the course shall be forwarded to concerned authority of the University.

B18BS4070	**SOFT SKILLS**	L	T	P	C
Total Hours: 60		**2**	**0**	**0**	**2**

Note: The students will have to undergo Skill Development course being conducted by Training and Placement cell of the University.

B18BS4080	CLOUD COMPUTING ARCHITECTURE AND DESIGN LAB	L	T	P	C
Total Hours: 30		**0**	**0**	**2**	**2**

LAB EXPERIMENTS:

1. ESXi Hypervisor – Installation and Configure
2. vCenter – Installation and Configure
3. Virtual Machine (Linux) – Create and Manage on ESXi
4. Virtual Machine (Windows) – Create and Manage on ESXi
5. Configure Cluster and High Availability of VMware Esxi server
6. Xen Server – Installation and Configure
7. Xen Center – Installation and Configure
8. Virtual Machine (Linux) – Create and Manage on Xen server
9. Virtual Machine (Windows) – Create and Manage on Xen Server
10. Configure Cluster and High Availability on Xen Server

B18BS4090	OBJECT ORIENTED MODELING AND DESIGN LAB	L	T	P	C
Total Hours: 30		0	0	2	2

To draw the necessary UML diagrams using any suitable UML drawing tool and implement a program in Java or C++ or C# to demonstrate the design pattern specified by the examiner. For analysis and design models -, Class Diagram, Use-Case, Sequence diagrams should be drawn

NOTE: ANY SUPPORTING TOOL MAY BE USED.

LAB EXPERIMENTS:

1. **Publisher-Subscriber:**Define a one-to-many dependency between objects so that when one object changes state all its dependents are notified and updated automatically. The Observer pattern is also known as Dependents, Publisher-Subscriber. The need to maintain consistency between related objects without making classes tightly coupled.

2. **Command Processor**: The command processor design pattern separates the request for Service from its execution. A command processor component manages request as separate objects, schedules their execution and provides additional service.

3. **Forwarder-Receiver**: Distributed peers collaborate to solve a particular problem. A peer may act as a Client, requesting services, as a server, providing services, or both. The forwarder-receiver design pattern provides transparent inter process communication for software system with a peer-to-peer interaction model. It introduces forwarder and receiver to decouple peers from the underlying communication mechanism.

4. **Client-Dispatcher:** Provide a dispatcher component to act as an intermediate layer between clients and servers. The dispatcher implements a name service that allows client to refer to servers by name instead of physical locations, thus providing transparency. Each server is uniquely identified by its name and is connected to clients by the dispatcher. Client relay on the dispatcher to locate a particular server and to establish a communication like with the server.

5. **Proxy**: A proxy object can act as the intermediary between the client and target object. The proxy object has the same interface as the target object. The proxy holds a reference to the target object and can forward requests to target as required. In effect the proxy object has the authority the act on behalf of client to interact with the target object.

6. **Polymorphism**: When related alternatives or behaviors vary by type (class), assign responsibility for the behavior using polymorphic operations to the types for which the behavior varies.This interface will provide the behavior which varies according to the class type. All classes implementing this interface will write the method accordingly.

7. **Whole-Part**: The idea of the Whole-Part pattern is to introduce a component that encapsulates smaller objects, and prevents clients from accessing these constituent parts directly. Define an interface for the aggregate that is the only means of access to the functionality of the encapsulated objects, allowing the aggregate to appear as a semantic unit.

8. **Controller Design Pattern**: Use a controller as the initial point of contact for handling a request. The controller manages the handling of the request, including invoking security services such as authentication and authorization, delegating business processing, managing the choice of an appropriate view, handling errors, and the selection of content creation strategies.

FIFTH SEMESTER

S.NO	Code	Title	HC/SC/FC	Credit Pattern			Credits	Working Hrs
				L	T	P		
1	B18BS501	Public Cloud platforms	HC	2	1	0	3	4
2	B18BS502	Big Data Analytics using Hadoop	HC	3	0	1	4	5
3	B18BS503	Programming with Python	HC	2	1	0	3	4
4	B18BS5041	Mobile Networks &Computing	SC	2	1	0	3	4
	B18BS5042	Information Security and Cryptography						
5	B18BS5051	Introduction to Web programming	SC	2	0	1	3	4
	B18BS5052	Data Science using Tableu						
6	B18BS5061	Cloud Databases	SC	2	1	0	3	4
	B18BS5062	Enterprise Resource Planning						
7	B18BS5070	Soft skills	RULO	2	0	0	2	2
Practical Courses								
8	B18BS5080	AWS and Azure Public Cloud lab	HC	0	0	2	2	2
9	B18BS5090	Programming with Python lab	HC	0	0	2	2	2
Total Credits				**15**	**4**	**6**	**25**	**31**

B18BS5010	PUBLIC CLOUD PLATFORM	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:

- Have hands on knowledge on Azure cloud
- Have hands on knowledge on Amazon cloud

COURSE OUTCOMES:

- Ability to deploy a customer's complete web infrastructure with end to end to design with auto scaling mode, load balancer and public DNS on Amazon cloud and azure cloud
- Ability to provision cloud storage, Cloud database services, deploying web application and connecting to database service securely
- Ability to control access and roles to the cloud for a customer account and configure virtual private cloud in Amazon cloud
- Ability to provision and manage customer web infrastructure and manage on AWS and azure cloud

COURSE   CONTENTS:

UNIT I Microsoft Azure Cloud Foundation   15 Hours

Azure overview, choosing a subscription, exploring the portal, examining Azure services like compute services, Data Services, App services, network services, Designing a system for Azure with case study, Interacting with Azure windows and Linux virtual machines, attaching and detaching cloud storage to Azure virtual machines.

UNIT II Microsoft Azure Cloud Intermediate   15 Hours

Deploy, configure, monitor, and scale websites, Implement virtual machine workloads, images, disks, networking and storage, Configure, deploy, manage, and monitor cloud services, Implement blobs, Azure files, SQL databases, and recovery services, Manage access and configure diagnostics, monitoring, and analytic, Implement an Azure Active Directory and integrate apps, Configure and modify virtual networks

UNIT III Amazon Web Services Cloud   15 Hours

Amazon Web Services overview, working with Amazon Simple Storage Service (S3), Elastic compute cloud: security groups, key pair, launch Linux and windows instances .

UNIT IV Amazon Cloud Intermediate   15 Hours

Amazon machine images modification, EC2 applications, Simple queue Service, SQS applications, Elastic Block Storage, Dynamo DB, AWS networking, AWS security ,RDS, beanstalk, code pipeline, code commit

Text Books:

1. Learning Windows Azure Paperback – October 16, 2014, by Geoff Webber-Cross

2. Implementing Microsoft Azure Infrastructure Solutions, By Michael Washam, Rick Rainey

3. Programming Amazon Web Services: S3, EC2, SQS, FPS, and SimpleDB Paperback ,by James Murty

4. AWS System Administration: Best Practices for Sysadmins in the Amazon Cloud Paperback – March 25, 2015 by Mike Ryan (Author)

5. Amazon Web Services For Dummies Paperback – September 10, 2013 by Bernard Golden

Reference Books:

1. Getting started with Amazon book series available on AWS Book references http://www.amazon.com/Getting-Started-AWS-Amazon-Services-ebook

2. For Azure online documentations https://docs.microsoft.com/en-us/azure/

B18BS5020	BIG DATA ANALYTICS USING HADOOP	L	T	P	C
Total Hours: 60		3	1	0	4

COURSE OBJECTIVES:

The objective of this course is to:

- Understand Hadoop basics and perform Hadoop administration

COURSE OUTCOMES:

A student who successfully completes the course will have the ability to:

- Ability to install and configure Hadoop on single machine

- Ability to install and configure Hadoop on Multiple machine (cluster)

- Ability to perform Hadoop administrative takes.

- Get a strong foundation knowledge about Hadoop.

COURSE   CONTENTS:

UNIT-I: Hadoop Foundation   **15 Hours**

Motivation for Hadoop /Big Data, Hadoop concepts, hdfs, getting started with Hadoop frameworks and Hadoop Installation checking the pre-requisites, install Hadoop on local Ubuntu machine, download Hadoop , configuring and running Hadoop, understand three modes of Hadoop, configuring the base directory of Hadoop , formatting the name node, starting Hadoop, using HDFS, run your first Program Hello world of MapReduce, Monitoring Hadoop from the web browser, YARN, Hadoop I/O. Chapter 1-5 (Hadoop-The.Definitive.Guide_4.edition_a_Tom.White_April-2015.pdf)

UNIT-II: **MapReduce**   **15 Hours**

Devloping a MapReduce program, setting up the development environment, writing a unit test with MRunit, MapReduce workflows, How MapReduce works, Failures ,MapReduce types and format, MapReduce features. Chapter 6-9 (Hadoop-The.Definitive.Guide_4.edition_a_Tom.White_April-2015.pdf).

UNIT-III: Hadoop administration Flume and Sqoop: **15 Hours**

Hadoop administration, basics of Hadoopadministration, basics of MapReduce development, Hadoop Input/output, Testing Hadoop Programs. Monitoring Hadoop, Killing a Data node process, killing a task tracker process, killing a job tracker process, killing the name node process, setting up a node Hadoop cluster, Administering Hadoop. What is Flume, installing Flume,integrating Flume with applications.What is Sqoop, getting Sqoop, Sqoop imports a deeper look,working with imported data in Sqoop. Chapter 10,11,14,15 ((Hadoop-The.Definitive.Guide_4.edition_a_Tom.White_April-2015.pdf).

UNIT-IV: **Big Data ecosystem projects Pig,Hive, Spark,HBase, zookeeper**:   **15 Hours**

Introduction to Pig,Installing and running Pig,Pig Latin,User defined function in Pig,Data processing operators in Pig, Pig in practice, Introduction to Hive, Installing and configuring Hive, comparison with traditional databases,HiveQL, Tables, querrying data, UDF in Hive. Introduction to Spark, Installing Spark,anatomy of Spark job run, executors and cluster managers. Introduction to HBase,Installation of HBase, using HBase clients, HBase vs RDMS. Introduction to zookeeper, Installing and running zookeeper, building applications with zookeeper, zookeeper in production

Chapter   16,17,19,20,21   (Hadoop-The.Definitive.Guide_4.edition_a_Tom.White_April-2015.pdf)

Text Books:

1. Pro Apache Hadoop Paperback – September 10, 2014 by Jason Venner (Author), Sameer Wadkar (Author), Madhu Siddalingaiah (Author)

2. Hadoop Beginner's Guide Paperback – February 22, 2013 by Garry Turkington (Author)

Reference Books:

1. Pro Apache Hadoop Paperback – September 10, 2014 by Jason Venner (Author), Sameer Wadkar (Author), Madhu Siddalingaiah (Author)

2. Hadoop Beginner's Guide Paperback – February 22, 2013 by Garry Turkington (Author)

LAB EXPERIMENTS

1. Setup single node Hadoop cluster
2. Setup multi node Hadoop cluster
3. Run Hadoop sample jobs
4. Install configure Hive perform analytics
5. Install and configure Flume and perform analytics
6. Hadoop operations and troubelshooting
7. Install and work on HBase
8. Install and work on Spark

B18BS5030	PROGRAMMING WITH PYTHON	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:

- To Define the implementation of python language
- To Identify various features in python
- To solve the given problem using the syntactical structures of python language.

COURSE OUTCOMES:

A student who successfully completes the course will have the ability to:

- Ability to write programs using ruby and python
- Develop simple web application using python and Ruby and connect to database to store student information
- Understand how to connect python with backend database.

UNIT-I: Introduction to Python   **15 Hours**

Introduction of python, origin, Programming Basics and Strings, Numbers and Operators, Variables Names for Values, Program Files, Directories ,Changing Data Through Names**,** Copying Data**,** Accessing a Tuple Through Another Tuple

UNIT-II: Decision making in Python   **15 Hours**

Making Decisions: Comparing Values for Sameness, Comparing Values for Difference, More Than or Equal, Less Than or Equal**,** Reversing True and False, Repetition, Handling Errors

UNIT-III: Functions in Python   **15 Hours**

Functions: Grouping Code under a Name, Describing a Function in the Function**,** Layers of Functions

UNIT-IV: Classes and Objects in Python   **15 Hours**

Classes and Objects: What is an Object, Defining a Class, Creating an Object from the Class, Objects and their Scope, Inheritance, Overriding a method, Writing simple programs using classes and objects in Python.

Text Books:

1. Introducing Python by Bill Lubanovic(chapters 1-6), Oriely Publications, 1st Edition
2. Python Programming for absolute beginners by Michael Dawson, Course Technology-A part of CENGAGE Learning, 3rd Edition

B18BS5041	MOBILE NETWORKS & COMPUTING	L	T	P	C
Total Hours: 60		2	1	0	3

- To impart basic understanding of the wireless communication systems.

- To expose students to various aspects of mobile computing techniques.

- Understand the basic concepts of mobile computing.

- Be familiar with the network protocol stack

- Gain knowledge about different mobile platforms and application development.

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Explain the basics of mobile telecommunication system

- Choose the required functionality at each layer for given application

- Identify solution for each functionality at each layer

- Use simulator tools and design Ad hoc networks

- Develop a mobile application.

COURSE CONTENTS:

UNIT-I: Wireless Networks & Wireless LAN   **15 Hours**

Wireless Network, Wireless Network Architecture, Wireless Switching Technology, Wireless Communication problem, Wireless Network Reference Model, Wireless Networking Issues & Standards. Infra red Vs radio transmission, Infrastructure and Ad-hoc Network, IEEE 802.11: System Architecture, Protocol Architecture, 802.11b, 802.11a, Newer Developments, HIPERLAN 1, HIPERLAN 2, Bluetooth : User Scenarios, Architecture.

UNIT-II: Mobile Network Layer & Mobile Transport Layer   **15 Hours**

Mobile IP: Goals, Assumptions, Entities and Terminology, IP Packet Delivery, Agent Discovery, Registration, Tunneling and Encapsulation, Optimizations, Dynamic Host Configuration Protocol (DHCP) Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP, TCP over 2.5G/3G Wireless Networks.

UNIT-III: **Mobile Computing**   **15 Hours**

Introduction to Mobile Computing ,What is Mobile Computing? Mobile Computing vs. Wireless Networking, Mobile Computing Applications ,Characteristics of Mobile

Computing , Structure of Mobile Computing Application ,Cellular Mobile Communication ,Generations of Cellular Communication Technologies, Global System for Mobile Communications (GSM),GSM Services, System Architecture of GSM, GSM Security, General Packet Radio Service (GPRS), GPRS Services, GPRS Architecture, Universal Mobile Telecommunications System (UMTS), UMTS Network Architecture, Software Defined Radio (SDR).

UNIT-IV: **Mobile Platforms And Applications**   **15 Hours**

Basic Concepts, Mobile Device Operating Systems – Special Constrains & Requirements ,A survey of Commercial Mobile Operating Systems –windows mobile, palm OS, Symbian, iOS, Android, BlackBerry, OS for Sensor Networks.

Text Books:

1. Jochen Schiller, "Mobile Communications", Pearson Education, Second Edition, 2008. (unit 1 and 2)

2. Dr. Sunilkumar, et al "Wireless and Mobile Networks: Concepts and Protocols", Wiley India.

3. Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI

Learning Pvt. Ltd, New Delhi – latest.(unit 3 and unit 4)

4. Raj Kamal, "Mobile Computing", OXFORD UNIVERSITY PRESS.

Reference Books:

1. Asoke K Talukder, et al, "Mobile Computing", Tata McGraw Hill, 2008.

2. Matthew S.Gast, "802.11 Wireless Networks", SPD O'REILLY.

3. Ivan Stojmenovic, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2007.

4. Kumkum Garg, "Mobile Computing", Pearson.

5. Handbook of Security of Networks, Yang Xiao, Frank H Li, Hui Chen, World Scientific, 2011.

B18BS5042	INFORMATION SECURITY AND CRYPTOGRAPHY	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:

The objectives of this course are to:

- Introduce the concepts of computer network security covering security architecture and services.
- Describe security encryption algorithms and standards such as DES.
- Provide the knowledge about Public key Cryptographic Principles and Algorithms.
- Explain the features of network security applications
- Gain expertise in electronic mail security systems.

COURSE OUTCOMES:

On successful completion of this course; student shall be able to:

- Explain the concepts of computer network security covering security architecture and services.
- Use security encryption algorithms and standards such as DES for developing applications
- Implement Public key Cryptographic Algorithms and integrate them with secured data transaction based systems.
- Demonstrate the features of network security applications
- Deploy electronic mail security applications in campus/organization networks

COURSE CONTENTS:

UNIT-I: Introduction 15 Hours

The OSI Security Architecture, Security Attacks, Security Services, mechanisms, A model for network security, standards, symmetric encryption principles, Symmetric Block Encryption Algorithms, Data Encryption Standards, Strength of DES, Triple DES, Advanced Encryption Standard.

UNIT-II: Public-Key Cryptography and Message Authentication 15 Hours

Public key Cryptographic Principles, Public Key Cryptographic Algorithms (RSA, Diffie-Hellman), Approaches to Message Authentication, Secure Hash Functions (SHA-512), Message Authentication Codes, Digital Signatures. Overview of Kerberos (Key Exchange),Overview Intrusion Detection.

UNIT-III: Cloud Security   **15 Hours**

Security Concerns, Risk Issues, and Legal Aspects, Cloud Computing, Security, Assessing Your Risk Tolerance in Cloud Computing, Legal and Regulatory Issues, Securing the Cloud, Architecture, Security Requirements for the Architecture, Cloud Security Architecture, Planning Key Strategies for Secure Operation. Securing the Cloud, Data Security, Overview of Data Security in Cloud Computing, Cloud Data Security, Sensitive Data Categorization. Cloud Data Storage, Cloud Lock-in.

UNIT-IV: Electronic Mail Security   **15 Hours**

Password Management, Virus and threats, Virus Countermeasures, Firewalls, The Need for Firewalls, Firewall Characteristics, Types of Firewalls, Introduction to Cloud Security.

Text Books:

1. William Stallings, Network Security Essentials Applications and Standards, Fifth edition, Prentice Hall, 2011

2. Behrouz A. Forouzan, Cryptography and Network Security, Mc Graw Hill,2007.

3. Vic (J.R.) Winkler, Securing The Cloud: Cloud Computing Security Techniques and Tactics ,(Syngress/Elsevier) - 978-1-59749-592-9

Reference Books:

1. William Stallings, Cryptography and Network Security Principles and Practise, Pearson, Sixth edition,2013

2. Joseph Migga Kizza, Guide to Computer Security, Springer Science & Media Inc., Third edition, 2015

3. Andrew S.Tanenbaum, Computer Networks, Pearson, Fifth edition

4. Atul Kahate, Cryptography and Network Security, Mc Graw Hill, 2013.

5. Springer Journal of Cryptographic Engineering , ISSN 2190-8508

6. ACM,ACM- International Journal of Applied Cryptography,ISSN:1753-0563

7. IEEE, IEEE Transactions on Information Forensics and Security.

B18BS5051	INTRODUCTION TO WEB PROGRAMMING	L	T	P	C
Total Hours: 60		2	0	1	3

COURSE OBJECTIVES:

The objectives of this course are to:

- Describe rich internet applications that use most recent client-side programming technologies.
- Apply client-side validations using Java Script.
- Capture core technical skills necessary for a complete understanding of front-end web development, including HTML5 and CSS, JavaScript, DOM.

COURSE OUTCOMES :

On successful completion of this course, the student will be able to:

- Apply different elements of html in webpage
- Classify functionality of internet and web system
- Analyze various properties of CSS in HTML
- Demonstrate form controls in HTML
- Construct events handlings in JavaScript
- Analyses dynamic documents with JavaScript

COURSE CONTENTS :

UNIT-I: Fundamentals of Web   **15 Hours**

Fundamentals of Web: A Brief Introduction to the Internet, The World Wide Web, Web Browsers, Web Servers, Uniform Resource Locators, Multipurpose Internet Mail Extensions, The Hypertext Transfer Protocol. Introduction to XHTML: Basic Syntax, Standard XHTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, Syntactic Differences between HTML and XHTML.CSS: Levels of Style Sheets, Style Specification Formats, Selector Forms, Property Value Forms, Font Properties, List Properties, Color, Alignment of Text, The Box Model, Background Images, The <span> and <div> Tags.

UNIT-II: HTML 5   **15 Hours**

Detecting HTML5 features – Canvas, Video, Local Storage, Web Workers, Offline Applications, Geolocation, Placeholders and input types, What Does It All Mean–Doctype, Root, Headers, Articles, Dates and Times, Navigation and Footers. Simple Shapes, Canvas, Paths, Texts, Gradients and Images. A Form of Madness– PlaceHolders, Autofocus Fields, Email, and Numbers As Spinboxes and Sliders.

UNIT-III: JavaScript and XHTML Documents   **15 Hours**

The Basics of JavaScript: Overview of JavaScript, Object Orientation and JavaScript, General Syntactic Characteristics, Primitives Operations and ExpressionsJavaScript: Screen Output and Keyboard Input, Control Statements, Object Creation and Modification, Arrays, Functions, Pattern Matching Using Regular Expressions, Errors in Scripts. The Document Object Model, Element Access in JavaScript, Events and Event Handling.:Handling Events from Body Elements, Handling Events from Button Elements, Handling Events from Text Box and Password Elements, The DOM 2 Event Model. Dynamic Documents with JavaScript: Introduction, Positioning Elements, Moving Elements, Element Visibility

UNIT-IV: Introduction to Angular -JS   and Introduction to XML   **15 Hours**
ANGULAR JS: Understanding jQuery   ,Event   Manipulation   Methods, AngularJS Template & live data binding,Struts architecture & versions. **Introduction,** Syntax of XML, XML document structure, Document Type Definitions, Namespaces, XML Schemas, Displaying Raw XML Documents with CSS. XSLT Style Sheets: Overview of XSLT, XSL Transformations for Presentation, XML Processors

Text Books:
 1. Robert W Sebesta, "Programming the World Wide Web", 4th Edition, Pearson Education, 2008**.** (Chapters: 1, 2, 3, 4, 5 and 6)

2. Achyut S. Godbole and AtulKahate, Web Technologies, Tata McGraw Hill, 2003.

3. Jason Hunter, William Crawford, Java Servlet Programming, O'Reilly Publications, 1998.

Reference Books:

1. M.Deitel, P.J.Deitel, A.B.Goldberg, "Internet & World Wide Web How to program", 3rd Edition, Pearson Education / PHI, 2004.

2. Chris Bates, "Web Programming Building Internet Applications", 3rd Edition, Wiley India, 2006. 3. Xue Bai et al, "The Web Warrior Guide to Web Programming", Thomson, 2003.

3. Sklar, "The Web Warrior Guide to Web Design Technologies", 1st Edition, Cengage Learning India.

LAB PROGRAMS

PART A

1. Create an HTML5 page to demonstrate the usage of

- Text Formatting tags
- Links
- Images
- Tables

2.   Develop and demonstrate the usage of inline and external style Sheet using CSS.

3. Write a Program using JavaScript to display a table of the numbers from 5 to 15 and their squares and cubes using alert.

4. Develop and demonstrate using Java script, a XHTML document that display random numbers (integers).

5. Program to demonstrate various event handlers when an image is moved from the top stacking position, it returns to its original position   using   JavaScript.

6. Develop using Java script, an XHTML document that use of on load and on focus events.

7. Program on xml to read Employee details and display the   details using CSS.

8. Develop a web form to display the student details using XML and XSLT style sheets.

PART B

Build a client-side web application in the following areas:

1. Educational Institutions.
2. Online shopping.
3. Hospital Management System.
4. Real Estate.
5. Reservation System.

B18BS5052	DATA SCIENCE USING TABLEAU	L	T	P	C
Total Hours: 60		2	0	1	3

To explore the fundamental concepts of big data analytics

- To understand the applications using MapReduce Concepts.
- To learn to use various techniques for mining data stream.
- To understand the various search methods and visualization techniques.

Student will be able to

- Work with Data using Tableau including Data Extraction & Blending
- Create various Charts in Tableau
- Use Tableau Filtering
- Use Tableau Groups, Sets, Calculations
- Create Tableau Maps

UNIT-I: Basic Workaround & Charting on Tableau   15 Hours

Installation & Basics of Tableau, Installing Tableau on your Computer, Connecting Tableau to a Data File, Navigating your way in Tableau, Creating Calculated Fields ,Adding Colors to your Worksheet in Tableau, Adding Labels and Performing Formatting, Exporting Worksheets in Tableau, Time Series Aggregation & Filters, Working with Data Extracts in Tableau, Working with Time Series, Understanding Aggregation Granularity and Level of Detail, Creating an Area Chart, Adding Filters and Quick Filters to your Worksheet

UNIT-II: Maps, Scatter plots, Dashboards and Joins   15 Hours

Maps, Scatter plots and Dashboards, Joining Multiple Data Sets in Tableau, Creating a Map and Working with Hierarchies,   Creating Scatter Plots and Applying Filters to Multiple Worksheets, Creating a Dashboard, Adding an Interactive Action Filter, Joining and Blending Data, Learning the Types of Joins, Joining Data ,vs Blending Data, Creating a Dual Axis Chart, Creating a Calculated Field in a Blend.

UNIT-III: Data Mining with Tableau   **15 Hours**

Using Tableau for Data Mining, Getting the Data Set for an A-B Test, Visualizing an Ad-hoc A-B Test in Tableau, Working with Aliases, Adding a Reference Line to your Chart, Looking for Anomalies in our Chart, Validating our Approach, Advanced Data Mining with Tableau, Getting the Data Set for a Chi-Squarred Test , Validating Tableau Data Mining Using Chi-Squarred Test, Chi-Squarred Test – Statistics,   Using Chi-Squarred Test for Two or More Categories ,Visualizing Balance and Estimated Salary Distributions

UNIT-IV: Advanced Dashboards and Data Preparation   **15 Hours**

Table Calculations and Advanced Dashboards Storytelling , Mapping to Set Geographical Roles, Creating Table Calculations for Gender, Creating Bins and Distribution for Age, Power of Parameters in Tableau, Creating a Tree Map Chart, Creating the Customer Segmentation Dashboard, Performing Advanced Activities on the Dashboard, Analyzing the Customer Segmentation Dashboard, Creating a Storyline, Advanced Data Preparation Understanding the Data Format, Interpreting Data via Tableau, Pivot Data in Tableau, Splitting Column into Multiple Columns, Working with Meta Data Grid ,Fixing Geographical Data Errors in Tableau

Text Books:

1. Tableau 9: The Official Guide by George Peck
2. Tableau for Dummies by Molly Monsey and Paul Sochan

B18BS5061	CLOUD DATABASES	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:

The objective of this course is to:

- To classify the latest trends in databases.
- To summarize the features of NoSQL systems.
- To distinguish NoSQL databases with each other and relational systems
- To compare the various NoSQL Data models.
- To acquire knowledge in parallel, distributed databases and its applications.
- To understand the usage of advanced data models.
- To learn emerging databases like MongoDB, HBase etc.

The student should know and understand:

- Describe NoSQL Databases.
- Compare the four types of NoSQL Databases (Document oriented, Key Value Pairs, Column oriented and Graph).
- Explain the need of NoSQL databases in handling Big data.
- Distinguish between the types of NOSQL databases.
- Demonstrate the data models in these databases.
- Apply appropriate Data model for any application.
- Design and write queries in NOSQL Databases.
- Evaluate NoSQL database development tools and programming languages
- Apply the principles behind Distributed storage models

COURSE CONTENTS:

UNIT-I: Introduction to NOSQL   **15 Hours**

Introduction to NoSQL Definition of NOSQL-Challenges in traditional RDBMS, History of NOSQL,Why NoSQL, Need for NOSQL- Big Data and NoSQL, Need for schema less databases. Aggregate data models, Distribution models, Types of NOSQL Data base models-key-value , Column store, document data models and Graph Data models Distribution models, CAP theorem.

UNIT-II: Postgresql Database   **15 Hours**

Install and operate PostgreSQL, Create and delete databases and database users, Produce and delete tables, Use Pgcrypto to store passwords safely, Insert, update, and delete data from tables.

Introduction to Key-value stores- Exploring Redis Redis data model Storing Data in and Accessing Data from Apache Redis –Querying in Redis.

UNIT-III: Document stores and its applications   **15 Hours**

Introduction to Document stores, Exploring MongoDB, MongoDB data model, Storing Data in and Accessing Data from MongoDB, CRUD operations in MongoDB. Querying in MongoDB using examples, Interact with MongoDB using Language Binding using any one language(PHP/JAVA/PYTHON)

UNIT-IV: Advanced NOSQL   **15 Hours**

Big MongoDB Indexing , Data processing with MongoDB, MongoDB storage architecture-
Horizontal Scaling through sharding. Import and Export commands in MongoDB, MongoDB
Database Administration.

Text books:

1. Pramod. J. Sadalge, Martin Fowler, NoSQL distilled, A brief guide to emerging world
   of Polyglot persistence. Addison-Wesley 2013.
2. Lars GeorgeHBase: A definitive Guide, OReilly publications,2011.
3. Josiah L. Carlson, Redis in Action,Manning Publications, 2013.
4. The Definitive guide to MongoDB, The NoSQL Database for Cloud and Desktop
   Computing, Apress 2010 .
5. Instant PostgreSQL Starter by Daniel K. Lyons

Reference Books:

1. "Professional NOSQL" by Shashank Tiwari, 2011, WROX Press
2. Kristina Chodorow, MongoDB: The Definitive Guide, 2nd Edition, O'Reilly
   publications,2013.

Reference Websites:

1. www.mongodb.org
2. www.redis.io
3. www.HBase.apache.org

Unit wise Text books reference.

- Unit 1- R1- Chapter 1, T1-Chapter 1-4,5.3.1
- Unit 2- www.redis.io, www.HBase.apache.org
- Unit 3-T4-chapter 4,6
- Unit 4-Chapter 9; R1-Chapter 4

LAB EXPERIMENTS

1. Setting up mongdb server
2. CRUD operations in Mongodb
3. Connecting sample application to mongodb
4. Install and configure postgresql
5. CRUD operations in Postegresql
6. Setup postgress sql master and slave replication.

B18BS5062	ENTERPRISE RESOURCE PLANNING	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:

To make student able to:

- Build an understanding of the fundamental concepts of ERP systems, their architecture, and working of different modules in ERP.

- learn various components of an application software that help computerize functioning of an enterprise such as sales, materials, production, financial , customer relationship AND supply chain modules.

- Provide a contemporary and forward - looking on the theory and practice of Enterprise Resource Planning Technology.

- Develop the basic understanding of how ERP enriches the business organizations in achieving a multidimensional growth.

- Prepare the students technological competitive and make them ready to self - upgrade with the higher technical skills.

COURSE OUTCOMES :

After completing this course, student will be able to

- Make basic use of Enterprise software, and its role in integrating business functions

- Analyze the strategic options for ERP identification and adoption.

- Design the ERP implementation strategies.

- Create reengineered business processes for successful ERP implementation

- Comprehend the technical aspects of ERP systems.

- Analyze the steps and activities in the ERP life cycle

- Identify the typical functionality in an ERP system;

- Explain the scope of common Enterprise Systems (e.g., MM, SCM, CRM, HRM, procurement)

- Explain the challenges associated with implementing enterprise systems and their impacts on organizations

-

UNIT-I:Introduction to ERP   **15 Hours**

Introduction to ERP - Basic ERP concepts - Risks of ERP- Benefits of ERP,ERP Technology: **E**RP and Related Technologies, Business Intelligence, E-Commerce and E-Business, Business Process Reengineering, Data Warehousing, Data Mining, Supply Chain Management, Customer Relationship Management.(Part I, II)

UNIT-II: ERP Implementation   **15 Hours**

Implementation Challenges - Implementation Strategies - Implementation Life Cycle Implementation Methodologies, Project Management and Monitoring, Post Implementation activities. (Part III)

UNIT-III: ERP Business modules & Market   **15 Hours**

Business Modules of an ERP Package, Finance, Manufacturing, Human Resource, Quality Management, Marketing, Sales, Distribution and Service, ERP Marketplace and Marketplace Dynamics, SAP AG, Oracle Corporation, PeopleSoft. (Part V & VI)

UNIT-IV: ERP Present and Future   **15 Hours**

Turbo Charge the ERP System , Enterprise Application Integration -ERP , Internet and WWW - ERP II – ERP and Total Quality Management - Future directions and Trends in ERP. (Part VII)

Text Book:

1. Alexis Leon, "ERP Demystified", Tata McGraw Hill, 1999.(Part I to III, V to VII)

Reference Book:

1. Joseph A. Brady, Ellen F. Monk, Bret J. Wangner, "Concepts in Enterprise Resource Planning", Thomson Learning, 2001.
2. Jose Antonio Fernandz, " The SAP R /3 Hand book", Tata McGraw Hill
3. Vinod Kumar Garg and Venkitakrishnan N K, "Enterprise Resource Planning – Concepts and Practice", PHI
4. Joseph A Brady, Ellen F Monk, Bret Wagner, "Concepts in Enterprise Resource Planning", Thompson Course Technology
5. Mary Summer, "Enterprise Resource Planning"- Pearson Education

B18BS5070	**SOFT SKILLS**	**L**	**T**	**P**	**C**
Total Hours: 30		**0**	**0**	**2**	**2**

Note: The students will have to undergo Skill Development course being conducted by Training and Placement cell of the University.

B18BS5080	**AWS AND AZURE PUBLIC CLOUD LAB**	**L**	**T**	**P**	**C**
Total Hours: 30		**0**	**0**	**2**	**2**

LAB EXPERIMENTS:

Amazon EC2- Win server 2016

- Launch Windows server latest Instance
- Decrypt Password and download RDP shortcut client
- connect to the EC2 Windows latest instance
- Terminate the Windows server latest Instance

Amazon Elastic Block Store (Hands on lab by students)

- Create Standard Volume
- Create and delete snapshots
- Create Provisioned I/o Volume
- Assign volumes to Windows server latest and Ubuntu 14.04 server
- Disassociate and Delete volumes

Amazon Elastic Load Balancing (ELB)   (Hands on lab by students)

- Lab 1
    1. Launch Two Ubuntu EC2 Instances- apache web servers with user data
    2. Edit HTML files to both the servers
    3. Test your web Servers through internet
- Lab 2
    1. Create Elastic Load Balancer
    2. Add both the Ubuntu servers to ELB
    3. Test your Elastic Load Balancer
    4. Delete your Elastic Load Balancer

- Lab 3

AWS Route53

- What is Route53
- Route-53 demo integration with ELB you created (Performed by Instructor only)

Auto Scaling and Bootstrapping   (Hands on lab by students)

- Overview Of   Autoscaling
- ELB: Configuring The Elastic Load Balancer for Autoscaling group
- Configuring The AMI For Our Web Application
- Auto Scaling And Bootstrapping
- Scale out VM's though stress test
- Scaling VM 's based on low utilization

AWS- Webapp and RDS   (Hands on lab by students)

- RDS- An overview
- RDS –read replica
- RDS- Multi AZ failover
- RDS snapshots
  1. Lab 1 : Create a RDS instance
  2. Lab 2 : connecting to an RDS instance
  3. Lab 3 : creating a RDS snapshots and restoring snapshot
  4. Lab 4: Deleting RDS snapshots
- Deploy Web application in Amazon Ec2 (media wiki)
- Connect your Media wiki web application with RDS instances securely
- Make media wiki available on public url for user sign up and write knowledge wiki
- Delete Your RDS instance
  - Deploy workloads on Azure Resource Manager (ARM) virtual machines (VMs)
    - Identify workloads that can and cannot be deployed; run workloads, including Microsoft and Linux; create VMs; connect to a Windows/Linux VM
- Implement Azure storage blobs and Azure files
  - Read data, change data, set metadata on a container, store data using block and page blobs, stream data using blobs, access blobs securely, implement async blob copy, configure a Content Delivery Network (CDN), design blob hierarchies, configure custom domains, scale blob storage
- Integrate an Azure Active Directory (Azure AD) with existing directories

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    o Implement Azure AD Connect and single sign-on with on-premises Windows Server latest R2, add custom domains, monitor Azure AD

AWS s3 (Hands on lab by students)

- AWS s3- Overview and pricing
- Create Bucket and Folder
- Upload, download, share and delete object
- Delete Bucket

Text Books:

1. Learning Windows Azure Paperback – October 16, 2014, by Geoff Webber-Cross
2. Implementing Microsoft Azure Infrastructure Solutions, By Michael Washam, Rick Rainey
3. Programming Amazon Web Services: S3, EC2, SQS, FPS, and SimpleDB Paperback, by James Murty
4. AWS System Administration: Best Practices for Sysadmins in the Amazon Cloud Paperback – March 25, 2015 by Mike Ryan (Author)
5. Amazon Web Services For Dummies Paperback – September 10, 2013 by Bernard Golden

References:

1. Getting started with Amazon book series available on AWS Book references http://www.amazon.com/Getting-Started-AWS-Amazon-Services-ebook
2. For Azure online documentations https://docs.microsoft.com/en-us/azure/

B18BS5090	**PROGRAMMING WITH PYTHON LAB**	**L**	**T**	**P**	**C**
Total Hours: 30		**0**	**0**	**2**	**2**

LAB EXPERIMENTS:

PART-A

- Lab 01: Write a Python program to establish DB connection & Accept queries from user & execute it & return the result.

- Lab 02: Write a Python program which accepts the radius of a circle from the user and compute the area

- Lab 03: Define a class Person and its two child classes: Male and Female. All classes have a method "getGender" which can print "Male" for Male class and "Female" for Female class.

- Lab 04: Define a function that can accept an integer number as input and print the "It is an even number" if the number is even, otherwise print "It is an odd number".

- Lab 05: A website requires the users to input username and password to register. Write a program to check the validity of password input by users.

  Following are the criteria for checking the password:

  1. At least 1 letter between [a-z]

  2. At least 1 number between [0-9]

  1. At least 1 letter between [A-Z]

  3. At least 1 character from [$#@]

  4. Minimum length of transaction password: 6

  5. Maximum length of transaction password: 12

  Your program should accept a sequence of comma separated passwords and will check them according to the above criteria. Passwords that match the criteria are to be printed, each separated by a comma.

  Example

  If the following passwords are given as input to the program:

  ABd1234@1, aF1#, 2w3E*, 2We3345

  Then, the output of the program should be:

  ABd1234@1

- Lab 06: Write a program that computes the net amount of a bank account based a transaction log from console input. The transaction log format is shown as following:

108

D 100

W 200

D means deposit while W means withdrawal.

Suppose the following input is supplied to the program:

D 300

D 300

W 200

D 100

Then, the output should be:

500

PART-B

1. Design Jumble Game. Enjoy Playing it.

2. Design GuessMyNumber Game. Check if you are able to Guess the correct Number

SIXTH SEMESTER

Sl. No.	Code	Title	HC/SC/FC	Credit Pattern			Credits	Working Hrs
				L	T	P		
1	B18BS6010	Automation Tools for Cloud Deployment	HC	3	0	1	4	5
2	B18BS6020	Building Private Cloud with Openstack	HC	2	1	0	3	4
3	B18BS6030	Big Data and Hadoop on AWS and Azure	HC	2	1	0	3	4
4	B18BS6040	Software Engineering	HC	4	0	0	4	4
5	B18BS6051	Wireless Sensor Networks	SC	2	1	0	3	4
	B18BS6052	Cyber security & Big data Security						
6	B18BS6061	Advanced Web Programming using Ruby	SC	2	0	1	3	4
	B18BS6062	Data Analytics using R						
7	B18BS6070	Soft Skills	RULO	2	0	0	2	2
Practical Courses								
8	B18BS6080	Big Data and Hadoop on AWS and Azure lab	HC	0	0	2	2	2
9	B18BS6090	Building Private Cloud with Openstack lab	HC	0	0	2	2	2
Total Credits				**17**	**3**	**6**	**26**	**31**

B18BS6010	AUTOMATION TOOLS FOR CLOUD DEPLOYMENT	L	T	P	C
Total Hours: 60		3	0	1	4

COURSE OBJECTIVES:

- Introduction to Chief Configuration Management Framework
- Introduction to Puppet configuration management framework
- Hands on Knowledge on install and configure Chef and puppet

COURSE OUTCOMES:

- Ability to build chef and puppet server infrastructure to manage nodes
- Ability to write infrastructure deployment code like cookbook(chef) , manifests (puppet)
- Bootstrap windows server,rhel,Ubuntu nodes and deploy web servers on them
- Able to automate package deployment on win and linux nodes

COURSE CONTENTS:

UNIT I Chef Automation tool   **15 Hours**

Introduction, The Chef Server, Installing and configuring the Chef Server, Install and congiure chef workstation on widnows and linux, Bootstrp a windows 2016, redhat linux and Ubuntu server, chef-solo.Modelling your chef infrastructure, Integrating with the cloud, working with cookbooks

UNIT II Develop a Complex Cookbook   **15 Hours**

Resource and Providers, HA, Cloud Provisioning with Vagrant and Chef, Troubleshooting. Overview of community cookbooks of OpenStack cloud and their usage

UNIT III Puppet Automation tools   **15 Hours**

Getting Started with Puppet, Building Hosts with Puppet , Working with Environments , Puppet Scalability , Externalizing Puppet Configuration , Exporting and Storing Configuration,

UNIT IV Puppet Consoles   **15 Hours**

Dashboard and The Foreman, Tools and Integration , Reporting with Puppet, Extending Factor and Puppet , Marionette Collective , Working with Puppet

Text Books:

1. Chef: Powerful Infrastructure Automation Paperback – Import, 16 May 2017 by John Ewart (Author), Matthias Marschall (Author), Earl Waud (Author)
2. Book on puppet : Learning Puppet Jussi Heinonen

3. https://www.packtpub.com/networking-and-servers/learning-puppet

HANDS ON LAB
1. Chef server- Install and configure
2. Install and configure Chef-Workstation on Ubuntu
3. Install and configure Chef-Workstation on Windows 7
4. Create and apply a cookbook for Ubuntu server ,centos7 and win 2016
5. Creating dependency cookbook
6. Install and configure puppet server and puppet nodes
7. Write manifest to automate deployment of web infrastructure on centos7, Ubuntu and windows 2016 server

B18BS6020	BUILDING PRIVATE CLOUD WITH OPENSTACK	L	T	P	C
Total Hours: 60		2	0	1	3

COURSE OBJECTIVES:

- Build Open Stack private cloud while leveraging and integrating VMware and Hyperv virtualization technology to spin cloud instances /VM's

COURSE OUTCOMES:

- Ability to deploy Open Stack multi node
- Prepare VMware virtual infrastructure and integrate with Open Stack
- Prepare Hyper-v latest or higher version virtual infrastructure and integrate with Open Stack

COURSE CONTENTS:

UNIT I OpenStack ecosystem introduction and Deploying Single node OpenStack-KVM   **15 Hours**
OpenStack ecosystem, components and its role in OpenStack, OpenStack architecture, Deploying Ubuntu server and installing nova, glance, neutron, cinder keystone and build private cloud on single machine . Deploying Centos 7 or above and installing nova, glance, neutron, cinder keystone and build private cloud on single machine

UNIT II OpenStack Mulitnode setup on Ubuntu KVM   **15 Hours**

OpenStack Installation Module, Deployment Planning for OpenStack, Ubuntu Server Installation, Network and Disk Partitioning on Linux , NTP Server Installation and Configuration, MySQL Server – Theory and Lab, OpenStack Keystone Module – Theory and Lab, Create Keystone users ,tenants, and roles, OpenStack Glance -An Overview, and create linux Glance images, Cinder Module – Theory and Lab, Neutron services – Theory

and Lab, Nova services – Theory, and lab , Horizon Module – Theory and Lab, OpenStack CLI operations

UNIT III Lab sessions on Preparing vmware infrastructure and integrate with OpenStack   15 Hours
Preparing vCenter Environment ,   Configure ESXi Host01 for OpenStack integration, configure ESXi Host02 for OpenStack Integration, Install vsphere client ,   vCenter – Installation and Configure, Add hosts & Create cluster, Create br-int on each host for OpenStack integration, Enable port for novnc console

UNIT IV Lab sessions on Preparing Hyper-v latest infrastructure and integrating with OpenStack   15 Hours
Install OpenStack controller, network node and integrate with Microsoft hyper latest or above Install Windows latest on Host01, Install Windows latest on Host02, , Install Hyper-V Role on both Hosts, Install nova-compute with installer

Text Books:
1. OpenStack Cloud Computing Cookbook, 2nd Edition ,By Kevin Jackson, Cody Bunch
2. OpenStack Cloud Computing: Architecture Guide by John Rhoton, Jan De Clercq

Reference guides/Links for labs
1. http://docs.OpenStack.org
2. http://docs.OpenStack.org/admin-guide-cloud/content/

B18BS6030	BIG DATA AND HADOOP ON AWS AND AZURE	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:

The objective of this course is to:
- Deploy Hadoop /use Hadoop on OpenStack ,Amazon cloud and Azure cloud

COURSE OUTCOMES:

A student who successfully completes the course will have the ability to:
- Create and Manage HDInsight clusters on Windows Azure
- Understand the different HDInsight services and configuration files
- Develop and run MapReduce jobs using .NET and PowerShell
- Use Hadoop on Amazon Web services
- Use Hadoop on OpenStack
- Troubleshoot common problems.

UNIT I Hadoop on Amazon Web Service cloud **15 Hours**

what is AWS Elastic MapReduce, the EMR Architecture, EMR use cases, Programming Hadoop on AWS EMR, Hello world , mapper implementation, reducer implementation, driver implementation, Executing Hadoop jobs on AWS EMR,: creating EC2 key pair and S3 bucket, how to launch EMR cluster, viewing results. AWS EMR cluster management, monitoring and troubleshooting,EMR best practices, EMR launch, monitor EMR cluster via Command line ,Hadoop streaming and Advanced customization on EMR

UNIT II Hadoop on Microsoft Azure cloud **15 Hours**

Introducing HDInsight ,Understanding Windows Azure HDInsight Service, Provisioning Your HDInsight Service Cluster, Automating HDInsight Cluster Provisioning, Submitting Jobs to Your HDInsight Cluster ,Exploring the HDInsight Name Node ,Using Windows Azure HDInsight Emulator, Accessing HDInsight over Hive and ODBC , Consuming HDInsight from Self-Service BI Tools ,Integrating HDInsight with SQL Server Integration Services , Logging in HDInsight , Troubleshooting Cluster Deployment ,Troubleshooting Job Failures

UNIT III Hadoop on OpenStack **15 Hours**

Introducing OpenStack Sahara project (Hadoop-As-Service), rationale ,architecture and roadmap of OpenStack Sahara, Sahara installation and configuration, create keystone endpoints and enabled Sahara OpenStack dashboard.

UNIT IV Sahara advanced configuration **15 Hours**

Getting started and sahara configuration UI , registering an image and running Hadoop jobs on Sahara project, openstakc heat introduction, setup a Hadoop cluster via OpenStack heat.

Text Books:
1. Learning Big Data with Amazon Elastic MapReduce by Amarkant Singh, Vijay Rayapati
2. Pro Microsoft HDInsight Hadoop on Windows By Debarchan Sarkar
3. Bigdata on OpenStack. http://docs.OpenStack.org

B18BS6040	SOFTWARE ENGINEERING	L	T	P	C
Total Hours: 60		4	0	0	4

COURSE OBJECTIVES:

- To provide an insight into the processes of software development
- To understand and practice analysis, design, development, testing of Software Engg.
- To develop skills to construct software of high quality with high reliability

COURSE OUTCOMES:

- Get an insight into the processes of software development
- Able to understand the problem domain for developing SRS and various models.
- Able to Model software projects into high level design using DFD,UML diagrams
- Able to Measure the product and process performance using various metrics
- Able to Evaluate the system with various testing techniques and strategies

COURSE CONTENTS:

UNIT I Introduction   **14 Hours**
Introduction to Software Engineering: Defining the Discipline, Software Process, software engineering practice, software development myths. The Changing nature of Software, **Software Process structure**: Generic process model, defining a framework activity. **Process models:** Perspective and specialized process models, the unified process.

UNITII Requirement Analysis and Design - Traditional / WEB / Mobile application
                                                                        18 Hours
Understanding Requirements,Functional and Non-functional requirements, RequirementsModeling (Scenario-based & Class-based methods), Design Concepts, Architectural design (Webapp Design, Mobileapp Design), Software Configuration Management Process.

UNIT III Agile Implementation and Managing Change   **18 Hours**
AGILE development, Implementing AGILE process, Technology Directions, Project ManagementConcepts, Project Estimation and Scheduling, Risk Management, Maintenance and Re-engineering.

UNIT IV Software Quality Management Process, Security, Process Improvement
                                                                        10 Hours
Quality Concepts, Software Quality Assurance, Testing Strategies, Application Testing, Security Engineering, Verification Models, Software Process Improvement, The SPI Process, Trends and Return of Investment, working on Trello dashboard

Text Books:

1. Software Engineering A practitioner's Approach, 8th edition, Roger S Pressman, Bruce R. Maxim. McGraw Hill Education, 2015.

Reference Books:
1. Software Engineering, Ian Somerville, 9th edition, Pearson education.
2. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007.

B18BS6051	WIRELESS SENSOR NETWORKS	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:

The objectives of this course are to:
- Explain the emerging field of wireless sensor networks, which consist of many tiny, low-power devices equipped with sensing, computation, and wireless communication capabilities.
- Describe operating systems, radio communication, networking protocols,
- Explain the time synchronization, localization, energy management in Wireless sensor network
- Describe the programming abstractions, mobility, and applications of wireless sensor network.

COURSE OUTCOMES:

On successful completion of this course; the student will be able to:
- Analyze low-power devices equipped with sensing, computation, and wireless communication capabilities.
- Describe the operating systems, radio communication, networking protocols,.
- Apply time synchronization, localization, energy management in Wireless sensor network
- the programming abstractions, mobility, and applications of wireless sensor network

COURSE CONTENTS:

UNIT I Overview of Wireless Sensor Networks Architecture   15 Hours
Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks. Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT II Networking Sensors **15 Hours**

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, the Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses,

UNIT III Infrastructure Establishment **15Hours**

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

UNIT IV Sensor Network Platforms and Tools **15Hours**

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level Software platforms, Node-level Simulators, State-centric programming. Recent trends in the related areas from various sources.

Text Books:
1. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 1st edition, 2005.
2. Feng Zhao and Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
3. KazemSohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks-Technology, Protocols, and Applications", John Wiley, 2007.
4. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2nd edition, 2003.

B18BS6052	CYBER SECURITY & BIG DATA SECURITY	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:

The objectives of this course are to:
- Understanding significance of privacy, ethics in big data environment
- Analyzing the steps to secure big data

COURSE OUTCOMES:

On successful completion of this course, the student will be able to:
- Building security in Hadoop environment and its ecosystem.
- Analyzing data security and event logging

COURSE CONTENT:

UNIT I BigData Privacy, Ethics and Security **15 Hours**

Privacy–Reidentification of Anonymous People–Why BigData Privacy is self-regulating?–

Ethics –Ownership–Ethical Guidelines–BigData Security–Organizational Security.

UNIT II Security, Compliance, Auditing, and Protection   15 Hours

Steps to secure bigdata–Classifying Data–Protecting–BigData Compliance–Intellectual Property Challenge–Research Questions in Cloud Security– Open Problems.

UNIT III Hadoop Ecosystem Security   15 Hours

Kerberos –Default Hadoop Model without security-Hadoop Kerberos Security Implementation & Configuration. Configuring Kerberos for Hadoop ecosystem components– Pig, Hive, Oozie, Flume, HBase, Sqoop.

UNIT IV Data Security & Event Logging   15 Hours

Integrating Hadoop with Enterprise Security Systems-Securing Sensitive Data in Hadoop–SIEM system– Setting up audit logging in Hadoop cluster.

Text Books:

1. MarkVanRijmenam, "Think Bigger: Developing a Successful BigData Strategy for Your
   Business", Amazon,1 edition,2014.
2. FrankOhlhorst John Wiley & Sons, "BigData Analytics: Turning BigData into BigMoney", JohnWiley & Sons, 2013.
3. HerifSakr,"Large Scale and BigData:Processing and Management", CRCPress,2014.
4. UdeeshNarayanan,"SecuringHadoop",PacktPublishing,2013.
5. BenSpivey, JoeyEcheverria, "Hadoop Security Protecting Your BigData Problem", O'Reilly Media,2015.
6. Top Tips for Securing BigData Environments:e-book
7. http://www.dataguise.com/?q=securing-Hadoop-discovering-and-securing-sensitive-data- Hadoop-data-stores
8. GazzangforHadoophttp://www.cloudera.com/content/cloudera/en/solutions/enterprise- solutions/security-for-Hadoop.html
9. eCryptfsforHadoophttps://launchpad.net/ecryptfs.
10. Project Rhino-https://GitHub.com/intel-Hadoop/project-rhino

B18BS6061	ADVANCED WEB PROGRAMMING USING RUBY	L	T	P	C
Total Hours: 60		2	0	1	3

COURSE OBJECTIVES:

The objective of this course is to:

- Provide Storage foundational knowledge of Software programming using Ruby
- Learn the basic syntax and semantics of the ruby language and programming environment
- Ruby on rails
- Interactive with databases

COURSE OUTCOMES:

A student who successfully completes the course will have the ability to:

- Ability to write programs using ruby
- Develop web application in Ruby and connect to database
- Understand how to connect ruby application with backend database

COURSE CONTENTS:

UNIT I Foundations and core of Ruby   **15 Hours**

Bootstrapping Your Ruby Literacy, Objects, methods, and Local variables, Organizing objects with classes, Modules and Program organization, The default object (self) ,scope and visibility ,and control flow techniques

UNIT II Built in classes and modules   **15 Hours**

Built in essentials, strings, symbols, scalar objects, Collection of container objects, collection central : Enumerable and Enumerator, Regular expression , File and I/o operations , callbacks, hooks, and Runtime Introspection

UNIT III Ruby testing   **15 Hours**

A test driven fible, Test driven development basics, test driven rails, What makes great tests, Adding data to tests, setting up cucumber, Integration testing with cucumber , unit testing using java scripts.

UNIT IV Ruby on rails   **15 Hours**

Getting started with ruby on rails, Develop and design UI /UX, the frontend interface, ,frontend styling and production deploy , Add signup forms, add admin user functionality , Testing for security, adding user, roles, troubleshooting and debugging,

Text Books:

1. The-well-grounded-rubyist-second-edition
2. Rails-Test-Prescriptions-Healthy-Codebase

3. Build Your Own Ruby on Rails Web Applications 1st Edition by Patrick Lenz (Author)

Reference Books:

1. Web docs: https://www.tutorialspoint.com/ruby

HANDS-ON EXPERIMENTS

1. Lab 01: Write a Ruby program which accept the user's first and last name and print them in reverse order with a space between them
2. Lab 02: Write a Ruby program to create a new string where "if" is added to the front of a given string. If the string already begins with "if", return the string unchanged.
3. Lab 03: Write a Ruby program to check a given string contains 'i' characters
4. Lab 04: Write a Ruby program that tells you how many minutes there are in a year (do not bother right now about leap years etc.).
5. Lab 05: Write a web app using Ruby on Rails with DB connectivity, RDBMS.
6. Lab 06: Write a Ruby program that tells you how many minutes there are in a year (do not bother right now about leap years etc.)
7. Crete a webapplication portal
8. Design UI/Ux for the portal
9. Create user sign up form
10. Create admin panel
11. Connect to database to store user information
12. Troubleshoot issues with application
13. Debugging application
14. Deploy application on Dockers container

B18BS6062	DATA ANALYTICS USING R	L	T	P	C
Total Hours: 60		2	0	1	3

COURSE OBJECTIVES:

- To expose students to data analytics features using R.

COURSE OUTCOMES:

Students will be able to

- Install & set up R
- Use strings in R
- Work with Vectors, Matricies & Lists in R
- Create & work with Data Frames in R
- Use web scrapping in R.

UNIT I Getting Used to R and its Data Types   15 Hours

Introduction to R and its Fundamentals, Introduction to R ,Why learn R, for Data Analysis?
, Installing R and Setting up the Environmental Variables ,Overview of the R Console and
the R Studio , Using Basic Commands on R Studio Working with System Directories and
Scripts ,Data Types in R, Introduction to R Data Types, Character Data Type and
Concatenation, Using Strings in R, Logical Data Types in R, Learning Coercion or Type-
Casting in R

UNIT II Vectors, Matrices and Lists in R   15 Hours

Data Structures in R – Vectors ,An Introduction to Vectors, Indexing with Vectors, Vector
Labels and Indexing, Assigning Attributes to a Vector, Data Structures in R – Matrices,
Learning How to Create Matrices in R, Matrices Dimensions, Matrix Indexing, Advanced
Indexing and Indexing using Dimension Names, Operations on Matrices , Data Structures in
R – Lists, An Introduction   to Lists in R ,Comparing The Nature of Lists with Vectors,
Converting Lists to and from Vectors, Length and Class of Elements in a List
List Indexing

UNIT III Data Frames and Control Structures in R   15 Hours

Data Structures in R - Data Frames, An Introduction to Data Frames in R, Creating Data
Frames and Exploring Common Functions, Using Advanced Functions on Data Frames,
Creating a Data Frame from a List and Vector, Sub setting a Data Frame, Handling Missing
Values in Data Frames, Advanced Techniques to Subset a Data Frame , Control Structures
in R, Using WHILE Loops in R, Using FOR Loops in R, Using IF-ELSE Structure in R

UNIT IV Real - Time Web Scrapping   15 Hours

Performing Data Analysis in R Using Web Scrapping , Web Scrapping and its Importance,
Converting Structured Web Data into an R Data Frame ,Data Wrangling and
Transformations, Data Cleansing in R, Contextual Understanding of an HTML Document,
Web Scrapping using Xpath in R, An Introduction to Rselenium, Installing Rselenium in R
and Initializing Rselenium Server, Connecting to Rselenium Server using Reference Class
,Navigating Web Pages and Using Xpath for Data Extraction, Using Functions to Extract
Data from Rselenium Objects, Data Cleansing Using Functions, Advanced Data Frames
Manipulation

Text Books :

1. R for Data Science Import, Tidy, Transform, Visualize, and Model Data by Hadley
   Wickham and Garret Grolemund   (Chapter 1-8)
2. Automated Data Collection with R: A Practical Guide to Web Scraping and Text
   Mining
   by Simon Munzert, Christian Rubba, Peter MeiBner & Dominic Nyhuis

LAB EXPERIMENTS

1. Install R and Set up the Environmental Variables
2. Convert Lists to and from Vectors
3. Creating Data Frames and Exploring Common Functions
4. Converting Structured Web Data into an R Data Frame
5. Data Cleansing in R

B18BS6070	SOFT SKILLS	L	T	P	C
Total Hours: 30		2	0	0	2

Note: The students will have to undergo Skill Development course being conducted by Training and Placement cell of the University.

B18BS6080	BIG DATA AND HADOOP ON AWS AND AZURE LAB	L	T	P	C
Total Hours: 30		0	0	2	2

LAB EXPERIMENTS:

List of experiment for Big Data on AWS and Azure
1. Deploy 2 node Hadoop Cluster on Azure Cloud.
2. Install Hive and run sample Hive programs.
3. Install Flume and run sample Flume program.
4. Deploy Azure managed Bigdata cluster.
5. Running Flume program kn Azure managed biodata cluster
6. AWS elastic MapReduce cluster deployment.
7. Run sample jade job on was MapReduce cluster.
8. Run Hive scripts on was elastic MapReduce.
9. Ingest from cloud born or on premise data, store data in azure data lake, store data in azure BLOB storage, perform routine small writes on continuous basis on azure.
10. Run sample program using Pig.
11. Deploy apache Spark cluster.
12. Twitter analysis

B18BS6090	BUILDING PRIVATE CLOUD WITH OPENSTACK LAB	L	T	P	C
Total Hours: 30		0	0	2	2

LAB EXPERIMENTS:

1. Integrate OpenStack with kvm
2. Install and configure kvm server
3. Install and configure OpenStack controllers
4. Install and configure network node
5. Install and configure compute node
6. Install and configure database server
7. Integrate OpenStack with vmware
8. Integrate OpenStack with Microsoft hyperv

SEVENTH SEMESTER

S.NO	Code	Title	HC/SC/FC	Credit Pattern			Credits	Working Hrs
				L	T	P		
1	B18BS7010	Deployment &Management of Private Cloud	HC	2	1	0	3	4
2	B18BS7020/ **M18MS1010**	Big Data Technologies on Google Cloud	HC	3	0	1	4	5
3	B18BS7030	Devops	HC	2	1	0	3	4
4	B18BS7040	Project Work – Phase-1	Others	0	2	2	4	8
5	B18BS7051	Software Project Management	SC	2	1	0	3	4
	B18BS7052/ **M18MS1062**	Advanced DBMS						
6	B18BS7061	Software Testing	SC	2	0	1	3	4
	B18BS7062	Machine Learning						
7	B18BS7071	Fundamentals of Cloud Computing*	OE	4	0	0	4	4
	B18BS7072	Basics of Data Analytics*	OE					
Practical Courses								
8	B18BS708	Deployment &Management of Private Cloud lab	HC	0	0	2	2	2
9	B18BS709	Devops lab	HC	0	0	2	2	2
Total Credits				**15**	**5**	**8**	**28**	**37**

B18BS7010	DEPLOYMENT & MANAGEMENT OF PRIVATE CLOUD	L	T	P	C
Total Hours: 60		2	1	0	3

The objective of this course is to:

- Deploying a OpenStack private cloud with high availability
- Install and configure a Private cloud using Microsoft System Centre Product using Microsoft Hyper-v latest server virtualization backend

COURSE OUTCOMES:

A student who successfully completes the course will have the ability to:

- Deploying OpenStack cloud in Highly available for controller ,network and compute nodes

COURSE CONTENT:

UNIT I High availability basics using HA Proxy   **15 Hours**

Apache working with modules, improving logging, using content compression,looking beyond apache with Nginx ,apache and php, multi server setups using Nginx and Apache , proxy options in Nginx, Load balancer features and using multiple backend servers

UNIT II Building OpenStack High Availability   **15 Hours**

Install two OpenStack controller on different machines, network node on different machines and compte node (kvm) on different machines. Configure OpenStack services on both controllers like Keystone, rabbitmq , nova, cinder ,glance ,horizon , test and validate the HA configure 2 KVM hosts and shared storage and integrate with OpenStack controllers and , test failover of cloud

UNIT III Microsoft system Centre latest or above   **15 Hours**

Virtual machine Manager, Introduction to App controller, Configuration Manager, Data Protection Manager

UNIT IV Implementing and Managing   **15 Hours**

Introduction to Operations Manager, Introduction to Advisor, Introduction to Service Manager, Introduction to Orchestrator, Introduction to Windows azure pack
Text Books

1. Open Stack Operations Guide ,Set Up and Manage Your OpenStack Cloud , By Tom Fifield, Diane Fleming, Anne Gentle, Lorin Hochstein, Jonathan Proulx, Everett Toews, Joe Topjian

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2. OpenStack Cloud Computing Cookbook Second Edition by Kevin Jackson (Author), Cody Bunch (Author)
3. Microsoft System Center latest Unleashed Paperback – June 11, latest by Chris Amaris (Author), Rand Morimoto (Author), Pete Handley (Author), David Ross (Author)
4. Introducing Microsoft System Center latest R2 Technical Overview by Mitch Tulloch with   Symon   Perriman   and   the   System   Center Team(http://download.microsoft.com/download/C/8/A/C8A5F520-F31E-4BB4-B972-8D2525D17C38/Microsoft_Press_ebook_Introducing_System_Center_latest_PDF.pdf)
5. Pro Linux High Availability Clustering By Sander van Vugt
6. Learning OpenStack Networking (Neutron) by James Denton
7. Building OpenStack Highly Available Infrastructure by Anil Bidari (to Be launched soon)

References Books :
1. Web docs : https://www.microsoft.com/en-us/cloud-platform/system-center

B18BS7020/ M18MS1010	BIG DATA TECHNOLOGIES ON GOOGLE CLOUD	L	T	P	C
Total Hours: 60		3	0	1	4

COURSE OBJECTIVES:
- Get students well versed Google Cloud

COURSE OUTCOMES:
- Ability to understand Google cloud platform
- Ability to deploy win and Linux virtual machines and connect
- Ability to create cloud storage and attach to vm
- Ability to deploy load balancer and add web servers backend to the load balancer
- Use cloud DNS service
- Ability to work on Google cloud sql db service, deploy web application on vm and connect application to db
- Deploy big data on Google cloud engine

COURSE CONTENTS:

UNITI GCP Fundamentals   15 Hours
Identify the purpose and value of Google Cloud Platform products and services,Interact with Google Cloud Platform services, Google App Engine, Google Kubernetes Engine, and Google Compute Engine, Choose among and use Google Cloud Platform storage options: Google Cloud Storage, Google Cloud SQL, Google Cloud Bigtable, and Google Cloud Datastore, BigQuery, Make basic use of Google Stackdriver, Google's monitoring, logging, and diagnostics system, Autoscaling, load balancer

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UNIT II Designing data processing systems   **15 Hours**
 Designing flexible data representations. Considerations include, Designing data pipelines. Considerations include, Designing data processing infrastructure. future advances in data technology , Building and maintaining data structures and databases, Building and maintaining pipelines , Building and maintaining processing infrastructure.

UNIT III Analyzing Data and machine learning   **15 Hours**
Analyzing data and enabling machine learning, data collection and labeling,data visualization,dimensionality reduction, data cleaning/normalization, defining success metrics, Modeling business processes for analysis and optimization   , Optimizing   data representations, data infrastructure performance and cost, Ensuring reliability , Assessing, troubleshooting, and improving data representations and data processing infrastructure.

UNIT IV Visualizing Date and design for security   **15 Hours**
Visualizing data and advocating policy, Building (or selecting) data visualization and reporting tools. Considerations include: automation , decision support, data summarization, (e.g, translation up the chain, fidelity, trackability, integrity, Advocating policies and publishing data and reports.,Designing for security and compliance, Designing secure data infrastructure and processes. Considerations include, Identify and Access Management (IAM), data security, penetration testing, Separation of Duties (SoD), security control
7.2 Designing for legal compliance. Considerations include:

Reference books:
1. Google cloud official documentation https://cloud.google.com, https://cloud.google.com/certification/guides/data-engineer/#certificate-exam-guide
2. https://cloud.google.com/training/courses/core-fundamentals

B18BS7030	DEVOPS	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:
- Understand the DevOps culture and implement DevOps complete CI/CD pipeline

COURSE OUTCOMES:
A student who successfully completes the course will have the ability to:
- Understand DevOps
- Its principles and complete 360 degree picture on source control to code analysis to deployment
- Work on containerization
- Deploy and configure Jenkins

UNIT I DevOps the big picture   15 Hours

What is DevOps ? , why DevOps, DevOps and performance, DevOps - culture or technology, DevOps with business , DevOps tools

UNIT II DevOps – Learning Ansible   15 Hours

Getting Started with Ansible, Devloping ,testing and releasing playbooks, Taking Ansible to Production,Error Handling ,Rollback, working with custom modules,Provisioning

UNIT-III: DevOps – containerization   15 Hours

What is containerization?, Docker , Docker installation and configuration, building   a continuous integration pipeline with Docker, Kubernetes architecture, deploy minkube Kubernetes cluster, POD, deployment, replication controller, Kubernetes volume, auto scaling, ingress controller, rolling updates , Kubernetes authentication and authorization

UNIT IV DevOps- CI/CD   15 Hours

What is CI/CD?   , overview on : Git, GitHub, Jenkins, code analysis tool & artifact storage, build CI/CD pipeline with DevOps tools , demo and hands-on with case study

Text Book:
1. DevOps for Beginners: DevOps Software Development Method Guide for Software Developers and It Professionals : by Joseph Joyner (Author)
2. DevOps: From Newbie to Professional. Fast and Simple Guide to DevOps - by Dan Warnock
3. Learning Ansible by Madhurranjan Mohaan, Ramesh Raithatha , November 2014

Reference books:
1. Official documentation for Dockerhttps://www.Docker.com/
2. Official documentation for GitHub : www.GitHub.com
3. Offical documentation for Sonar qube www.sonarqube.org/
4. Official documentation for Jenkins https://jenkins.io/

B18BS7040	**PROJECT WORK – PHASE-1**	L	T	P	C
Total Hours: 60		0	2	2	4

Guide Lines
- The project should be inter disciplinary
- Team size should be of max **two** members
- Use any version control software
- Project should be of Client/Server based
- Latest database servers with PL/SQL statements is must

- Proper and meaningful reports should be generated by making use of latest reporting tools
- Project report should follow standard template with the following contents:
  - a) Abstract
  - b) Introduction to project
  - c) Basic Diagrams like (DFD, ER, Class diagram, etc..)
  - d) Database and stored procedure design
  - e) Screen shots
  - f) Concussion
  - g) Future enhancement
  - h) Bibliography
- project reports should be submitted for evaluation

Appendix: User Manual with the help of screen shots and text description.

B18BS7051	SOFTWARE PROJECT MANAGEMENT	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES:

- Will be able to understand the fundamental principles of Software Project management & also have a good knowledge of responsibilities of project manager and to handle the various projects.
- Be familiar with the different methods and techniques used for project management.
- By the end of this course student will have good knowledge of the issues and challenges faced while doing the Software project Management.
- Will be able to know the reasons for the software projects failures and how that failure probability can be reduced effectively.
- Will be able to do the Project Scheduling, Tracking, Risk analysis, Quality management.
- Will be able to estimate the Project Cost using different techniques.

COURSE OUTCOMES:

- Identify project goals, constraints, deliverables, performance criteria, control needs, and resource requirements in consultation with stakeholders.
- Carry out an evaluation and selection of projects against strategic, technical and economic criteria and use a variety of cost benefit evaluation techniques for choosing among competing project proposals.
- Approach project planning in an organized step by step manner and select an appropriate process model produce an activity plan for a project.
- Identify project risks, monitor and track project deadlines and produce a work plan and resource schedule.Plan the evaluation of a proposal or a product and manage people in software environments.

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UNIT I Conventional Software Management   **15 Hours**

The waterfall model, conventional software Management performance.Evolution of Software Economics: Software Economics, pragmatic software cost estimation.The old way and the new: The principles of conventional software engineering, principles of modern software management, transitioning to an iterative process.

(TB 1: Chapters – 01, 02 & 04)

UNIT II Life cycle phases   **15 Hours**

Engineering and production stages, inception, Elaboration, construction, transition phases. Artifacts of the process: The artifact sets, Management artifacts, Engineering artifacts, programmatic artifacts. Model based software architectures: A Management perspective and technical perspective.

(TB 1: Chapters - 05, 06 & 07)

UNIT III Work Flows of the process   **15 Hours**

Software process workflows, Iteration workflows, Checkpoints of the Process: Major Mile Stones, Minor Milestones, Periodic status assessments. Iterative Process Planning: Work breakdown structures, Planning guidelines, The Cost and Schedule Estimating Process, The Iteration planning process, Pragmatic planning.

Project Organizations and Responsibilities: Line-of-Business Organizations, Project Organizations, Evolution of Organizations.

(TB 1: Chapters - 08, 09, 10 & 11)

UNIT IV Process Automation   **15 Hours**

Automation Building Blocks, The Project Environment. Project Control and Process instrumentation: The server care Metrics, Management indicators, quality indicators, life cycle expectations pragmatic Software Metrics, Metrics automation.

(TB 1: Chapters - 12 & 13)

Text Book:

1. 'Software Project Management- A Unified Frame Work', Walker Royce, Pearson Education, 2013.

References:

1. 'Software Project Management', Bob Hughes, Mike Cotterell & Rajib Mall, FIFTH Edition, Tata McGraw Hill, 2016.

2. 'Managing Global Projects', Ramesh, Gopalaswamy,Tata McGraw Hill, 2001.

B18BS7052/ M18MS1062	ADVANCED DBMS	L	T	P	C
Total Hours: 60		2	1	0	3

The objectives of this course are to:

- Learn the modeling and design of databases
- Acquire knowledge on parallel and distributed databases and its applications
- Study the usage and applications of object oriented database
- Understand the usage of advanced data models
- Acquire inquisitive attitude towards research topics in databases

On successful completion of this course; the student will be able to:

- Select the appropriate high performance database like parallel and distributed database
- Design a semantic based database to meaningful data access
- Embed the rule set in the database to implement intelligent databases
- Represent the data using XML database for better interoperability
- Model and represent the real world data using object oriented database
- To learn transaction processing and concurrency control.

UNIT I Overview of Storage and Indexing **12 Hours**

Memory hierarchy: RAID; Disk space management; Buffer manager: Files of records; Page formats and record format, Structured Indexing,, Data on external storage; File organizations and Indexing, Index data structures; Comparison of file organizations; Indexes and performance tuning. Intuition for tree indexes; Indexed sequential access method; B+trees , Hash-Based Indexing.

UNIT II Overview of Query Evaluation, External Sorting and Relational Query Optimizer **18 Hours**

The system catalog, Introduction to operator evaluation; Algorithm for relational operations; Introduction to query optimization; When does a DBMS sort data? A simple two-way merge sort; External merge sort, Evaluating Relational Operators The Selection operation; General selection conditions; The Projection operation; The Join operation; The Set operations; Aggregate operations; The impact of buffering.

UNIT III Concurrency Control **18 Hours**

Serializability and Transaction processing: Enforcing, Serializability by Locks, Locking Systems With Several, Lock Modes, Architecture for a Locking Scheduler Managing .

Transaction processing: Introduction of transaction processing, advantages and disadvantages of transaction processing system, online transaction processing system, resolving deadlock, Transaction management in multi-database system, long duration transaction, high-performance transaction system.

UNIT IV Parallel and Distributed Databases and XML data   12 Hours

Architectures for parallel databases; Parallel query evaluation; Parallelizing individual operations; Parallel query optimizations; Introduction to distributed databases; Distributed DBMS architectures; Storing data in a Distributed DBMS; Information retrival and XML data: Colliding Worlds: Databases, IR, and XML, Introduction to Information Retrieval, Indexing for Text Search, Web Search Engines, Managing Text in a DBMS, A Data Model for XML, XQuery: Querying XML Data. Mobile databases, Multimedia databases, geographic databases, temporal databases, biological databases

Text Books:

1. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3rd Edition, McGraw-Hill, 2003[Chapters:8,9,10,11,12,13,14,22,23,27,29]

Reference Books:

1. Michael Rosenblum and Dr. Paul Dorsey," PL/SQL FOR DUMMIES",WILLEY Publications 2006
2. Elmasri and Navathe: Fundamentals of Database Systems,5th Edition, Pearson Education, 2007.
3. Conolly and Begg: Database Systems, 4th Edition, Pearson Education, 2002.
4. Steven Feuerstein,"oracle PL/SQL Programming",OREILLYpublications,Sixth edition 2014

B18BS7061	SOFTWARE TESTING	L	T	P	C
Total Hours: 60		2	0	1	3

COURSE   OBJECTIVES :

- To classify the various Software Process Models.
- To analyze a given problem and identify requirements.
- To design a software using standard software engineering techniques.
- To apply well defined software testing strategies to produce quality software.

COURSE OUTCOMES:

After the completion of the course the student will be able to:

- Apply knowledge of software engineering to analyze and identify requirements.
- Design and manage the development of a computing-based system, component or process to meet desired needs within realistic constraints in one or more application domains.

- Function with multidisciplinary teams
- Perform software testing using well defined strategies to produce quality software.

COURSE CONTENT :

UNIT I Introduction   15 Hours

The Nature of Software, Software Engineering, the Software Process, and Process Models: A Generic Process Model: Defining a Framework Activity, Identifying a Task Set. Process Assessment and Improvement, Perspective Process Models: The Waterfall Model, Incremental Process Model, Evolutionary Process Models.

Agile Development: What is Agility? Agility and the Cost of Change, Agile Process: Agility Principles, Human Factors, Extreme Programming (XP), Other Agile Process Models: Adaptive Software Development (ASD), Scrum, Dynamic System Development Method(DSDM), Crystal, Feature Driven Development(FDD).

UNIT II Requirements Modelling   15 Hours

Understanding Requirements: SRS Template (Example Case Study) ,Developing Use Case, Requirements Modeling:Requirements Analysis,Scenario Based Methods, UML Models That Supplement the Use Case, Class-Based Methods, Behavior, Flow oriented models – DFD's,And Web/Mobile Apps.

UNIT III Design Concepts   15Hours

Design Concepts: The Design Process, Design Concepts, The Design Model, User Interface Design: The Golden Rules, User Interface Design Patterns. WebApp Design: Design Goals, A design pyramid for web app, WebApp interface design.

UNIT IV Software Quality Assurance and Software Testing   15 Hours

Elements of Software Quality Assurance, SQA Tasks, Goals, and Metrics, Six Sigma for Software Engineering, Software Reliability. Software Testing: Humans and Errors, Bugs, Faults and Failures, Purpose of Software Testing, Testing Techniques, Types of Testing, Basic Concepts and definitions. Testing life Cycle, Software Testing Verification and Validation Techniques, Static Testing, Testing Tool: Introduction, Automation Testing Framework, Types of automation tools, Case Study, Test Planning.

Text Books:
1. Roger S. Pressman – "SOFTWARE ENGINEERING, A Practitioner's approach", 7th Edition, McGRAW-HILL Publication, 2010. (Unit I – IV) (Chapters: 1, 2, 3, 5, 6, 7, 8, 11, 13, 16)
2. SandeepDesai, AbhishekSrivastava–"SOFTWARE TESTING : A Practical Approach", 2nd Edition, PHI Learning Pvt Ltd, 2016 (Unit IV –Software Testing) (Chapters: 1, 2, 3, 4, 6, 7)

Reference Books:
1. Software Engineering, Ian Somerville, 9th edition, Pearson education.
2. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007.

Example Case Study for SRS:

The railway reservation system functions as follows;

The passenger is required to fill in a reservation form giving detail of his journey. The counter clerk ensures whether the place is available. If so, entries arc made in i register, tickets are prepared, amount is computed and cash is accepted. A booking statement is prepared in triplicate format from the reservation register. One copy of it is retained as office copy; the other is pasted on compartment and third is passed on to the train conductor. Besides booking statement, cash statement is prepared at the end of each shift.

Lab Experiments:

1. Design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Derive test cases for your program based on decision-table approach, the test cases and discuss the results

2. Design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on boundary-value analysis, execute the test cases and discuss the results.

3. Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of dataflow testing, derive different test cases, execute these test cases and discuss the test results.

4.Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of boundary value testing, derive different test cases, execute these test cases and discuss the test results.

5.Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of equivalence class testing, derive different test cases, execute these test cases and discuss the test results.

B18BS7062	MACHINE LEARNING	L	T	P	C
Total Hours: 60		2	0	1	3

COURSE OBJECTIVES :

- The course describes the basic components of Machine Learning
- The course differentiates broad categories of Machine learning
- Compare different types of algorithms used in Machine Learning domain with limitations
- Examine the limitations of various machine learning algorithms and the way to evaluate performance of machine learning algorithms

COURSE OUTCOMES :

- The student will be able to explain concepts and theories of Machine Learning
- The students will be able to formulate innovative ideas or techniques of machine learning for the real world problems
- The students can apply Machine Learning algorithms for specific problems.
- The students can understand the challenges and issues related to machine learning application areas

COURSE CONTENT :

UNIT I Introduction   15 Hours
Overview of ML, broad categories of Machine learning- Supervised, Unsupervised, Semi-supervised, and Reinforcement Learning, Applications areas of Machine Learning. Examples and Case studies
Supervised Learning: Introduction, Classification and Linear Regression, k-Nearest Neighbor, Linear models, Decision Trees, Naive Bayes Classifiers, Kernelized Support Vector Machine (SVM) Algorithm. Neural Networks (deep learning), Comparison of different algorithms, discussions on case studies.

UNIT II Unsupervised Learning   15 Hours
Introduction, types and challenges, preprocessing and scaling of datasets, Dimensionality reduction, feature extraction. Principal Component Analysis (PCA), k-means, agglomerative, and DBSCAN clustering algorithms. Comparison of different cluster algorithms, discussions on Case studies

UNIT III Semi-supervised   15 Hours
Introduction, discussion on Generative models and Graph-based methods. Reinforcement: Introduction, the learning task, Q learning –function, convergence, & updating sequence, rewards and actions, relationship to dynamic programming, discussions on Case studies

UNIT IV Analytical Learning   **15 Hours**

Inductive and Analytical learning problems, Prolog-Ebg, Deductive learning, Explanation-based learning, knowledge level learning.

Combining Inductive and Analytical Learning: Approaches, KBANN algorithm with example, TangentProp algorithm, EBANN algorithm, FOCL algorithm.

Text Books:
1. Introduction of Machine Learning with Python – by Andreas C Muller & Sarah Guido – O'Reilly & Shroff publishers. Chapters 1, 2 and 3.
2. Introducing Python, Oreilly Publications .Chapters 1 to 6
3. Machine Learning by Tom M Mitchell – McGraw Hill Education publication – 2013. Chapter 11,12, and 13.

References Books:

1. Machine Learning: The Art and Science of algorithms – by Peter Flach – Cambridge University Press. Chapter 12
2. Machine Learning - by Ethem Alpaydin – PHI learning private limited. Chapter 1, 7, 16, 18, 19
3. Bayesian Reasoning and Machine Learning – by David barber - Cambridge University Press. Chapter 13, 15
4. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2006
5. Semi-Supervised Learning - by Olivier Chapelle, Bernhard Sch¨olkopf, and Alexander Zien - The MIT Press Cambridge
6. The Elements of Statistical Learning – by Trevor Hastie, Robert Tibshirani and Jerome Friedman – Springer 2017 publication
7. Python Programming for absolute beginners-3rd Edition by Michael Dawson
8. IEEE Transactions on Artificial Intelligence & Machine Learning
9. Journal of Machine Learning Research

LAB MODULES:

1. Implementation of regression algorithm
2. Implementation of Naïve Bayes algorithm
3. Implementation of Decision Tree algorithm
4. Implementation of K-means algorithm
5. Implementation of PCA algorithm
6. Implementation of SVM algorithm
7. Implementation of Q- algorithm

The above algorithms has to be executed on different sets/types of datasets

B18BS7071	FUNDAMENTALS OF CLOUD COMPUTING	L	T	P	C
Total Hours: 60		4	0	0	4

COURSE OBJECTIVES :

- To learn how to use Cloud Services.
- To implement Virtualization
- To implement Task Scheduling algorithms.
- Apply Map-Reduce concept to applications.
- To build Private Cloud.
- Broadly educate to know the impact of engineering on legal and societal issues involved.

COURSE OUTCOMES :

- Understand Introduction to Cloud Computing
- Understanding the roots and essential characteristics of cloud computing
- Understanding the Management and Monitoring Process of Cloud Computing.
- Understand Migration and Business model of Cloud.

COURSE CONTENT:

UNIT I 15 Hours

Introduction to Cloud Computing, Understanding SaaS, IaaS and PaaS, Difference between Public, Private and Hybrid cloud, Trends of cloud computing, Standards and needs for cloud computing, History of cloud computing, Network protocols and Web Services, Functions and Operations of Server in Datacenter, Understanding of Service Oriented Architecture (SOA) Building an SOA, Implementation of Private and Hybrid Clouds, Implementing Data security using Open Web Application Security Project.

UNIT II 15 Hours

Understanding the roots and essential characteristics of cloud computing, Understanding and Implementing Migration, Improvements in the Performance of the Data Center, Features of Cloud computing, Expectations of customers, Interoperability and Reliability of Cloud computing, Scaling up the Performance of cloud computing, Classification of cloud workload, Understanding the Service Level Agreements (SLAs), Planning the CPU utilization, I/O data reads per second, Dynamic characterization, Cloud data storage, Computing Resources.

UNIT III   **15 Hours**

Understanding the Management and Monitoring Process, Cloud setup and basic tools, Zones, Regions, Instances and Types of Instances, Load Balancers, Elastic Load Balancer, Management Requirements, Monitoring Essentials like Cloud Watch Nagios etc, Protection of private data, Understanding Access Control, Key security concerns on cloud models, Authentication and Authorization, Secure storage and computations, Security issues, Variations in Security issues with cloud computing.

UNIT IV   **15 Hours**

Migration to Cloud, Business models of cloud, B2C, B2B, C2C. Complex migrations to cloud, Introduction to Electronics Design Automation (EDA), EDA tools and flows, Cloud Mapping steps, Cloud computing adaptions and considerations, Costing and Billing Management in cloud, Pay as You Go, Amazon EC2, Instances, Elastic IP, Elastic Load Balancing, Auto Scaling, Cost Minimization, Analytics in Cloud, Understanding MapReduce in cloud, Hadoop in cloud, Future Trends of Cloud, Internet of Things (IoT), Edge Computing, Security considerations for Edge Computing

Text Book:

1. Cloud Computing – Concepts and Practices by Naresh Sehgal & Pramod Chandra.

OPEN ELECTIVE

B18BS7072	**BASIC OF DATA ANALYTICS**	**L**	**T**	**P**	**C**
Total Hours: 60		**4**	**0**	**0**	**4**

COURSE OBJECTIVES :

In this course the students will learn

- The principles and methods of statistical analysis, but will also put them into practice using a range of real-world data sets.
- provide a basic understanding of data analysis using statistics and to use computational tools on problems of applied nature

COURSE OUTCOMES :

- Understand concepts, terminologies and the characteristics of Big Data.
- Understand different data types of Big Data.
- Understand what drives Big Data in business
- Understand challenges & planning for Big Data adoption
- Understand the processing concepts of Big Data.

UNIT I **15 Hours**

Understanding Big Data Concepts and terminologies, Big Data Characteristics, Different types of data.

UNIT II **15 Hours**

Business Motivation & Drivers of Big DataMarket place dynamics, Business Architecture, Business Process Management, ICT, IoE.

UNIT III **15 Hours**

Big Data Adoption & Planning ConsiderationsOrganization Prerequisites, Data Procurement, Privacy, Security, Provenance, Realtime Support, Performance Challenges, Governance requirements, Methodology, Big Data Analytics Life cycle.

UNIT IV **15 Hours**

Big Data Processing ConceptsParallel Data Processing, Distributed data Processing, Hadoop, Processing Workloads, Cluster, Processing in Batch Mode, Processing in real time mode.

Text Book:

1. Big Data Fundamental by Thomas Erl, Wajid Khattak & Paul Buhler

B18BS7080	**DEPLOYMENT & MANAGEMENT OF PRIVATE CLOUD LAB**	**L**	**T**	**P**	**C**
Total Hours: 30		**0**	**0**	**2**	**2**

LAB EXPERIMENTS:

1. Install and configure OpenStack Controllers on three virtual machines in Active/Active mode for High Availability (3 virtual Machines) , configure VIP using existing Load balancer at customer site
2. Setup the three MariaDB database in Active/Active mode servers in the form of Virtual machine. Setup Synchronous replication to secondary database (3 x virtual Machines) \
3. Install and configure Rabbitmq cluster
4. Install and configure OpenStack service endpoints
5. Configure vxlan network for OpenStack network addresses

B18BS7090	DEVOPS LAB	L	T	P	C
Total Hours: 30		0	0	2	2

LAB EXPERIMENTS:

1. GitHub – Create an account and fork your application code
2. Git clone the GitHub code , Use maven to compile and package java source code
3. Deploy .war file manually
4. Jenkins – Deploy Jenkins on Ubuntu server (each student will deploy his Jenkins server)
5. Continuous Integration setup – Jenkins and GitHub
6. Automation Maven test, Compile and Package (.war) using Jenkins
7. Students to Integrate Jenkins (CI) server with Sonarqube (lab by students)
8. Sonarqube –static code analysis and set quality gates
9. Use freestyle and pipeline job
10. Integrate Jenkins with Docker for ci/cd pipeline slave nodes
11. Ansible server installation and configure win 2016, cento7 and Ubuntu node under management
12. Write playbook to deploy web infrastructure on win 2016, cento7 and Ubuntu node under management

EIGHTH SEMESTER

SL. NO	Code	Title	HC/SC/FC	Credit Pattern			Credits	Working Hrs
				L	T	P		
1	B18BS8011	Cloud Storage using Open Stack Swift	SC	2	0	1	3	4
	B18BS8012/ M18MS2020	Linear Algebra						
2	B18BS8021	Internet of Things	SC	2	1	0	3	4
	B18BS8022/ M18MS2041	System Simulation and Modeling						
3	B18BS8030	Project Work– Phase-2	HC	0	4	4	8	16
Total Credits				**4**	**5**	**5**	**14**	**24**

B18BS8011	CLOUD STORAGE USING OPEN STACK SWIFT	L	T	P	C
Total Hours: 60		2	0	1	3

COURSE OBJECTIVES :

- Get students well versed with next generation storage i.e. Object based storage using OpenStack swift.

COURSE OUTCOMES :

- Learn Swift's concepts for organizing, distributing, and serving data
- Explore basic and advanced features of the Swift RESTful API
- Delve into Swift's many client libraries, including useful Python features
- Write middleware to customize and simplify your storage system
- Understand requirements for planning a Swift deployment—including your specific use case
- Learn options for coaxing the best performance from your cluster
- Get best practices for daily operations, such as monitoring and planning capacity additions
- Pick up techniques for testing and benchmarking your Swift cluster.

COURSE CONTENT :

UNIT I Storage Evolution   **15 Hours**
The Evolution of Storage, Storage Needs for Today's Data, No One-Size-Fits-All Storage System , Object Storage Compared with Other Storage Types, A New Storage Architecture: Software-Defined Storage, Software-Defined Storage Components ,Why OpenStack Swift? Conclusion

UNIT II Swift Data model and architecture   **15 Hours**
 Swift Data Model , Swift Architecture , Server Processes , Consistency Processes , Locating the Data , Creating and Updating the Rings , □ Talking to the Cluster: The Swift API , Sending a Request , Authorization and Taking Action, Getting a Response, Communication Tools Example Scenarios

UNIT III Ceph storage concepts   **15 Hours**
Planning for Ceph, Deploying Ceph, Bluestore, erasure coding ,developing with Lib Rados

Distributed computation with Ceph storage, monitoring Ceph, tiering with Ceph, tuning Ceph, troubleshooting.

Text Books :

1. Book for swift : Implementing-Cloud-Storage-OpenStack-Swift-by Amar Kapadia, Sreedhar Varma, Kris Rajana
2. Book for Ceph : Mastering CephNick Fisk,May 2017

B18BS8012/ M18MS2020	LINEAR ALGEBRA	L	T	P	C
Total Hours: 60		2	0	1	3

COURSE OBJECTIVES :

This course will:

- Recall basic concepts of matrices and matrix algebra
- Present methods of solving systems of linear equations
- Demonstrate basic concepts of vector spaces
- Interpret the concepts of linear transformations by using the matrices
- Develop methods of computing and using eigen values and eigenvectors.

COURSE OUTCOMES :

Students in this course will able to:

- Solve the system of Linear Equations by using Matrix Algebra
- Derive the Norms and Inner Product Spaces
- Summarize the vector space properties.
- Analyze different forms of the Linear Transformations

COURSE CONTENT :

UNIT I   **15 Hours**

Vector Spaces, Subspaces, Linear Combinations and Systems of Linear Equations, Linear Dependence and Linear Independence, Bases and Dimension, Maximal Linearly Independent Subsets; Linear Transformations, Null Spaces, and Ranges, The Matrix Representation of a Linear Transformation, Composition of Linear Transformations, and Matrix Multiplication, Invertibility and Isomorphisms, The Change of Coordinate Matrix, The Dual Space; Elementary Matrix Operations and Elementary Matrices, The Rank of a Matrix and Matrix Inverses, Systems of Linear Equations.

UNIT II   **15 Hours**

Properties of Determinants, Cofactor Expansions, Elementary Operations and Cramer's Rule; Eigenvalues and Eigenvectors, Diagonalizability, Invariant Subspaces and the Cayley-Hamilton Theorem; Inner Products and Norms, (No theorem proof).

UNIT III   **15 Hours**

The Adjoint of a Linear Operator, Normal and Self-Adjoint Operators, Unitary and Orthogonal Operators and Their Matrices, Orthogonal Projections and the Spectral Theorem; Bilinear and Quadratic Forms (No theorem proof)

UNIT IV   **15 Hours**

The Diagonal form, The Triangular form; The Jordan Canonical Form; The Minimal Polynomial; The Rational Canonical Form (No theorem proof).

Text Books:

1. S. Friedberg, A. Insel, and L. Spence - Linear Algebra, Fourth Edition, PHI, 2009.
2. Jimmie Gilbert and Linda Gilbert – Linear Algebra and Matrix Theory, Academic Press, An imprint of Elsevier.
3. I. N. Herstein – Topics in Algebra, Vikas Publishing House, New Delhi.
4. Hoffman and Kunze – Linear Algebra, Prentice-Hall of India, 1978, 2nd Ed.,
5. P. R. Halmos – Finite Dimensional Vector Space, D. Van Nostrand, 1958.
6. S. Kumeresan – Linear Algebra, A Geometric approach, Prentice Hall India, 2000.

B18BS8021	**INTERNET OF THINGS**	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE   OBJECTIVES :

The objectives of this course are to:

- Discuss the basics of Microcontroller & Microprocessor
- Identify different IoT applications and their application areas.
- Explain the emerging field of wireless sensor networks and IoT, which consist of many tiny, low-power devices equipped with sensing, computation, and wireless communication capabilities.
- Describe operating systems, radio communication, networking protocols, Methodologies of IoT.

COURSE OUTCOMES :

On successful completion of this course; the student will be able to:

- Create the IoT applications with the help of IoT enabled Technologies
- Sketch protocols for IoT Applications
- Analyze low-power devices equipped with sensing, computation, and wireless communication capabilities.
- Develop the operating systems, radio communication, networking protocols, using Methodologies of IoT

COURSE CONTENT:

UNIT I Internet of Things   **15 Hours**

An overview : Introduction, Internet of Things definition evolution, IoT , architectures, Resource management, IoT data management and analytics, Communication protocols,

Internet of Things applications, Security, Identity management and authentication, Privacy, Standardization and regulatory limitations,

UNIT II Open Source Semantic Web Infrastructure for Managing IoT Resources in the Cloud   15 Hours

Introduction, Background/Related Work, OpenIoT Architecture for IoT/Cloud Convergence, Scheduling Process and IoT Services Lifecycle, Scheduling and Resource Management; Validating Applications and Use Cases,

UNIT III Domain Specific IoTs   15 Hours

Introduction, Home Automation, Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, Cities, Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance, Emergency Response, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Lifestyle

UNIT IV Developing Internet Of Things   15 Hours
IoT Design Methodology, Step 1: Purpose & Requirements Specification, Step 2: Process Specification , Step 3: Domain Model Specification , Step 4: Information Model Specification , Step 5: Service Specifications , Step 6: IoT Level Specification, Step 7: Functional View Specification, Step 8: Operational View Specification ,Step 9: Device & Component Integration, Step 10: Application Development.

Text Books:
1. Buyya, R. and Dastjerdi, A.V. eds., 2016. Internet of Things: Principles and paradigms. Elsevier. (chapter 1 &2)
2. Internet of Things-An Hands on Approach- Vijay Madisetti (Author), Arshdeep Bahga, 2014 (chapter: 2, 5)

Reference Books:
1.CunoPfister Getting Started with the Internet of Things, OReilly, 2011.
2.FrancisDaCosta, Rethinking Internet of things, Apress Open Edition, 2013
3.Adrian McEwen, Hakim Cassimally, Design of Internet of Things, 2014 John Wiley and Sons, Ltd.

B18BS8022/ M18MS2041	SYSTEM SIMULATION AND MODELLING	L	T	P	C
Total Hours: 60		2	1	0	3

COURSE OBJECTIVES :

The objectives of this course are:

- Make the students to understand the importance simulation and .modeling in a range of important application   areas.
- Explain the event – scheduling, time-advance algorithm in computer networks.
- Introduce discrete event stochastic models and queuing models.
- Learn the benefits of probability, random process verification and validation of the models.

COURSE OUTCOMES :

On successful completion of this course, the student is expected to be able to:

- Outline the various applications of simulation.
- Describe the role of important elements of simulation in modeling paradigm.
- Generate Random numbers using different techniques.
- Apply simulation on various layers for Optimization and random number generation.
- Present the Modeling techniques for event systems.

COURSE CONTENT:

UNIT I Introduction   **15 Hours**
Why is Simulation Important? When simulation is the appropriate tool and when it is not appropriate? Areas of application, Systems and system environment; Components of a system, Discrete and continuous systems, Model of a system; Types of Models; Discrete-Event System Simulation. Simulation examples: Simulation of queuing systems; Simulation of inventory systems; other examples of simulation. What is model? Advantages and Disadvantages of Modeling and Simulation, Common Pitfalls of Modeling and Simulation and Rules of Thumb, Overview of M&S tools.

UNIT II General principal, statistical & queuing models   15 Hours
Simulation Software: Concepts in Discrete-Event Simulation: The Event-Scheduling / Time- Advance Algorithm, World Views, Manual simulation Using Event scheduling; List processing.Review of terminology and concepts; Useful statistical models; discrete distributions; Continuous distributions; Poisson process; Empirical   distributions. Characteristics of queuing systems; Queuing notation; Long-run measures of performance of queuing systems; Steady-state behavior of M/G/1 queue; Networks of queues.

UNIT III Random-number   **15 Hours**

Properties of random Numbers; Generation of pseudo-random numbers; Techniques for generating random numbers; Tests for Random Numbers. Random-Variate Generation: Inverse transform technique; Acceptance-Rejection technique; Special properties. **Input Modeling:** Data Collection; Identifying the distribution with data; Parameter estimation; Goodness of Fit Tests; Fitting a non-stationary Poisson process; selecting input models without data; Multivariate and Time-Series input models.

UNIT IV Verification and validation of simulation models   **15 Hours**

Model building, verification and validation; Verification of simulation models; Calibration and validation of models. Optimization via Simulation. Modeling and Simulation using Network Simulator: RF Propagation Wired MANE, Network Layer.

Text Books:
1. Jerry Banks , John S. Carson II , Barry L. Nelson , David M. Nicol, ''Discrete-Event System Simulation'', Pearson Education, 5th edition, 2015 (chapters 1-10).
2. Averill M. Law, ''Simulation Modeling and Analysis'', Tata McGraw-Hill, 4th edition, 2007.(chapters 7, 8).
3. Wehrle, Klaus, Günes, Mesut, Gross, James, "Modeling and Tools for Network Simulation", 2010.(chapters 1-5).

Reference Books:
1. Sheldon M Ross, "Simulation", Elsevier Publication, 5th Edition, 2014(chapters 4, 7, 8 and 11).

B18BS8030	PROJECT WORK– PHASE-2	L	T	P	C
Total Hours:60		0	4	4	8

COURSE CONTENT:

Guidelines for Project Formulation

Type of Project

As majority of the students are expected to work out a real life project in some industry/research and development laboratories/educational institutions/software companies, it is suggested that the project is to be chosen which should have some direct relevance in day-to-day activities of the candidates in his/her institution. Students are encouraged to work in the areas listed at the end. However, it is not mandatory for a student to work on a real life project. The student can formulate a project problem with the help of Guide.

Project Proposal (Synopsis)

The project proposal should be prepared in consultation with your guide. The project proposal should clearly state the project objectives and the environment of the proposed project to be undertaken. The project work should compulsorily include the software development. The project proposal should contain complete details in the following form:

1. Title of the Project
2. Introduction and Objectives of the Project
3. Project Category (RDBMS/OOPS/Networking/Multimedia/Artificial Intelligence/Expert Systems etc.)
4. Analysis (DFDs at least up to second level , ER Diagrams/ Class Diagrams/ Database Design etc. as per the project requirements).
5. A complete structure which includes: Number of modules and their description to provide an estimation of the student's effort on the project. Data Structures as per the project requirements for all the modules. Process Logic of each module. Testing process to be used. Reports generation (Mention tentative content of report)
6. Tools / Platform, Hardware and Software Requirement specifications
7. Are you doing this project for any Industry/Client? Mention Yes/No. If Yes, Mention the Name and Address of the Industry or Client
8. Future scope and further enhancement of the project.

Items To Be Included In The Project Report

The following items should be included in the Project Report:

The project report must contain the following:

1. Introduction Objectives
2. Tools/Environment Used
3. Analysis Document (This should include SRS in proper structure based on Software Engineering concepts, E-R diagrams/Class diagrams/any related diagrams (if the former are not applicable), Data flow diagrams/other similar diagrams (if the former is not applicable), Data dictionary).
4. Design Document (Modularization details, Data integrity & constraints including database design, Procedural design, User interface design) Program code (Complete code (well indented)/Detailed specification instead of code*, Comments & Description. The program code should always be developed in such a way that it includes complete error handling, passing of parameters as required, placement of procedure/function statements as needed.)
5. Testing (Test case designs are to be included separately for Unit testing, Integration testing, System testing; Reports of the outcome of Unit testing, Integration testing, System testing are to be included separately. Also, details of debugging and code improvement are to be included.)
6. Input and Output Screens
7. Limitations of the Project
8. Future Application of the Project
9. Bibliography

CAREER DEVELOPMENT AND PLACEMENT

Having a degree will open doors to the world of opportunities for you. But Employers are looking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

1. Willingness to learn
2. Self-motivation
3. Team work
4. Communication skills and application of these skills to real scenarios
5. Requirement of gathering, design and analysis, development and testing skills
6. Analytical and Technical skills
7. Computer skills
8. Internet searching skills
9. Information consolidation and presentation skills
10. Role play
11. Group discussion, and so on

REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counseling and Placement division, namely Career Development Center (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counselors and placement officers and other efficient supportive team does handle all aspects of Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improves their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality.

The need of the hour in the field of Computer Science is not only knowledge in the subject, but also the skill to do the job proficiently, team spirit and a flavour of innovation. This kept

in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and March forward to make better career. The School of Computer Science and Applications also has emphasised subject based skill training through lab practice, internship, project work, industry interaction and many such skilling techniques. The students during their day to day studies are made to practice these skill techniques as these are inbuilt in the course curriculum. Concerned teachers also continuously guide and monitor the progress of students.

The University has also established University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director to facilitate skill related training to REVA students and other unemployed students around REVA campus. The center conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development centre the students shall compulsorily complete at least two skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The University has also signed MOU's with Multi-National Companies, research institutions, and universities abroad to facilitate greater opportunities of employability, students' exchange programs for higher learning and for conducting certification programs.

Programme Regulations

Summary of REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Four Year Graduate Degree Programs

1. **Teaching and Learning Process:**

   The Teaching & Learning process under CBCS – CAGP of education in each course of study will have three components, namely**: L:T:P.**

   (i) L= Lecture (ii) T= Tutorial (iii) P=Practice, where:

   L stands for **Lecture** session consisting of classroom instruction.

   T stands for **Tutorial** session consisting participatory discussion / self study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

   P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies that equip students to acquire the much required skill component.

2. **Courses of Study and Credits**

   a. The study of various subjects in B. Sc in Computer Science with specialization in Cloud Computing and Big Data (Research) degree program are grouped under various courses. Each of these courses carries credits which are based on the number of hours of teaching and learning.

   b. In terms of credits, every **one hour session of L amounts to 1 credit per Semester** and a minimum of **two hour session of T or P amounts to 1 credit per Semester or a three hour session of T / P amounts to 2 credits** over a period of one Semester of 16 weeks for teaching-learning process.

   c. **The total duration of a semester is 20 weeks inclusive of semester-end examination.**

d. **A course shall have either or all the four components.** That means a course may have only lecture component, or only practical component or combination of any two or all the three components.

e. The total credits earned by a student at the end of the semester upon successfully completing the course are L + T + P.

3. **Courses of Study**

Different C**ourses of Study** are labeled and defined as follows:

a. **Core Course:**
A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course. The CORE courses of Study are of THREE types, viz – (i) Foundation Course, (ii) Hard Core Course, and (iii) Soft Core Course.

b. **Foundation Course (FC):**
The foundation Course is a core course which should be completed successfully as a part of graduate degree program irrespective of the branch of study.

c. **Hard Core Course (HC):**
The **Hard Core Course** is a Core Course in the main branch of study and related branch(es) of study, if any, that the candidates have to complete compulsorily.

d. **Soft Core Course (SC):**
A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study.

e. O**pen Elective Course (OE):**
An elective course chosen generally from other discipline / subject, with an intention to seek exposure to the basics of subjects other than the main discipline the student is studying is called an O**pen Elective Course.**

f. **Project Work / Dissertation:**
Project work / Dissertation work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A project work carrying **FOUR or SIX** credits is called **Minor Project** work / **Dissertation.** A project work of **EIGHT, TEN, TWELVE or SIXTEEN** credits is called **Major Project** work / **Dissertation**. **A Minor Project work may be a hard**

core or a Soft Core as decided by the BoS / concerned. But the Major Project shall be Hard Core.

3. Scheme, Duration and Medium of Instructions:

3.1   B. Sc in Computer Science with specialization in Cloud Computing and Big Data (Research) degree program is of 8 semesters - 4 years duration. A candidate can avail a maximum of 16 semesters - 8 years as per double duration norm, in one stretch to complete B. Sc in Computer Science with specialization in Cloud Computing and Big Data (Research) degree program including blank semesters, if any. Whenever a candidate opts for blank semester, he/she has to study the prevailing courses offered by the School when he/she resumes his/her studies.

3.2 The medium of instruction shall be English

4. Minimum Credits to be Earned

4.1 **A candidate has to earn 192 credits for successful completion of** B. Sc in Computer Science with specialization in Cloud Computing and Big Data (Research) degree program with the distribution of credits for different courses as prescribed by the university. A candidate can enroll for a maximum of 32 credits and a minimum of 20 credits per Semester. However he / she may not successfully earn a maximum of 32 credits per semester. This maximum of 32 credits does not include the credits of courses carried forward by a candidate.

4.2 Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to VIII semester and complete successfully 192 credits in 8 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

4.3. **Add- on Proficiency Certification:**

To acquire **Add on Proficiency Certification** a candidate can opt to complete a minimum of 4 extra credits either in the same discipline /subject or in different discipline / subject in excess to 192 credits for the B. Sc in Computer Science with specialization in Cloud Computing and Big Data (Research) degree program.

4.3.1. Add on Proficiency Diploma:

To acquire **Add on Proficiency Diploma,** a candidate can opt to complete a minimum of 18 extra credits either in the same discipline /subject or in different discipline / subject in excess to 192 credits for the B. Sc in Computer Science with specialization in Cloud Computing and Big Data (Research) degree program.

The A**dd on Proficiency Certification / Diploma** so issued to the candidate contains the courses studied and grades earned.

5. Scheme of Assessment and Evaluation

5.1. The Scheme of Assessment and Evaluation will have two parts, namely;

i. Internal Assessment (IA); and
ii. Semester End Examination (SEE)

5.2. Assessment and Evaluation of each Course shall be for 100 marks. The Internal Assessment (IA) and Semester End Examination (SEE) of UG Engineering programs shall carry 40:60 marks respectively (i.e., 40 marks internal assessment; 60 marks semester end examination).

5.3. The 40 marks of internal assessment shall comprise of:

Internal Test	= 30 marks
Assignments / Seminars / Model Making etc.	= 10 marks

5.4. There shall be **three internal tests** conducted as per the schedule given below. **The students have to attend all the three tests compulsorily.**

- 1st test for 15 marks at the end of 6th week of the beginning of the semester;
- 2nd test for 15 marks at the end of 13th week of the beginning of the semester; and
- 3rd test for 15 marks at the end of 16th week of the beginning of the semester.

5.5. The coverage of syllabus for the said three tests shall be as under:

- For the 1st test syllabus shall be 1st unit and 1st half 2nd unit of the Course;
- For the 2nd test it shall be 2nd half of 2nd unit and 3rd unit of the Course;
- For the 3rd test the syllabus will be 4th unit of the Course.

5.6. Out of 3 tests, the highest marks scored in **two tests** are automatically considered while assessing the performance of the students.

5.7. There shall be two Assignments / Seminars each carrying 5 marks ; whereas the number of model designs and the marks for each model design shall be decided by the School well in advance and should be announced before commencement of the Semester to avoid ambiguity and confusion among students and faculty members.

5.8. The Semester End Examination for 60 marks shall be held in the 19th and 20th week of the beginning of the semester and the syllabus for the semester end examination shall be entire 4 units.

5.9. The duration of the internal test shall be 75 minutes and for semester end examination the duration shall be 3 hours.

5.10. Summary of Internal Assessment and Evaluation Schedule is provided in the table given below.

Summary of Internal Assessment and Evaluation Schedule

Type of Assessment	Period	Syllabus	Marks	Activity
Allocation of Topics for Assignments / Seminars / Model making*	Beginning of 5th Week	First Unit and Second Unit		Instructional process and Continuous Assessment
First Internal Test	2nd Part of 6th Week	First Unit and 1st half of Second Unit	15	Consolidation of 1st Unit 1st half of 2nd Unit
Submission of Assignments / Conduct of Seminars / Presentation of Model Design*	8th Week	First Unit and Second Unit	5	Instructional process and Continuous Assessment
Second Internal Test	2nd Part of 13th Week	Second half of Second Unit and Third Unit	15	Consolidation of Second half of Second Unit and 3rd Unit
Allocation of Topics for Assignments / Seminars / Model making*	Beginning of 11th Week	Third Unit and Fourth Unit		Instructional process and Continuous Assessment
Submission of Assignments / Conduct of Seminars / Presentation of Model Design*	14th Week	Third Unit and Fourth Unit	5	Instructional process and Continuous Assessment
Third Test	2nd Part of 16th Week	Fourth Unit	15	Consolidation of Fourth Unit
Semester-end Practical Examination	17th & 18th Week	Entire syllabus	60	Conduct of Semester - end Exams
Preparation for Semester-end Theory Exam	17th & 18th Week	Entire Syllabus		Revision and preparation for semester–end exam
Semester End Theory Examination	19th Week & 20th Week	Entire Syllabus	60	Evaluation and Tabulation
	End of 21st Week			Notification of Final Grades

Note: 1. *As per the model making is concerned, the School shall decide about the Marks and the Number of Model Designs and as well the schedule of allocation and presentation of model design(s). If the model design carries 5 marks, there shall be two model designs; and in case of 10 marks, there shall be one model design. However, the decision of the School should be announced in the beginning of the Semester for students to avoid ambiguity and

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confusion.

2. Examination and Evaluation shall take place concurrently and Final Grades shall be announced latest by 5 day after completion of the examination.

3. Practical examination wherever applicable shall be conducted after 3rd test and before semester end examination. The calendar of practical examination shall be decided by the respective School Boards and communicated well in advance to the Registrar (Evaluation) who will notify the same immediately.

6. Assessment of Performance in Practical's

6.1. The performance in the practice tasks / experiments shall be assessed on the basis of:

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting.

6.2. The 40 marks meant for Internal Assessment (IA) of the performance in carrying out practical shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the semester	20 marks
ii	Maintenance of lab records	10 marks
iii	Performance of mid-term test (to be conducted while conducting second test for theory courses); the performance assessments of the mid-term test includes performance in the conduction of experiment and write up about the experiment.	10 marks
	Total	**40 marks**

6.3. The 60 marks meant for Semester End Examination (SEE), shall be allocated as under:

i	Conduction of semester end practical examination	40 marks
ii	Write up about the experiment / practical conducted	10 marks
iii	Viva Voce	10 marks
	Total	**60 marks**

6.4. The duration for semester-end practical examination shall be decided by the concerned School Board.

7. Evaluation of Minor Project / Major Project / Dissertation:

7.1. Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in

addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

Component – I	Periodic Progress and Progress Reports (25%)
Component – II	Results of Work and Draft Report (25%)
Component– III	Final Evaluation and Viva-Voce (50%). Evaluation of the report is for 30% and the Viva-Voce examination is for 20%.

8.   Provision for Appeal

If a candidate is not satisfied with the evaluation of Internal Assessment components (Mid-term Tests and Assignments), he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of respective semester-end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

For every program there will be one grievance cell. The composition of the grievance cell is as follows:-

▪ The Registrar (Evaluation) - Ex-officio Chairman / Convener

▪ One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.

▪ One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

9. Eligibility to Appear for Semester End Examination (SEE)

Only those students who fulfill a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc, as part of the program, as provided in the succeeding sections, shall be eligible to appear for Semester End examination.

10. Requirements to Pass the Semester and to Carry Forward the Failed Subjects / Courses:

10.1   Requirements to Pass a Course

A candidate's performance from IA and SEE will be in terms of scores, and the sum of IA and SEE scores will be for a maximum of 100 marks (IA = 40 + SEE = 60) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 25% (15 marks) in Semester End Examination (SEE) which is compulsory.

10.2 Provision to Carry Forward the Failed Subjects / Courses:

The total number of "F" Grades that can be carried forward by a student at the end of any even semester shall not be more than four courses.

10.3.Re-Registration and Re-Admission:

a)   In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is considered as dropped the semester and is not allowed to appear for end semester examination and he / she shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

b)   In such case where in a candidate drops all the courses in a semester due to personal reasons, it is considered that the candidate has dropped the semester and he / she shall seek re-admission to such dropped semester.

11.   Attendance Requirement:

11.1.   All students must attend every lecture, tutorial and practical classes.

11.2.   In case a student is on approved leave of absence (e g:- representing the university in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

11.3.   Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc, during a semester shall not be permitted to appear to the end semester examination and such student shall seek

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re-admission as provided in 10.3.

11.4. Teachers offering the courses will place the above details in the School Board meeting during the last week of the semester, before the commencement of Semester end examination, and subsequently a notification pertaining to the above will be brought out by the Director of the School before the commencement of Semester end examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

11.5.Absence during Internal Test:

In case a student has been absent from a internal tests due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Head of the School, for conducting a separate internal test. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special internal test for such candidate(s) well in advance before the Semester end examination of that respective semester. Under no circumstances internal tests shall be held / assignments are accepted after Semester end examination.

12. Grade Card and Grade Point

12.1.Provisional Grade Card: The tentative / provisional grade card will be issued by the Registrar (Evaluation) at the end of every semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average** (SGPA).

12.2. Final Grade Card: Upon successful completion of B. Sc in Computer Science with specialization in Cloud Computing and Big Data (Honors) Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Registrar (Evaluation).

12.3. The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below.

Marks P	Grade G	Grade Point (GP=V x G)	Letter Grade
90 >100	10	v*10	O
80 > 90	9	v*9	A+
70 > 80	8	v*8	A
60 > 70	7	v*7	B+
55 > 60	6	v*6	B
50 > 55	5.5	V*5.5	C+
40 > 50	5	v*5	C
0-40	0	v*0	F
ABSENT			AB

O - Outstanding; A+-Excellent; A-Very Good; B+-Good; B-Above Average; C+-Average; C-Satisfactory; F – Unsatisfactory.

Here, P is the percentage of marks (P=[IA + SEE]) secured by a candidate in a course which is **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

12.3.1. Computation of SGPA and CGPA

The Following procedure to compute the Semester Grade Point Average (SGPA)

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e :

SGPA (Si) = $\sum$(Ci x Gi) / $\sum$Ci where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA and CGPA
Illustration No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	**4**	**A+**	**9**	**4X9=36**
Course 2	**4**	**A**	**8**	**4X8=32**
Course 3	**3**	**B+**	**7**	**3X7=21**
Course 4	**3**	**O**	**10**	**3X10=30**
Course 5	**3**	**C**	**5**	**3X5=15**
Course 6	**3**	**B**	**6**	**3X6=18**
Course 7	**2**	**O**	**10**	**2X10=20**
Course 8	**2**	**A**	**8**	**2X8=16**
	24			**188**

Thus, **SGPA = 188 $\div$ 24 = 7.83**

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	**4**	**A**	**8**	**4X8=32**
Course 2	**4**	**B+**	**7**	**4X7=28**
Course 3	**3**	**A+**	**9**	**3X9=27**
Course 4	**3**	**B+**	**7**	**3X7=21**
Course 5	**3**	**B**	**6**	**3X6=18**
Course 6	**3**	**C**	**5**	**3X5=15**
Course 7	**2**	**B+**	**7**	**2X7=21**
Course 8	**2**	**O**	**10**	**2X10=20**
	24			**175**

Thus, **SGPA = 175 ÷ 24 = 7.29**

Illustration No.3

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	O	10	4 x 10 = 40
Course 2	4	A+	9	4 x 9 = 36
Course 3	3	B+	7	3 x 7 = 21
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	B+	7	3 x 7 = 21
Course 7	2	A+	9	2 x 9 = 18
Course 8	2	A+	9	2 x 9 = 18
	24			**199**

Thus**, SGPA = 199 ÷ 24 = 8.29**

12.4.   Cumulative Grade Point Average (CGPA):

12.4.1. Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (192) for B. Sc in Computer Science with specialization in Cloud Computing and Big Data (Honors) degree program is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e : **CGPA = $\sum$(Ci x Si) / $\sum$Ci**

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

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The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration:

CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	24	6.83	24 x 6.83 = 163.92
2	24	7.29	24 x 7.29 = 174.96
3	24	8.11	24 x 8.11 = 192.64
4	26	7.40	26 x 7.40 = 192.4
5	26	8.29	26 x 8.29 = 215.54
6	24	8.58	24 x 8.58 = 205.92
7	24	9.12	24 x 9.12 = 218.88
8	24	9.25	24 x 9.25 =222
Cumulative	196		1588.26

Thus, **CGPA** =

$$\frac{24x6.83+24x7.29+24x8.11+26x7.40+26x8.29+24x8.58+24x9.12+24x9.25}{196} = 8.10$$

12.4.2. CONVERSION OF GRADES INTO PERCENTAGE:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.10 x 10=81.0

12.5. Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

CGPA	Grade (Numerical Index) G	Letter Grade	Performance	FGP Qualitative Index
9 >= CGPA 10	10	O	Outstanding	Distinction
8 >= CGPA < 9	9	A+	Excellent	
7 >= CGPA < 8	8	A	Very Good	First Class
6 >= CGPA < 7	7	B+	Good	
5.5> = CGPA < 6	6	B	Above average	Second Class
> 5 CGPA < 5.5	5.5	C+	Average	
> 4 CGPA <5	5	C	Satisfactory	Pass

Overall percentage=10*CGPA

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13. **Challenge Valuation:**

   a. A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script(s) of semester end examination by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 10 days after the announcement of the results. **This challenge valuation is only for semester end examination.**

   b. **The answer scripts for which challenge valuation is sought for shall be evaluated by the external examiner who has not involved in the first evaluation. The higher of two marks from first valuation and challenge valuation shall be the final.**

14. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

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