Sri Krishna College of Engineering and Technology

An Autonomous Institution, Affiliated to Anna University

Coimbatore – 641 008

CURRICULUM AND SYLLABI

B.Tech. COMPUTER SCIENCE AND BUSINESS SYSTEMS

REGULATION 2019

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

VISION AND MISSION OF THE DEPARTMENT

VISION

To produce industry ready professionals with information technology acquaintance and human values to contribute to the society at large.

MISSION

- To develop and to promote student ability thereby to compete globally through excellence in education.
- To inculcate varied skill sets that meets industry standards and to practice moral values.
- To enrich high integrity to lead and to serve the society.

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

PROGRAMME OUTCOMES OF THE DEPARTMENT

PROGRAMME OUTCOMES

PO – a Graduates would be able to apply knowledge of mathematics and computing respectively.

PO – b Graduates would be able to analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions by using appropriate techniques, skills, and tools necessary for computing practice.

PO – c Graduates would be able to design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

PO – d Graduates would be able to receive the broad education necessary to understand the impact of computer science solutions in a global and societal context.

PO – e Graduates would be able to communicate effectively in a variety of professional contexts.

PO – f Graduates would be able to recognize the responsibilities for the computing profession and make informed judgments in computing practice based on legal and ethical principles

PO – g Graduates would be able to acquire independent thinking, possess problem-solving skills related to professional, ethical, legal, security and social issues, and excel in the capability for self-learning to allow for life-long learning.

PO – h Graduates would be able to recognize the attributes and roles of businessmen, entrepreneur, managers, consultants, which will help to possess acquaintance along with the soft skills and to react aptly when confronted to hit on critical decision making.

PO – i Graduates would clearly understand the Life Cycle and process of Project Management, organizational Behavior, individual process happening in an organization, the group process, performance appraisal, personality and attitudes to adhere to the quality management.

PO – j Graduates would be able to have solid knowledge in computer science and business systems, including programming and languages, algorithms, theory, databases, organizational behavior etc.

PO – k Graduates would be able to apply design and development principles in the construction of software systems of varying complexity and excel in Business tactics towards software evolution.

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

PROGRAMME EDUCATIONAL OBJECTIVES & PROGRAMME SPECIFIC OBJECTIVES OF THE DEPARTMENT

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1 Challenges in their profession through the application of theory and principles of computer engineering.
PEO2 Problem solving skills in computer science and engineering by applying mathematical, scientific and engineering fundamentals and also to pursue higher studies.
PEO3 Good scientific and engineering breadth so as to comprehend, analysis, design, and create novel products and solutions for the real-life problems.
PEO4 Possess professional and ethical attitude, effective communication skills, team working skills, multi-disciplinary approach, and an ability to relate engineering issues to broader social context.
PEO5 Exhibit leadership qualities and progress through life-long learning.

PROGRAMME SPECIFIC OBJECTIVES

At the end of the programme, Graduate shall have

PSO 1 Enriched knowledge in aiding academic excellence in order to adopt to changing demands in the cutting-edge technology.

Mapping of PO's to PEO's

Programme Educational Objectives	Programme Outcomes										
	a	b	c	d	e	f	g	h	i	j	k
PEO 1	3	3	3	3	3	3	3	3	3	3	2
PEO 2	3	3	3	3	3	2	3	2	3	3	3
PEO 3	3	2	3	3	3	3	1	2	3	3	3
PEO 4	3	3	3	2	3	2	3	3	3	3	3
PEO 5	3	2	3	3	3	3	3	1	2	1	1

1	Reasonably agreed	**2**	Moderately agreed	**3**	Strongly agreed

B.TECH. COMPUTER SCIENCE AND BUSINESS SYSTEMS

REGULATION 2019

SEMESTER I							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credits**	**Ext/Int**	**Category**
THEORY							
1	19MA102	Discrete Mathematics	3/1/0	4	4	50/50	BS
2	19MA103	Probability and Statistics	3/1/0	4	4	50/50	BS
THEORY CUM PRACTICAL							
3	19EE111	Principles of Electrical Engineering	3/0/2	5	4	40/60	ES
4	19CB101	Computer Programming	3/0/2	5	4	40/60	ES
5	19PH103	Physics for Computing Science	3/0/2	5	4	40/60	BS
6	19EN101	Business Communication and Value Science I	2/0/2	4	3	40/60	HM
MANDATORY COURSE							
7	19MCXXX	Mandatory Course I					MC
			Total	**27**	**23**	**600**	

SEMESTER II							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1	19MA202	Linear Algebra	3/1/0	4	4	50/50	BS
2	19EN201	Business Communication and Value Science II	2/0/2	4	3	50/50	HM
3	19MG211	Fundamentals of Economics	3/0/0	3	3	50/50	ES
THEORY CUM PRACTICAL							
4	19CB201	Data Structures	3/0/2	5	4	40/60	PC
5	19EC211	Principles of Electronics Engineering	3/0/2	5	4	40/60	ES
6	19MA203	Statistical Modelling	3/0/2	5	4	40/60	BS
MANDATORY COURSE							
7	19MCXXX	Mandatory Course II					MC
			Total	**26**	**22**	**600**	

SEMESTER III							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1	19CB301	Formal Language and Automata Theory	3/1/0	4	4	50/50	PC
2	19CB302	Computer Organization and Architecture	3/0/0	3	3	50/50	PC
3	19CB303	Object Oriented Programming	3/0/0	3	3	50/50	PC
THEORY CUM PRACTICAL							
4	19MA308	Computational Statistics	3/0/2	5	4	40/60	ES
5	19CB304	Software Engineering	3/0/2	5	4	40/60	PC
PRACTICAL							
6	19CB305	Object Oriented Programming Laboratory	0/0/3	3	1.5	40/60	PC
MANDATORY COURSE							
7	19MCXXX	Mandatory Course III					MC
			Total	**23**	**19.5**	**600**	

SEMESTER IV							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1	19CB401	Database Management Systems	3/0/0	3	3	50/50	PC
2	19CB402	Introduction to Innovation, IP Management and Entrepreneurship	3/0/0	3	3	50/50	ES
3	19EN401	Business Communication and Value Science III	2/0/0	2	2	50/50	HM
THEORY CUM PRACTICAL							
4	19MA405	Operations Research	2/0/2	4	3	40/60	BS
5	19CB403	Software Design with UML	3/0/2	5	4	40/60	PC
6	19CB404	Operating Systems	3/0/2	5	4	40/60	PC
PRACTICAL							
7	19CB405	Database Management Systems Laboratory	0/0/3	3	1.5	40/60	PC
MANDATORY COURSE							
8	19MCXXX	Mandatory Course IV					MC
			Total	**25**	**20.5**	**700**	

SEMESTER V							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1	19CB501	Fundamentals of Management	2/0/0	2	2	50/50	ES
2	19CB502	Business Strategy	2/0/0	2	2	50/50	ES
3	19CB506	Design Thinking	3/0/0	3	3	50/50	PC
4	19CB9XX	Professional Elective – 1	2/0/2	4	3	50/50	PE
THEORY CUM PRACTICAL							
5	19CB503	Design And Analysis of Algorithms	3/0/2	5	4	40/60	PC
6	19CB504	Compiler Design	3/0/2	5	4	40/60	PC
PROJECT WORK							
7	19CB505	Mini Project	0/0/4	4	2	40/60	PW
			Total	**25**	**20**	**700**	

SEMESTER VI							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1	19XXXXX	Open Elective – 1	3/0/0	3	3	50/50	OE
2	19CB9XX	Professional Elective – 2	3/0/0	3	3	50/50	PE
3	19EN601	Business Communication and Value Science IV	2/0/0	2	2	50/50	HM
THEORY CUM PRACTICAL							
4	19CB601	Computer Networks	3/0/2	5	4	40/60	PC
5	19CB602	Information Security	2/0/2	4	3	40/60	PC
6	19CB603	Artificial Intelligence	2/0/2	4	3	40/60	PC
			Total	**21**	**18**	**600**	

SEMESTER VII							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1	19XXXXX	Open Elective – 2	3/0/0	3	3	50/50	OE
2	19XXXXX	Open Elective – 3	3/0/0	3	3	50/50	OE
3	19CB9XX	Professional Elective – 3	3/0/0	3	3	50/50	PE
4	19CB9XX	Professional Elective – 4	2/0/2	4	3	50/50	PE
5	19CB701	Usability Design of Software Applications	2/0/1	3	2.5	50/50	PC
THEORY CUM PRACTICAL							
6	19CB702	IT Workshop Skylab/Matlab	2/0/2	4	3	40/60	PC
PROJECT WORK							
7	19CB703	Project Evaluation I	0/0/6	6	3	40/60	PW
			Total	**26**	**20.5**	**700**	

SEMESTER VIII							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1	19MG801	Marketing Research and Marketing Management	2/0/0	2	2	50/50	HM
2	19MG802	Services Science and Service Operations Management	2/0/1	3	2.5	50/50	HM
3	19MG803	IT Project Management	2/0/1	3	2.5	50/50	HM
4	19CB9XX	Professional Elective – 5	3/0/0	3	3	50/50	PE
5	19CB9XX	Professional Elective – 6	2/0/2	4	3	50/50	PE
PROJECT WORK							
6	19CB801	Project Evaluation II	0/0/14	14	7	40/60	PW
			Total	**29**	**20**	**600**	

HUMANITIES AND MANAGEMENT (17 credits)

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
1	19EN101	Business Communication and Value Science I	2/0/2	4	3	40/60	HM
2	19EN201	Business Communication and Value Science II	2/0/2	4	3	50/50	HM
3	19EN401	Business Communication and Value Science III	2/0/0	2	2	50/50	HM
4	19EN601	Business Communication and Value Science IV	2/0/0	2	2	50/50	HM
5	19MG801	Marketing Research and Marketing Management	2/0/0	2	2	50/50	HM
6	19MG802	Services Science and Service Operations Management	2/0/1	3	2.5	50/50	HM
7	19MG803	IT Project Management	2/0/1	3	2.5	50/50	HM

BASIC SCIENCES (23 credits)

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
1	19MA102	Discrete Mathematics	3/1/0	4	4	50/50	BS
2	19MA103	Probability and Statistics	3/1/0	4	4	50/50	BS
3	19PH103	Physics for Computing Science	3/0/2	5	4	40/60	BS
4	19MA202	Linear Algebra	3/1/0	4	4	50/50	BS
5	19MA203	Statistical Modelling	3/0/2	5	4	40/60	BS
6	19MA405	Operations Research	2/0/2	4	3	40/60	BS

ENGINEERING SCIENCES (26 credits)

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
1	19EE111	Principles of Electrical Engineering	3/0/2	5	4	40/60	ES
2	19CB101	Computer Programming	3/0/2	5	4	40/60	ES
3	19MG211	Fundamentals of Economics	3/0/0	3	3	50/50	ES
4	19EC211	Principles of Electronics Engineering	3/0/2	5	4	40/60	ES
5	19MA308	Computational Statistics	3/0/2	5	4	40/60	ES
6	19CB402	Introduction to Innovation, IP Management and Entrepreneurship	3/0/0	3	3	50/50	ES

7	19CB501	Fundamentals of Management	2/0/0	2	2	50/50	ES
8	19CB502	Business Strategy	2/0/0	2	2	50/50	ES

PROFESSIONAL CORE (58.5 credits)

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
1	19CB201	Data Structures	3/0/2	5	4	40/60	PC
2	19CB301	Formal Language and Automata Theory	3/1/0	4	4	50/50	PC
3	19CB302	Computer Organization and Architecture	3/0/0	3	3	50/50	PC
4	19CB303	Object Oriented Programming	3/0/0	3	3	50/50	PC
5	19CB304	Software Engineering	3/0/2	5	4	40/60	PC
6	19CB305	Object Oriented Programming Laboratory	0/0/3	3	1.5	40/60	PC
7	19CB401	Database Management Systems	3/0/0	3	3	50/50	PC
8	19CB403	Software Design with UML	3/0/2	5	4	40/60	PC
9	19CB404	Operating Systems	3/0/2	5	4	40/60	PC
10	19CB405	Database Management Systems Laboratory	0/0/3	3	1.5	40/60	PC
11	19CB503	Design And Analysis of Algorithms	3/0/2	5	4	40/60	PC
12	19CB504	Compiler Design	3/0/2	5	4	40/60	PC
13	19CB506	Design Thinking	3/0/0	3	3	50/50	PC
14	19CB601	Computer Networks	3/0/2	5	4	40/60	PC
15	19CB602	Information Security	2/0/2	4	3	40/60	PC
16	19CB603	Artificial Intelligence	2/0/2	4	3	40/60	PC
17	19CB701	Usability Design of Software Applications	2/0/1	3	2.5	50/50	PC
18	19CB702	IT Workshop Skylab/Matlab	2/0/2	4	3	40/60	PC

MANDATORY COURSES

S.No.	Course Code	Course Title	Category
1	19MC001	Induction Program	MC
2	19MC002	MOOC Certification	MC
3	19MC101	Environmental Sciences	MC
4	19MC201	Indian Constitution	MC
5	19MC301	Essence of Indian Traditional Knowledge	MC
6	19MC401	Stress Management by Yoga	MC

PROFESSIONAL ELECTIVE COURSES

S.No.	Course Code	Course	L	T	P	Credit	Ext/Int
Digital Technology and Data Science							
1	19CB911	Conversational Systems	2	0	2	3	50/50
2	19CB912	Cloud, Microservices and Application	2	0	2	3	50/50
3	19CB913	Machine Learning	2	0	2	3	50/50
4	19CB921	Robotics and Embedded Systems	2	0	2	3	50/50
5	19CB922	Modern Web Applications	2	0	2	3	50/50
6	19CB923	Data Mining and Analytics	2	0	2	3	50/50
7	19CB931	Cognitive Science and Analytics	3	0	0	3	50/50
8	19CB932	Introduction to IoT	3	0	0	3	50/50
9	19CB933	Cryptology	3	0	0	3	50/50
10	19CB941	Quantum Computation and Quantum Information	2	0	2	3	50/50
11	19CB942	Advanced Social, Text and Media Analytics	2	0	2	3	50/50
12	19CB943	Mobile Computing	2	0	2	3	50/50
13	19CB963	Image Processing and Pattern Recognition	2	0	2	3	50/50
Business Systems							
1	19CB951	Behavioral Economics	3	0	0	3	50/50
2	19CB952	Computational Finance & Modeling	3	0	0	3	50/50
3	19CB953	Psychology	3	0	0	3	50/50
4	19CB961	Enterprise Systems	2	0	2	3	50/50
5	19CB962	Advance Finance	2	0	2	3	50/50

Open Elective Courses offered to other departments

S.No.	Course Code	Course	L	T	P	Credit	Ext/Int
1	19CB001	Java Programming	3	0	0	3	50/50
2	19CB002	Usability Design	3	0	0	3	50/50
3	19CB003	Financial Modeling	3	0	0	3	50/50
4	19CB004	Artificial Intelligence and Expert Systems	3	0	0	3	50/50

Open Elective Courses offered by other departments

S.No.	Course Code	Course	L	T	P	Credit	Ext/Int
1	19MG011	Financial and Cost Accounting	3	0	0	3	50/50
2	19MG012	Financial Management	3	0	0	3	50/50
3	19MG013	Human Resource Management	3	0	0	3	50/50
4	19MG014	Management Information System	3	0	0	3	50/50
5	19CE001	Disaster Management	3	0	0	3	50/50
6	19CE002	Engineering Risk benefit analysis	3	0	0	3	50/50
7	19CE003	Environmental and Social Impact Assessment	3	0	0	3	50/50
8	19CE004	Environmental Geomechanics	3	0	0	3	50/50
9	19CE005	Geographic Information System	3	0	0	3	50/50
10	19CE006	Industrial Pollution Prevention	3	0	0	3	50/50

11	18EC002	Telemedicine	3	0	0	3	50/50
12	18EC003	Artificial Intelligence and Deep Learning	3	0	0	3	50/50
13	18EC004	Brain computer interface	3	0	0	3	50/50
14	18EC005	Wireless Wearable systems	3	0	0	3	50/50
15	18EC006	Power Management for IOT Devices	3	0	0	3	50/50
16	18EE001	Power plant Engineering	3	0	0	3	50/50
17	18EE002	Energy Auditing, Conservation and Management	3	0	0	3	50/50
28	18EE003	Smart Grid	3	0	0	3	50/50
19	18EE004	Servo and Robot Drives	3	0	0	3	50/50
20	18EE005	Renewable Energy Sources	3	0	0	3	50/50
21	18EE006	Industrial Electronics	3	0	0	3	50/50
22	18EE007	Electrical Materials	3	0	0	3	50/50
23	18EE008	Special Purpose Machines	3	0	0	3	50/50
24	18MT001	Reliability Engineering	3	0	0	3	50/50
25	18MT002	Vehicle Dynamics	3	0	0	3	50/50
26	18MT003	Micro Machining	3	0	0	3	50/50
27	18MT004	Field and Service Robotics	3	0	0	3	50/50
28	18MT005	Automation System	3	0	0	3	50/50
29	18MT006	Basics of Robotics	3	0	0	3	50/50

One Credit Courses

S. No.	Course Code	Course
1	19CB801	Communicative English
2	19CB802	Business Ethics
3	19CB803	Tensorflow
4	19CB804	Angular JS
5	19CB805	Devops
6	19CB806	Anaconda
7	19CB807	MongoDB

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

S. No	Stream	Credits/Semester									Credits
		I	II	III	IV	V	VI	VII	VIII		
1.	Humanities and Management (HM)	3	3		2		2		7		17
2.	Basic Sciences (BS)	12	8		3						23
3.	Engineering Sciences (ES)	8	7	4	3	4					26
4.	Professional Core (PC)		4	15.5	12.5	11	10	5.5			58.5
5.	Professional Electives (PE)					3	3	6	6		18
6.	Open Electives (OE)						3	6			9
7.	Project Work (PW)					2		3	7		12
8.	Employability Skills									1.5	1.5
9.	Mandatory Course (MC)										**Non credit**
Total		**23**	**22**	**19.5**	**20.5**	**20**	**18**	**20.5**	**20**	**1.5**	**165**

19MA102 **DISCRETE MATHEMATICS** **3/1/0/4**

Nature of Course: J (Problem Analytical)

Course Objectives:

1 To know the fundamental concepts of Group theory

2 To learn the working of class of functions which transform a finite set into another finite set which relates to input and output functions in computer science

3 To acquaint with the concepts of calculus needed for problems in all engineering disciplines

Course Outcomes:

Upon completion of the course, students shall have ability to

C102.1	Evaluate double integral and triple integral to compute area, volume for two dimensional and three-dimensional solid structure	[AP]
C102.2	Understand the basic concepts of Boolean algebra	[U]
C102.3	To recall the basic concepts of sets, groups and truth table	[R]
C102.4	Understand and apply the basic concepts of mathematical induction	[AP]

Course Contents:

Boolean algebra: Introduction of Boolean algebra, truth table, basic logic gate, basic postulates of Boolean algebra, principle of duality, canonical form, Karnaugh map.

Calculus: Basic concept of Differential calculus and integral calculus – evaluation of double and triple integrals (cartesian Coordinates) - Change the order of integration (cartesian Coordinates) - application of double (area) and triple (volume) integral (cartesian Coordinates).

Abstract algebra: Set: definition – simple problems, Relation: types – simple problems, Group: monoid - semigroup – group – Abelian group – simple problems, Ring: definition – simple problems, field: definition – simple problems.

Combinatorics: Basic counting, balls and bins problems, generating functions, recurrence relations. Proof techniques, principle of mathematical induction, pigeonhole principle – simple problems.

Total Hours: 60

Text Books:

1. I. N. Herstein, “Topics in Algebra”, John Wiley and Sons.
2. M. Morris Mano, “Digital Logic & Computer Design”, Pearson.
3. B. S. Grewal, “Higher Engineering Mathematics”, Khanna Publication, Delhi.

Reference Books:

1 Gilbert Strang: Introduction to linear algebra.

2 Peter V. O'Neil, “Advanced Engineering Mathematics”, 7th Edition, Thomson Learning.

3 M. D. Greenberg, “Advanced Engineering Mathematics”, 2nd Edition, Pearson Education.

4 P. N. Wartikar and J. N. Wartikar, “Applied Mathematics”. Vol. I & II, Vidyarthi Prakashan.

Web References:

1 http://nptel.ac.in/video.php?subjectId=122107037

2 http://nptel.ac.in/courses/122107036/

3 http://nptel.ac.in/video.php?subjectId=117102060

Online Resources:

1 https://www.coursera.org/learn/pre-calculus

2 https://www.coursera.org/learn/linearalgebra1

3 https://alison.com/courses/Advanced-Mathematics-1

4 https://www.edx.org/course/algebra-lineal-mexicox-acf-0903-1x.

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C102.1	Remember	Classroom or Online Quiz	2
C102.2	Understand	Class Presentation/Power point presentation	4
C102.3	Apply	Group Assignment	7
C102.4	Apply	Group activities	7

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
20	30	50	100

Course Outcome (CO)	**Programme Outcomes (PO)**											**Programme Specific Outcomes (PSO)**
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**
C102.1	3											
C102.2	2	2										
C102.3	1											
C102.4	3											

19MA103 PROBABILITY AND STATISTICS 3/1/0/4

Nature of Course: J (Problem analytical)

Prerequisites: Basic knowledge of high school maths and basic concepts of Probability

Course Objectives:

1 To study the basic probability concepts

2 To understand and have a well – founded knowledge of standard distributions which can be used to describe real life phenomena

3 To learn the concepts of evaluation using statistical analysis

Course Outcomes:

Upon completion of the course, students shall have ability to

C103.1	Recall the concepts of basic probability.	[R]
C103.2	Understand the types of data and graphical representation in statistics.	[U]
C103.3	Use distribution in cluster analysis of similar binary variables	[AP]
C103.4	To understand the concepts of sampling techniques	[U]
C103.5	To apply the concepts of distributions which is the basic for analytics and inferential statistics	[AP]

Course Contents:

Probability: Concept of experiments, sample space, event. Definition of Combinatorial Probability-Definition of conditional probability, Baye's Theorem (Statement only) – Simple problems. Probability distributions: discrete & continuous distributions- Binomial, Poisson, Geometric, Uniform, Exponential, Normal, Chi-square, t, F distributions (No derivations of mean, variance and moment generating function & Simple problems only). Expected values & moments: mathematical expectation & its properties (statements only), Moments (first four moments including variance, skewness (Karl Pearson's)) & their properties (Statements only), Moment generating function- Definition – Simple problems.

Introduction to Statistics: Definition of Statistics, Basic objectives, Applications in various branches of science with examples. Collection of Data: Internal and external data, Primary and secondary Data. Population and sample, Representative sample. Descriptive Statistics: Classification and tabulation of univariate data, Graphical representation: Simple bar diagram, Pie chart, Pareto chart- Frequency curves: Histogram, Frequency curve, Frequency polygon, Ogives- Descriptive measures: Central tendency- Mean, Median and Mode, Dispersion- Range, Quartile deviation, Standard deviation. Bivariate data. Summarization, marginal and conditional frequency distribution (Problems only). Scatter diagram. Linear regression - Least squares method – correlation (Karl Pearson's)- Rank correlation (Spearman's).

Sampling Techniques: Random sampling - Sampling from finite and infinite populations. Estimates and standard error (sampling with replacement and sampling without replacement), Sampling distribution of sample mean, stratified random sampling (Theory only).

Total Hours: 60

Text Books:

1. Introduction of Probability Models, S.M. Ross, Academic Press, N.Y.
2. Fundamentals of Statistics (vol. I and vol. II) - A. Goon, M. Gupta and B. Dasgupta.

Reference Books:

1. A first course in Probability, S.M. Ross.
2. Probability and Statistics for Engineers (4th Edition) - I.R. Miller, J.E. Freund and R. Johnson.

Web References:

1 http://nptel.ac.in/courses/111104079/
2 http://nptel.ac.in/video.php/subjectId=117105085
3 http://nptel.ac.in/syllabus/111105041/
4 http://freevideolectures.com/Course/3028/Econometric-Modelling/22#

Online Resources:

1 www.edx.org/Probability
2 *https*://*ocw.mit.edu/*courses/.../18-440-probability-and-random-variables-spring-2014/
3 *https*://*onlinecourses.*nptel.ac.in/noc15_ec07/

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C103.1	Remember	Class room or online Quiz	2
C103.2	Understand	Class presentation	4
C103.3	Apply	Power-point Presentation /Group Activities	4
C103.4	Understand	Class presentation	4
C103.5	Apply	Group Assignment	6

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
20	30	50	100

Course Outcome (CO)	Programme Outcomes (PO)											Programme Specific Outcomes (PSO)
	a	b	c	d	e	f	g	h	i	j	k	1
C103.1	1											
C103.2	2											
C103.3	3											
C103.4	2											
C103.5	3											

19EE111 PRINCIPLES OF ELECTRICAL ENGINEERING 3/0/2/4

Nature of Course: G (Theory & analytical)

Pre requisites: Nil

Course Objectives:

1. To remember the basic concepts in ac circuit and dc circuits.
2. To analyse the electrical circuit parameters of dc circuits by applying network theorems.
3. To understand and apply the principle of electrostatics and electromechanics in single phase transformer.
4. To understand the signal measuring devices and electrical wiring systems.

Course Outcomes:

Upon completion of the course, students shall have the ability to

C111.1	Know the basic concepts of work, power, energy for electrical, mechanical and thermal systems	[R]
C111.2	Understand and apply knowledge of Kirchoff's laws and network theorems to solve electrical networks	[AP]
C111.3	Realize the construction, principle of operation, specifications and applications of capacitors and batteries	[U]
C111.4	Understand and apply fundamental concepts of magnetic and electromagnetic circuits for operation of single-phase transformer	[AP]
C111.5	Understand the basic terms of single phase and three phase ac circuits with wiring systems and the use of measuring instruments	[U]

Course Contents:

Introduction and overviews: Electron Devices, Circuits and Systems, Integrated Circuits, Analog and digital signals

Basic Concepts and Circuit Analysis: Concept of Potential difference, voltage, current, Fundamental linear passive and active elements to their functional current-voltage relation, Terminology and symbols in order to describe electric networks, Concept of work, power, energy and conversion of energy. DC Circuits-Current-voltage relations of electric network by mathematical equations to analyse the network (Thevenin's theorem, Norton's Theorem, Maximum Power Transfer theorem) voltage source and current sources, ideal and practical, Kirchhoff's laws and applications to network solutions using mesh analysis, Simplifications of networks using series- parallel, Star/Delta transformation. Superposition theorem. AC Circuits-AC waveform definitions, form factor, peak factor, study of R-L, R-C,RLC series circuit, R-L-C parallel circuit, phasor representation in polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor, 3 phase Balanced AC Circuits.

Principle of Electromechanics and Electrostatics: Electrostatic field, electric field intensity, electric field strength, absolute permittivity, relative permittivity, capacitor composite, dielectric capacitors, capacitors in series& parallel, energy stored in capacitors, charging and discharging of capacitors, Principle of batteries, types, construction and application. Electro-mechanics: Electricity and Magnetism, magnetic field and faraday's law, self and mutual inductance, Ampere's law, Magnetic circuit, Magnetic material and B-H Curve, Single phase transformer, principle of operation, EMF equation, voltage ratio, current

ratio, KVA rating, efficiency and regulation, Electromechanical energy conversion, Basic concept of indicating and integrating instruments.

Measurements and Sensors: Introduction to measuring devices/sensors and transducers related to electrical signals, Elementary methods for the measurement of electrical quantities in DC and AC systems and their practical application. Electrical Wiring and Illumination system: Basic layout of distribution system, Types of Wiring System &Wiring Accessories, Necessity of earthing, Types of earthing, Different types of lamps (Incandescent, Fluorescent, Sodium Vapour, Mercury Vapour, Metal Halide, CFL, LED)

Lab Components

1. Familiarization of electrical Elements, sources, measuring devices and transducers related to electrical circuits. [R]
2. Determination of resistance temperature coefficient. [U]
3. Verification of Network Theorem (Superposition, Thevenin, Norton, Maximum Power Transfer theorem). [AP]
4. Simulation of R-L-C series circuits for XL> XC , XL< XC & XL= XC. [U]
5. Simulation of Time response of RC circuit. [U]
6. Verification of relation in between voltage and current in three phase balanced star and delta connected loads. [AP]
7. Demonstration of measurement of electrical quantities in DC and AC systems. [R]

Total Hours 75

Text Books:

1. Fitzgerald. A.E., Charles KingselyJr, Stephen D.Umans, 'Electric Machinery', Tata McGraw Hill, 6th edition 2015.
2. B.L.Theraja- "A Textbook of Electrical Technology" Volume- I, S.Chand and Company Ltd.,New Delhi, 2015.
3. V. K. Mehta, - "Basic Electrical Engineering", S. Chand and Company Ltd., New Delhi,2012
4. J. Nagrath and Kothari – "Theory and problems of Basic Electrical Engineering", Prentice Hall ofIndia Pvt. Ltd, 2nd edition, 2017.

Reference Books:

1. Edward Hughes – "Electrical Technology"- Pearson Education Publication,10th edition, 2011.
2. Vincent. Del. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 2nd edition, 2015.
3. Sudhakar Shyammohan, "Circuits and Networks: Analysis and Synthesis", Tata McGraw-Hill Education, 5th edition, 2015.

Web References:

1. http://nptel.ac.in/course.php?disciplineId=108
2. https://ocw.mit.edu/courses/find-by topic/#cat=engineering&subcat=electricalengineering&spec=electricpower
3. https://nptel.ac.in/video.php?subjectId=117103063
4. https://onionesquereality.wordpress.com/.../more-video- lectures-iit-open
5. https://nptel.iitg.ernet.in/Elec_Comm_Engg/.../Video-ECE.pdf

Online Resources:

1. Electrical Knowhow@lifeneverask
2. Electricity & Magnetism, Part 1- PHYS 102.1x (edx.in)
3. Fundamentals of Electrical Engineering@coursera

4. Circuits and Electronics@edxonline
5. https://www.coursera.org/learn/electronics
6. NPTEL e learning courses

Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Rubrics based practical Assessment [30 Marks]**	
	CIA1 [10 marks]	**CIA2 [10 marks]**	**CIA3 [10 marks]**		
Remember	50	-	40	40	40
Understand	-	60	40	30	30
Apply	50	40	20	30	30
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcome (CO)	**Programme Outcomes (PO)**											**Programme Specific Outcomes (PSO)**
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**
C111.1	1	1										
C111.2	3	3										
C111.3	2	2										
C111.4	3	3										
C111.5	2	2										

19CB101 **COMPUTER PROGRAMMING** **3/0/2/4**

Nature of Course: K (Problem Programming)
Pre requisites: Nil
Course Objectives:

1 To understand problem solving concepts.
2 To learn operators and expressions in C.
3 To gain knowledge about the control structures in C.
4 To write C programs using arrays, functions, pointers, structures and files.
5 To learn Unix system interface and programming method.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Apply problem solving techniques to solve real world problems	[AP]
C101.2	Understand C fundamental constructs and control structures	[U]
C101.3	Use the concept of pointers, arrays, structures, functions and files in programs	[AP]
C101.4	Understand Unix system interface and programming method	[U]

Course Contents:

General Problem-Solving concepts: Algorithm, and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops.

Imperative languages: Introduction to imperative language; syntax and constructs of a specific language (ANSI C)

- Types Operator and Expressions with discussion of variable naming and Hungarian Notation: Variable Names, Data Type and Sizes (Little Endian Big Endian), Constants, Declarations, Arithmetic Operators, Relational Operators, Logical Operators, Type Conversion, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, proper variable naming and Hungarian Notation
- Control Flow with discussion on structured and unstructured programming: Statements and Blocks, If-Else-If, Switch, Loops – while, do, for, break and continue, Goto Labels, structured and un- structured programming
- Functions and Program Structure with discussion on standard library: Basics of functions, parameter passing and returning type, C main return as integer, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialisation, Recursion, Pre-processor, Standard Library Functions and return types
- Pointers and Arrays: Pointers and address, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Multi-dimensional array and Row/column major formats, Initialisation of Pointer Arrays, Command line arguments, Pointer to functions, complicated declarations and how they are evaluated.
- Structures: Basic Structures, Structures and Functions, Array of structures, Pointer of structures, Self-referral Structures, Table look up, Typedef, Unions, Bit-fields
- Input and Output: Standard I/O, Formatted Output – printf, Formated Input – scanf, Variable length argument list, file access including FILE structure, fopen, stdin, sdtout and stderr, Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions
- Unix system Interface: File Descriptor, Low level I/O – read and write, Open, create, close and unlink, Random access – lseek, Discussions on Listing Directory, Storage allocator

Programming Method: Debugging, Macro, User Defined Header, User Defined Library Function, makefile utility.

Total Hours:45

Lab Exercises:

1. Algorithm and flowcharts of small problems like GCD [AP]
2. Structured code writing with: [AP]
   i. Small but tricky codes
   ii. Proper parameter passing
   iii. Command line Arguments
   iv. Variable parameter
   v. Pointer to functions
   vi. User defined header
   vii. Make file utility
   viii. Multi file program and user defined libraries
   ix. Interesting substring matching / searching programs
   x. Parsing related assignments

Total Hours: 30

Text Books:

1 B. W. Kernighan and D. M. Ritchi, The 'C Programming Language", 2nd Edition, PHI.
2 B. Gottfried, "Programming in C", Second Edition, Schaum Outline Series, 1st Edition,2008.

Reference Books:

1 Herbert Schildt, "C: The Complete Reference", 4th Edition, McGraw Hill,2015.
2 Yashavant Kanetkar, "Let Us C", BPB Publications,15th Edition 2017.

Web References:

1 https://onlinecourses.nptel.ac.in/noc17_cs43/
2 http://raptor.martincarlisle.com/
3 https://scratch.mit.edu/

Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical Rubric based CIA [30 Marks]**	
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**		
Remember	20	20	20	-	-
Understand	30	30	30	30	30
Apply	50	50	50	70	70
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)											Programme Specific Outcomes (PSO)
	a	b	c	d	e	f	g	h	i	j	k	1
C101.1	3	3	3				3	3		3	3	3
C101.2	2	2	2				2	2		2	2	2
C101.3	3	3	3				3	3		3	3	3
C101.4	2	2	2				2	2		2	2	

19PH103 **PHYSICS FOR COMPUTING SCIENCE** **3/0/2/4**

Nature of Course: E (Theory skill based)
Pre requisites: Nil
Course Objectives:

1 To learn the basic concepts of physics needed for computing engineering
2 To apply the physics concepts in solving real time engineering problem
3 To implement and visualize theoretical aspects in the laboratory
4 To familiarize the students to handle various instruments and equipment

Course Outcomes:
Upon completion of the course, students shall have ability to

C103.1	Reproduce the basic concepts of lasers, fibre optics, thermodynamics, simple harmonic and damped oscillations	[R]
C103.2	Discuss the fundamental concepts of interference, diffraction and polarization	[U]
C103.3	Describe the basics of Quantum mechanics	[U]
C103.4	Recall the basic concepts of crystal structure of the various materials	[R]
C103.5	Solve complex problems in everyday life using the knowledge gained from the course	[AP]
C103.6	Practice to solve problems using theoretical knowledge as a team	[AP]

Course Contents:

Oscillation and fundamental of wave optics:

Periodic motion-simple harmonic motion-characteristics of simple harmonic motion-vibration of simple springs mass system. Resonance-definition, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor.

Interference-principle of superposition – Polarisation: Basic definition and types of interference of light - young's double slit experiment of interference and Newton's rings - Diffraction-Two kinds of diffraction (Fresnel's diffraction and Fraunhofer's diffraction) -Difference between interference and diffraction - Fraunhofer diffraction at single slit-plane diffraction grating (multi slit diffraction). Coherence - Temporal and Spatial Coherence. Polarization definition - production of polarized beam as plane, elliptical and circularly polarized light, polarisation by reflection (Brewster's law), double refraction.

Quantum Mechanics and Crystallography:

Introduction - Planck's quantum theory - Matter waves, de-Broglie wavelength, Heisenberg's Uncertainty principle, time independent and time dependent Schrödinger's wave equation, Physical significance of wave function, Particle in a one dimensional potential box.
Crystallography - Basic terms-types of crystal systems, Bravais lattices, miller indices,d-spacing, Debye Scherrer powder method, Laue method- Atomic packing factor for SC, BCC, FCC and HCP structures.
Semiconductor Physics - Basic concept of Band theory - classification of materials into conductor, semiconductor and Insulator.

Laser and Fiber optics:

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: CO_2 and Neodymium lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and highly intense, applications of lasers in engineering.
Fiber optics and Types of optical fibers.

Thermodynamics:
Basic definitions of Zeroth law of thermodynamics, first law of thermodynamics, Applications of 1st law, second law of thermodynamics and concept of heat Engine, entropy, change in entropy in reversible and irreversible processes, third law of thermodynamics (definition only).

Lab Component

1	Magnetic field along the axis of current carrying coil – Stewart and Gee	[U]
2	Determination of Hall co-efficient of semiconductor	[U]
3	Determination of Plank Constant	[U]
4	Determination of wavelength of light by Laser diffraction method	[U]
5	Determination of wavelength of light by Newton's ring method	[U]
6	Determination of laser and optical parameter	[U]
7	Determination of Stefan's Constant.	[U]

Total Hours: 75

Text Books:

1. Beiser A, Concepts of Modern Physics, 5th Ed., McGraw Hill International, 2010.
2. David Halliday, Robert Resnick, Jearl Walker "Fundamentals of Physics" Wileyplus.2010

Reference Books:

1. Ajoy Ghatak "Optics" 5th Ed., Tata McGraw Hill, 2012
2. University Physics-Sears & Zemansky (Addison-Wesley)
3. Jenkins and White, "Fundamentals of Optics"

Web References:

1. https://www.drdo.gov.in/drdo/data/Laser%20and%20its%20Applications.pdf
2. https://www3.nd.edu/~powers/ame.20231/planckdover.pdf
3. https://www.corning.com/in/en/products/communication-networks/.../fiber.html
4. *https://physics.info/*
5. *http://www.feynmanlectures.caltech.edu/info/*
6. http://nptel.ac.in/courses/113106032/4%20-%20Crystal%20structure.pdf
7. http://www.phys.ufl.edu/courses/phy2054/s09/lectures/2054_ch21A.pdf
8. *https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2013/*
9. https://web.iit.edu/sites/web/files/departments/academic-affairs/academic-resource-center/pdfs/Miller_Indices.pdf
10. https://www2.physics.ox.ac.uk/sites/default/files/2011-06-08/optics_2016_week_1_notes_and_slides_pdf_19526.pdf

Online Resources:

1. https://www.patana.ac.th/secondary/science/anrophysics/ntopic4/commentary.htm
2. https://www.princeton.edu/ssp/joseph-henry-project/eddy-currents/A-students-guide-to-maxwells-equations-D.-FleischLEISC.pdf
3. https://www.jic.ac.uk/microscopy/links.html
4. http://esiksha.com/home.asp
5. *www.fiberopticsonline.com/*
6. https://ocw.mit.edu/courses/#physics
7. https://physics.stanford.edu/people/susmita-adhikari

Assessment Methods & Levels (based on Blooms' Taxonomy)					
Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical**	
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**	**Rubric based CIA [30 Marks]**	
Remember	30	20	30	20	30
Understand	60	60	60	40	60
Apply	10	20	10	30	10
Analyse	-	-	-	10	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcome (CO)	**Programme Outcomes (PO)**											**Programme Specific Outcomes (PSO)**
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**
C103.1			2	2								
C103.2			2	2								
C103.3			2	2								
C103.4			2	2								
C103.5			3	3								
C103.6			3	3								

19EN101 BUSINESS COMMUNICATION AND VALUE SCIENCE I 2/0/2/3

Nature of Course: Behavioral

Course Objectives:

1 Understand what life skills are and their importance in leading a happy and well -adjusted life
2 Motivate students to look within and create a better version of self
3 Introduce them to key concepts of values, life skills and business communication

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Remember the need for life skills and values	[R]
C101.2	Recognize own strengths and opportunities	[U]
C101.3	Apply the life skills to different situations	[AP]
C101.4	Understand the basic tenets of communication	[U]
C101.5	Apply the basic communication practices in different types of communication	[AP]

Course Contents:

Module 1

Introduction to Values - its importance and necessity – Overview of Business Communication (Importance of oral & written communication)- Listening skills (Hearing Vs Listening) – Body Language

Module 2

Tenses – Verbs – Helpings verbs – Subject-verb agreement – Articles – Prepositions – Conjunctions – Adjectives – Adverbs – Voice – Parts of Sentence – Identification of errors – Effective Communication - Types of Communication (Verbal, Written & Non-verbal Communication) – Barriers to Effective Communication – Tips to develop communication skills – Principles of Listening – The Process of Listening – Types of Listening.

Module 3

Email writing (Formal and Informal)- Its Advantages & Disadvantages – Pronunciation and Enunciation – Summary Writing – Story Writing – Vocabulary Enrichment – Life Skills – importance and necessity – Thinking skill – Social skill – Emotional skill – Howard Gardner's Multiple Intelligence – Embracing Adversity

Total Hours 60

Text Books:

1. APAART: Speak Well 1 (English language and communication)
2. APAART: Speak Well 2 (Soft Skills)

Reference Books:

1. Alan Mc'carthy and O'dell – English Vocabulary in Use – Third Edition – Cambridge University Press 2017
2. Dr. Saroj Hiremath – Business Communication – Nirali Prakashan

Web References:

1 Train your mind to perform under pressure- Simon sinek https://curiosity.com/ videos/simon-sinek-on-training-your-mind-to-perform-under-pressure-capture-your-flag/
2 Brilliant way one CEO rallied his team in the middle of layoffs https://www.inc.com/ video/simon-sinek-explains-why-you-should-put-people-before-numbers.html

3 Will Smith's Top Ten rules for success https://www.youtube.com/ watch?v=bBsT9omTeh0

Online Resources:

1 https://www.coursera.org/learn/learning-how-to-learn

2 https://www.coursera.org/specializations/effective-business-communication

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:30)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C101.1	Understand	Immersion Activity	5
C101.2	Understand	Create Resume	5
C101.3	Apply	Group Assignment	5
C101.3	Apply	Trek followed by project	5
C101.4	Understand	Group activities	5
C101.5	Apply	Record a conversation	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [40 marks]**
	Theory			
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**	
Remember	20	20	20	20
Understand	40	40	40	40
Apply	40	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Course Outcome (CO)	**Programme Outcomes (PO)**											**Programme Specific Outcomes (PSO)**
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**
C101.1					2							
C101.2					2							
C101.3					3							
C101.4					2							
C101.5					3							

19MC001 **MANDATORY COURSE I**

Nature of Course: Induction Program

Course Objectives:

1 To have broad understanding of society and relationships
2 To nurture the character and fulfil one's responsibility as an engineer, a citizen and a human being
3 To incorporate meta skills and values

Course Outcomes:

Upon completion of the course, students shall have ability to

C001.1	Explore academic interest and activities	[AP]
C001.2	Work for excellence	[AP]
C001.3	Promote bonding and give a broader view of life and character	[AP]

Course Contents:

PHYSICAL ACTIVITY
Yoga

CREATIVE ARTS (students can select any one of their choice)
Painting, sculpture, pottery, music, dance, craft making and so on

UNIVERSAL HUMAN VALUES
Enhancing soft skills

LITERARY AND PROFICIENCY MODULES
Reading, writing, speaking – debate, role play etc.
Communication and computer skills

LECTURES BY EMINENT PEOPLE
Guest lecture by subject experts

VISIT TO LOCAL AREAS
Meditation centre/orphanage/Hospital

FAMILIARIZATION TO DEPARTMENT/BRANCH INNOVATION
Lectures by Department's Head and senior faculty members

19MA202 **LINEAR ALGEBRA** **3/1/0/4**

Nature of Course: J (Problem analytical)

Pre requisites: Higher Secondary Mathematics

Course Objectives:

1. To analyze and solve a linear system of equations to find the determinant.
2. To understand the concepts independence, basis, dimensions orthogonality in vector spaces.
3. Evaluate mathematical expressions to compute quantities that deal with linear systems and Eigen value problems.
4. To find the Eigen values and Eigenvectors of a matrix or a linear transformation and diagonalize a matrix using it.
5. To diagonalize the symmetric and non-symmetric matrix using singular value decomposition and principal component analysis.

Course Outcomes:

Upon completion of the course, students shall have ability to

C202.1	Relate characteristics of solutions of a linear system to determinant and rank of its associated matrices.	[R]
C202.2	Test for independence of vectors and find the dimension and basis of a given vector space.	[U]
C202.3	Use computational techniques and algebraic skills essential for the study of systems of linear equations.	[AP]
C202.4	Solve algebraic Eigen value problems and find the extreme values of the given function.	[AP]
C202.5	Utilize singular value decomposition and principal component analysis.to characterize and analyze matrices, especially the correlation matrix.	[AP]

Course Contents:

MODULE 1: Determinants Introduction – Properties (without proof) - Solution of system of linear equations by Cramer's rule – Inverse of a matrix (using determinant).

MODULE 2: Matrices Introduction –Definition of vectors and linear combinations - Types of matrix: Symmetric, skew symmetric, Hermitian and unitary matrices (Simple problems)- Matrix operations - Rank of a matrix - Solution of system of linear equations by Gaussian elimination and LU decomposition. Eigen values and Eigenvectors, Linear transformation (orthogonal transformation). Singular value decomposition (simple problems) and Principal component analysis (definition)– Introduction to their application in image processing and machine learning (problems not included).

MODULE 3: Vector Space Vector space: Definition of dimension – Basis: Definition – simple problems, Orthogonality: Definition – simple problems, Definition of Projection – Simple problems in Gram-Schmidt orthogonalization and QR decomposition (theorems not included).

Total Hours: 60

Text Books:

1. Introduction to linear algebra, 5th edition, Gilbert Strang.
2. Higher Engineering Mathematics ,43rd edition B. S. Grewal.
3. Engineering Mathematics, 2nd edition Veerarajan T

Reference Books:

1. Advanced Engineering Mathematics, 7th edition, Peter V. O'Neil.

2 Advanced Engineering Mathematics, 2nd edition, M. D. Greenberg.
3 Applied Mathematics (Volumes I and II) by P. N. Wartikar & J. N. Wartikar
4 Digital Image Processing, R C Gonzalez and R E Woods

Web References:

1 https://www.udemy.com/topic/linear-algebra
2 https://www.edx.org/course/introduction-to-linear-models-and-matrix-algebra
3 https://www.deeplearningbook.org/contents/linear_algebra.html
4 https://machinelearningmastery.com/introduction-matrices-machine-learning

Online Resources:

1 https://onlinecourses.nptel.ac.in/noc19_ma06
2 https://www.coursera.org/learn/linear-algebra-machine-learning
3 https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/related-resources/

Assessment Methods & Levels (based on Revised Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C202.1	Remember	Classroom or Online Quiz	2
C202.2	Understand	Class Presentation/Power point presentation	4
C202.3	Apply	Group Assignment	6
C202.4 & C202.5	Apply	Group activities	8

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
20	30	50	100

Course Outcome (CO)	Programme Outcomes (PO)											Programme Specific Outcomes (PSO)
	a	b	c	d	e	f	g	h	i	j	k	1
C202.1	1											
C202.2	2											
C202.3	3											
C202.4	3											
C202.5	3											

19EN201 BUSINESS COMMUNICATION AND VALUE SCIENCE II 2/0/2/3

Nature of Course: Behavioral
Pre requisites: Basic Knowledge of English (verbal and written)
Completion of Business Communication and Value Science – I

Course Objectives:

1 To develop the art of effective writing, reading, presentation and group discussion skills.
2 To help students to identify their personality traits and evolve as a better team player.
3 To introduce the key concepts of morality, behavior and beliefs.
4 To introduce the key concepts diversity and inclusion.

Course Outcomes:
Upon completion of the course, students shall have ability to

C201.1	Understand tools of structured written communication and basics of presentation skills.	[U]
C201.2	Apply the basic concept of speed reading, skimming and scanning.	[AP]
C201.3	Understand and identifying the individual personality types and their role in a team along with the concept of morality and diversity.	[U]
C201.4	Recognize the concept of outward behavior and internal behavior	[AP]
C201.5	Organize an event to generate awareness and get support for a cause through communicative ability.	[AP]

Course Contents:
Course Contents:

Module: I
Identification of common errors in written communication and ways of rectification- Understanding speed reading techniques – Skimming and Scanning -Application of reading and writing skills.
Module: II
Analyzing personality traits - team player style -Understanding the concepts of Morality - Diversity and Inclusion -Application of these concepts.
Module: III
Creation of communication material –Experiencing diversity - Organizing events to support inclusion -Assignment – Assimilation of concepts and present them effectively.

Activities:
1. Immersion (interview)
2. Create CV
3. Group Assignment- Form an NGO
4. Group activities
5. Create and present a street play to articulate and amplify the social cause.

Total Hours: 60

Text Books:

1 There is no prescribed texts book for Semester II – there will be handouts and reference links.

Reference Books:

1 Dr. A.P.J. Abdul Kalam, & Arun Tiwari, “Guiding Souls: Dialogues on the purpose of life”, Ocean Books Pvt. Ltd, 2005.
2 Dr. A.P.J. Abdul Kalam & Acharya Mahapragya, “The Family and the Nation”, HarperCollins Publishers India, a joint venture with India Today, New Delhi, 2015.
3 Dr. A.P.J Abdul Kalam & Y.S. Rajan, “The Scientific Indian: A Twenty First Century Guide to the World Around Us”, Penguin Viking, 2011.
4 Dr.A.P.J. Abdul Kalam, “Forge Your Future: Candid, Forthright, Inspiring”, Rajpal & Sons, 2014
5 & Peter H. Diamandis & Steven Kotler, “Abundance: The Future is Better Than You Think”, Simon & Schuster, 2012.
6 Simon Sinek, “Start With Why: How Great Leaders Inspire Everyone to Take Action”, Penguin Publishers, 2011.
7 Sandra Moriaty, Nancy D. Mitchell, William D.Wells, “Advertising & IMC: Principles and Practice”, “Pearson Education India”, 15 June 2016.

Web References:

1 https://www.eolss.net/Sample-Chapters/C14/E1-37-01-00.pdf
2 https://www.brown.edu/academics/science-and-technology-studies/frameworkmaking-ethicaldecisions
3 http://faculty.winthrop.edu/meelerd/docs/rolos/5_Ethical_Approaches.pdf

Online Resources:

1 https://youtu.be/CsaTslhSDI
2 https://m.youtube.com/watch?feature=youtu.be&v=IIKvV8_T95M
3 https://m.youtube.com/watch?feature=youtu.be&v=e80BbX05D7Y
4 https://m.youtube.com/watch?v=dT_D68RJ5T8&feature=youtube
5 https://m.youtube.com/watch?v=7sLLEdBgYYY&feature=youtube

Summative assessment based on Continuous and End Semester Examination					
Revised Bloom’s Level	**Continuous Assessment**				**End Semester Examination (Theory) [50 marks]**
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**	**Activities (20 marks)**	
Remember	20	20	20	-	20
Understand	30	30	30	30	40
Apply	50	50	50	70	40
Analyse	-	-	-		-
Evaluate	-	-	-		-
Create	-	-	-		-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
20	30	50	100

Course Outcome (CO)	Programme Outcomes (PO)											Programme Specific Outcomes (PSO)
	a	b	c	d	e	f	g	h	i	j	k	1
C201.1					2				2			
C201.2					3				2			
C201.3					2				2			
C201.4					3				2			
C201.5					3				2			

19MG211 FUNDAMENTALS OF ECONOMICS 3/0/0/3

Nature of Course: C (Theory Concept)

Course Objectives:

1. To impart the knowledge of micro economics that deals with the study of economic decision making by individuals and individual firms.
2. To make the students understand the various concepts in macroeconomics that deals with the performance and behaviour of an economy.
3. To impart the knowledge of the economic behaviour of firms operating in perfect and imperfect competition.
4. To study the role of money and credit creation by banks in the economic development of a nation.

Course Outcomes:

Upon completion of the course, students shall have ability to

C211.1	Understand basic principles and concepts of Microeconomics and apply them to solve the business problems.	[AP]
C211.2	Explain the behaviour and performance of an economy of a nation.	[AP]
C211.3	Understand the concepts of banking and central bank's monetary policy in economic development of a nation.	[U]
C211.4	Understand the behaviour of firms operating in perfect and imperfect completions.	[U]

Course Contents:

Introduction: Economics –meaning - Elasticity of demand - Elasticity of Supply; principles of Demand and Supply – Microeconomics and Macroeconomics.

Microeconomics:— Supply Curves of Firms —Demand Curves of Households —Equilibrium and Comparative Statics (Shift of a Curve and Movement along the Curve); Welfare Analysis — Consumers' and Producers' Surplus — Price Ceilings and Price Floors; Consumer Behaviour— Axioms of Choice — Budget Constraints and Indifference Curves; Consumer's Equilibrium — Effects of a Price Change, Income and Substitution Effects —Derivation of a Demand Curve; Applications — Tax and Subsidies — Intertemporal Consumption — Suppliers' Income Effect; Theory of Production — Production Function and Iso-quants — Cost Minimization; Cost Curves — Total, Average and Marginal Costs — Long Run and Short Run Costs; Equilibrium of a Firm Under Perfect Competition; Monopoly and Monopolistic Competition

Macroeconomics: National Income and its Components — GNP, NNP, GDP, NDP; Consumption Function; Investment; Simple Keynesian Model of Income Determination and the Keynesian Multiplier; Government Sector — Taxes and Subsidies; External Sector — Exports and Imports; Money — Definitions; Demand for Money —Transactionary and Speculative Demand; Supply of Money — Bank's Credit Creation Multiplier; Integrating Money and Commodity Markets — IS, LM Model; Business Cycles and Stabilization — Monetary and Fiscal Policy — Central Bank and the Government; The Classical Paradigm — Price and Wage Rigidities — Voluntary and Involuntary Unemployment

Total Hours: 45

Text Books:

1. Microeconomics, Pindyck, Robert S., and Daniel L. Rubinfeld.
2. Macroeconomics, Dornbusch, Fischer and Startz.
3. Economics, Paul Anthony Samuelson, William D. Nordhaus

Reference Books:

1 Intermediate Microeconomics: A Modern Approach, Hal R, Varian.
2 Principles of Macroeconomics, N. Gregory Mankiw
3 S. Sankaran, Business Economics, Margham Publication, Chennai.

Web References:

1 https://www.rbi.org.in
2 https://data.oecd.org/economy.htm
3 *https://www.focus-economics.com*
4 www.mospi.gov.in
5 https://www.ibef.org

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C211.1	Apply	Assignment	5
C211.2	Apply	Quiz	5
C211.3	Understand	Group Discussion	5
C211.4	Understand	Case Presentation	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 marks]**
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**	
Remember	20	20	20	20
Understand	40	40	40	40
Apply	40	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Course Outcome (CO)	**Programme Outcomes (PO)**											**Programme Specific Outcomes (PSO)**
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**
C211.1	3	3	1	3	2	1	3	1	2	3	3	
C211.2	2	2	1	2	1	1	3	1	2	2	2	
C211.3	3	2	2	2	1	2	2	1	3	2	2	
C211.4	2	3	2	3	2	2	3	1	2	3	3	

19CB201 **DATA STRUCTURES** **3/0/2/4**

Nature of Course: K (Problem Programming)

Course Objectives:

1 To understand the algorithms and data structures used for solving a problem
2 To learn linear data structures such as linked list, stack and queue
3 To gain knowledge in non-linear data structures such as trees and graphs
4 To be familiar with file structures

Course Outcomes:

Upon completion of the course, students shall have ability to

C201.1	Analyse time and space complexity of an algorithm	[A]
C201.2	Understand linear and non-linear data structures	[R]
C201.3	Apply the suitable data structure to solve the problem	[AP]
C201.4	Understand the different searching and sorting algorithms	[U]
C201.5	Understand the concept of file structures	[U]

Course Contents:

MODULE I : Basic Terminologies & Introduction to Algorithm and Data Organisation: Algorithm specification, Recursion, Performance analysis, Asymptotic Notation - The Big-O, Omega and Theta notation, Programming Style, Refinement of Coding - Time-Space Trade Off, Testing, Data Abstraction

MODULE II : Linear Data Structure: Array, Stack, Queue, Linked-list and its types, Various Representations, Operations & Applications of Linear Data Structures. Non-linear Data Structure: Trees (Binary Tree, Threaded Binary Tree, Binary Search Tree, B & B+ Tree, AVL Tree, Splay Tree) and Graphs (Directed, Undirected), Various Representations, Operations (search and traversal algorithms and complexity analysis) & Applications of Non-Linear Data Structures

MODULE III : Searching and Sorting on Various Data Structures: Sequential Search, Binary Search, Breadth First Search, Depth First Search, Insertion Sort, Selection Sort, Shell Sort, Divide and Conquer Sort, Merge Sort, Quick Sort, Heap Sort, Introduction to Hashing File: Organisation (Sequential, Direct, Indexed Sequential, Hashed) and various types of accessing schemes.

Total Hours:45

List of Experiments:

1. Towers of Hanoi using user defined stacks. [AP]
2. Reading, writing, and addition of polynomials. [AP]
3. Line editors with line count, word count showing on the screen. [AP]
4. Trees with all operations. [AP]
5. All graph algorithms. [AP]
6. Saving / retrieving non-linear data structure in/from a file [AP]

Total Hours:30

Text Books:

1. E. Horowitz and S. Sahni, Fundamentals of Data Structures, Pitman Publishing, 1977.
2. V. Aho, J.E. Hopcroft and J. D. Ullman," Data Structures and Algorithms", 1st Edition, Pearson India, 2002.

Reference Books:

1. Donald E. Knuth, "The Art of Computer Programming: Volume 1: Fundamental Algorithms", 3rd edition, Addison Wesley; 1997.
2.Thomas, H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3rd edition, MIT Press, 2009.
3. Pat Morin, "Open Data Structures: An Introduction (Open Paths to Enriched Learning)", 31st ed. Edition, 31st ed. Edition, UBC Press, 2013.

Web References:

1 http://nptel.ac.in/courses//106103069/
2 https://www.coursera.org/learn/data-structures
3 http://web.stanford.edu/class/cs97si/

Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical Rubrics based CIA [30 Marks]**	
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**		
Remember	20	20	20	-	20
Understand	30	30	30	30	20
Apply	30	50	50	70	40
Analyse	20	-	-	-	20
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcome (CO)	**Programme Outcomes (PO)**											**Programme Specific Outcomes (PSO)**
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**
C201.1	2	2	2				2	2		2	2	2
C201.2	1	1	1				1	1		1	1	
C201.3	2	2	2				2	2		2	2	2
C201.4	1	1	1				1	1		1	1	1
C201.5	1	1	1				1	1		1	1	1

19EC211 PRINCIPLES OF ELECTRONICS ENGINEERING 3/0/2/4

Nature of Course: C(Theory)

Pre requisites: Nil

Course Objectives:

1 To introduce the basic concepts of semiconductors and its types

2 To enable the students to understand the diode characteristics and diode-based circuits

3 To enable the student to understand the bipolar junction transistor configurations and its characteristics

4 To introduce the basic concept of Field Effect Transistor and its characteristics

5 To allow students to gain knowledge in Operational amplifier and its circuits

6 To enable the students to understand the fundamentals of digital circuits

Course Outcomes:

Upon completion of the course, students shall have ability to

C211.1	Understand the basics of semiconductors	[U]
C211.2	Analyse the diode characteristics and its applications	[AN]
C211.3	Understand the concepts of BJTs and its characteristics	[U]
C211.4	Understand the principles and configurations of Field Effect Transistors and its types	[U]
C211.5	Analyse the characteristics of Operational Amplifier	[AN]
C211.6	Understand the fundamentals of digital circuits and its implementation	[U]

Course Contents:

Semiconductors: Crystalline material: Mechanical properties, Energy band theory, Fermi levels; Conductors, Semiconductors & Insulators: electrical properties, band diagrams. Semiconductors: intrinsic & extrinsic, energy band diagram, P&N-type semiconductors, drift & diffusion carriers.

Diodes and Diode Circuits: Formation of P-N junction, energy band diagram, built-in-potential, forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics; Junction capacitance. Linear piecewise model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.

Bipolar Junction Transistors: Formation of PNP / NPN junctions; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, transistor action, injection efficiency, base transport factor and current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor

Field Effect Transistors: Concept of Field Effect Transistors (channel width modulation), Gate isolation types, JFET Structure and characteristics, MOSFET Structure and characteristics, depletion and enhancement type; CS, CG, CD configurations; CMOS: Basic Principles-Inverter

Feed Back Amplifier, and Operational Amplifiers: Concept (Block diagram), properties, positive and negative feedback, loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, output impedance, input impedance, sensitivities (qualitative), bandwidth stability. Introduction to integrated circuits, operational amplified and its terminal properties; Application of operational amplifier; inverting and non-inverting mode of operation, Adders, Subtractors, Constant-gain multiplier, Voltage follower, Comparator, Integrator, Differentiator

Digital Electronics Fundamentals: Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using two and three variable K- map

Definitions: Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters.

Total Hours:45

List of experiments:

1. Characteristic of PN junction diode	[U]
2. Characteristics of Zener diode	[U]
3. Input and output characteristics of Bipolar junction transistors	[U]
4. Drain and transfer characteristics of JFET	[U]
5. Integrator and differentiator using op amp ic741	[AP]
6. Adder and subtractor using op amp IC 741	[AP]
7. Implementation of basic logic functions using combinational circuits.	[AP]

Total Hours:30

Text Books:

1 Electronics Devices & Circuits, S. Salivahanan, N. Suresh Kumar, A. Vallavaraj

2 Linear Integrated circuits, D. RoyChoundhry and ShailB. Jain

3 Digital Logic & Computer Design, M. Morris Mano.

Reference Books:

1 Solid State Electronic Devices, 6th Edition, Ben Streetman, Sanjay Banerjee

2 Electronic Principle, Albert Paul Malvino.

3 Electronics Circuits: Discrete & Integrated, D Schilling, C Belove, T Apelewicz, R Saccardi.

4 Microelectronics, Jacob Millman, Arvin Grabel

5 Microelectronics Circuits, Adel S. Sedra and Kenneth Carless Smith

6 Electronic Devices & Circuit Theory, 11th Edition, Robert L. Boylestad, Louis Nashelsky.

Web References:

1 http://www.learnabout-electronics.org/

2 https://www.electronics-tutorials.ws/

3 http://engineering.nyu.edu/gk12/amps-cbri/pdf/Basic%20Electronics.pdf

Online Resources:

1 https://freevideolectures.com/course/1990/circuits-and-electronics

2 https://onlinecourses.nptel.ac.in/noc18_ee10/preview

3 https://www.allaboutcircuits.com/video-lectures/

Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical Rubrics based CIA [30 Marks]	
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]		
Remember	20	20	20	-	20
Understand	20	30	30	30	20
Apply	40	50	50	70	40
Analyse	20	-	-	-	20
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)											Programme Specific Outcomes (PSO)
	a	b	c	d	e	f	g	h	i	j	k	1
C211.1	3	3	2	1							1	2
C211.2	3	2	1	1							1	1
C211.3	3	2	2	1							1	1
C211.4	3	2	2	1							1	2
C211.5	3	2	2	1							1	2
C211.6	3	3	3	3				2	2	2	3	3

19MA203 **STATISTICAL MODELLING** **3/0/2/4**

Nature of Course: K (Problem Programming)

Pre Requisites: Basic knowledge of high school mathematics and basic concepts of Statistics

Course Objectives:

1 To study the linear statistical models

2 To learn the concept of testing hypothesis using statistical analysis

3 To understand the fundamental concepts of estimation methods

4 To learn the concepts of R Programming.

Course Outcomes:

Upon completion of the course, students shall have ability to

C203.1	Understand the basic concepts of linear statistical models and Estimation methods	[R]
C203.2	Learn the concept of testing of hypothesis using statistical analysis	[U]
C203.3	To interpret the results of Bivariate and Multivariate Regression and Correlation Analysis, for forecasting and also perform ANOVA and F-test	[AP]
C203.4	Apply the knowledge of time series analysis in economics and engineering.	[AP]
C203.5	Understand and use the various graphics in R for data visualization	[U]

Course Contents:

Linear Statistical Models (no derivations): Simple linear regression & correlation, multiple regression & multiple correlation (three variables), Analysis of variance: one way, two way (no RBD, Latin square design)

Estimation (no derivations): Definition of Point estimation, criteria for good estimates (un-biasedness, consistency)- Simple problems, Method of estimation: Maximum likelihood estimation - **Sufficient Statistic (no derivations)**: Concept & examples, complete sufficiency, their application in estimation (Simple problems) - **Test of hypothesis**: Concept & formulation, Type I and Type II errors, Neyman Pearson lemma (statement only),Procedures of testing: Small samples- Student's t test, F test , Chi square test- Large samples -Mean and proportions only.

Non-parametric Inference (no derivations): Comparison with parametric inference, Use of order statistics. Sign test, Wilcoxon signed rank test, Tolerance region (simple problems) - **Basics of Time Series Analysis & Forecasting:** Stationary, ARIMA Models: Identification, Estimation and Forecasting (simple problems).

Programming Method: R statistical programming language

Total Hours:45

Lab Exercises:

1. Introduction to R, Functions, Control flow and Loops
2. Working with Vectors and Matrices
3. Reading in Data, Writing Data, Working with Data, Manipulating Data
4. Simulation
5. Linear model

6. Data Frame
7. Graphics in R
8. Building ARIMA Models
9. Fitting the multiple regression **Total Hours:30**

Text Books:

1. "Probability and Statistics for Engineers (4th Edition)", I.R. Miller, J.E. Freund and R. Johnson.
2. Fundamentals of Statistics (Vol. I & Vol. II), A. Goon, M. Gupta and B. Dasgupta.
3. The Analysis of Time Series: An Introduction, Chris Chatfield.

Reference Books:

1. Introduction to Linear Regression Analysis, D.C. Montgomery & E. Peck
2. Introduction to the Theory of Statistics, A.M. Mood, F.A. Graybill& D.C. Boes.
3. Applied Regression Analysis, N. Draper & H. Smith
4. Hands-on Programming with R, Garrett Grolemund
5. R for Everyone: Advanced Analytics and Graphics, Jared P. Lander

Web References:

1 https://onlinecourses.nptel.ac.in/noc17_ch03/preview

2 https://www.edx.org/course/statistical-modeling-and-regression-analysis

Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical Rubric based CIA [30 Marks]**	
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**		
Remember	20	20	20	-	-
Understand	30	30	30	30	30
Apply	50	50	50	70	70
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcome (CO)	**Programme Outcomes (PO)**											**Programme Specific Outcomes (PSO)**
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**
C203.1	1											
C203.2	2											
C203.3	3											
C203.4	3											
C203.5	2							1				

19CB301 FORMAL LANGUAGES AND AUTOMATA THEORY 3/1/0/4

Nature of Course: J (Problem Analytical)

Pre requisites:

Course Objectives:

1. To describe the mathematical foundations of computation and conduct mathematical proofs for computation and algorithms.
2. To introduce the Formal Languages, computational models -Finite Automata, Regular Expressions, Grammars, Push Down Automata, Turing Machine.
3. To gain knowledge in Computational theory.

Course Outcomes:

Upon completion of the course, students shall have ability to

C301.1	Apply the computational models to solve problems in diverse areas such as pattern matching and language design.	[AP]
C301.2	Analyze machines by their power to recognize languages.	[A]
C301.3	Apply pumping lemma to Regular Languages and Context Free Languages	[AP]
C301.4	Identify deterministic and non-deterministic machines.	[R]
C301.5	Construct a Turing Machine for a recursive language	[E]
C301.6	Understand the differences between decidability and undecidability.	[U]

Course Contents:

Module I : Introduction, Regular languages and finite automata: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages. Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, Kleene's theorem, pumping lemma for regular languages, Myhill-Nerode theorem and its uses, minimization of finite automata.

Module II : Context-free languages and pushdown automata, Context-sensitive languages: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs. Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.

Module III : Turing machines, Undecidability, Basic Introduction to Complexity: The basic model for Turing machines (TM), Turing recognizable(recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators. Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages. Basic Introduction to Complexity: Introductory ideas on Time complexity of deterministic and nondeterministic Turing machines, P and NP, NP- completeness, Cook's Theorem, other NP -Complete problems.

Total Hours: 60

Text Books:

1. Hopcroft, J.E. Motwani, R. and Ullman, J.D "Introduction to Automata Theory, Languages and Computations", 3rd Edition, Pearson Education, 2014.
2. Martin, J., "Introduction to Languages and the Theory of Computation", 3rd Edition, Tata McGraw Hill, 2007.

Reference Books:

1 Kamala Krithivasan and Rama. R, "Introduction to Formal Languages, Automata Theory and Computation", Pearson Education, 2009

2 Lewis, H. and Papadimitriou, C.H "Elements of the Theory of Computation", 2nd Edition, Pearson Education/PHI, 2003

3 Michael Sipser, "Introduction to the Theory of Computation", 3rd Edition, Cengage Learning, 2013

4 Peter Linz, "An Introduction to Formal Language and Automata", Narosa Publishers, New Delhi, 2011

5 M. R. Garey and D. S. Johnson, "Computers and Intractability: A Guide to the Theory of NP Completeness", 1979

Web References:

1 www.jflap.org/

2 automatonsimulator.com/

3 http://www.jflap.org/tutorial/grammar/bruteforceCFG/index.html

4 https://turingmachinesimulator.com/

5 http://weitz.de/pump/

Online Resources:

1 https://nptel.ac.in/courses/106104028/

2 https://nptel.ac.in/courses/106103070/

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C301.4	Remember	Assignment	10
C301.2	Analyze	Tutorial	10

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 Marks]**
	CIA-1 [10 Marks]	**CIA-2 [10 Marks]**	**CIA-3 [10 Marks]**	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	30	50	30	30
Analyze	20	-	-	10
Evaluate	-	-	20	10
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcome (CO)	Programme Outcomes (PO)											Programme Specific Outcomes (PSO)
	a	b	c	d	e	f	g	h	i	j	k	1
C301.1	2	2	2	2						2	2	3
C301.2	2	2	2	2						2	2	2
C301.3	2	2	2	2						2	2	2
C301.4	1	1	1	1						1	1	2
C301.5	3	3	3	3						3	3	3
C301.6	1	1	1	1						1	1	2

19CB302 **COMPUTER ORGANIZATION AND ARCHITECTURE** **3/0/0/3**

Nature of Course: D (Theory Application)

Pre requisites: Nil

Course Objectives:

1	To recognize the basic structure of a digital computer and representation of non-numeric data.
2	To learn different arithmetic operations and organization of control unit.
3	To study memory organization, different ways of communication with I/O devices and parallel processors.
4	To understand the concept of pipelining and its impact in processor design.

Course Outcomes:

Upon completion of the course, students shall have ability to

C302.1	Discuss the functionalities of various blocks of a digital computer and express the data representation.	[U]
C302.2	Illustrate the logic design of Arithmetic and control Unit.	[AP]
C302.3	Infer the concepts of memory system, concurrence access in parallel processors and classify the approaches for I/O communication.	[U]
C302.4	Distinguish hazards in pipelining and outline its impact in the performance of the processors.	[A]

Course Contents:

Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. **Instruction set architecture of a CPU:** Registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Outlining instruction sets of some common CPUs. **Data representation:** Signed number representation, fixed and floating point representations, character representation.

Computer arithmetic: Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and-add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic, IEEE 754 format. **Introduction to x86 architecture**. **CPU control unit design:** Hardwired and micro-programmed design approaches, design of a simple hypothetical CPU.

Memory system design: Semiconductor memory technologies, memory organization. **Peripheral devices and their characteristics:** Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in process state transitions, I/O device interfaces – SCII, USB. **Pipelining:** Basic concepts of pipelining, throughput and speedup, pipeline hazards. Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency. **Memory organization:** Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

Total Hours: 45

Text Books:

1. Morris Mano, "Computer System Architecture" 3rd Edition, Prentice Hall of India, New Delhi, 2014.
2. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Elsevier, 5th Edition 2013.
3. Carl Hamacher, Zvonko Vranesic, SafwatZaky, Naraig Manjikian, "Computer Organization and Embedded Systems" McGraw-Hill, 6th Edition 2014.

Reference Books:

1 John P. Hayes, Computer Architecture and Organization, McGraw-Hill ,3rd Edition, 2013.
2 William Stallings, "Computer Organization and Architecture – Designing for Performance", 10th Edition, Pearson Education, 2015.
3 Vincent P. Heuring and Harry F. Jordan," Computer System Design and Architecture", Prentice Hall, 2nd Edition, 2004.

Web References:

1 http://pages.cs.wisc.edu/~david/courses/cs354/onyourown/reps.chars.html
2 https://www.cp.eng.chula.ac.th/~piak/teaching/ca/s1.htm

Online Resources:

1 https://www.coursera.org/learn/comparch
2 https://nptel.ac.in/courses/106105163/

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C302.1	Understand	Online Quiz	5
C302.2	Apply	Tutorial	5
C302.3	Understand	Assignment	5
C302.4	Analyze	Case Study	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [50 Marks]
	CIA-1 [10 Marks]	CIA-2 [10 Marks]	CIA-3 [10 Marks]	
Remember	20	10	10	10
Understand	50	40	40	40
Apply	30	50	30	30
Analyze	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcome (CO)	Programme Outcomes (PO)											Programme Specific Outcomes (PSO)
	a	b	c	d	e	f	g	h	i	j	k	1
C302.1		2	2					2		1		1
C302.2	1	1	3	1				1		1		1
C302.3			2					2			1	
C302.4	1		1	1			1	1				1

19CB303 **OBJECT ORIENTED PROGRAMMING** **3/0/0/3**

Nature of Course: F (Theory Programming)

Pre requisites: Fundamentals of Computer Science

Course Objectives:

1. To explain the difference between object oriented programming and procedural programming.
2. To build C++ classes using appropriate encapsulation and design principles.
3. To introduce advanced C++ features such as composition of objects, operator overloads, dynamic memory allocation, inheritance and polymorphism, file I/O, exception handling, etc.
4. To apply object oriented concepts to solve bigger computing problems

Course Outcomes:
Upon completion of the course, students shall have ability to

C303.1	Understand the concepts and relative merits of C++	[U]
C303.2	Implement programs using object oriented concepts such as encapsulation, inheritance and polymorphism	[AP]
C303.3	Implement stream I/O, templates and operator overloading	[AP]
C303.4	Understand Object Oriented Design and Modeling	[U]

Course Contents:

Procedural programming, An Overview of C: Types Operator and Expressions, Scope and Lifetime, Constants, Pointers, Arrays, and References, Control Flow, Functions and Program Structure, Namespaces, error handling, Input and Output (*C*-way), Library Functions (string, math, stdlib), Command line arguments, Pre-processor directive. Some difference between C and C++: Single line comments, Local variable declaration within function scope, function declaration, function overloading, stronger type checking, Reference variable, parameter passing – value vs reference, passing pointer by value or reference, #define constant vs const, Operator new and delete, the typecasting operator, Inline Functions in contrast to macro, default arguments

The Fundamentals of Object Oriented Programming: Necessity for OOP, Data Hiding, Data Abstraction, Encapsulation, Procedural Abstraction, Class and Object. More extensions to C in C++ to provide OOP Facilities: Scope of Class and Scope Resolution Operator, Member Function of a Class, private, protected and public Access Specifier, this Keyword, Constructors and Destructors, friend class, error handling (exception). Essentials of Object Oriented Programming: Operator overloading, Inheritance – Single and Multiple, Class Hierarchy, Pointers to Objects, Assignment of an Object to another Object, Polymorphism through dynamic binding, Virtual Functions, Overloading, overriding and hiding, Error Handling

Generic Programming: Template concept, class template, function template, template specialization - Input and Output: Streams, Files, Library functions, formatted output - Object Oriented Design and Modeling: UML concept, Use case for requirement capturing, Class diagram, Activity diagram and Sequence Diagram for design, Corresponding C++ code from design.

Total Hours: 45

Text Books:

1. Bjarne Stroustrup, “The C++ Programming Language”, Pearson Education, 3rd Edition, 2009
2. Debasish Jana, “C++ and Object-Oriented Programming Paradigm”, PHI Learning, 2nd Edition, 2005

Reference Books:

1 Bjarne Stroustrup, “Programming: Principles and Practice Using C++”, Addison Wesley, 2009

2 Bjarne Stroustrup, “The Design and Evolution of C++”, Pearson Education, 2009

Web References:

1 https://www.studytonight.com/cpp/cpp-and-oops-concepts.php

2 https://www.tutorialspoint.com/What-are-basic-Object-oriented-programming-concepts

Online Resources:

1 https://onlinecourses.nptel.ac.in/noc16_cs17/preview

2 https://www.geeksforgeeks.org/basic-concepts-of-object-oriented-programming-using-c/

3 http://www.iitk.ac.in/esc101/05Aug/tutorial/java/concepts/index.html

<table>
<tr><th colspan="5">Assessment Methods & Levels (based on Blooms’Taxonomy)</th></tr>
<tr><th colspan="5">Formative assessment based on Capstone Model (Max. Marks:20)</th></tr>
<tr><th>Course Outcome</th><th>Bloom’s Level</th><th colspan="2">Assessment Component</th><th>Marks</th></tr>
<tr><td>C303.1,4</td><td>U</td><td colspan="2">Quiz</td><td>10</td></tr>
<tr><td>C303.2,3</td><td>AP</td><td colspan="2">Assignment</td><td>10</td></tr>
<tr><th colspan="5">Summative assessment based on Continuous and End Semester Examination</th></tr>
<tr><th rowspan="2">Bloom’s Level</th><th colspan="3">Continuous Assessment</th><th rowspan="2">End Semester Examination [50 Marks]</th></tr>
<tr><th>CIA-1 [10 Marks]</th><th>CIA-2 [10 Marks]</th><th>CIA-3 [10 Marks]</th></tr>
<tr><td>Remember</td><td>20</td><td>20</td><td>20</td><td>20</td></tr>
<tr><td>Understand</td><td>30</td><td>20</td><td>30</td><td>20</td></tr>
<tr><td>Apply</td><td>50</td><td>60</td><td>50</td><td>60</td></tr>
<tr><td>Analyze</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Evaluate</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Create</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcome (CO)	Programme Outcomes (PO)											Programme Specific Outcomes (PSO)
	a	b	c	d	e	f	g	h	i	j	k	1
C303.1		2	2	2				2				2
C303.2		2	2	2				2		2		2
C303.3		2	3	3	2			2		3	2	2
C303.4		2	3	3	2			2		3	2	2

19MA308 **COMPUTATIONAL STATISTICS** **3/0/2/4**

Nature of Course: K (Problem Programming)
Pre requisites: Probability and Statistics

Course Objectives:

1 To study the concepts of linear regression models

2 To develop a sound understanding of current, modern computational statistical approaches and their application to a variety of datasets.

3 To understand the key technologies in data science and business analytics such as data mining, machine learning, visualization techniques, predictive modeling, and statistics.

4 To apply principles of data science to analyze the business problems.

5 To effectively visualize the data.

Course Outcomes:

Upon completion of the course, students shall have ability to

C308.1	Remember the basic concepts of linear statistical models	[R]
C308.2	Interpret the results of Multivariate Regression models	[AP]
C308.3	Develop a sound understanding of current, modern computational statistical approaches and their application to a variety of datasets.	[AP]
C308.4	Write original, non-trivial Python programs.	[AP]
C308.5	Apply algorithms to build machine intelligence.	[AP]

Course Contents:

Multivariate Normal Distribution: Multivariate Normal Distribution Functions, Conditional Distribution and its relation to regression model, Estimation of parameters-**Multiple Linear Regression Model:** Standard multiple regression models with emphasis on detection of collinearity, outliers, non-normality and autocorrelation, Validation of model assumptions-**Multivariate Regression:** Assumptions of Multivariate Regression Models, Parameter estimation, Multivariate Analysis of variance and covariance

Discriminant Analysis: Statistical background, linear discriminant function analysis, Estimating linear discriminant functions and their properties. **Principal Component Analysis:** Principal components, Algorithm for conducting principal component analysis, deciding on how many principal components to retain, H-plot. **Factor Analysis:** Factor analysis model, Extracting common factors, determining number of factors, Transformation of factor analysis solutions, Factor scores. **Clustering and Segmentation Analysis:** Introduction, Types of clustering, Correlations and distances, clustering by partitioning methods, hierarchical clustering, overlapping clustering, K-Means Clustering-Profiling and Interpreting Clusters

Python Concepts, Data Structures, Classes: Interpreter, Program Execution, Statements, Expressions, Flow Controls, Functions, Numeric Types, Sequences and Class Definition, Constructors, Text & Binary Files - Reading and Writing. **Data Wrangling:** Combining and Merging Datasets, Reshaping and Pivoting, Data Transformation, String Manipulation, Regular Expressions. **Data Aggregation, Group Operations, Time series:** GroupBy Mechanics, Data Aggregation, Groupwise Operations and Transformations, Pivot Tables and Cross Tabulations, Time Series Basics, Data Ranges, Frequencies and Shifting **Visualization in Python:** Matplotlib package, Plotting Graphs, Controlling Graph, Adding Text, More Graph Types, Getting and setting values, Patches.

Total Hours: 45

Lab Exercises:

1. Basic Python Programs
2. Program using String Operations
3. Program on python Data structures
4. Working with data in python using pandas.
5. Perform various numpy operations and special functions.
6. Draw statistical graphics using seaborn
7. Implement k-means, logistic and time series algorithm using Scikit-learn
8. Visualization in python using matplotlib.

Total Hours: 30

Text Books:

1 T.W. Anderson, "An Introduction to Multivariate Statistical Analysis", Wiley, 3rd Edition, 2003

2 J.D. Jobson, "Applied Multivariate Data Analysis", Vol I & II, Springer, 2012

3 Magnus Lie Hetland, "Beginning Python: From Novice to Professional", Apress, 2nd Edition, 2008

Reference Books:

1 Stanley A Mulaik, "Foundations of Factor Analysis", CRC Press, 2nd Edition, 2009

2 Douglas C. Montogomery, Elizabeth A. Peck, G. Geoffrey Vining, "Introduction to Linear Regression Analysis", Wiley,5th Edition,2012

3 Wes Mc Kinney, "Python for Data Analysis", O'Reilly, 2018

4 Mark Lutz, "Programming Python", Shroff Publishers, 3rd Edition, 2006

5 Tim Hall and J-P Stacey, "Python 3 for Absolute Beginners", Apress, 2009

Web References:

1 https://www.edx.org/course/statistical-modeling-and-regression-analysis
2 https://www.cin.ufpe.br/~embat/Python%20for%20Data%20Analysis.pdf
3 https://www.kdnuggets.com/2016/07/statistical-data-analysis-python.html
4 https://people.duke.edu/~ccc14/sta-663/

Online Resources:

1 https://onlinecourses.nptel.ac.in/noc19_mg13/preview
2 https://nptel.ac.in/courses/110106064/
3 https://www.analyticsvidhya.com/blog/2016/01/complete-tutorial-learn-data-science-python-scratch-2/
4 https://www.datacamp.com/community/tutorials/python-statistics-data-science
5 https://github.com/cliburn/Computational-statistics-with-Python/tree/master/

Summative assessment based on Continuous and End Semester Examination					
Revised Bloom's Level	**Continuous Assessment [60 Marks]**				**End Semester Examination (Theory) [40 marks]**
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**	**Practical Rubric based CIA [30 Marks]**	
Remember	20	20	20	20	20
Understand	30	30	30	30	30
Apply	50	50	50	50	50
Analyze	-	-	-		-
Evaluate	-	-	-		-
Create	-	-	-		-

Course Outcome (CO)	**Programme Outcomes (PO)**											**Programme Specific Outcomes (PSO)**
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**
C308.1	3	2	2	1			2	2				
C308.2	3	2	2	1			2	2				
C308.3	3	2	2	1			2	3				2
C308.4	2	2	3	1			3	3	2	2		
C308.5	2	2	3	1			3	3	2	2		2

19CB304 **SOFTWARE ENGINEERING** **3/0/2/4**

Nature of Course: D (Theory Application)
Pre requisites:
Course Objectives:

1	To gain knowledge of basic SW engineering methods and practices, and their appropriate application.
2	To describe software engineering layered technology and Process frame work.
3	To identify software measurement and software risks.
4	To describe the approaches to verification and validation using static and dynamic testing.
5	To examine the good qualities of a software.

Course Outcomes :
Upon completion of the course, students shall have ability to

C304.1	Apply software engineering principles and techniques.	[AP]
C304.2	Explain project management and process improvement activities.	[U]
C304.3	Analyze the user requirements and design an application using software engineering concepts	[A]
C304.4	Produce efficient, reliable, robust and cost-effective software solutions.	[AP]
C304.5	Apply various testing activities for real time applications	[AP]

Course Content:

Introduction: Programming in the small vs. programming in the large; software project failures and importance of software quality and timely availability; engineering approach to software development; role of software engineering towards successful execution of large software projects; emergence of software engineering as a discipline. **Software Project Management:** Basic concepts of life cycle models – different models and milestones; software project planning –identification of activities and resources; concepts of feasibility study; techniques for estimation of schedule and effort; software cost estimation models and concepts of software engineering economics; techniques of software project control and reporting; introduction to measurement of software size; introduction to the concepts of risk and its mitigation; configuration management. **Software Quality and Reliability:** Internal and external qualities; process and product quality; principles to achieve software quality; introduction to different software quality models like McCall, Boehm, FURPS / FURPS+, Dromey, ISO – 9126; introduction to Capability Maturity Models (CMM and CMMI); introduction to software reliability, reliability models and estimation.

Software Requirements Analysis, Design and Construction: Introduction to Software Requirements Specifications (SRS) and requirement elicitation techniques; techniques for requirement modeling – decision tables, event tables, state transition tables, Petri nets;requirements documentation through use cases; introduction to UML, introduction to softwaremetrics and metrics based control methods; measures of code and design quality. **Object Oriented Analysis, Design and Construction:** Concepts -- the principles of abstraction, modularity, specification, encapsulation and information hiding; concepts of abstract data type; Class Responsibility Collaborator (CRC) model; quality of design; design measurements; concepts of design patterns; Refactoring; object oriented construction principles; object oriented metrics.

Software Testing: Introduction to faults and failures; basic testing concepts; concepts of verification and validation; black box and white box tests; white box test coverage – code coverage, condition coverage, branch coverage; basic concepts of black-box tests – equivalence classes, boundary value tests, usage of state tables; testing use cases; transaction based testing; testing for non-functional requirements – volume, performance and efficiency; concepts of inspection.

Total hours: 45

Lab Exercises:

Prepare the following documents for any one of the experiment and develop the software using software engineering methodology.

- Problem Analysis and Project Planning Thorough study of the problem
- Identify project scope, Objectives, infrastructure
- Software Requirement Analysis Describe the individual Phases/ modules of the project, Identify deliverables.
- Data Modelling Use work products – data dictionary, use case diagrams and activity diagrams, build and test class diagrams, sequence diagrams and add interface to class diagrams.
- Software Development and Debugging
- Software Testing Prepare test plan, perform validation testing, coverage analysis, memory leaks, develop test case hierarchy, Site check and site monitor
- Understand a given business scenario and identify product backlog, user stories and sprint tasks

1. Course Registration System
2. Quiz System
3. Online ticket reservation system
4. Remote computer monitoring
5. Student marks analysing system
6. Expert system to prescribe the medicines for the given symptoms
7. ATM system
8. Platform assignment system for the trains in a railway station
9. Stock maintenance.

Total Hours: 30

Text Books:

1 Ian Sommerville, "Software Engineering", Addison-Wesley, 2011.

2 Object Oriented Software Engineering: A Use Case Driven Approach --Ivar Jacobson

Reference Books:

1. Fundamentals of Software Engineering, Carlo Ghezzi, Jazayeri Mehdi, Mandrioli Dino

2. Software Requirements and Specification: A Lexicon of Practice, Principles and Prejudices, Michael Jackson

3. The Unified Development Process, Ivar Jacobson, Grady Booch, James Rumbaugh

4. Design Patterns: Elements of Object-Oriented Reusable Software, Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides

5. Software Metrics: A Rigorous and Practical Approach, Norman E Fenton, Shari Lawrence Pfleeger

Web References:

1 http://www.site.uottawa.ca/school/research/lloseng/weblinks.html

2 https://www.geeksforgeeks.org/software-engineering/

3 http://www.rspa.com/index.html

Online Resources:

1 https://nptel.ac.in/courses/106101061/

2 https://cosmolearning.org/courses/introduction-to-software-engineering/video-lectures/

3 http://www.nptel.ac.in/courses/Webcourse-contents/IITKharagpur/Soft Engg/New_index1.html

Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination [40 Marks]**
	CIA-1 [10 marks]	**CIA-2 [10 marks]**	**CIA-3 [10 marks]**	**Practical Rubric based CIA [30 Marks]**	
Remember	20	10	20	10	20
Understand	30	20	20	20	20
Apply	50	50	60	40	60
Analyze	-	20	-	30	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcome (CO)	**Programme Outcomes (PO)**											**Programme Specific Outcomes (PSO)**
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**
C304.1	3	2	3	1	1	1	3	3	2	3	3	2
C304.2	1	1	1	1	1	1	3	2	1	3	3	2
C304.3	3	3	3	1	1	1	3	2	2	3	3	3
C304.4	3	2	2	1	1	2	3	3	2	2	3	3
C304.5	2	3	3	1	1	1	2	2	2	3	3	2

19CB305 **OBJECT ORIENTED PROGRAMMING LABORATORY** **0/0/3/1.5**

Nature of Course: F (Theory Programming)

Co requisites: Object Oriented Programming

Course Objectives

1. To study about different UML diagrams
2. To familiarize with constructors, inheritance, polymorphism, templates and exception handling.
3. To develop applications using files in C++.

Course Outcomes:
Upon completion of the course, students shall have ability to

C305.1	Understand the different UML diagrams	[U]
C305.2	Apply object oriented programming concepts to solve real time problems	[AP]
C305.3	Employ the concepts of constructors, inheritance and polymorphism	[AP]
C305.4	Develop software applications using templates, exception handling and files in C++	[AP]

Course Contents:
Lab Exercises:

1. Study of different UML diagrams
2. Programs on concept of classes and objects
3. Programs using friend functions
4. Programs using static polymorphism
5. Programs using constructors
6. Programs using inheritance
7. Programs on dynamic polymorphism
8. Programs on exception handling
9. Programs on generic programming using template function & template class
10. Programs on file handling

Total Hours: 45

Text Books:

1. Bjarne Stroustrup, “The C++ Programming Language”, Pearson Education, 3rd Edition, 2009
2. Debasish Jana, “C++ and Object-Oriented Programming Paradigm”, PHI Learning, 2nd Edition, 2005

Reference Books:

1. Bjarne Stroustrup, “Programming: Principles and Practice Using C++”, Addison Wesley, 2009
2. Bjarne Stroustrup, “The Design and Evolution of C++”, Pearson Education, 2009

Web References:

1. https://www.studytonight.com/cpp/cpp-and-oops-concepts.php
2. https://www.tutorialspoint.com/What-are-basic-Object-oriented-programming-concepts

Online Resources:

1 https://www.geeksforgeeks.org/basic-concepts-of-object-oriented-programming-using-c/
2 http://www.iitk.ac.in/esc101/05Aug/tutorial/java/concepts/index.html

Assessment Methods & Levels (based on Blooms' Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment[60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	20	20
Understand	20	20
Apply	60	60
Analyze	-	-
Evaluate	-	-
Create	-	-

Course Outcome (CO)	**Programme Outcomes (PO)**											**Programme Specific Outcomes (PSO)**
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**
C305.1		3	3	2			2	2		2	2	2
C305.2		2	2	2			2				2	3
C305.3		3	2	2				2		2	2	2
C305.4		2	2					2		2	2	2

19CB401 **DATABASE MANAGEMENT SYSTEMS** **3/0/0/3**

Nature of Course: G (Theory Analytical)

Pre requisites: Nil

Course Objectives:

1	To discuss the fundamentals of data models to conceptualize and depict a database system using ER diagram.
2	To illustrate the relational database implementation using SQL with effective relational database design concepts.
3	To explain the fundamental concepts of transaction processing- concurrency control techniques and recovery procedure
4	To demonstrate Query evaluation and optimization techniques.
5	To introduce the concepts of Database Security**,** Object Oriented, Data Warehousing and Data Mining

Course Outcomes:

Upon completion of the course, students shall have ability to

C401.1	Distinguish database systems from file systems and describe data models and DBMS architecture.	[R]
C401.2	Identify the basic issues of transaction processing and concurrency control.	[U]
C401.3	Demonstrate with understanding of SQL Programming language and normalization theory.	[AP]
C401.4	Practice the query evaluation techniques, query optimization and familiar with basic database storage structures and access techniques.	[AP]
C401.5	Analyze and derive an information model expressed in the form of an entity relation diagram and transform into a relational database schema.	[A]

Course Contents:

MODULE I : Introduction: Introduction to Database. Hierarchical, Network and Relational Models. **Database system architecture**: Data Abstraction, Data Independence. **Data models**: Entity-relationship model, network model, relational and object-oriented data models, integrity constraints, data manipulation operations. **Relational query languages**: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server.

MODULE II : Relational Database Design: Domain and data dependency, Armstrong's axioms, Functional Dependencies, Normal forms, Dependency preservation, Lossless design. **Query processing and optimization**: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms. **Storage strategies**: Indices, B-trees, Hashing.

MODULE III : Transaction Processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp-based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery. **Database Security**: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection. **Advanced topics**: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

Total Hours: 45

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", 7th Edition, Tata McGraw Hill, March 2019.
2. Gupta G K, "Database Management Systems", Tata McGraw Hill Education Private Limited, New Delhi, 2011.
3. Peter rob, Carlos Coronel, "Database Systems – Design, Implementation and Management", 9th Edition, Thomson Learning, 2009.

Reference Books:

1. J. D. Ullman, "Principles of Database and Knowledge – Base Systems", Vol 1, Computer Science Press, Inc. New York, 1998.
2. R. Elmasri and S. Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson, 2016.
3. Serge Abiteboul, Richard Hull, Victor Vianu, "Foundations of Databases", Addison-Wesley Publishing Company, 1995.

Web References:

1. www.tutorialspoint.com/dbms/
2. https://alison.com/courses/IT-Management-Software-and-Databases
3. https://mva.microsoft.com/en-us/training-courses/database-fundamentals-8243?l=TEBiexJy_5904984
4. http://www.sqlcourse.com/
5. https://university.mongodb.com/
6. http://www.edureka.co/mongodb
7. https://www.lynda.com/NoSQL-training-tutorials/1473-0.html

Online Resources:

1. https://www.udemy.com/database-management-system/
2. http://www.nptelvideos.in/2012/11/database-management-system.html
3. https://www.coursera.org/learn/database-management

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C401.1	Remember	Online Quiz	3
C401.2	Understand	Technical Presentation	3
C401.3	Apply	Group Assignment	5
C401.4	Apply	Group Assignment	5
C401.5	Analyze	Surprise Test	4

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	Continuous Assessment			End Semester Examination [50 Marks]
	CIA-1 [10 Marks]	CIA-2 [10 Marks]	CIA-3 [10 Marks]	
Remember	30	30	20	20
Understand	30	20	40	30
Apply	20	30	20	30
Analyze	20	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcome (CO)	Programme Outcomes (PO)											Programme Specific Outcomes (PSO)
	a	b	c	d	e	f	g	h	i	j	k	1
C401.1		1	1							1	1	1
C401.2		1	1							1	1	1
C401.3		2	2							2	2	2
C401.4		2	2							2	2	2
C401.5		2	2							2	2	2

19CB402	INTRODUCTION TO INNOVATION, IP MANAGEMENT AND ENTREPRENEURSHIP	3/0/0/3

Nature of Course: C (Theory Concept)

Pre requisites:

Course Objectives

The successful completion of the course will help students gain knowledge on:

1. How to identify and discover market needs
2. How to manage an innovation program
3. How to create, protect, assetize and commercialize intellectual property
4. Opportunities and challenges for entrepreneurs

Course Outcomes:

Upon completion of the course, students shall have ability to

C402.1	Summarize the life cycle and types of innovation.	[U]
C402.2	Interpret the needs, benefits and procedure of filing an IPR.	[U]
C402.3	Examine a business plan to ensure success of a start-up.	[AP]
C402.4	Devise an innovative idea, protect it through IPR and explore the scope of converting it to a startup.	[A]

Course Contents

Innovation: A primer on Innovation, IP Rights and Entrepreneurship, Types of Innovation (incremental, disruptive, etc.), Lifecycle of Innovation (idea, literature survey, PoT, PoC, etc.), Challenges in Innovation (time, cost, data, infrastructure, etc.), co-innovation and open innovation (academia, start-ups and corporates)

Intellectual Property Right: Types of IPR (patents, copyrights, trademarks, GI, etc.), Lifecycle of IP (creation, protection, assetization, monetization), Balancing IP risks & rewards (Right Access and Right Use of Open Source and 3rd party products, technology transfer & licensing), IP valuation (methods, examples, limitations).

Entrepreneurship: Opportunity identification in technology entrepreneurship (customer pain points, competitive context), Market research, segmentation & sizing, Product positioning & pricing, go-to-market strategy, Innovation assessment (examples, patentability analysis),. Startup business models (fund raising, market segments, channels, etc.), Innovation, Incubation & Entrepreneurship in Corporate Context, Technology-driven Social Innovation & Entrepreneurship, Manage innovation, IP and Entrepreneurship Programs- Processes, Governance and Tools

Case study – A technology innovation that resulted in an IP portfolio which was commercialized by an entrepreneur.

Total Hours: 45

Books/Articles for References:

Innovation

- The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail,
- Crossing the Chasm, http://www.geoffreyamoore.com/books-by-geoffrey-moore/
- The Innovator's Toolkit: 50+ Techniques for Predictable and Sustainable Organic Growth, https://onlinelibrary.wiley.com/doi/book/10.1002/9781118258316

- Camels, Tigers & Unicorns, https://www.worldscientific.com/worldscibooks/10.1142/q0093
- Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages, http://www.carlotaperez.org/pubs?s=tf&l=en&a=technologicalrevolutionsandfinancialcapital

Intellectual Property

Harvesting Intangible Assets: Uncover Hidden Revenue in Your Company's Intellectual Property, https://searchworks.stanford.edu/view/10018248

- Intellectual Property and Open Source: A Practical Guide to Protecting Code, http://shop.oreilly.com/product/9780596517960.do
- Edison in the Boardroom: How Leading Companies Realize Value from Their Intellectual Assets, https://www.wiley.com/en-us/Edison+in+the+Boardroom%3A+How+Leading+Companies+Realize+Value+from+Their+Intellectual+Assets-p-9780471217350
- Valuation and Deal making of Technology-Based Intellectual Property: Principles, Methods and Tools, http://razgaitis.com/books/dealmaking/

Technology Entrepreneurship

- Effectuation: Elements of Entrepreneurial Expertise, https://www.e-elgar.com/shop/effectuation
- Spin-Outs: Creating Businesses from University Intellectual Property, https://www.oreilly.com/library/view/spin-outs-creating-businesses/9781906659424/
- Zero to One: Notes on Startups, or How to Build the Future, https://www.goodreads.com/book/show/18050143-zero-to-one
- The Four Steps to the Epiphany: Successful Strategies for Startups That Win, https://www.goodreads.com/book/show/762542.The_Four_Steps_to_the_Epiphany

Scaling the Revenue Engine, https://medium.com/ceoquest/scaling-the-revenue-engine/home

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C402.3	Apply	Case Study	10
C402.4	Analyze	Technical presentation	10

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [50 Marks]**
	CIA-1 [10 Marks]	**CIA-2 [10 Marks]**	**CIA-3 [10 Marks]**	
Remember	20	20	20	20
Understand	40	40	40	40
Apply	40	40	20	20
Analyze	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
20	30	50	100

Course Outcome (CO)	Programme Outcomes (PO)											Programme Specific Outcomes (PSO)
	a	b	c	d	e	f	g	h	i	j	k	1
C402.1	1	2	2	3			3				3	3
C402.2	2	3	3	3	3	3	3		3	2	3	3
C402.3	2	2	3	3	3	1	3			2	3	3
C402.4	2	3	3	3	3	3	3		3	2	3	3

19EN401 BUSINESS COMMUNICATION & VALUE SCIENCE III 3/0/0/4

Nature of Course: Behavioral
Pre requisites: Basic Knowledge of English (verbal and written)
Completion of all units from Semesters 1, 2 and 3

Course Objectives:

1 Develop technical writing skills
2 Introduce students to Self-analysis techniques like SWOT & TOWS.
3 Introduce students to key concepts of:
a) Pluralism & cultural spaces
b) Cross-cultural communication
c) Science of Nation building.

Course Outcomes:

Upon completion of the course, students shall have ability to

C401.1	Apply & analyze the basic principles of SWOT & life positions.	[U]
C401.2	Understand, analyze & leverage the power of motivation in real life.	[AP]
C401.3	Identify & respect pluralism in cultural spaces.	[AP]
C401.4	Understand and apply the concepts of Global and glocal.	[C]
C401.5	Analyze cross cultural communication.	[U]
C401.6	Apply the science of Nation building.	[AP]
C401.7	Identify the common mistakes made in cross-cultural communication.	[E]
C401.8	Understand, apply & analyze the tools of technical writing.	[U]
C401.9	Recognize the roles and relations of different genders.	[AP]
C401.10	Understand Artificial intelligence &recognize its impact in daily life.	[U]
C401.11	Identify the best practices of technical writing.	[AP]
C401.12	Differentiate between the diverse culture of India.	[E]

Course Contents:

Module I

REUNION- Recap activity on the earlier learning- Summarize the basic principles of SWOT and Life Positions- Apply SWOT in real life scenarios- Pat your back activity- strength will be written by others- Create your SWOT- SWOT Vs. TOWS The

Balancing Act- Group Presentations on what are the strengths they have identified to survive in the VUCA World- Recognize how motivation helps real life- Motivation Stories -YouTube videos on Maslow's Theory-Leverage motivation in real life scenarios- Scenario based activity on identifying and leveraging motivation- Present their findings and approaches as groups. They need to explain the idea of motivation with the help of examples-Identify pluralism in cultural spaces- Rivers of India-Awareness and respect for pluralism in cultural spaces- Differentiate between the different cultures of India- Rhythms of India (Cultures in India).

Module II

Define the terms global and global- Differentiate between global and glocal culture-Debate on Global and global impacts- Cross-cultural communication-Recognize the implications of cross-cultural communication- Apply cross cultural communication - Identify the common mistakes made in cross-cultural communication- Gender awareness- Gender awareness campaign-Differentiate between the roles and relations of different genders- Quiz Time- Role of science in nation building-Introduce the topic and discuss the role of scientists and mathematicians from ancient India-Summarize the role of science in nation building- Role of science post-independence.

Module III

Introduction to technical writing- Basic rules of technical writing through examples-Identify the best practices of technical writing- Practice activity on technical writing-Apply technical writing in real-life scenarios- Assessment on technical writing on certain topic- Define AI (Artificial Intelligence)- "Voice of the Future" Activity-Recognize the importance of AI-AI in Everyday Life-Design your college in the year 2050- debate related to Artificial Intelligence in the presence of an external moderator- Applying technical writing in profession.

Lab Components

1	Apply SWOT in real life scenarios.	[AN]
2	Motivation in real life.	[AN]

Summative Assessment based on End Semester Project

1	Written Assessment, project and group discussion	[U, AP, AN]

Total Hours: 48

Text Books:

1. Handbook of Technical Writing, Gerald.J.Alred, Charles T. Brusaw, Walter E. Oliu, Bedford/St. Martin's Boston , New York,2009
2. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.

Reference Books:

1. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
2. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Web References:

1. Examples of Technical Writing for Students https://freelance-writing.lovetoknow.com/kinds-technical-writing
2. 11 Skills of a Good Technical Writer https://clickhelp.com/clickhelp-technical-writing-blog/11-skills-of-a-good-technicalwriter/
3. 13 benefits and challenges of cultural diversity in the workplace https://www.hult.edu/blog/benefits-challenges-cultural-diversity-workplace/

Online Resources:

1. https://youtu.be/CsaTslhSDI
2. https://m.youtube.com/watch?feature=youtu.be&v=IIKvV8_T95M
3. https://m.youtube.com/watch?feature=youtu.be&v=e80BbX05D7Y
4. https://m.youtube.com/watch?v=dT_D68RJ5T8&feature=youtu.be
5. https://m.youtube.com/watch?v=7sLLEdBgYYY&feature=youtu.be

Assessment Methods & Levels (based on Blooms' Taxonomy)					
Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [50 marks]**
	Theory			**Practical& Project**	
	CIA-I [10 marks]	**CIA-II [10 marks]**	**CIA-III [10 marks]**	**Rubric based CIA [20 Marks]**	
Remember	20	20	20	20	20
Understand	30	30	30	30	30
Apply	30	30	30	30	30
Analyse	20	20	20	20	20
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	**Summative Assessment**		**Total**
	Continuous Assessment	**End Semester Examination**	
20	30	50	100

Course Outcome (CO)	Programme Outcomes (PO)											Programme Specific Outcomes (PSO)
	a	b	c	d	e	f	g	h	i	j	k	1
C401.1				2	2	2	2		2			
C401.2				2	2	2	2		2			
C401.3				2	2	2	2		2			
C401.4				3	3	3	3		3			
C401.5				2	2	2	2		2			
C401.6				2	2	2	2		2			
C401.7				3	3	3	3		3			
C401.8					2	2	2		2			
C401.9				2	2	2	2		2			
C401.10				2	2	2	2		2			
C401.11					2	2	2		2			
C401.12				3	3	3	3		3			

19MA405 **OPERATIONS RESEARCH** **2/0/2/3**

Nature of Course: D (Theory Application)

Pre requisites:

Course Objectives:

1 To use appropriate techniques and optimization solvers to interpret the results obtained and translate solutions into directives for action.
2 To analyse and solve linear programming and network models arising from a wide range of applications
3 To manage inventory analysis in a scientific manner.
4 To use transportation and assignment model techniques for effective decisions–making.
5 To apply and extend queueing models to analyse real world systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C405.1	Solve linear programming problems	[AP]
C405.2	Understand the optimization techniques to interpret the solutions	[U]
C405.3	Solve mathematical model (linear programming problem) for a physical situations	[AP]
C405.4	Solve the problem of transporting the products from origins to destinations with least transportation cost.	[AP]
C405.5	Compute the traffic intensity, blocked traffic and the utilization of some queueing systems	[AP]

Course Contents:

Introduction to OR - Origin of OR and its definition. Concept of optimizing performance measure, Types of OR problems, Deterministic vs. Stochastic optimization, Phases of OR problem approach – problem formulation, building mathematical model, deriving solutions, validating model, controlling and implementing solution - Some basic concepts and results of linear algebra – Vectors, Matrices, Linear Independence/Dependence of vectors, Rank, Basis, System of linear eqns.

Linear Programming:

Linear programming – Examples from industrial cases, formulation & definitions, Matrix form. Implicit assumptions of LPP – Hyper plane, Convex set, Convex polyhedron, Extreme points, Basic feasible solutions - Geometric method: 2-variable case, Special cases – infeasibility, unboundedness, redundancy &degeneracy, Sensitivity analysis - Simplex Algorithm – slack, surplus & artificial variables, computational details, big-M method - identification and resolution of special cases through simplex iterations - Duality – formulation, results, fundamental theorem of duality, dual-simplex and primal-dual algorithms.

Transportation and Assignment problems:

TP - Examples, Definitions – decision variables, supply & demand constraints, formulation, Balanced & unbalanced situations, Solution methods – NWCR, minimum cost and VAM, test for optimality(MODI method), degeneracy and its resolution - AP - Examples, Definitions – decision variables, constraints, formulation, Balanced &unbalanced situations, Solution method – Hungarian, test for optimality (MODI method), degeneracy & its resolution-**PERT – CPM -** Project definition, Project scheduling techniques – Gantt chart, PERT & CPM, Determination of critical paths, Estimation of Project time and its variance in PERT using statistical principles, Concept of project crashing/time-cost trade-off - **Inventory Control -**Functions of inventory and its disadvantages, ABC analysis, Concept of inventory costs, Basics of inventory policy (order, lead time, types), Fixed order-quantity models – EOQ, POQ & Quantity discount models. EOQ models for discrete units, sensitivity analysis and Robustness, Special cases of EOQ models for safety stock with known/unknown stock out situations, models under prescribed policy, Probabilistic situations.

Queuing Theory:
Definitions – queue (waiting line), waiting costs, characteristics (arrival, queue, service discipline) of queuing system, queue types (channel vs. phase) - Kendall's notation, Little's law, steady state behaviour, Poisson's Process & queue, Models with examples - M/M/1 and its performance measures; M/M/m and its performance measures; brief description about some special models- **Simulation Methodology**- Definition and steps of simulation, random number, random number generator, Discrete Event System Simulation – clock, event list, Application in Scheduling, Queuing systems and Inventory systems.

Total Hours: 60

Text Books:
1 Kanti Swarup, P.K.Gupta, Manmohan, "Operations research", Sultan Chand and Sons,2nd Edition 2015
2 Taha H.A, "Operation Research", Pearson Education,10th Edition, 2017
3 J.W. Prichard and R.H. Eagle, "Modern Inventory Management", Wiley, 1965

Reference Books:
1 H.M. Wagner, "Principles of OR with Application to Managerial Decisions", Prentice Hall, 1975
2 F.S. Hiller and G.J. Lieberman, "Introduction to Operations Research", McGraw Hill, 2001
3 Thomas L. Saaty, "Elements of Queuing Theory", McGraw Hill, 1961
4 A. Ravi Ravindran, "Operations Research and Management Science, Hand Book", CRC Press, 2008

Web References:
1 http://nptel.ac.in/courses/111104079/
2 http://nptel.ac.in/video.php/subjectId=117105085
3 http://nptel.ac.in/syllabus/111105041/
4 http://freevideolectures.com/Course/3028/Econometric-Modelling/22#

Online Resources:
1 https://onlinecourses.nptel.ac.in/noc15_ec07/
2 https://onlinecourses.nptel.ac.in/noc16_ch03
3 https://nptel.ac.in/courses/111104027/

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C405.1	Remember	Class Quiz	2
C405.2	Understand	Group Presentation	4
C405.3, C405.4 & C405.5	Apply	Tutorial and Group Assignment	14

Summative assessment based on Continuous and End Semester Examination

Revised Bloom's Level	Continuous Assessment			End Semester Examination (Theory) [50 marks]
	CIA-1 [10 marks]	CIA-2 [10 marks]	CIA-3 [10 marks]	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)											Programme Specific Outcomes (PSO)
	a	b	c	d	e	f	g	h	i	j	k	1
C405.1	3	2										
C405.2	2	1										
C405.3	3	2										
C405.4	3	2										
C405.5	3	2										

19CB404	Software Design with UML	3/0/2/4

Nature of Course: G (Theory Analytical)
Pre requisites: Software Engineering

Course Objectives

1 To know the importance of modeling in the software development life cycle.
2 To understand the object-oriented approach to analyzing and designing systems and software solutions
3 To employ the UML notation and symbols to create effective and efficient system designs

Course Outcomes:
Upon completion of the course, students shall have ability to

C404.1	Understand the software development process models	[U]
C404.2	Interpret the contemporary issues and discuss about analysis and coding standards	[AP]
C404.3	Analyze the design methods and modeling	[A]
C404.4	Employ UML diagrams for real time problems	[AP]

Course Contents

Introduction to on Object Oriented Technologies and the UML Method.
Software development process: The Waterfall Model vs. The Spiral Model. -The Software Crisis, description of the real world using the Objects Model. -Classes, inheritance and multiple configurations-Quality software characteristics. -Description of the Object-Oriented Analysis process vs. the Structure Analysis Model-Introduction to the UML Language. Analysis of system requirements -Actor Definitions-Writing a case goal. -Use Case Diagram -Use Case Relationships-Requirements Analysis Using Case Modeling.

Transfer from Analysis to Design in the Characterization Stage: Interaction Diagrams-Description of goal-Defining UML Method, Operation, Object Interface, Class-Sequence Diagram -Finding objects from Flow of Events-Describing the process of finding objects using a Sequence Diagram-Describing the process of finding objects using a Collaboration Diagram-The Logical View Design Stage: The Static Structure Diagrams-The Class Diagram Model-Attributes descriptions.-Operations descriptions. -Connections descriptions in the Static Model. -Association, Generalization, Aggregation, Dependency, Interfacing, Multiplicity.

Package Diagram Model- Description of the model-White box, black box-Connections between packagers. -Interfaces. -Create Package Diagram. -Drill Down. Dynamic Model: State Diagram / Activity Diagram-Description of the State Diagram. -Events Handling. -Description of the Activity Diagram. -Exercise in State Machines. Component Diagram Model- Physical Aspect. -Logical Aspect. -Connections and Dependencies. -User face. -Initial DB design in a UML environment. Deployment Model-Processors -Connections -Components-Tasks. -Threads. -Signals and Events.

Total Hours: 45

Lab Exercises:

To develop a mini-project by following the 9 exercises listed below.
1. To develop a problem statement.
2. Identify Use Cases and develop the Use Case model.
3. Identify the conceptual classes and develop a domain model with UML Class diagram.
4. Using the identified scenarios find the interaction between objects and represent them using UML Sequence diagrams.
5. Draw relevant state charts and activity diagrams.

6. Identify the User Interface, Domain objects, and Technical services. Draw the partial layered, logical architecture diagram with UML package diagram notation.
7. Develop and test the Technical services layer.
8. Develop and test the Domain objects layer.
9. Develop and test the User interface layer.

Suggested domains for Mini-Project:

1. Passport automation system.
2. Book bank
3. Exam Registration
4. Stock maintenance system.
5. Online course reservation system
6. E-ticketing
7. Software personnel management system
8. Credit card processing
9. e-book management system
10. Recruitment system

Total Hours: 30

Text Books:

1. Bernd Bruegge and Allen H. Dutoit, "Object-Oriented Software Engineering: using UML, Patterns, and Java", Pearson, 3rd Edition, 2013
2. Craig Larman, "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development", Pearson Education, 3rd Edition, 2005
3. Martin Fowler, Kendall Scott, "UML Distilled: A Brief Guide to the Standard Object Modeling Language", Addison Wesley, 3rd Edition, 2003
4. Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Ph.D., Jim Conallen Kelli A. Houston, "Object Oriented Analysis and Design with Applications", Addision-Wesely, 3rd Edition, 2007

Reference Books:

1 Erich Gamma, Richard Helm, Ralph Johnson, John M. Vlissides, "Design Patterns: Elements of Reusable Object-Oriented Software", Pearson, 2012

2 Roger. S. Pressman and Bruce R. Maxim, "Software Engineering – A Practitioner's Approach", 7th Edition, Tata McGraw Hill, 2015.

3. Freeman, Eric & Robson, Elisabeth, "Head First Design Patterns" 1st Edition, O'Reilly, 2004

Web References:

1 http://www.uml.org/

2 http://modeling-languages.com/uml-tutorial-online

Online Resources:

1 https://www.coursera.org/software engineering

2 https://www.coursera.org/uml approach

3 http://nptel.ac.in/courses

Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 Marks]**
	CIA-1 [10 Marks]	**CIA-2 [10 Marks]**	**CIA-3 [10 Marks]**	**Practical Rubrics based CIA [30 marks]**	
Remember	20	20	20	20	20
Understand	20	20	20	20	20
Apply	60	40	30	30	40
Analyze	-	20	30	30	20
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcome (CO)	**Programme Outcomes (PO)**											**Programme Specific Outcomes (PSO)**
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**
C404.1	2	3	3	3	2		3	2		2	3	3
C404.2	2	3	3	3	2		3	2		3	3	3
C404.3	1	3	3	3	2		2	2		3	3	2
C404.4	1	3	3	3	2		1	1		3	3	2

19CB405 **OPERATING SYSTEMS** **3/0/2/4**

Nature of Course: G (Theory analytical)

Pre requisites: Fundamentals of Computing and Programming

Course Objectives:

1. To recognize the fundamentals of operating systems.
2. To describe the mechanisms of OS to handle processes and threads and their communication.
3. To discuss the principles of concurrency and Deadlocks.
4. To identify the mechanisms involved in memory management and its schemes.
5. To identify I/O management, File systems and security issues.

Course Outcomes:

Upon completion of the course, students shall have ability to

C405.1	Identify the basic concepts and design issues of operating systems.	[U]
C405.2	Apply Process management concepts including scheduling, Inter process communication, deadlocks and multithreading in real world problems	[AP]
C405.3	Apply concepts of memory management including Virtual Memory and Page Replacement to the issues that occur in Real time applications.	[AP]
C405.4	Identify issues related to IO hardware, file system and disk management	[U]

Course Contents:

Introduction: Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine, Resource Manager view, process view and hierarchical view of an OS. Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads. Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, and Response Time. Scheduling algorithms: Pre-emptive and non-pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF. Inter-process Communication Concurrent processes, precedence graphs, Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Semaphores, Strict Alternation, Peterson's Solution, The Producer/ Consumer Problem, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem, Barber's shop problem.

Deadlocks and Memory Management: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery. Concurrent Programming: Critical region, conditional critical region, monitors, concurrent languages, communicating sequential process (CSP); Deadlocks - prevention, avoidance, detection and recovery. Memory Management: Basic concept, Logical and Physical address maps, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page allocation, Partitioning, Paging, Page fault, Working Set,

Segmentation, Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

I/O Hardware, File and Disk Management : I/O devices, Device controllers, Direct Memory Access, Principles of I/O. File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed),Free-space management (bit vector, linked list, grouping), directory implementation(linear list, hash table), efficiency and performance. Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks. **Case study:** UNIX OS file system, shell, filters, shell programming, programming with the standard I/O, UNIX system calls.

Total Hours: 45

Lab Exercises:

1. Analysis and Synthesis of Basic Linux Commands
2. Programs using Shell Programming
3. Implementation of Unix System Calls
4. Simulation and Analysis of Non pre-emptive and Pre-emptive CPU Scheduling Algorithms
5. Simulation of Producer – Consumer Problem using Semaphores and Implementation of Dining Philosopher's Problem to demonstrate Process Synchronization
6. Simulation of Banker's Algorithm for Deadlock Avoidance
7. Analysis and Simulation of Memory Allocation and Management Techniques
8. Implementation of Page Replacement Techniques
9. Simulation of Disk Scheduling Algorithms
10. Implementation of File organization Techniques
11. Design an efficient Traffic Control System to avoid traffic congestion in Metro Cities. Use Process Synchronization, Scheduling, Deadlock and Memory Management concepts to implement the system.

Total Hours: 30

Text Books:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts", 10th Edition, John Wiley, 2018
2. William Stallings, "Operating Systems –Internals and Design Principles", 8th Edition, Pearson Publications, 2014.
3. Maurice J. Bach, "Design of the Unix Operating Systems", Prentice/Hall International., Inc,2016.

Reference Books:

1 Charles Patrick Crowley, "Operating System: A Design-oriented Approach", 2001.

2 Daniel Pierre Bovet, Marco Cesati, "Understanding the Linux Kernel", 2000.

Web References:

1 http://geeksforgeeks.org/Operating Systems

2 https://www.tutorialspoint.com/operating_system

Online Resources:

1 https://www.coursera.org/courses?query=operating%20system

2 https://www.coursera.org/lecture/os-power-user/introduction-r0c5h

3 https://nptel.ac.in/courses/106106144/2

Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 Marks]**
	CIA-1 [10 Marks]	**CIA-2 [10 Marks]**	**CIA-3 [10 Marks]**	**Practical Rubric based CIA [30 marks]**	
Remember	-	-	-	-	-
Understand	20	20	20	20	20
Apply	40	40	50	40	50
Analyze	40	40	30	40	30
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcome (CO)	**Programme Outcomes (PO)**											**Programme Specific Outcomes (PSO)**
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**
C405.1	1	2	3	2	2	1	3	3	1	2	2	1
C405.2	3	3	3	1	2	1	2	2	1	2	2	3
C405.3	3	3	3	2	1	2	2	2	2	2	2	2
C405.4	3	3	3	2	1	1	3	2	1	3	3	2

19CB406 **DATABASE MANAGEMENT SYSTEMS LABORATORY** **0/0/3/1.5**

Nature of Course: M (Practical Application)

Co requisites: Database Management Systems

Course Objectives:

1	To design database using ER diagram.
2	To illustrate the relational database implementation using SQL
3	To demonstrate procedural extensions such as procedure, function, cursors and triggers
4	To develop application using front end and back end
5	To explain cloud storage for real time systems

Course Outcomes:

Upon completion of the course, students shall have ability to

C406.1	Sketch ER diagrams for real world applications	[AP]
C406.2	Select suitable SQL commands to manage the database	[A]
C406.3	Create databases using MongoDB	[C]
C406.4	Design front end and back end for enterprise applications	[C]

Course Contents:

Lab Exercises:

1. Conceptual Database design using E-R DIAGRAM
2. Implementation of SQL commands DDL, DML, DCL and TCL
3. Queries to demonstrate implementation of Integrity Constraints
4. Practice of Inbuilt functions
5. Implementation of Join and Nested Queries AND Set operators
6. Implementation of virtual tables using Views
7. Practice of Procedural extensions (Procedure, Function, Cursors, Triggers)
8. Application Development using front end tools
9. Document Database creation using MongoDB
10. Study of Cloud Storage
    - i)IT Training Group Database
    - ii) Blood Donation System
    - iii)Salary Management System
    - iv)Traffic Light Information System
11. Mini Project (Application Development using DB)

Total Hours: 45

Text Books:

1. Gupta G K, “Database Management Systems”, Tata McGraw Hill Education Private Limited, New Delhi, 2011.

2. Peter rob, Carlos Coronel, “Database Systems – Design, Implementation and Management”, 9th Edition, Thomson Learning, 2009.

3. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, 4th Edition, Pearson/ Addision Wesley, 2007.

Reference Books:

1 J. D. Ullman, “Principles of Database and Knowledge – Base Systems”, Vol 1, Computer Science Press, Inc. New York, 1998.

2 R. Elmasri and S. Navathe, “Fundamentals of Database Systems”, 7th Edition, Pearson, 2016.

3 Serge Abiteboul, Richard Hull, Victor Vianu, “Foundations of Databases”, Addison-Wesley Publishing Company, 1995.

Web References:

1 www.tutorialspoint.com/dbms/

2 http://www.edureka.co/mongodb

3 https://www.lynda.com/NoSQL-training-tutorials/1473-0.html

Online Resources:

1 https://www.udemy.com/database-management-system/

2 http://www.nptelvideos.in/2012/11/database-management-system.html

3 https://www.coursera.org/learn/database-management

Assessment Methods & Levels (based on Blooms’ Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom’s Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	-	-
Understand	20	20
Apply	30	30
Analyze	20	20
Evaluate	-	-
Create	30	30

Course Outcome (CO)	Programme Outcomes (PO)											Programme Specific Outcomes (PSO)
	a	b	c	d	e	f	g	h	i	j	k	1
C406.1		2	2							2	2	2
C406.2		2	2							2	2	2
C406.3		3	3							3	3	3
C406.4		3	3							3	3	3