

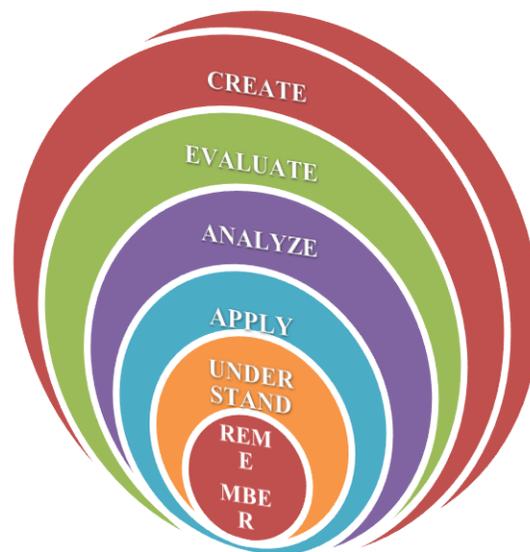
OUTCOME BASED EDUCATION BOOKLET

COMPUTER SCIENCE ENGINEERING

M.Tech

For the Batch of Students admitted during

Academic Year 2016-17



.....Moving Towards Perfection in Engineering



INSTITUTE OF AERONAUTICAL ENGINEERING

(AUTONOMOUS)

Approved by AICTE: Affiliated to JNTUH and Accredited by NAAC with 'A' Grade

Dundigal, Hyderabad - 500 043

Vision

The Vision of the department is to produce competent graduates suitable for industries and organizations at global level including research and development with Social responsibility.

Mission

To provide an open environment to foster professional and personal growth with a strong theoretical and practical background having an emphasis on hardware and software development making the graduates industry ready with social ethics.

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As Per NBA Norms Post June, 2015
Semester: I-I, I-II, II-I, & II-II

Part – I

PROGRAM EDUCATIONAL OBJECTIVES AND OUTCOMES

First version 22 July, 2014

Program Educational Objectives, Program Outcomes and Assessment Criteria (Approved by DAC CSE on 3/9/2014):

Computer Science and Engineering Department Advisory Council: The Computer Science and Engineering Department Advisory Council (CSEDAC) include a diverse group of experts from academic and industry, as well as alumni representation. The Advisory Board meets annually, or as needed, for a comprehensive review of the Computer Science and Engineering Department strategic planning and programs. The Advisory Council meets with administration, faculty and students and prepares a report, which is presented to principal. In each visit, the Department of Computer Science and Engineering responds to the report indicating improvements and amendments to the program.

1. PROGRAM EDUCATIONAL OBJECTIVES, OUTCOMES AND ASSESSMENT CRITERIA

Learning Outcomes, Assessment Criteria

The educational aims of a module are statements of the broad intentions of the teaching team. They indicate the objectives that the teaching team intends to cover and the learning opportunities that are necessary to be available to the student. A learning outcome is a statement that indicates the content that a learner (student) is expected to know, understand and/or be able to do at the end of a period of learning. It is advisable to express learning outcomes with the common prefix:

‘On completion of (the period of learning e.g. module), the student is expected to be able to...’

Generally, learning outcomes do not specify curriculum, but more general areas of learning. It is not possible to prescribe precisely how specific a learning outcome statement should be. There is a balance to be struck between the degree of specificity in a learning outcome statement and that achieved by the assessment criteria. If there are too many learning outcomes for a module, then either they are becoming assessment criteria or they are specifying too much curricular detail. The curriculum should be described in the range statement. Too few learning outcomes are unlikely to provide sufficient information on the course. As a guide, there should be between 4 and 8 learning outcomes for a course.

The Program Educational Objectives (PEOs) of the Computer Science and Engineering department are broad statements or road maps describing career and professional objectives that intend the graduates to achieve through this program.

2. M. TECH – COMPUTER SCIENCE AND ENGINEERING PROGRAM

EDUCATIONAL OBJECTIVES

A Post graduate of Institute of Aeronautical Engineering in Computer Science and Engineering discipline should have a successful career in Computer Science and Engineering or a related field, and within two to four years, should attain the following:

PROGRAM EDUCATIONAL OBJECTIVES:

PEO-I	Independently design and develop computer software systems and products based on sound theoretical principles and appropriate software development skills.
PEO-II	Demonstrate knowledge of technological advances through active participation in life-long learning.
PEO-III	Accept to take up responsibilities upon employment in the areas of teaching, research, and software development.
PEO-IV	Exhibit technical communication, collaboration and mentoring skills and assume roles both as team members and as team leaders in an organization.

These objectives are quite broad by intention, as Computer Science and Engineering graduates may seek further education or work in diverse areas. To make these objectives meaningful, they may be demonstrated by performance, actions, or achievements.

- i. To prepare the students who will be able to attain a solid foundation in Computer Science and engineering fundamentals with an attitude to pursue continuing education.**
 - Make the students to understand their aptitude to choose the correct path of study which leads to higher qualifications and heights in the chosen field.
 - Should be prepared to undergo rigorous training in their fields of working.
 - Be capable of utilizing the solid foundation obtained at institute to apply successfully in solving the real time engineering problems.
 - Students need to have creative thinking processes that are acquired through good training to find solutions to engineering problems.
- ii. To prepare the students to function professionally in an increasingly international and rapidly changing world due to the advances in technologies and concepts and to contribute to the needs of the society.**
 - Adoptability and accommodative mind set to suit modern world and changing economies.
 - By working hard in the chosen field and sharing the professional experience at different forums within and outside the country.
 - Desirable to be a member of various professional societies (IEEE, IETE, ISTE, IE, and etc.) to keep yourself abreast with the state-of-the-art technology.
 - Should continue additional education in a broad range of subjects other than engineering may be needed in order to meet professional challenges efficiently and effectively.

- ❑ Continuous interaction with educational and research institutions or industrial research labs.
- ❑ Have a sound foundation of knowledge within a chosen field and achieve good depth and experience of practice in it.
- ❑ Able to relate knowledge within chosen field to larger problems in society and able to appreciate the interaction between science, technology, and society.
- ❑ Strong grasp of quantitative reasoning and an ability to manage complexity and ambiguity.
- ❑ To conduct research, and design, develop, test and oversee the development of electronic systems for global upliftment.
- ❑ Applying scientific knowledge to solve technical problems and develop products and services that benefit the society.
- ❑ An electronic engineer shall contribute to the society by research, design and development, testing and evaluation, application by manufacturing, maintenance by service, management and other functions like sales, customer service and etc.

iii. To prepare the students to acquire and exercise excellent leadership qualities, at various levels appropriate to their experience, to address issues in a responsive, ethical, and innovative manner.

- ❑ Gives ample opportunity to work in diverse fields to acquire leadership roles in professional circles outside the workplace.
- ❑ Should keep in mind that the opportunities may change with the times.
- ❑ Should be prepared for creative solo and collaborative brainstorming sessions.
- ❑ Be able to inspire the team with selfless motivation and attitude to achieve success.
- ❑ Ability to think laterally or at-least have a flexibility of thought and make choices based on the requirement for situation.

iv. To prepare the students who will be able to excel, in their careers by being a part of success and growth of an organization, with which they are associated.

- ❑ To achieve this, the focus should not be limited to an engineering curriculum and even to the class room.
- ❑ Continuing professional education by attending short term in courses design to update engineering skills.
- ❑ A lifelong commitment to learning new and specialized information.
- ❑ Should accept first person responsibility and should take the initiative in carrying out the work.
- ❑ Should be determined for the duty and dedicated to work and have passion for that.
- ❑ Be delight at work with a positive attitude.
- ❑ Should be a detailed worker so that one can be relied by the organization.

The department of Computer Science and Engineering periodically reviews these objectives and as part of this review process, encourages comments from all interested parties including current students, alumni, prospective students, faculty those who hire or admit our graduates to other programs members of related professional organizations, and colleagues from other educational Institutions.

3. M. TECH - COMPUTER SCIENCE AND ENGINEERING PROGRAM OUTCOMES

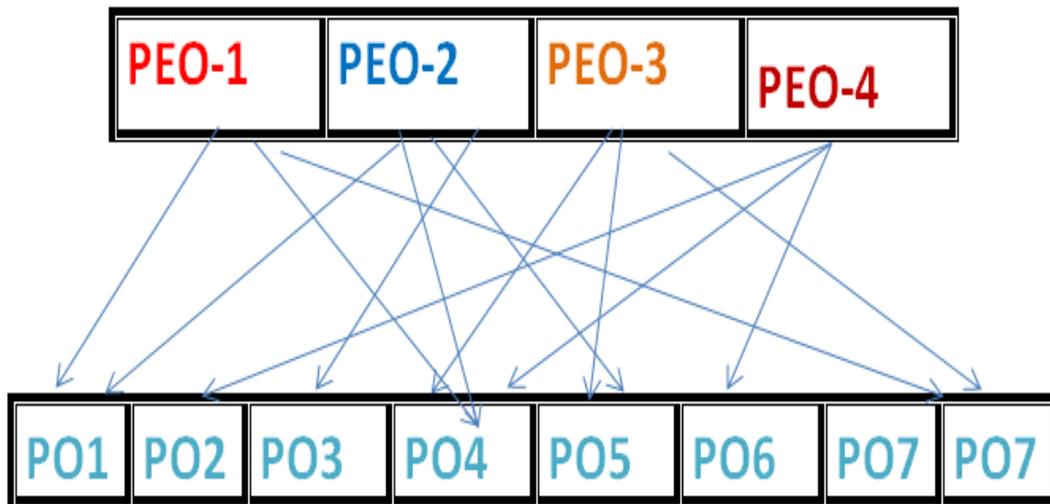
A graduate of the Computer Science and Engineering Program Outcomes will demonstrate:

PROGRAM OUTCOMES:

- PO1:** Analyze a problem, identify and define computing requirements, design and implement appropriate solutions
- PO2:** Solve complex heterogeneous data intensive analytical based problems of real time scenario using State of the art hardware/software tools
- PO3:** Demonstrate a degree of mastery in emerging areas of CSE/IT like IoT, AI, Data Analytics, Machine Learning, cyber security, etc.
- PO4:** Write and present a substantial technical report/document
- PO5:** Independently carry out research/investigation and development work to solve practical problems
- PO6:** Function effectively on teams to establish goals, plan tasks, meet deadlines, manage risk and Produce deliverables
- PO7:** Engage in life-long learning and professional development through self-study, continuing education, professional and doctoral level studies.

4. MAPPING OF PROGRAM EDUCATIONAL OBJECTIVES TO PROGRAM OUTCOMES

The following Figure shows the correlation between the PEOs and the POs and PSOs



The following Table shows the correlation between the Program Educational Objectives and the Program Outcomes & Program Specific Outcomes

	Program Educational Objectives		Program Outcomes
I	Students will establish themselves as effective professionals by solving real problems through the use of computer science knowledge and with attention to team work, effective communication,	PO1	Analyze a problem, identify and define computing requirements, design and implement appropriate solutions

	critical thinking and problem solving skills.	PO2	Solve complex heterogeneous data intensive analytical based problems of real time scenario using state of the art hardware/software tools
II	Students will develop professional skills that prepare them for immediate employment and for life-long learning in advanced areas of computer science and related fields.	PO3 PO4 PO5 PO6	Demonstrate a degree of mastery in emerging areas of CSE/IT like IoT, AI, Data Analytics, Machine Learning, cyber security, etc. Write and present a substantial technical report/document Independently carry out research/investigation and development work to solve practical problems Function effectively on teams to establish goals, plan tasks, meet deadlines, manage risk and produce deliverables
III	Students will be provided with an educational foundation that prepares them for excellence, leadership roles along diverse career paths with encouragement to professional ethics and active participation needed for a successful career.	PO7	Engage in life-long learning and professional development through self-study, continuing education, professional and doctoral level studies

5. RELATION BETWEEN THE PROGRAM OUTCOMES AND PROGRAM EDUCATIONAL OBJECTIVES

A broad relation between the Program Educational Objectives and the Program Outcomes is given in the following table:

PEOs POs	(1) Excellence in Career	(2) Professional Effectiveness And Contribution to Society	(3) Continuing Education	(4) Exercising Leadership
PO1	3		2	3
PO2	3		2	
PO3	2	3	2	
PO4	2	3		
PO5		S	3	
PO6	2	3	3	
PO7	2	3	3	

Relationship between Program Outcomes and Program Educational Objectives

Key: 3 = Highly Related; 2 = Supportive

Note:

- The assessment process can be direct or indirect.
- The direct assessment will be through interim assessment by the faculty or by industry / technology experts.
- The indirect assessment on the other hand could be by students through course outcomes, lab evaluation, department associations, exit interviews, engineering services, GATE etc.
- Frequency of assessment can be once in a semester and justified by the program coordinator.

6. PROGRAM OUTCOMES OF (M.Tech) CSE GRADUATES:

Graduates from accredited programs must achieve the following learning outcomes, defined by broad areas of learning.

The outcomes are distributed within and among the courses within our curriculum, and our students are assessed for the achievement of these outcomes, as well as specific course learning objectives, through testing, surveys, and other faculty assessment instruments. Information obtained in these assessments is used in a short-term feedback and improvement loop.

Each Computer Science and Engineering student will demonstrate the following attributes by the time they post graduate:

PO1: Analyze a problem, identify and define computing requirements, design and implement appropriate Solutions

- ❑ Identify the concepts and/or equations
- ❑ Execute the solution using a logic and structured approach
- ❑ Evaluate the solution of the problem

PO2: Solve complex heterogeneous data intensive analytical based problems of real time scenario using State of the art hardware/software tools

- ❑ Identify an engineering problem
- ❑ Formulate appropriate theoretical basis for the analysis of a given problem
- ❑ Analyze an engineering problem
- ❑ Evaluate the appropriate solution to an engineering problem

PO3: Demonstrate a degree of mastery in emerging areas of CSE/IT like IoT, AI, Data Analytics, Machine Learning, cyber security, etc.

- ❑ Awareness of global effects of the product /practice /event
- ❑ Understanding of economic factors
- ❑ Awareness of implications to society at large

PO4: Write and present a substantial technical report/document

- ❑ Identify problem/purpose
- ❑ Prepare hypothesis
- ❑ Outline procedure
- ❑ List materials and equipment

- Conduct experiment
- Record observations, data and results
- Perform analysis
- Document conclusions

PO5: Independently carry out research/investigation and development work to solve practical problems

- Use modern engineering tools for the system design, simulation and analysis
- Use software application effectively to write technical reports and oral presentations
- Use modern equipment and instrumentation in the design process, analysis and troubleshooting

PO6: Function effectively on teams to establish goals, plan tasks, meet deadlines, manage risk and Produce deliverables

- Informal meetings on current issues
- Participation in public service extra curricular activities
- Required Humanities and Social Sciences(HSS) courses on contemporary issues

PO7: Engage in life-long learning and professional development through self-study, continuing education, professional and doctoral level studies.

- Develop a methodology to accomplish the design
- Select a solution from the potential solutions
- Implement the solution

6 Courses offered in Computer Science and Engineering Curriculum (IARE-R16) –Vs- Program Outcomes Attained through course modules for I-I, I-II Semesters

S No	Course Code	Course Name	Engineering Knowledge	Complex Problem Solving	Advances in Systems	Technical Presentation Skills	Research Problems	Project Management and Deliverables	Life Long Learning
1	BCS001	Foundations of Data Science	✓	✓	✓	✓	✓	✓	
2	BCS002	Data Structures and Problem Solving	✓	✓	✓	✓	✓	✓	✓
3	BCS003	High Performance Architecture	✓	✓	✓	✓			
4	BCS212	Big Data Analytics	✓	✓	✓	✓	✓		✓
5	BCS204	Advanced Web Technologies	✓	✓	✓	✓	✓	✓	✓
6	BES001	Embedded C	✓	✓	✓	✓	✓	✓	✓
7	BCS001	Data Science Laboratory	✓	✓	✓			✓	

8	BCS004	Distributed Operating Systems	✓	✓		✓	✓	✓	✓
9	BCS005	Advanced Database Management System	✓	✓	✓	✓	✓	✓	✓
10	BCS006	Cyber Security	✓		✓	✓	✓		✓
11	BCS201	Web Intelligent and Algorithms	✓	✓	✓	✓		✓	✓
12	BCS208	Soft Computing	✓	✓		✓	✓	✓	✓
13	BCS703	Research Methodology	✓	✓		✓	✓	✓	✓
14	BCS102	Distributed Operating Systems Laboratory	✓	✓	✓	✓	✓	✓	✓
15	BCS401	Seminar and Technical writing	✓	✓	✓	✓	✓	✓	✓
16	BCS501	Comprehensive Examination	✓	✓	✓	✓	✓	✓	✓
17	BCS103	Application Development Mini Project	✓	✓	✓	✓	✓	✓	✓
18	BCS601	Project Work (Phase -I)	✓	✓	✓	✓	✓	✓	✓
19	BCS602	Project Work (Phase -II)	✓	✓	✓	✓	✓	✓	✓
No. of courses mapped with each component			19	18	16	18	16	16	16
Percentage of courses mapped with each component (%)			100	94.7	84.2	94.73	84.2	84.2	84.2

7. PROCEDURES FOR OUTCOME DELIVERY AND ASSESSMENT WITH RESPECT TO PROGRAM OUTCOMES

The categorization of outcomes of the above Computer science and Engineering courses is grouped as follows:
The Courses covered by Individual Program outcomes

PO1: Engineering Knowledge			
Analyze a problem, identify and define computing requirements, design and implement appropriate Solutions			
BCS001	Foundations of Data Science	BCS001	Data Science Laboratory
BCS002	Data Structures and Problem Solving	BCS004	Distributed Operating Systems
BCS003	High Performance Architecture	BCS005	Advanced Database Management System
BCS212	Big Data Analytics	BCS006	Cyber Security
BCS204	Advanced Web Technologies	BCS201	Web Intelligent and Algorithms
BES001	Embedded C	BCS208	Soft Computing
BCS703	Research Methodology		
BCS102	Distributed Operating Systems Laboratory		
BCS401	Seminar and Technical writing		
BCS501	Comprehensive Examination		
BCS103	Application Development Mini Project		
BCS601	Project Work (Phase -I)		

PO2: Complex problem solving			
Solve complex heterogeneous data intensive analytical based problems of real time scenario using State of the art hardware/software tools			
BCS001	Foundations of Data Science	BCS001	Data Science Laboratory
BCS002	Data Structures and Problem Solving	BCS004	Distributed Operating Systems
BCS003	High Performance Architecture	BCS005	Advanced Database Management System
BCS212	Big Data Analytics	BCS201	Web Intelligent and Algorithms
BCS204	Advanced Web Technologies	BCS208	Soft Computing
BES001	Embedded C	BCS703	Research Methodology
BCS501	Comprehensive Examination	BCS102	Distributed Operating Systems Laboratory
BCS103	Application Development Mini Project	BCS401	Seminar and Technical writing
BCS601	Project Work (Phase -I)		
BCS602	Project Work (Phase -II)		
PO3: Advances in system			
Demonstrate a degree of mastery in emerging areas of CSE/IT like IoT, AI, Data Analytics, Machine Learning, cyber security, etc			
BCS001	Foundations of Data Science		
BCS002	Data Structures and Problem Solving	BCS005	Advanced Database Management System
BCS003	High Performance Architecture	BCS006	Cyber Security
BCS212	Big Data Analytics	BCS201	Web Intelligent and Algorithms
BCS204	Advanced Web Technologies	BCS102	Distributed Operating Systems Laboratory
BES001	Embedded C	BCS401	Seminar and Technical writing
BCS001	Data Science Laboratory	BCS501	Comprehensive Examination
BCS103	Application Development Mini Project	BCS602	Project Work (Phase -II)
BCS601	Project Work (Phase -I)		
PO4: Technical presentation skills			
Write and present a substantial technical report/document			
BCS001	Foundations of Data Science	BCS004	Distributed Operating Systems
BCS002	Data Structures and Problem Solving	BCS005	Advanced Database Management System
BCS003	High Performance Architecture	BCS006	Cyber Security
BCS212	Big Data Analytics	BCS201	Web Intelligent and Algorithms
BCS204	Advanced Web Technologies	BCS208	Soft Computing
BES001	Embedded C	BCS703	Research Methodology
BCS401	Seminar and Technical writing	BCS102	Distributed Operating Systems Laboratory
BCS501	Comprehensive Examination	BCS401	Seminar and Technical writing

BCS103	Application Development Mini Project	BCS501	Comprehensive Examination
PO5: Research problems			
Independently carry out research/investigation and development work to solve practical problems			
BCS001	Foundations of Data Science	BCS212	Big Data Analytics
BCS002	Data Structures and Problem Solving	BCS204	Advanced Web Technologies
BCS208	Soft Computing	BES001	Embedded C
BCS703	Research Methodology	BCS103	Application Development Mini Project
BCS102	Distributed Operating Systems Laboratory	BCS601	Project Work (Phase -I)
BCS401	Seminar and Technical writing	BCS602	Project Work (Phase -II)
BCS501	Comprehensive Examination		
PO6: Project Management and deliveries			
Function effectively on teams to establish goals, plan tasks, meet deadlines, manage risk and Produce deliverables			
BCS001	Foundations of Data Science	BCS208	Soft Computing
BCS002	Data Structures and Problem Solving	BCS703	Research Methodology
BCS204	Advanced Web Technologies	BCS102	Distributed Operating Systems Laboratory
BES001	Embedded C	BCS401	Seminar and Technical writing
BCS001	Data Science Laboratory	BCS501	Comprehensive Examination
BCS004	Distributed Operating Systems	BCS103	Application Development Mini Project
BCS005	Advanced Database Management System	BCS601	Project Work (Phase -I)
		BCS602	Project Work (Phase -II)
PO7: Life Long learning			
Engage in life-long learning and professional development through self-study, continuing education, professional and doctoral level studies.			
BCS002	Data Structures and Problem Solving	BCS103	Application Development Mini Project
BCS212	Big Data Analytics	BCS601	Project Work (Phase -I)
BCS204	Advanced Web Technologies	BCS602	Project Work (Phase -II)
BES001	Embedded C	BCS102	Distributed Operating Systems Laboratory
BCS208	Soft Computing	BCS401	Seminar and Technical writing
BCS703	Research Methodology	BCS501	Comprehensive Examination

8. METHODS OF MEASURING LEARNING OUTCOMES AND VALUE ADDITION

There are many different ways to assess student learning. In this section, we present the different types of Assessment approaches available and the different frameworks to interpret the results.

- i. Mid Semester Course Evaluation
- ii. End-of Semester Course Evaluation

- iii. Continuous Evaluation of Classroom Performance
- iv. Course Objective Surveys
 - v. Course Instructor's Evaluations
 - vi. Post Graduating Senior's survey
 - vii. Alumni Survey
 - viii. Employer Survey
 - ix. Laboratory and Project Works
 - x. Balanced Composition in Curriculum
 - xi. Department Academic Committee and Faculty Meetings
 - xii. Professional Societies

The above assessment indicators are detailed below.

i. Mid Semester Course Evaluation

Mid semester course reviews are conducted for all courses by the department. All students are encouraged to actively participate in this evaluation process. These evaluations are critically reviewed by HOD and senior faculty and the essence is communicated to the faculty concerned to analyze, improve and practice so as to improve the performance of the student.

ii. End-of Semester Course Evaluation

The end-of semester course reviews are conducted, feedback taken from students and remedial measures will be taken up such that the student gets benefited before going for the university end exams. The positive and negative comments made by the students about the course are recorded and submitted to the departmental academic council(DAC) and to the Principal for taking necessary actions to better the course for subsequent semesters.

iii. Continuous Evaluation of Classroom Performance

Students are encouraged and motivated to participate actively in the class room proceedings by way of interactive teaching by the instructor. Surprise class tests comprising of short answer questions, quiz based discussions, multiple-choice, true-false, and matching tests are conducted to strengthen the teaching-learning process. A part from teacher control and covering content, the teacher also acts a safe licitator and students discover things for themselves, enabling them to be more independent and becoming life-long learners exploring student-centric educational philosophy.

iv. Course Objective Surveys

Students are encouraged to fill-out a brief survey on the fulfillment of course objectives. The data is reviewed by the concerned course faculty and the results are kept open for the entire faculty. Based on this, alterations or changes to the Course objectives are undertaken by thorough discussions in faculty and DAC meetings.

v. Course Instructor's Evaluations

The course coordinator will collect the course portfolios from their respective instructors of each course offered in a given semester at the beginning of the semester as well as at the end of the semester. They remain on file for verification and study by the entire faculty. This helps the course coordinator and faculty to understand how effectively we can teach the

given course. Betterment can be achieved from time to time and continuous improvement can be shown in handling courses in the sub sequent semesters.

vi. Graduating Senior's Survey

The graduating seniors survey Form is to be filled by all the students leaving the institution. The questionnaire is designed in such away to gather information from the students regarding the program educational objectives, solicit about program experiences, Carrier choices, as well as any suggestions and comments for the improvement of the program. The opinions expressed in exit interview forms are reviewed by the DAC for implementation purposes.

vii. Alumni Survey

The survey asks former students of the department about the status of their Employment and further education, perceptions of institutional emphasis, estimated Gains in knowledge and skills, involvement as under Graduate students, and continuing involvement with Institute of Aeronautical Engineering. This survey Is administered every three years. The data obtained will be Analyzed and used In continuous improvement.

viii. Employer Survey

The main purpose of this employer questionnaire is to know employer's views about the skills They require of employees compared to the skills actually possessed by them. The purpose is also to identify gaps in technical and vocational skills, need for required training practices of ill these gaps and criteria for hiring we employees. These Employer surveys are reviewed by the College Academic Council (CAC) to affect the present curriculum to suit the requirements of the employer.

ix. Laboratory and Project Works

The laboratory work is continuously monitored and assessed to suit the present demands Of the industry. Students are advised and guided to do project works giving Solutions to research/industrial problems to the extent Possible by the capabilities and limitations of the student. The results of the assessment of the individual projects and Laboratory work cane easily be conflated in order to Provide the students with periodic reviews of their overall progress and to produce terminal marks and grading.

x. Balanced Composition in Curriculum

The undergraduate program in Computer Science and engineering is designed To prepare students for successful careers in engineering and related fields By providing a balanced education, that prepares students to apply analytical, computational, experimental, And methodological tool to solve engineering problems; a strong foundation in mathematics and physical sciences; abroad and balanced general education in the humanities, arts, social sciences, and interdisciplinary studies; Sufficient training and development of skills for effective communication and teamwork; a proper understanding of an engineer's professional and ethical responsibilities in Relation to engineering fields and society; and Recognition of the need for lifelong learning. The student's intellectual and ethical development is assessed continuously in relation to the balanced composition in curriculum.

xi. Department Academic Committee and Faculty Meetings

The DAC meets biannually for every academic year to review the Strategic planning and modification of PEOs. Faculty meetings are conducted at least once in fortnight for ensuring the implementation of DAC' suggestions and guidelines. All these proceeding are recorded and kept for the availability of all faculties.

xii. Professional Societies

The importance of professional societies like IEEE, IETE, ISTE etc., are explained to the students and they are encouraged to become members of the above to carry out their continuous search for knowledge. Student and faculty chapters of the above societies are constituted for a better technical and entrepreneurial environment. These professional societies promote excellence in instruction, research, public service and practice.

Part - II

METHODOLOGY FOR PREPARATION AND ASSESSMENT OF COURSE LEVEL STUDENT LEARNING OUTCOMES

Although the term “Expected Learning Outcome” may be new, the process of identifying the key concepts or skills that students are expected to learn during specific courses is not. Many people are more familiar with the terms “course objective” or “course competency”. Expected learning outcomes are really very similar to both of these concepts, so if you already have course objectives or competencies, you are close to having expected learning outcomes for class.

This will provide information on exactly what expected learning outcomes are and what methods can be used to assess them. This is designed to assist faculty with the process of developing expected learning outcomes and methods for assessing those outcomes in their courses. This provides basic information related to (1) course purpose; (2) expected learning outcomes; (3) methods for assessing expected learning outcomes; (4) criteria for grade determination; and (5) course outline.

Expected Learning Outcomes:

After reading and completing this, individuals will be able to:

- Prepare a description of the course as well as a written statement regarding the course’s purpose;
- Construct/develop expected learning outcomes for the course;
- Create an assessment plan that outlines the specific methods that will be used to assess the expected student learning outcomes for a course;
- Describe how grades will be determined in a process that is separate and distinct from assessing the expected learning outcomes;
- Identify the common components of a course outline
- Revise their course syllabi to incorporate a course purpose, expected learning outcomes, methods to assess those outcomes, the criteria for grade determination, and a course outline.
- This process uses some terminology related to expected learning outcomes and assessment. A brief glossary of terms has been provided below for reference purposes.

Assessment of expected learning outcomes:

The process of investigating (1) what students are learning and (2) how well they are learning it in relation to the stated expected learning outcomes for the course.

Assessment plan:

The proposed methods and timeline for assessment-related activities in a given course (e.g., when are you going to check what/how well the students are learning and how are you going to do that?).

Classroom Assessment Technique (CAT):

Angelo and Cross (1993) developed a variety of techniques/activities that can be used to assess students’ learning. These CATs are often done anonymously and are not graded. These activities check on the

class' learning while students are still engaged in the learning process. An example of a CAT is a non-graded quiz given a few weeks before the first exam.

Course description:

A formal description of the material to be covered in the course.

Course purpose:

The course purpose describes the intent of the course and how it contributes to the programme. The course purpose goes beyond the course description.

Expected learning outcome:

A formal statement of what students are expected to learn in a course (synonyms for “expected learning outcome” include learning outcome, learning outcome statement, and student learning outcome).

Evaluation:

Making a judgment about the quality of student's learning/work and assigning marks based on that judgment. Evaluation activities (such as exams, papers, etc.) are often seen as formal ways to assess the expected learning outcomes for a course.

Methods for assessing student learning outcomes:

This term refers to any technique or activity that is used to identify what students are learning or how well they are learning. Formal methods for evaluating student learning outcomes include Continuous Assessment Tests, Mid Semester Test, Tutorials, End Semester Examination etc. The assessment methods are used to identify how the well students have acquired the learning outcomes for the course.

1. COURSE PURPOSE

One of the first steps in identifying the expected learning outcomes for a course is identifying the purpose of teaching in the course. By clarifying the purpose of the course, faculty can help discover the main topics or themes related to students' learning. These themes help to outline the expected learning outcomes for the course.

The course purpose involves the following:

1. What role does this course play within the programme?
2. How is the course unique or different from other courses?
3. Why should/do students take this course? What essential knowledge or skills should they gain from this experience?
4. What knowledge or skills from this course will students need to have mastered to perform well in future classes or jobs?
5. Why is this course important for students to take?

The “Course Description” provides general information regarding the topics and content addressed in the course, the “Course Purpose” goes beyond that to describe how this course fits in to the students' educational experience in the programme.

2. EXPECTED LEARNING OUTCOMES

Expected Learning Outcome (definition)

An expected learning outcome is a formal statement of what students are expected to learn in a course. Expected learning outcome statements refer to specific knowledge, practical skills, areas of

professional development, attitudes, higher-order thinking skills, etc. that faculty members expect students to develop, learn, or master during a course (Suskie, 2004). Expected learning outcomes are also often referred to as “learning outcomes”, “student learning outcomes”, or “learning outcome statements”.

Simply stated, expected learning outcome statements describe:

- What faculty members want students to know at the end of the course and
- What faculty members want students to be able to do at the end of the course

Learning outcomes have three major characteristics

- They specify an action by the students/learners that is **observable**
- They specify an action by the students/learners that is **measurable**
- They specify an action that is done by the **students/learners** (rather than the faculty members)

Effectively developed expected learning outcome statements should possess all three of these characteristics. When this is done, the expected learning outcomes for a course are designed so that they can be assessed (Suskie, 2004).

3. TO DEFINE EFFECTIVE LEARNING OUTCOME STATEMENTS

When stating expected learning outcomes, it is important to use verbs that describe exactly what the learner(s) will be able to do upon completion of the course.

Examples of good action words to include in expected learning outcome statements:

Compile, identify, create, plan, revise, analyze, design, select, utilize, apply, demonstrate, prepare, use, compute, discuss, explain, predict, assess, compare, rate, critique, outline, or evaluate

There are some verbs that are unclear in the context of an expected learning outcome statement (e.g., know, be aware of, appreciate, learn, understand, comprehend, and become familiar with). These words are often vague, have multiple interpretations, or are simply difficult to observe or measure (American Association of Law Libraries, 2005). As such, it is best to avoid using these terms when creating expected learning outcome statements.

For example, please look at the following learning outcomes statements:

- The students will understand basic Data Mining techniques.
- The students will appreciate knowledge discovery from Data Mining techniques.

Both of these learning outcomes are stated in a manner that will make them difficult to assess. Consider the following:

- How do you observe someone “understanding” a theory or “appreciating” Data Mining techniques?
- How easy will it be to measure “understanding” or “appreciation”?

These expected learning outcomes are more effectively stated the following way:

- The students will be able to identify and describe what techniques are used to extract knowledge from Database Repositories.
- The students will be able to identify the characteristics of Classification techniques from other Data Mining techniques.

Incorporating Critical Thinking Skills into Expected Learning Outcomes Statements

Many faculty members choose to incorporate words that reflect critical or higher-order thinking into their learning outcome statements. Bloom (1956) developed a taxonomy outlining the different types of thinking skills people use in the learning process. Bloom argued that people use different levels of thinking skills to process different types of information and situations. Some of these are basic cognitive skills (such as memorization) while others are complex skills (such as creating new ways to apply information). These skills are often referred to as critical thinking skills or higher-order thinking skills.

Bloom proposed the following taxonomy of thinking skills. All levels of Bloom's taxonomy of thinking skills can be incorporated into expected learning outcome statements. Recently, Anderson and Krathwohl (2001) adapted Bloom's model to include language that is oriented towards the language used in expected learning outcome statements. A summary of Anderson and Krathwohl's revised version of Bloom's taxonomy of critical thinking is provided below.

Definitions of the different levels of thinking skills in Bloom's taxonomy

- 1. Remember** – recalling relevant terminology, specific facts, or different procedures related to information and/or course topics. At this level, a student can remember something, but may not really understand it.
- 2. Understand** – the ability to grasp the meaning of information (facts, definitions, concepts, etc.) that has been presented.
- 3. Apply** – being able to use previously learned information in different situations or in problem solving.
- 4. Analyze** – the ability to break information down into its component parts. Analysis also refers to the process of examining information in order to make conclusions regarding cause and effect, interpreting motives, making inferences, or finding evidence to support statements/arguments.
- 5. Evaluate** – being able to judge the value of information and/or sources of information based on personal values or opinions.
- 6. Create** – the ability to creatively or uniquely apply prior knowledge and/or skills to produce new and original thoughts, ideas, processes, etc. At this level, students are involved in creating their own thoughts and ideas.

List of Action Words Related to Critical Thinking Skills

Here is a list of action words that can be used when creating the expected student learning outcomes related to critical thinking skills in a course. These terms are organized according to the different levels of higher-order thinking skills contained in Anderson and Krathwohl's(2001) revised version of Bloom's taxonomy.

REMEMBER	UNDERSTAND	APPLY	ANALYZE	EVALUATE	CREATE
Choose	Classify	Apply	Analyze	Agree	Adapt
Define	Compare	Build	Assume	Appraise	Build
Find	Contrast	Choose	Categorize	Assess	Change
How	Demonstrate	Construct	Classify	Award	Choose
Label	Explain	Develop	Compare	Choose	Combine

List	Extend	Experiment with	Conclusion	Compare	Compile
Match	Illustrate	Identify	Contrast	Conclude	Compose
Name	Infer	Interview	Discover	Criteria	Construct
Omit	Interpret	Make use of	Dissect	Criticize	Create
Recall	Outline	Model	Distinguish	Decide	Delete
Relate	Relate	Organize	Divide	Deduct	Design
Select	Rephrase	Plan	Examine	Defend	Develop
Show	Show	Select	Function	Determine	Discuss
Spell	Summarize	Solve	Inference	Disprove	Elaborate
Tell	Translate	Utilize	Inspect	Estimate	Estimate
What			List	Evaluate	Formulate
When			Motive	Explain	Happen
Where			Relationships	Importance	Imagine
Which			Simplify	Influence	Improve
Who			Survey	Interpret	Invent
Why			Take part in	Judge	Make up
			Test for	Justify	Maximize
			Theme	Mark	Minimize
				Measure	Modify
				Opinion	Original
				Perceive	Originate
				Prioritize	Plan
				Prove	Predict
				Rate	Propose
				Recommend	Solution
				Rule on	Solve
				Select	Suppose
				Support	Test
				Value	Theory

4. TIPS FOR DEVELOPING COURSE LEVEL EXPECTED LEARNING OUTCOMES STATEMENTS

- Limit the course-level expected learning outcomes to 5 - 10 statements for the entire course (more detailed outcomes can be developed for individual units, assignments, chapters, etc.).
- Focus on overarching or general knowledge and/or skills (rather than small or trivial details).
- Focus on knowledge and skills that are central to the course topic and/or discipline.
- Create statements that are student-centered rather than faculty-centered (e.g., “upon completion of this course students will be able to list the name of all Communication techniques” versus “one objective of this course is to teach the names of all Communication techniques”).
- Focus on the learning that results from the course rather than describing activities or lessons in the course.
- Incorporate or reflect the institutional and departmental missions.

Incorporate various ways for students to show success (outlining, describing, modeling, depicting, etc.) rather than using a single statement such as “at the end of the course, students will know _____” as the stem for each expected outcome statement.

5. SAMPLE EXPECTED LEARNING OUTCOMES STATEMENTS

The following depict some sample expected learning outcome statements from selected courses.

Computer Networks:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand basic computer network technology.
2. Understand and explain Data Communications System and its components.
3. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
4. Identify the different types of network topologies and protocols.
5. Identify the shortest path in a given network.
6. Model mathematically various error control schemes.
7. Analyze different LLC multiplexing mechanisms, node-to-node flow and error control.
8. Analyze different MAC mechanisms (Aloha, Slotted Aloha, TDMA, FDMA) and understand their pros and cons.
9. Identify the different types of network devices and their functions within a network.
10. Enable to interconnect various heterogeneous networks.
11. Understand and building the skills of sub netting and routing mechanisms.
12. Design and implement a peer to peer file sharing application utilizing application layer protocols such as HTTP, DNS, and SMTP and transportation layer protocol.
13. Predict ethical, legal, security and social issues related to computer networks.

Linux Programming:

After completing this course the student must demonstrate the knowledge and ability to:

1. Identify and use Linux utilities to create and manage simple file processing operations, organize directory structures with appropriate security.
2. Develop shell scripts to perform more complex tasks.
3. Illustrate file processing operations such as standard I/O and formatted I/O.
4. Generalize Signal generation and handling signals.
5. Develop programs using different Inter Process Communication (IPC) Mechanisms.
6. Use multithreading concepts to reduce the wastage of CPU time.
7. Design various client server applications using TCP or UDP protocols.

Operating Systems:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the difference between different types of modern operating systems, virtual machines and their structure of implementation and applications.
2. Understand the difference between process & thread, issues of scheduling of user-level processes/ threads and their issues.
3. Produce customized algorithmic solutions for given synchronization problems.
4. Use modern operating system calls and synchronization libraries in software/ hardware interfaces.

5. Identify the rationale behind various memory management techniques along with issues and challenges of main memory, virtual memory and file system.
6. Infer the performance of page replacement algorithms in various scenarios.
7. Recognize the issues related to file system interface and implementation, disk management.
8. Compare and Contrast the time complexities of various disk scheduling algorithms.
9. Understand the concepts of deadlock in operating systems and how they can be managed / avoided and implement them in multiprogramming system.

6. AN OVERVIEW OF ASSESSMENT

What is assessment?

According to Palomba and Banta (1999) assessment involves the systematic collection, review, and use of evidence or information related to student learning. Assessment helps faculty understand how well their students understand course topics/lessons. Assessment exercises are often anonymous. This anonymity allows students to respond freely, rather than trying to get the “right” answer or look good. Assessment exercises attempt to gauge students’ understanding in order to see what areas need to be re-addressed in order to increase the students’ learning.

In other words, assessment is the process of investigating (1) what students are learning and (2) how well they are learning it in relation to the stated expected learning outcomes for the course. This process also involves providing feedback to the students about their learning and providing new learning opportunities/strategies to increase student learning.

For example, Dr. JVR initiates a class discussion on material from Chapter One and determines that most students are confused about Topic X. This class discussion served as a method for assessing student learning and helped determine the fact that student learning related to Topic X is somewhat lacking. Dr. JVR now has the opportunity to (1) inform the students that there is some confusion and (2) make adjustments to address this confusion (e.g., ask student to re-read Chapter One, re-lecture over Topic X, etc.). This assessment process helps increase students’ learning.

What is the difference between “evaluation” and “assessment”?

Evaluation focuses on making a judgment about student work to be used in assigning marks that express the level of student performance. Evaluation is usually used in the process of determining marks. Evaluation typically occurs after student learning is assumed to have taken place (e.g., a final exam). Evaluation is part of the assessment process. Course assignments that are evaluated/graded (e.g., exams, papers, tutorials, etc.) are often seen as formal assessment techniques.

While evaluation is an important component of most classrooms, it does have some limitations. For example, if the class average on an exam is a 45%, it seems pretty clear that something went wrong along the way. When one has only evaluated the final learning product, it can be challenging to go back and discover what happened. It can also be difficult to address the situation or provide opportunities for students to learn from their mistakes. Yes, a curve on an exam can help address a low class average, but does it help the students learn? Engaging in informal assessment activities throughout the course can help avoid this situation.

What is involved in the assessment process?

1. Establishing expected learning outcomes for the course;
2. Systematically gathering, analyzing, and interpreting evidence (through formal assessment activities such as exams or papers and informal assessment activities such as in-class discussions exercises) to determine how well the students' learning matches:
 - Faculty expectations for what students will learn and
 - The stated expected learning outcomes for the course
3. Faculty members should use this evidence/assessment of student learning to:
 - Provide questionery to students about their learning (or lack thereof) and
 - Adjust their teaching methods and/or students' learning behaviors to ensure greater student learning (Maki, 2004).

The Best Practice in a Classroom Assessment and is an example of a method that can be used to assess learning outcomes. At the end of a class period or major topic, faculty ask students to anonymously write down what point(s) were the most unclear to them. After class, faculty members review these responses and then re-teach or re-address any confusing topics, thus increasing student learning (Angelo & Cross, 1993).

7. DESCRIPTION OF A COURSE PURPOSE

When planning a course and determining the Learning Outcomes for that course, it is important to examine the course's purpose within the context of the college, and/or the department/program. This process will assist faculty in determining the intent of the course as well as how the course fits into the curriculum. This will help identify the essential knowledge, skills, etc. that should be incorporated into the course and the stated expected learning outcomes for the course. The course purpose section should clarify the level of the course within the programme(e.g., is the course required as a core or an elective and whether it requires any pre-requisites etc.). It should also describe the course's role in the departmental/programmatic curriculum by addressing the intent (importance, main contribution etc.) of the course.

STEP ONE: Determine if the course is part of the IEEE / ACM / AICTE Model Curriculum

The earliest curriculum was published in 1968 for computer science (CS) by the Association for Computing Machinery (ACM), and in 1977 the Computer Society of the Institute for Electrical and Electronic Engineers (IEEE-CS) provided its first curriculum recommendations. In the late 1980's the ACM and the IEEE-CS together formed a task force to create curricula for computer science and computer engineering. The core curriculum covers classes in computer science curriculum, and subsequently separate curricula reports were issued for information systems, software engineering and computer engineering

STEP TWO: Determine how the course fits into the departmental curriculum

Here are some questions to ask to help determine how a course fits in the departmental curriculum:
What role does the course play in the departmental/programmatic curriculum?

- Is this course required?
- Is this course an elective?
- Is this course required for some students and an elective for others?
- Does this class have a pre-requisite?
- Is this class a pre-requisite for another class in the department?
- Is this course part of IEEE / AICTE Model Curriculum?

How advanced is this course?

- Is this course an undergraduate or graduate course?
- Where does this course fall in students' degree plan - as an introductory course or an advanced course?
- Can I expect the students taking this course to know anything about the course topic?
- Are other faculty members counting on students who have taken this course to have mastered certain knowledge or skills?

When students leave this course, what do they need to know or be able to do?

- Is there specific knowledge that the students will need to know in the future?
- Are there certain practical or professional skills that students will need to apply in the future?
- Five years from now, what do you hope students will remember from this course?

What is it about this course that makes it unique or special?

- Why does the program or department offer this course?
- Why can't this course be "covered" as a sub-section of another course?
- What unique contributions to students' learning experience does this course make?
- What is the value of taking this course? How exactly does it enrich the program or department?

8. PROCEDURE FOR DEVELOPMENT OF EXPECTED LEARNING OUTCOMES FOR A COURSE

The following pages should be of assistance in developing several broad, effectively stated expected learning outcomes for a course. When beginning to construct expected learning outcome statements, it is always good to think about the learners.

Please take a moment to think about the student learners in the course. Please consider the following questions:

- What are the most essential things the students need to know or be able to do at the end of this course?
- What knowledge and skills will they bring with them?
- What knowledge and skills should they learn from the course?

When you begin thinking about the expected learning outcomes for a course, it is a good idea to think broadly. Course-level expected learning outcomes do not need to focus on small details; rather, they address entire classes of theories, skill sets, topics, etc.

The "Course Description" contains the following contents:

- Course Overview
- Prerequisite(s)
- Marks Distribution
- Evaluation Scheme
- Course Objectives
- Course Outcomes
- How Course Outcomes are assessed
- Syllabus
- List of Text Books / References / Websites / Journals / Others
- Course Plan

- Mapping course objectives leading to the achievement of the program outcomes
- Mapping course outcomes leading to the achievement of the program outcomes

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ANNEXURE - A: SAMPLE COURSE DESCRIPTION (As Per NBA Norms post June, 2015)



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

COMPUTER SCIENCE AND ENGINEERING

COURSE DESCRIPTOR

Course Title	BIG DATA ANALYTICS			
Course Code	BCS212			
Programme	M.Tech			
Semester	I			
Course Type	Elective			
Regulation	R16			
Course Structure	Theory		Practical	
	Lectures	Tutorials	Practicals	Credits
	3	-	-	-
Course Faculty	Mr. C Raghavendra, Assistant Professor			

I. COURSE OVERVIEW:

Big data is a field that treats ways to analyze, systematically extract information from, or otherwise deal with data sets that are too large or complex to be dealt with by traditional data processing application software. Data with many rows offer greater statistical power, while data with higher complexity i.e., more attributes or columns may lead to a higher false discovery rate. Big data challenges include capturing data, data storage, data analysis, search, sharing, transfer, visualization, querying, updating, information privacy and data source.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
-	-	-	Database Management Systems	-
-	-	-	Big Data and Business Analytics	-

III. MARKS DISTRIBUTION

Subject	SEE Examination	CIA Examination	Total Marks
Big Data Analytics	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	LCD / PPT	✓	Seminars	✓	Videos	✓	MOOCs
✗	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each module carries equal weight age in terms of marks distribution. The question paper pattern is as follows. Two full questions with “either” or “choice” will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
30 %	To test the analytical skill of the concept.
20 %	To test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Technical Seminar and Term Paper.

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
	CIE Exam	Technical Seminar and Term Paper	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 9th and 17th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration, consisting of 5 one mark compulsory questions in part-A and 4 questions in part-B. The student has to answer any 4 questions out of five questions, each carrying 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Technical Seminar and Term Paper:

Two seminar presentations and the term paper with overview of topic are conducted during I semester. The evaluation of Technical seminar and term paper is for maximum of 5 marks. Marks are awarded by taking average of marks scored in two Seminar Evaluations.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	Analyze a problem, identify and define computing requirements, design and implement appropriate solutions	1	Term paper
PO 2	Solve complex heterogeneous data intensive analytical based problems of real time scenario using state of the art hardware/software tools	1	Seminar and Guest Lecturers
PO 3	Demonstrate a degree of mastery in emerging areas of CSE/IT like IoT, AI, Data Analytics, Machine Learning, cyber security, etc.	2	Guest Lecturers
PO 5	Independently carry out research/investigation and development work to solve practical problems	1	NPTEL Videos and Guest Lecturers
PO 7	Engage in life-long learning and professional development through self-study, continuing education, professional and doctoral level studies	2	MOOCs and Guest Lecturers

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES:

The course should enable the students to:

I	Understand about big data
II	Learn the analytics on big data
III	Explore on map reduce fundamentals

VIII. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Explains importance and role of data, classifications, challenges of analytics and knowledge extraction.	CLO 1	Understand what Big Data, importance and various sources of data
		CLO 2	Ability to understand elements of big data, distributed and parallel computing
		CLO 3	Demonstrate conceptually how Big Data is stored on cloud
		CLO 4	Examine data scientists and terminologies that are used in data environments
		CLO 5	Describe how Big Data can be analysed to extract knowledge from basically available soft state eventual consistency (BASE)
CO 2	Describes text analytics, analysis and development, various analytical tools.	CLO 6	Distinguish between different types of BIG DATA analytical approaches and tools.
		CLO 7	Elucidate the framework of map reduce and techniques to optimize map reduce jobs.
CO 3	Explore map reduce framework, role of HBase in big data, HDFS file system.	CLO 8	Understand the architecture of HDFS files, file system types, commands and packages.
		CLO 9	Explain the HBase architecture, operations, combining HBase and HDFS.

CO 4	Demonstrate NoSQL, hadoop, distributed challenges, HDFS demons and various Big data technologies.	CLO 10	Interpret NoSQL, Hadoop, RDBMS versus hadoop, Distributed computing challenges
		CLO 11	Outline the history of hadoop overview, use case of hadoop and hadoop distributors.
		CLO 12	Illustrate about HDFS daemons, managing resources and applications with hadoop YARN
CO 5	Explain text mining, sentiment analysis, web analytics, and mobile analytics.	CLO 13	Identify the importance of social media and key elements of social media
		CLO 14	Classify the text mining process, sentiment analysis, mobile analytics and web analytics.
		CLO 15	Compare the types of results from mobile analytics and applications for mobile analytics.

IX. COURSE LEARNING OUTCOMES(CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to	PO's Mapped	Strength of Mapping
BCS212.01	CLO 1	Understand what Big Data, importance and various sources of data	PO 3	2
BCS212.02	CLO 2	Ability to understand elements of big data, distributed and parallel computing	PO 1, PO 2	1
BCS212.03	CLO 3	Demonstrate conceptually how Big Data is stored on cloud	PO 3, PO 5	2
BCS212.04	CLO 4	Examine data scientists and terminologies that are used in data environments	PO 5, PO 7	1
BCS212.05	CLO 5	Describe how Big Data can be analysed to extract knowledge from basically available soft state eventual consistency (BASE)	PO 1	2
BCS212.06	CLO 6	Distinguish between different types of BIG DATA analytical approaches and tools.	PO 1, PO 2	1
BCS212.07	CLO 7	Elucidate the framework of map reduce and techniques to optimize map reduce jobs.	PO 3	2
BCS212.08	CLO 8	Understand the architecture of HDFS files, file system types, commands and packages.	PO 3, PO 5	1
BCS212.09	CLO 9	Explain the HBase architecture, operations, combining HBase and HDFS.	PO 3, PO 2	1
BCS212.10	CLO 10	Interpret NoSQL, Hadoop, RDBMS versus hadoop, Distributed computing challenges	PO 5, PO 7	2
BCS212.11	CLO 11	Outline the history of hadoop overview, use case of hadoop and hadoop distributors.	PO 1	2
BCS212.12	CLO 12	Illustrate about HDFS daemons, managing resources and applications with hadoop YARN	PO 2, PO 5, PO 7	1
BCS212.13	CLO 13	Identify the importance of social media and key elements of social media	PO 1, PO 2	1

BCS212.14	CLO 14	Classify the text mining process, sentiment analysis, mobile analytics and web analytics.	PO 2, PO 7	1
BCS212.15	CLO 15	Compare the types of results from mobile analytics and applications for mobile analytics.	PO 3, PO 5, PO 7	1

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes (COs)	Program Outcome (PO)				
	PO 1	PO 2	PO 3	PO 5	PO 7
CO 1	2	1	2	2	1
CO 2	1	1	2		
CO 3		1	1	1	
CO 4	2	1		2	2
CO 5	1	2	1	1	1

XI. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Learning Outcomes (CLOs)	Program Outcome (PO)				
	PO 1	PO 2	PO 3	PO 5	PO 7
CLO 1			2		
CLO 2	1	1			
CLO 3			2	2	
CLO 4				1	1
CLO 5	2				
CLO 6	1	1			
CLO 7			2		
CLO 8			1	1	
CLO 9		1	1		
CLO 10				2	2
CLO 11	2				

CLO 12		1		1	2
CLO 13	1	1			
CLO 14		2			1
CLO 15			1	1	1

3 = High; 2 = Medium; 1 = Low

XII. ASSESSMENT METHODOLOGIES –DIRECT

CIE Exams	PO1,PO3, PO5	SEE Exams	PO1,PO3, PO5	Seminar and Term Paper	PO1,PO2,PO3, PO5
Viva	-	Mini Project	-	Laboratory Practices	-

XIII. ASSESSMENT METHODOLOGIES -INDIRECT

✓	Early Semester Feedback	✓	End Semester OBE Feedback
✗	Assessment of Mini Projects by Experts		

XIV. SYLLABUS:

UNIT I
DATA MANAGEMENT Data management: Introduction to big data; history of data management: Design data architecture and manage the data for analysis, understand various sources of data like sensors/signal/GPS, structuring big data, elements of big data, big data analytics, distributed and parallel computing for big data, example export all the data onto cloud ex. AWS/Rackspaceetc; Big data analytics: Introduction, classification of analytics, greatest challenges that prevent business from capitalizing big data, top challenges facing big data, big data analytics importance, data science; Data scientist, terminologies used in big data environments, basically available soft state eventual consistency (BASE), open source analytics tools.
UNIT II
BIG DATA ANALYTICAL APPROACHES AND TOOLS Understanding analytics and big data: Comparing reporting and analysis, types of analytics, points to consider during analysis, developing an analytic team, understanding text analytics; Analytical approach and tools to analyze data: Analytical approaches, history of analytical tools, introducing popular analytical tools, comparing various analytical tools.
UNIT III
MAP REDUCE AND HBASE Understanding map reduce fundamentals and HBase: The map reduce framework, techniques to optimize map reduce jobs, uses of map reduce, role of HBase in big data processing; Storing data in Hadoop: Introduction of HDFS, architecture, HDFS files, file system types, commands, org.apache.hadoop.io package, HDF, HDFS high availability. Introduction to HBase: Architecture, storing big data with HBase, interacting with the hadoop ecosystem, HBase in operations programming with HBase, installation, combining HBase and HDFS.
UNIT IV
HADOOP Big data technology landscape and hadoop: NoSQL, Hadoop, RDBMS versus hadoop,

distributed computing challenges, history of hadoop, hadoop overview; use case of hadoop, hadoop distributors, HDFS, HDFS daemons, read, write, replica processing of data with hadoop, managing resources and applications with hadoop YARN.

UNIT V

SOCIAL MEDIA ANALYTICS AND TEXT MINING

Social media analytics and text mining: Introducing social media, key elements of social media, text mining, understanding text mining process, sentiment analysis, performing social media analytics and opinion mining on tweets; Mobile analytics: Introducing mobile analytics, define mobile analytics, mobile analytics and web analytics, types of results from mobile analytics, types of applications for mobile analytics, introducing mobile analytics tools.

TEXT BOOKS:

- 1 Seema Acharya, Subhasinin Chellappan, "Big Data and Analytics", Wiley Publications, 2nd Edition, 2014.
- 2 DT Editorial Services, "Big Data", Dream Tech Press, 2nd Edition, 2015.
- 3 Albright, Winston, "Business Analytics", Cengage Learning, 6th Edition, 2015.

REFERENCES:

- 1 Rajiv Sabherwal, Irma Becerra- Fernandez, "Business Intelligence –Practice, Technologies and Management", John Wiley, 1st Edition, 2011.
- 2 Lariss T. Moss, Shaku Atre, "Business Intelligence Roadmap", Addison-Wesley It Service, 2nd Edition, 2011.
- 3 Yuli Vasiliev, "Oracle Business Intelligence: The Condensed Guide to Analysis and Reporting", Shroff Publishers and Distributors, 2nd Edition, 2012.

XV. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No	Topic Outcomes	Topic/s to be covered	Reference
1	Discuss Data management	Introduction to Big Data, history	T1:1.1
2	Define distributed and parallel computing for big data	Importance, Purpose, Examples	T1:1.3
3- 5	Explain Big data analytics	Classifications, Challenges, Importance	T1:1.3.1
4	Discuss data science	Data scientist, terminologies	T1:2.2,2.3
6-9	Understanding analytics and big data	Reporting and analysis, types	T1:2.3.1
10-11	Understanding text analytics	History, Analytical approaches	T1:2.2
12-13	Understanding map reduce	Fundamentals, Map reduce framework, techniques	T2:4.1
14	Discuss HBase	role of HBase in big data, Storing data	T2:4.3
15-17	Define HDFS	Introduction, architecture, file system types, commands	T1:4.1
18-25	Explain HBase	Architecture, storing, operations, installation, combining HBase and HDFS	T2:4.4
26-27	Discuss Big data technology	NoSQL, Hadoop, RDBMS versus hadoop	T3:2.1
28-31	Define landscape and hadoop	Distributed computing challenges, history of hadoop, hadoop overview	T3:2.7
32-35	Discuss HDLC	Daemons, Read, Write, Replica Processing	T1:6.1

Lecture No	Topic Outcomes	Topic/s to be covered	Reference
36	Define managing resources	Applications with hadoop YARN	T1:6.2
37-49	Define Social media analytics	Introduction, key elements	T1:6.5
50-55	Understanding text mining	text mining process, sentiment analysis, opinion mining on tweets	T1:7.1
56-60	Discuss Mobile analytics	Introducing, web analytics, Types, Applications	T1:7.2

XVI. GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance with POs
1	HBase	Seminars / Guest Lectures / NPTEL	PO 1, PO 2, PO 3
2	HDFS, NoSQL	Work Shops/ Guest Lectures / NPTEL	PO 2, PO 3

XVII. DESIGN BASED PROBLEMS (DP) / OPEN ENDED PROBLEM:

1. Should companies embrace big data? Which ones (start-ups, big-companies, tech companies, retail, health care)? And how? Using vendors, outsourcing or by hiring employees? And how do you measure ROI on big data? Should they use redundant data to consolidate KPI's?
2. What do you consider to be big data? I tend to think of big data as anything 10 times larger (in terms of megabytes per day) than the maximum you are used to. Also, sparse data might not be as big as they look, can be costly to process. Is there a price per megabyte, for big data storage, big data transfers, and big data analytics?
3. What kind of training do you recommend for future data scientists? Any specific program in mind?
4. How to get university professors more involved in teaching students how to process real live, big data sets? Should curricula be adapted, outdated material removed, new material introduced?
5. Besides Hadoop-like and graph database environments, do you see other technology that would made data plumbing easier for big data?
6. Can you tell me 5 business activities that would benefit most from big data, and 5 that would benefit least?

Prepared By:
Mr. C Raghavendra, Assistant Professor

HOD, CSE