Sri Krishna College of Engineering and Technology

An Autonomous Institution, Affiliated to Anna University

Coimbatore – 641 008

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEM

CURRICULUM AND SYLLABI

B.Tech. COMPUTER SCIENCE AND BUSINESS SYSTEM

REGULATION 2020

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEM

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 SYSTEM

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 SYSTEM

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	1	2	2	1	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	2	3	3	3	3	2	3	3	3	3	3
PEO 5	1	2	2	3	3	3	3	3	2	1	3

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

B.TECH. COMPUTER SCIENCE AND BUSINESS SYSTEM

REGULATION 2020

SEMESTER I							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credits**	**Ext/Int**	**Category**
THEORY							
1	20MA102	Discrete Mathematics	3/1/0	4	4	50/50	BS
2	20MA103	Probability and Statistics	3/1/0	4	4	50/50	BS
THEORY CUM PRACTICAL							
3	20EE111	Principles of Electrical Engineering	3/0/2	5	4	40/60	ES
4	20CB101	Computer Programming	3/0/2	5	4	40/60	ES
5	20PH103	Physics for Computing Science	3/0/2	5	4	40/60	BS
6	20EN102	Business Communication and Value Science I	2/0/2	4	3	40/60	HM
MANDATORY COURSE							
7	20MCXXX	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	20MA202	Linear Algebra	3/1/0	4	4	50/50	BS
2	20EN201	Business Communication and Value Science II	2/2/0	4	3	50/50	HM
3	20MG211	Fundamentals of Economics	3/0/0	3	3	50/50	ES
THEORY CUM PRACTICAL							
4	20CB201	Data Structures	3/0/2	5	4	40/60	PC
5	20EC211	Principles of Electronics Engineering	3/0/2	5	4	40/60	ES
6	20MA203	Statistical Modelling	3/0/2	5	4	40/60	BS
MANDATORY COURSE							
7	20MCXXX	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	20CB301	Formal Languages and Automata Theory	3/1/0	4	4	50/50	PC
2	20CB302	Computer Organization and Architecture	3/0/0	3	3	50/50	PC
3	20CB303	Object Oriented Programming	3/0/0	3	3	50/50	PC
THEORY CUM PRACTICAL							
4	20MA308	Computational Statistics	3/0/2	5	4	40/60	BS
5	20CB304	Software Engineering	3/0/2	5	4	40/60	PC
PRACTICAL							
6	20CB305	Object Oriented Programming Laboratory	0/0/3	3	1.5	40/60	PC
MANDATORY COURSE							
7	20MCXXX	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	20CB401	Database Management Systems	3/1/0	4	4	50/50	PC
2	20CB402	Introduction to Innovation, IP Management and Entrepreneurship	3/0/0	3	3	50/50	ES
3	20EN401	Business Communication and Value Science III	2/0/0	2	2	50/50	HM
THEORY CUM PRACTICAL							
4	20MA408	Operations Research	2/0/2	4	3	40/60	BS
5	20CB403	Software Design with UML	3/0/2	5	4	40/60	PC
6	20CB404	Operating Systems	3/0/2	5	4	40/60	PC
PRACTICAL							
7	20CB405	Database Management Systems Laboratory	0/0/3	3	1.5	40/60	PC
MANDATORY COURSE							
8	20MCXXX	Mandatory Course IV					MC
			Total	**26**	**21.5**	**700**	

SEMESTER V							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1	20CB501	Fundamentals of Management	2/0/0	2	2	50/50	ES
2	20CB502	Business Strategy	2/0/0	2	2	50/50	ES
3	20CB506	Design Thinking	3/1/0	4	4	50/50	PC
4	20CB9XX	Professional Elective– 1	2/1/0	3	3	50/50	PE
THEORY CUM PRACTICAL							
5	20CB503	Design and Analysis of Algorithms	3/0/2	5	4	40/60	PC
6	20CB504	Compiler Design	3/0/2	5	4	40/60	PC
PROJECT WORK							
7	20CB505	Mini Project	0/0/4	4	2	40/60	PW
			Total	**25**	**21**	**700**	

SEMESTER VI							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1	20XXXXX	Open Elective – 1	3/0/0	3	3	50/50	OE
2	20CB9XX	Professional Elective – 2	2/1/0	3	3	50/50	PE
3	20EN603	Business Communication and Value Science IV	2/0/0	2	2	50/50	HM
THEORY CUM PRACTICAL							
4	20CB601	Computer Networks	3/0/2	5	4	40/60	PC
5	20CB602	Information Security	3/0/2	5	4	40/60	PC
6	20CB603	Artificial Intelligence	3/0/2	5	4	40/60	PC
EMPLOYABILITY ENHANCEMENT SKILLS							
7	20EES01	Employability Enhancement Skills			2		EES
			Total	**23**	**22**	**600**	

SEMESTER VII							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1	20CB9XX	Professional Elective – 3	3/0/0	3	3	50/50	PE
2	20CB9XX	Professional Elective – 4	3/0/0	3	3	50/50	PE
3	20CB9XX	Professional Elective – 5	2/1/0	3	3	50/50	PE
4	20MG7XX	Emerging Elective – 1	3/1/0	3	4	50/50	EE
5	20CB7XX	Emerging Elective – 2	2/1/0	3	3	50/50	EE
THEORY CUM PRACTICAL							
6	20CB7XX	Open Elective - 2	2/0/3	5	4	40/60	PC
PROJECT WORK							
7	20CB703	Project Evaluation I	0/0/10	10	4	40/60	PW
			Total	**25**	**24**	**700**	

SEMESTER VIII							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
PROJECT WORK							
1	20CB801	Project Evaluation II	0/0/30	30	12	40/60	PW
			Total	**30**	**12**	**100**	

HUMANITIES AND MANAGEMENT (10 credits)

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
1	20EN101	Business Communication and Value Science I	2/0/2	4	3	40/60	HM
2	20EN201	Business Communication and Value Science II	2/1/0	3	3	50/50	HM
3	20EN401	Business Communication and Value Science III	2/0/0	2	2	50/50	HM
4	20EN603	Business Communication and Value Science IV	2/0/0	2	2	50/50	HM

BASIC SCIENCES (27 credits)

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
1	20MA102	Discrete Mathematics	3/1/0	4	4	50/50	BS
2	20MA103	Probability and Statistics	3/1/0	4	4	50/50	BS
3	20PH103	Physics for Computing Science	3/0/2	5	4	40/60	BS
4	20MA202	Linear Algebra	3/1/0	4	4	50/50	BS
5	20MA203	Statistical Modelling	3/0/2	5	4	40/60	BS
6	20MA308	Computational Statistics	3/0/2	5	4	40/60	BS
7	20MA408	Operations Research	2/0/2	4	3	40/60	BS

ENGINEERING SCIENCES (22 credits)

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
1	20EE111	Principles of Electrical Engineering	3/0/2	5	4	40/60	ES
2	20CB101	Computer Programming	3/0/2	5	4	40/60	ES
3	20MG211	Fundamentals of Economics	3/0/0	3	3	50/50	ES
4	20EC211	Principles of Electronics Engineering	3/0/2	5	4	40/60	ES
5	20CB402	Introduction to Innovation, IP Management and Entrepreneurship	3/0/0	3	3	50/50	ES
6	20CB501	Fundamentals of Management	2/0/0	2	2	50/50	ES
7	20CB502	Business Strategy	2/0/0	2	2	50/50	ES

PROFESSIONAL CORE (57 credits)

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
1	20CB201	Data Structures	3/0/2	5	4	40/60	PC
2	20CB301	Formal Languages and Automata Theory	3/1/0	4	4	50/50	PC
3	20CB302	Computer Organization and Architecture	3/0/0	3	3	50/50	PC
4	20CB303	Object Oriented Programming	3/0/0	3	3	50/50	PC
5	20CB304	Software Engineering	3/0/2	5	4	40/60	PC
6	20CB305	Object Oriented Programming Laboratory	0/0/3	3	1.5	40/60	PC
7	20CB401	Database Management Systems	3/1/0	4	4	50/50	PC
8	20CB403	Software Design with UML	3/0/2	5	4	40/60	PC
9	20CB404	Operating Systems	3/0/2	5	4	40/60	PC
10	20CB405	Database Management Systems Laboratory	0/0/3	3	1.5	40/60	PC
11	20CB503	Design and Analysis of Algorithms	3/0/2	5	4	40/60	PC
12	20CB504	Compiler Design	3/0/2	5	4	40/60	PC
13	20CB506	Design Thinking	3/1/0	4	4	50/50	PC
14	20CB601	Computer Networks	3/0/2	5	4	40/60	PC
15	20CB602	Information Security	3/0/2	5	4	40/60	PC
16	20CB603	Artificial Intelligence	3/0/2	5	4	40/60	PC

MANDATORY COURSES

S.No.	Course Code	Course Title	Category
1	20MC101	Induction Program	MC
2	20MC102	Environmental Sciences	MC
3	20MC103	Soft Skills	MC
4	20MC105	General Aptitude	MC
5	20MC106	Life Skills and Ethics	MC
6	20MC107	Stress Management	MC
7	20MC108	Constitution of India	MC
8	20MC109	Essence of Indian Traditional Knowledge	MC

EMPLOYABILITY ENHANCEMENT SKILLS

S. No.	Course Code	Course Title	Duration	Credit	Category
1	20EES01	Employability Enhancement Skills	4 Weeks	2	EES

PROFESSIONAL ELECTIVE COURSES

S.No.	Course Code	Course	L	T	P	Credit	Ext/Int
Digital Technology and Data Science							
1	20CB911	Conversational Systems	3	0	0	3	50/50
2	20CB912	Fundamentals of Cloud Application Development	2	1	0	3	50/50
3	20CB913	Machine Learning	2	1	0	3	50/50
4	20CB921	Robotics and its Applications	2	1	0	3	50/50
5	20CB922	Modern Web Applications	2	1	0	3	50/50
6	20CB923	Data Mining and Analytics	2	1	0	3	50/50
7	20CB931	Cognitive Science and Analytics	3	0	0	3	50/50
8	20CB932	Internet of Things	3	0	0	3	50/50
9	20CB933	Cryptology	3	0	0	3	50/50
10	20CB941	Quantum Computation and Quantum Information	3	0	0	3	50/50
11	20CB942	Social Information Network	2	1	0	3	50/50
12	20CB943	Mobile Computing	3	0	0	3	50/50
13	20CB963	Image Processing and Pattern Recognition	2	1	0	3	50/50
14	20CB964	Advanced Java Programming	3	0	0	3	50/50
15	20CB965	Computer Graphics and Multimedia	3	0	0	3	50/50
16	20CB966	Block Chain Technology	3	0	0	3	50/50
Business Systems							
1	20CB951	Behavioural Economics	3	0	0	3	50/50
2	20CB952	Computational Finance &Modelling	3	0	0	3	50/50
3	20CB953	Psychology	3	0	0	3	50/50
4	20CB961	Enterprise Systems	2	1	0	3	50/50
5	20CB962	Advance Finance	2	1	0	3	50/50
6	20CB967	Financial Management	2	1	0	3	50/50
7	20CB968	Financial and Cost Accounting	2	1	0	3	50/50

EMERGING ELECTIVE COURSES

S No.	Course Code	Course	L/T/P	Contact hrs/week	Credit	Ext/Int	Category
1	20CB701	Usability Design of Software Applications	3/1/0	4	4	50/50	EE
2	20MG803	IT Project Management	2/1/0	3	3	50/50	EE
3	20CB969	Marketing Research and Marketing Management	3/1/0	4	4	50/50	EE

4	20CB970	Services Science and Service Operations Management	2/1/0	3	3	50/50	EE

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS

S.No.	Course Code	Course	L	T	P	Credit	Ext/Int
1	20CB001	Java Programming	3	0	0	3	50/50
2	20CB002	Usability Design	3	0	0	3	50/50
3	20CB003	Financial Modelling	3	0	0	3	50/50
4	20CB004	Artificial Intelligence and Expert Systems	3	0	0	3	50/50
5	20CB005	Intellectual Property and Entrepreneurship	3	0	0	3	50/50

ONE CREDIT COURSES

S. No.	Course Code	Course
1	20CB801	Communicative English
2	20CB802	Business Ethics
3	20CB803	Tensorflow
4	20CB804	Angular JS
5	20CB805	Devops
6	20CB806	Anaconda
7	20CB807	MongoDB

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

S. No	Stream	Credits/Semester									Credits	AICTE NORMS
		I	II	III	IV	V	VI	VII	VIII			
1.	Humanities and Management (HM)	3	3		2		2				10	12
2.	Basic Sciences(BS)	12	8	4	3						27	24
3.	Engineering Sciences(ES)	8	7		3	4					22	29
4.	Professional Core(PC)		4	15.5	13.5	12	12				57	49
5.	Professional Electives(PE)					3	3	9			15	18
6.	Open Electives (OE) / Emerging Elective (EE)						3	11			14	12
7.	Project Work(PW)					2		4	12		18	15
8.	Employability Enhancement Skills (EES)									2	2	
9.	Mandatory Course (MC)										**Non credit**	
Total		**23**	**22**	**19.5**	**21.5**	**21**	**20**	**24**	**12**	**2**	**165**	**159**

20MA102 **DISCRETE MATHEMATICS** **3/1/0/4**

Nature of Course: J (Problem Analytical)

Pre requisites: Nil

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]
C102.5	Use logical notation to define and reason mathematically about the fundamental data types and structures used in computer algorithms and systems.	[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	6
C102.4&C102.5	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**
C102.1	3											
C102.2	2	2										
C102.3	1											
C102.4	3											
C102.5	3											

20MA103 PROBABILITY AND STATISTICS 3/1/0/4

Nature of Course: J (Problem analytical)

Pre requisites: Nil

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 apply the concepts of sampling techniques	[AP]
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. S.M. Ross, "Introduction of Probability Models", 12th edition, Elsevier.
2. A. Goon, M. Gupta and B. Das Gupta, "Fundamentals of Statistics(vol. I and vol. II)".

Reference Books:

1. S.M. Ross, "A first course in Probability",8th edition, Pearson Education, Inc..
2. I.R. Miller, J.E. Freund and R. Johnson, "Probability and Statistics for Engineers", 8th edition, Pearson Education.

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	7
C103.4 & C103.5	Apply	Group Assignment	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
C103.1	1											
C103.2	2											
C103.3	3											
C103.4	3											
C103.5	3											

20EE111 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 electro mechanics 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 Kirchhoff'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 Electro mechanics 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)

Total Hours:45

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:30

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 of India Pvt. Ltd, 2nd edition, 2017.

Reference Books:

1. Edward Hughes – "Electrical Technology"- 10thedition, Pearson Education Publication,2011.
2. Vincent. Del. Toro, "Electrical Engineering Fundamentals",2nd edition Prentice Hall India, 2015.
3. Sudhakar Shyam mohan, "Circuits and Networks: Analysis and Synthesis",5th edition, Tata McGraw-Hill Education, 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	3	3	1				1			1	1	2
C111.2	3	3	1				2			1		2
C111.3	3	3	1				1			1	1	2
C111.4	2	2										1
C111.5	2	2										2

20CB101 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	[R]
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	2	2	2				2	2		2	2	2
C101.2	1	1	1				1	1		1	1	1
C101.3	1	1	1				1	1		1	1	2
C101.4	1	1	1				1	1		1	1	

20PH103 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).

Total Hours:45

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: 30

TEXT BOOKS

1. Beiser A, "Concepts of Modern Physics", Fifth Edition, McGraw Hill International.
2. David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of Physics", Wileyplus.

REFERENCE BOOKS

1. Ajoy Ghatak, "Optics" Fifth Edition, Tata McGraw Hill.
2. Sears &Zemansky, "University Physics", Addison-Wesley.
3. Jenkins and White, "Fundamentals of Optics", Third Edition, McGraw-Hill.

WEB RESOURCES

1. http://www.nanotech-now.com/Nanomat-Preso2.pdf
2. http://nptel.ac.in/courses/108106073
3. https://www.corning.com/in/en/products/communication-networks/.../fiber.html
4. https://physics.stanford.edu/node/201
5. https://www.amazon.com/Semiconductor-Materials-Physical...References/.../0849389...
6. https://books.google.co.in/books?isbn=1482238888
7. https://www.generalplastics.com/polyurethane-foam-dielectric-materials-f...
8. https://www.asme.org/.../nanotechnology/carbon-nanotube-super-fabric
9. https://web.iit.edu/.../web/.../Academic%20Resource%20Center/.../Miller...

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								

20EN101 BUSINESS COMMUNICATION AND VALUE SCIENCE I 2/0/2/3

Nature of Course: Behavioral

Pre requisites: Nil

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:

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

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.

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							

20MA202 **LINEAR ALGEBRA** **3/1/0/4**

Nature of Course: J (Problem analytical)

Pre requisites: NIL

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:

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

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).

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

Reference Books:

1 Peter V. O'Neil ,Advanced Engineering Mathematics, 7th edition,.
2 M. D. Greenberg ,Advanced Engineering Mathematics, 2nd edition,.
3 P. N. Wartikar& J. N. Wartikar ,Applied Mathematics (Volumes I and II).
4 R C Gonzalez and R E Woods ,Digital Image Processing.

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											

20EN201 BUSINESS COMMUNICATION AND VALUE SCIENCE II 2/2/0/3

Nature of Course Behavioral
Pre requisites 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	Remember the tools of structured written communication and basics of presentation skills.	[R]
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:

Good and Bad Writing. Identification of Common errors in punctuation rules, use of words - SATORI (sharing personal experience) - Introduction to basic presentation skills & ORAI app

Speed Reading - Introduction to skimming and scanning – Analysing personality traits - Dr.Meredith Belbin and his research on team work - Belbin's 8 Team Roles and Lindgren's Big 5 personality traits - Belbin's 8 team player styles

Diversity & Inclusion- Different forms of Diversity in our society – Organizing events to support - TCS values, Respect for Individual and Integrity.

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							
C201.2					2							
C201.3					3							
C201.4					2							
C01.5					3							

20MG211 FUNDAMENTALS OF ECONOMICS 3/0/0/3

Nature of Course: C (Theory Concept)

Pre requisites: NIL

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	Remember and 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. Pindyck, Robert S., and Daniel L. Rubinfeld, Microeconomics,7th Edition, Pearson Education. 2009
2. Dornbusch, Fischer and Startz. Macroeconomics, 12th Edition, McGraw Hill Education 2018.
3. Paul Anthony Samuelson, Economics, William D. Nordhaus, 19th Edition, McGraw Hill Education, 2010

Reference Books:

1. Hal R, Varian, Intermediate Microeconomics: A Modern Approach, W.W Norton and Company, 2009.
2. N. Gregory Mankiw, Principles of Macroeconomics, Cengage Learning India Pvt. Ltd., 2015.
3. S. Sankaran, Business Economics, Margham Publication, Chennai. Margham Publications, 2012.

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	Remember & 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	-	-	-	-

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
C211.1	2	3	1	2	2	1	3	3	2	2	2	
C211.2	2	2	1	2	2	1	3	2	2	2	2	
C211.3	1	2	2	2	2	2	2	2	3	2	2	
C211.4	2	3	1	3	2	1	3	2	2	2	3	

20CB201 **DATA STRUCTURES** **3/0/2/4**

Nature of Course: K (Problem Programming)
Pre requisites: Computer 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:

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

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

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

20EC211 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	Describe the basics of semiconductors	[R]
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 and Diodes: 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 and Field effect 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, Operational Amplifiers and Digital Electronics Fundamentals: 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. Forward and Reverse Characteristic of PN junction diode [U]
2. Forward and Reverse Characteristics of Zener diode [U]
3. Input and output characteristics of Bipolar junction transistors [U]
4. Drain and transfer characteristics of JFET [U]
5. Design of Integrator and differentiator using op amp ic741 [AP]
6. Design of 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 Salivahanan, ‘Electron Devices and Circuits’, 4th edition, McGraw Hill Education India Private Ltd., 2016

2 D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd.,2010 (Reprint)

3 M. Morris Mano, Michael D.Ciletti., ”Digital Design”,5th Edition, Pearson education, 2013

Reference Books:

1 Ben Streetman, Sanjay Banerjee 'Solid State Electronic Devices ' 6th Edition, prentice hall,2000

2 Albert Paul Malvino, 'Electronic Principle' Tata Mcgraw-Hill Publishing Company Limited,1st edition 1976

3 D Schilling, C Belove, T Apelewicz, R Saccardi. 'Electronics Circuits: Discrete & Integrated' 1st edition,1996.

4 Jacob Millman, Chritos C Halkias, Satyabrata Jit, 'Electronic Devices and Circuits', 4th edition (SIE), McGraw Hill Education India Private Ltd., 2015

5 Sedra and Smith, 'Microelectronic Circuits', Oxford University Press, 5th Edition, 2005.

6 Robert Boylestad and Louis Nashelsky, 'Electron Devices and Circuit Theory', 11th edition , Pearson New International Edition , 2013

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://nptel.ac.in/courses/117103063/

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	3	3

20MA203 **STATISTICAL MODELLING** **3/0/2/4**

Nature of Course: K (Problem Programming)
Pre Requisites: Probability and 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. I.R. Miller, J.E. Freund and R. Johnson, "Probability and Statistics for Engineers (4th Edition)", 8th edition, Pearson Education.
2. A. Goon, M. Gupta and B. Das Gupta, "Fundamentals of Statistics (vol. I and vol. II)".
3. Chris Chat field, "The Analysis of Time Series: An Introduction", 6th Edition, CRC Press.

Reference Books:

1. D.C. Montgomery & E.Peck , "Introduction to Linear Regression Analysis", 5th Edition .
2. A.M. Mood, F.A. Graybill & D.C. Boes, "Introduction to the Theory of Statistics", Wiley, New York.
3. N. Draper & H. Smith, "Applied Regression Analysis".
4. Garrett Grolemund, " Hands-on Programming with R"
5. Jared P. Lander, " 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				

20CB301 FORMAL LANGUAGES AND AUTOMATA THEORY 3/1/0/4

Nature of Course: J(Problem Analytical)

Pre requisites: Discrete Mathematics

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:

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.

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.

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

20CB302 **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" 3rdEdition, 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, ZvonkoVranesic, SafwatZaky, NaraigManjikian, "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", 10thEdition, Pearson Education, 2015.

3 Vincent P. Heuring and Harry F. Jordan,"Computer System Design and Architecture", Prentice Hall, 2ndEdition, 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	1	2	2	1				2		1		1
C302.2	1	1	3	1				1		1		1
C302.3	1	1	2					2			1	
C302.4	1	1	1	1			1	1				1

20CB303 **OBJECT ORIENTED PROGRAMMING** **3/0/0/3**

Nature of Course: F (Theory Programming)

Pre requisites: Computer Programming

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

Assessment Methods & Levels (based on Blooms’ Taxonomy)				
Formative assessment based on Capstone Model (Max. Marks:20)				
Course Outcome	**Bloom’s Level**	**Assessment Component**		**Marks**
C303.1,4	U	Quiz		10
C303.2,3	AP	Assignment		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	20	30	20
Apply	50	60	50	60
Analyze	-	-	-	-
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
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

20MA308 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, 2ndEdition, 2008

Reference Books:

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

2 Douglas C. Montogomery,ElizabethA.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

20CB304 SOFTWARE ENGINEERING 3/0/2/4

Nature of Course: D (Theory Application)
Pre requisites: NIL
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	Recall software engineering principles and methodologies.	[R]
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	Evaluate the applications by testing and debugging.	[E]

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 software metrics 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 experiments 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 analyzing 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. Carlo Ghezzi, Jazayeri Mehdi, Mandrioli Dino, “Fundamentals of Software Engineering”, 2nd Edition, Pearson,2002.

2. A Lexicon of Practice, Principles and Prejudices, Michael Jackson, “Software Requirements and Specification”, 1 Edition, 1995.

3. Ivar Jacobson, Grady Booch, James Rumbaugh, “The Unified Development Process”, Addison Wesley, 1999.

4. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, “Design Patterns: Elements of Object-Oriented Reusable Software”, 1st Edition, Addison Wesley, 1994.

5. Norman E. Fenton, Shari Lawrence Pfleeger, “Software Metrics: A Rigorous and Practical Approach”, 2nd Edition, International Thomson Computer Press, 1997.

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

2 https://cosmolearning.org

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	-	20	-
Evaluate	-	-	-	10	-
Create	-	-	-	-	-

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

20CB305 **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

20CB401 **DATABASE MANAGEMENT SYSTEMS** **3/1/0/4**

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:

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.

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.

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

20CB402	INTRODUCTION TO INNOVATION, IP MANAGEMENT AND ENTREPRENEURSHIP	3/0/0/3

Nature of Course: C (Theory Concept)

Pre requisites: NIL

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.	[R]
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

20EN401 BUSINESS COMMUNICATION AND VALUE SCIENCE III 2/0/0/2

Nature of Course: Behavioral
Pre requisites: Business Communication and Value Science 1,
Business Communication and Value Science 2

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 and analyze the basic principles of SWOT and life positions.	[AP]
C401.2	Differentiate between the diverse cultures of India and analyze the cross-cultural communication.	[AP]
C401.3	Understand and apply the concepts of Global and global.	[C]
C401.4	Remember and apply the tools of technical writing and identify the best practices of technical writing.	[R]
C401.5	Understand Artificial intelligence and recognize its impact in daily life.	[U]

Course Contents:

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).

Define the terms global and global- Differentiate between global and global 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.

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: 45

Text Books:

1 Gerald.J.Alred, Charles T. Brusaw, Walter E. Oliu , "Handbook of Technical Writing", Eleventh Edition, 672 pages, Bedford/St. Martin's Boston , New York,2009
2 Liz Hamp-Lyons and Ben Heasly, "Study Writing- A Course in Written English for Academic Purposes", Updated Edition, 214 pages, Cambridge University Press, 2006.

Reference Books:

1 Sanjay Kumar and Pushp Lata, "Communication Skills", Second Edition, 23 pages, Oxford University Press, 2015.
2 Central Institute of English, "Exercises in Spoken English. Parts. I-III", First Edition, CIEFL, Hyderabad, Oxford University Press,2001.

Web References:

1 Examples of Technical Writing for Students, Freelance Writing- Technical Writing. (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	
C401.1		1		1	2	2	3	3	3			
C401.2		1		1	2		2	2	2			
C401.3		2		2	2		2	2	2	2	2	
C401.4		2			3		2	2				
C401.5		2		1	2	3	2		2	2		

20MA408 **OPERATIONS RESEARCH** **2/0/2/3**

Nature of Course: D (Theory Application)

Pre requisites: Probability and Statistics, Linear Algebra

Course Objectives:

1. To use appropriate techniques and optimization solvers to interpret the results obtained and translate solutions into directives for action.
2. To analyze 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 analyze real world systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C408.1	Remember the principles of construction of mathematical models of conflicting situations	[R]
C408.2	Understand the optimization techniques to interpret the solutions	[U]
C408.3	Solve mathematical model (linear programming problem) for a physical situations	[AP]
C408.4	Solve the problem of transporting the products from origins to destinations with least transportation cost.	[AP]
C408.5	Compute the traffic intensity, blocked traffic and the utilization of some queueing systems	[AP]

Course Contents:

Introduction to OR and Linear Programming Problem

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** – 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.

Scheduling Techniques and Network Models

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 - for safety stock with known/unknown stock out situations, models under

prescribed policy, Probabilistic situations. **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

Queuing Theory and Simulation Methodology: 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: 45

Lab Component

1. Introduction to OR online tools
2. To Solve LPP graphically Using PHP simplex tool
3. To Solve LPP by simplex method Using PHP simplex tool
4. To Solve LPP by simplex method Using EXCEL solver
5. To Solve transportation problem Using EXCEL solver and online tool
6. To Solve Assignment problem Using EXCEL solver and online tool
7. To Solve Travelling salesman problem Using EXCEL solver and online tool
8. To Determination of critical Paths, Estimation of Project time and its variance in PERT using online PERT calculator.

Total Hours: 15

Text Books:

Kanti Swarup, P.K.Gupta, Manmohan, "Operations research", 2nd Edition, Sultan Chand and Sons, 2015

Taha H.A, "Operation Research", 10th Edition, Pearson Education, 2017

J.W. Prichard and R.H. Eagle, "Modern Inventory Management", Wiley, 1965

Reference Books:

H.M. Wagner, "Principles of OR with Application to Managerial Decisions", Prentice Hall, 1975

F.S. Hiller and G.J. Lieberman, "Introduction to Operations Research", McGraw Hill, 2001

Thomas L. Saaty, "Elements of Queuing Theory", McGraw Hill, 1961

A. Ravi Ravindran, "Operations Research and Management Science, Hand Book", CRC Press, 2008

Web References:

http://nptel.ac.in/courses/111104079/

http://nptel.ac.in/video.php/subjectId=117105085

http://nptel.ac.in/syllabus/111105041/

http://freevideolectures.com/Course/3028/Econometric-Modelling/22#

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

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& Project	
	CIA-I [10 marks]	CIA-II [10 marks]	CIA-III [10 marks]	Rubric based CIA [30 Marks]	
Remember	20	20	20	20	20
Understand	30	30	30	30	30
Apply	50	50	50	50	50
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Formative Assessment	Summative Assessment		Total
	Continuous Assessment	End Semester Examination	
-	60	40	100

Course Outcome (CO)	Programme Outcomes (PO)											Programme Specific Outcomes (PSO)
	a	b	c	d	e	f	g	h	i	j	k	1
C408.1	1											
C408.2	2	1										
C408.3	3	2						1				
C408.4	3	2						1				
C408.5	3	2						1				

20CB403 **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

C403.1	Understand the software development process models	[R]
C403.2	Interpret the contemporary issues and discuss about analysis and coding standards	[AP]
C403.3	Analyze the design methods and modeling	[A]
C403.4	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" 1stEdition, 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	-	-	-	-	-
Apply	60	40	40	40	40
Analyze	20	40	40	40	40
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

Course Outcome (CO)	**Programme Outcomes (PO)**											**Programme Specific Outcomes (PSO)**
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**1**
C403.1	2	3	3	3	2		3	2		2	3	3
C403.2	2	3	3	3	2		3	2		3	3	3
C403.3	1	3	3	3	2		2	2		3	3	2
C403.4	1	3	3	3	2		1	1		3	3	2

20CB404 **OPERATING SYSTEMS** **3/0/2/4**

Nature of Course: G (Theory analytical)

Pre requisites: Computer 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

C404.1	Identify the basic concepts and design issues of operating systems.	[R]
C404.2	Apply Process management concepts including scheduling, Inter process communication, deadlocks and multithreading concepts.	[AP]
C404.3	Apply concepts of memory management including Virtual Memory and Page Replacement to the issues that occur in Real time applications.	[AP]
C404.4	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", 8thEdition, 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

2 https://nptel.ac.in

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**	**3**
C404.1	1	1	1							1	1	3
C404.2	3	3	3							3	3	3
C404.3	3	3	3							3	3	2
C404.4	1	1	1							1	1	1

20CB405 **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

C405.1	Sketch ER diagrams for real world applications	[AP]
C405.2	Select suitable SQL commands to manage the database	[A]
C405.3	Create databases using MongoDB	[C]
C405.4	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 http://nptel.ac.in/video.php?subjectId=106106093

2 http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-830-database-systems-fall-2010/

3 www.tutorialspoint.com/dbms/

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

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

Online Resources:

1 http://nptel.ac.in/video.php?subjectId=106106093

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

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

4 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
C405.1		2	2							2	2	2
C405.2		2	2							2	2	2
C405.3		3	3							3	3	3
C405.4		3	3							3	3	3

20MC101 **INDUCTION PROGRAMME** **1/0/0/0**

Nature of Course Induction Programme

Pre requisites Nil

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

C101.1	Explore academic interest and activities	[AP]
C101.2	Work for excellence	[AP]
C101.3	Promote bonding and give a broader view of life and character	[AP]

Course Contents:

PHYSICAL ACTIVITY: Research over the past years has shown Yoga to have stress-relieving powers on students, paving the way for improved academic performance with the practice of asanas, meditation and breathing exercises. To prove these words Yoga classes has been planned in this module.(CO mapping: C101.1, C101.2, C101.3)

CREATIVE ARTS (students can select any one of their choice): Cultural development supports students to understand, feel comfortable with, value and appreciate the potential enrichment of cultural diversity. They should challenge discrimination, whether based on cultural or racial difference. Students should experience cultural traditions embedded in arts, crafts, language, literature, theatre, song, music, dance, sport, Science, technology and travel. Students should develop an appreciation of beauty both in experiencing artistic expression and by exploring their own creative powers. To inculcate those skills they are given a chance to exhibit their talents through painting, sculpture, pottery, music, dance, craft making and so on. .(CO mapping: C101.1, C101.2, C101.3)

UNIVERSAL HUMAN VALUES: Moral development involves supporting students to make considered choices around their behaviour and the values that provide a framework for how they choose to live. Moral development is also learning about society's values, understanding the reasons for them, how they are derived and change; and how disagreements are resolved. Students must consider the consequences of personal and societal decisions on the wider community – local and global- and on the environment and future generations. To acquire this the students are exposed to training to enhance their soft skills. .(CO mapping: C101.1, C101.2, C101.3)

LITERARY AND PROFICIENCY MODULES: Social development helps students to work effectively together, developing the inter-personal skills required to relate positively with their peers and people of all ages. Students must also understand how to participate productively in a diverse and plural society and learn about, and how to effectively engage with societal institutions and processes. They should understand that a person may have different roles and responsibilities within society. To reach this the following aspects are given in the form of Reading, writing, speaking – debate, role play etc.Communication and computer skills. (CO mapping: C101.1, C101.2, C101.3)

LECTURES BY EMINENT PEOPLE: Teaching with Lectures. ... It is essential to see lectures as a means of helping students learn to think about the key concepts of a particular subject, rather than primarily as a means of transferring knowledge from instructor to student. During the induction period students will attend to Guest lectures by subject experts.(CO mapping: C101.1, C101.2, C101.3)

VISIT TO LOCAL AREAS: Traveling is in fact a way of learning to learn. You are out of your comfort zone and so you must learn to be able to adapt to a new learning environment in a very short time. It also helps in your overall learning as well. In the induction period students will be taken to different places near college to learn new things. Eg. Meditation centre /orphanage/Hospital. (CO mapping: C101.1, C101.2, C101.3)

FAMILIARIZATION TO DEPARTMENT/BRANCH INNOVATION: Hod's of different branches will present about their department followed by department visit to view various facilities available at their department, new innovations from students and faculties etc.(CO mapping: C101.1, C101.2, C101.3)

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C101.1						3	3	3	3	3	3	3			1
C101.2						3	3	3	3	3	3	3			1
C101.3						3	3	3	3	3	3	3			1

20MC102 ENVIRONMENTAL SCIENCES 2/0/0/0

Nature of Course Theory Concept

Pre requisites Basics in Environmental Studies

Course Objectives:

1. To learn the integrated themes on various natural resources.
2. To gain knowledge on the type of pollution and its control methods.
3. To have an awareness about the current environmental issues and the social problems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C102.1	Recall and play an important role in transferring a healthy environment for future generation.	[R]
C102.2	Understand the importance of natural resources and conservation of biodiversity.	[U]
C102.3	Understand and analyze the impact of engineering solutions in a global and societal context.	[U]
C102.4	Apply the gained knowledge to overcome pollution problems.	[AP]
C102.5	Apply the gained knowledge in various environmental issues and sustainable development.	[AP]

Course Contents:

Module 1: Natural Resources 10 Hours

Introduction-Forest resources: Use and abuse, case study-Major activities in forest-Water resources-over utilization of water, dams-benefits and problems. Mineral resources-Use and exploitation, environmental effects of mining- case study–Food resources- World food problems, case study. Energy resources -Renewable and non-renewable energy sources Land resources- Soil erosion and desertification – Role of an individual in conservation of natural resources.

Module 2: Environmental Pollutions 10 Hours

Definition – causes, effects and control measures of: a. Air pollution-Acid rain - Green house effect-Global warming- Ozone layer depletion – case study- Bhopal gas tragedyb. Water pollution c. Solid waste management-Recycling of plastics-Pyrolysis method- causes, effects and control measures of municipal solid wastes d. Noise pollution. e. Nuclear hazards-case study-Chernobyl nuclear disaster-Role of an individual in prevention of pollution.

Module 3: Social issues and the Environment 10 Hours

Sustainable development-water conservation, rain water harvesting, E-Waste Management – Environmental ethics: 12 Principles of green chemistry-Scheme of labelling of environmental friendly products (Eco mark) – Emission standards – ISO 14001 standard. HIV AIDS.

Total Hours: 30

Text Books:

1. Anubha Kaushik and C P Kaushik “Perspectives in Environmental Studies” 4th Edition, New age International (P) Limited, Publisher Reprint 2014. New Delhi
2. Rajagopalan, R, “Environmental Studies-From Crisis to Cure”, Oxford University Press 2015.

Reference Books:

1 Tyler Miller, Jr, "Environmental Science", Brooks/Cole a part of Cengage Learning, 2014.
2 William Cunningham and Mary Cunningham, "Environmental Science", 13th Edition, McGraw Hill,2015.
3 Gilbert M. Masters, "Introduction to Environmental Engineering and Science", Third Edition, Pearson Education, 2014.

Web References:

1 http://nptel.ac.in/courses/104103020/20
2 http://nptel.ac.in/courses/120108002
3 http://nptel.ac.in/courses/122106030
4 http://nptel.ac.in/courses/120108004/
5 http://nptel.ac.in/courses/122102006/20

Online Resources:

1 https://www.edx.org/course/subject/environmental-studies
2 www.environmentalscience.org

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:40)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C102.1	Remember	Quiz	**5**
C102.2	Understand	Mini project based on environmental aspect	**15**
C102.3	Understand	Class Presentation	**10**
C102.4 C102.5	Apply	Group Assignment	**10**

Summative assessment based on Continuous Assessment	
Revised Bloom's Level	**Term End Assessment [100 marks]**
Remember	30
Understand	40
Apply	30
Analyse	-
Evaluate	-
Create	-

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C102.1						2	2						2		
C102.2						2	2						2		
C102.3						2	2							2	
C102.4						3	3						2		
C102.5						3	3						2		

20MC103 **SOFT SKILLS** **2/0/0/0**

Nature of Course: Theory Concept

Pre requisites: Technical Communication Skills

Course Objectives:

1. To develop the students competency level and their capabilities.
2. To teach the students to be effective in workplace and social environments.
3. To create self confidence among the students and to resolve stress and conflict within themselves.
4. To help the students to enhance their career skills by increasing their productivity and performances.
5. To concentrate more on conversation skills, presentation skills, verbal ability, critical and creative thinking.

Course Outcomes:

Upon completion of the course, students shall have ability to

C103.1	Remember the principles of soft skills required for their profession.	[R]
C103.2	Understand the importance of Interpersonal communication Skills among individuals, groups and cultures.	[U]
C103.3	Apply verbal and non-verbal communication skills in corporate environment.	[AP]
C103.4	Analyse and apply creativity skills, critical thinking skills and problem solving skills.	[AN]
C103.5	Articulate oral and written messages in an appropriate and persuasive manner to suit specific purposes, audiences and contexts at work place.	[AP]
C103.6	Apply good teamwork skills and Leadership Skills	[AP]

Course Contents:

Module 1: Professional Communication Skills **10 Hours**

Introduction to the Soft Skills, Performance Evaluation 1 –Significance of Soft Skills- Understanding the basic Communication Principles –Listening Skills- Listening Exercises- Speaking Skills- How to start and Sustain a Conversation- Speaking in Groups- Understanding self and Personal Branding, attitude, types of attitude, Positive Attitude, Self Confidence and Self-Motivation - Personal Application/Action Taken. Advanced Writing Skills-Principles of Business Writing- E mails- Writing Reports- Types of Reports- Strategies for Report Writing- Personal Application/Action Taken. Verbal Ability- Analogy- Classification- Odd One Out- Idioms and Phrases- Sentence Correction- Empathy and its importance in career -Personal Application/Action Taken.

Module 2: Interpersonal Communication **10 Hours**

Nonverbal Communication- Individual, Groups and Cultures- Body Language- Attire and Etiquettes- Interpersonal Skills- dealing with diverse People- Networking- Emotional Intelligence and its importance. Personal Application/Action Taken. Developing Creativity- Critical Thinking and Problem Solving Skills- Making the Right Choice- Never Give Up- Begin to Grow- Personal Application/Action Taken. Interviews- Facing Job Interviews - Planning and Preparing- Effective Resume along with Covering Letter- Planning and Preparing- Personal Application/Action Taken. Self-Discipline - Self Presentation - Personal Application/Action Taken.

Module 3: Teamwork and Leadership Skills **10 Hours**

Industry Expectations- Universal Hiring Rule- Personal Application/Action Taken. Importance of Human Values-Importance of Team Work- Developing Key Traits in Motivation, Persuasion, Negotiation and Leadership Skills- Being an Effective Team Player- Personal Application/Action Taken. Planning- Prioritization - Delegation- Conflict Management- Decision and its necessity in crucial situations- Group Discussion- Personal Application/Action Taken. Essential Skills in working Strategies- Presentation and Interaction Skills- What to Present and How- Being Assertive- Multimedia Presentation-Making Effective Presentations.
Interview Skills- Do's and Don'ts - Body Language – Answering the Common Questions of Interview- Performance Evaluation 2- Mock Interview

Total Hours: 30

Text Books:

1. Penrose, "Business Communication for managers: An advanced approach", Cengage learning.
2. H.E. Sales, "Professional Communication in Engineering", Palgrave Macmillan 2009.
3. W. P. Scott, Bertil Billing, "Communication for Professional Engineers", Thomas Telford, 1998.

Reference Books:

1. Peter Davson-Galle, "Reason and Professional Ethics", Ashgate Publishing, Ltd., 2009.
2. William B. Gudykunst, "Cross Cultural and Inter Cultural Communication", Sage Publications India Pvt Ltd, New Delhi, 2003.
3. Joep Cornelissen, "Corporate Communications: Theory and Practice", Sage Publications India Pvt Ltd, New Delhi, 2004.

Web References:

1. https://onlinecourses.nptel.ac.in/noc16_hs15/preview
2. https://www.getinternship.switchidea.com/NTAT/syllabus/Interpersonal-Communication.
3. https://smude.edu.in/smude/programs/bca/soft-skills.html

Online Resources:

1. https://swayam.gov.in/course/4047-developing-soft-skills-and-personality
2. https://www.clearias.com/interpersonal-skills-including-communication-skills-for-csat/
3. https://www.bizlibrary.com/soft-skills-training/

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:40)			
Course Outcome	**Revised Bloom's Level**	**Assessment Component**	**Marks**
C103.1	Remember	Group Discussion	10
C103.2 & C103.3	Understand	Listening Skills	10
C103.4	Apply	Interview	10
C103.5 & C103.6	Apply	Formal Presentation	10

Summative assessment based on Continuous and End Semester Examination

Revised Bloom's Level	Tentative End Assessment Examination (Theory) [60 marks]
Remember	30
Understand	40
Apply	30
Analyse	-
Evaluate	-
Create	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C103.1						1	1	2	2	3	2	2			1
C103.2							1	1	3	3	2	2			1
C103.3									2	3	2	2			1
C103.4						1	1	1	2	3	3	2			1
C103.5						1	1		2	3	2	2			1
C103.6							1	2	3	3	2	2			1

20MC105 **GENERAL APTITUDE** **2/0/0/0**

Nature of Course Problem analytical

Pre requisites Basic Mathematical calculations

Course Objectives:

1. To ensure that students learn to think critically about mathematical models for relationships between different quantities and use those models effectively to solve problems and reach conclusions about them.
2. To impart skills that enable students to effectively use and interpret data, formulas, and graphs in the workplace.
3. To instills confidence in facing technical aptitude questions interviewed by recruiters.

Course Outcomes:

Upon completion of the course, students shall have ability to

C105.1	To teach the basics of Quantitative Techniques in a graded manner.	[R]
C105.2	Understand the verbal and non-verbal nature of problems in reality and know the shortcut methods of solving it.	[U]
C105.3	Solve problems using their general mental ability.	[AP]
C105.4	To give intense focus on improving and increasing the ability of solving real problems.	[AP]
C105.5	Think critically about mathematical models for relating different quantities to reach conclusion.	[AP]
C105.6	Enable effective use of data interpretation, formulas, graphs and assumptions.	[AP]

Course Contents:

Module 1: Number Theory and Statistics **14 Hours**

Number Systems– HCF and LCM of Numbers – Decimal Fractions – Simplification – Square Root and Cube Root of a number – Surds and Indices – Problems on numbers – Percentage – Ratio and Proportion – Divisibility – Mixtures – Averages- Polynomials – Solving Equations and Inequalities – Discard's rule of signs – Problems on ages – Chain rule – Time and Work – Time and Distance – Problems on Trains – Problems on Boats and Streams- Measures of central tendency – Mean, Median and Mode – Variance and Standard deviation Logarithms – Profit and Loss – Simple Interest – Compound Interest.

Module 2: Logic and Decision Making **8 Hours**

Analogy – Classification – Series completion – Coding and Decoding – Blood Relations – Puzzle Test – Direction Sense test – Logical Venn Diagrams - Number Ranking and Time Sequence Test – Decision Making – Assertion and Reason– Inserting the missing one – Logical Sequence of words – Syllogisms.

Module 3: Reasoning **8 Hours**

Logic – Statement and Arguments – Statements and Assumptions – Statements and Course of Action – Statements and Conclusions – Deriving conclusions from passages – Functions – Different kinds of functions – Miscellaneous sets- Series – Analogy – Classifications – Analytical Reasoning – Problems on Cubes and Dice – Mirror Images – Water Images – Rule Detection.

Total Hours: 30

Text Books:

1. Aggarwal R. S, "Quantitative Aptitude" Revised Edition, S. Chand Publication.
2. Abhijit Guha, "Quantitative Aptitude" 5th Edition, McGraw Hill Education.

Reference Books:

1 Edgar Thorpe "Mental Ability & Quantitative Aptitude" 3rd Edition, McGraw Hill Education.

Web References:

1 https://www.wiziq.com/tutorial/815468-quantitative-aptitude-reasoning-data-interpretation-video-lectures
2 https://learningpundits.com/contest?referrer=harsh.cse15@nituk.ac.in
3 https://nptel.ac.in/courses/114106041/8
4 https://nptel.ac.in/courses/111103020/2

Online Resources:

1 http://aptitudetraining.in/home/index.php
2 https://www.udemy.com/vedicmaths/
3 https://www.youtube.com/channel/UCtmn-DsF4BhPug-ff9LiDAA?disable_polymer=true

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:40)			
Course Outcome	**Revised Bloom's Level**	**Assessment Component**	**Marks**
C105.1	Remember	Classroom or Online Quiz	10
C105.2 & C105.3	Understand	Formal presentation	10
C105.4, C105.5 & C105.6	Apply	Formal interview tests	20

Summative assessment based on Continuous and End Semester Examination	
Bloom's Level	**Term End Assessment Examination (Theory) [60 marks]**
Remember	20
Understand	40
Apply	40
Analyse	-
Evaluate	-
Create	-

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes(PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C105.1	3	3	1												
C105.2	3	2	1												
C105.3	3	3	1												
C105.4	3	2	1										2		
C105.5	3	3	1										2		
C105.6	3	2	1										2		

20MC106 **LIFE SKILLS AND ETHICS** **2/0/0/0**

Nature of Course Theory Concept

Pre requisites Nil

Course Objectives:

1. To develop communication competence in prospective engineers.
2. To enable them to convey thoughts and ideas with clarity and focus.
3. To develop report writing skills.
4. To equip them to face interview & Group Discussion.
5. To inculcate critical thinking process.
6. To prepare them on problem solving skills.
7. To provide symbolic, verbal, and graphical interpretations of statements in a problem description.

Course Outcomes:

Upon completion of the course, students shall have ability to

C106.1	Define and identify different life skills required in personal and professional life.	[U]
C106.2	Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.	[AP]
C106.3	Explain the basic mechanics of effective communication and demonstrate these through presentations.	[AN]
C106.4	Use appropriate thinking and problem-solving techniques to solve new problems.	[AP]
C106.5	Understand the basics of teamwork and leadership	[U]

Course Contents:

Communication Skill:
Introduction to Communication, The Process of Communication, Barriers to Communication, Listening Skills, Writing Skills, Technical Writing, Letter Writing, Job Application, Report Writing, Non-verbal Communication and Body Language, Interview Skills, Group Discussion, Presentation Skills, Technology-based Communication.

Critical Thinking & Problem Solving:
Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats Mind Mapping & Analytical Thinking. Teamwork: Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts.

Ethics, Moral & Professional Values:
Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE. **Leadership Skills:** Leadership, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation

Total Hours: 30

Reference Books:

1. Barun K. Mitra, “Personality Development & Soft Skills”, First Edition, Oxford Publishers, 2011.
2. Kalyana, “Soft Skill for Managers”, 1st Edition, Wiley Publishing Ltd, 2015.
3. Larry James, “The First Book of Life Skills”, 1st Edition, Embassy Books, 2016
4. Shalini Verma, “Development of Life Skills and Professional Practice”, 1st Edition, Sultan Chand (G/L) & Company, 2014
5. John C. Maxwell, “The 5 Levels of Leadership”, Centre Street, A division of Hachette Book Group Inc, 2014.

Web References:

1 https://www.coursera.org/courses?query=ethics

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:40)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C106.1	Remember	Quiz	**5**
C106.2	Understand	Assignment	**15**
C106.3	Understand	Presentation	**10**
C106.4 C106.5	Apply	Group Discussion	**10**

Summative assessment based on Continuous Assessment	
Revised Bloom's Level	**Term End Assessment [60 marks]**
Remember	30
Understand	40
Apply	30
Analyse	-
Evaluate	-
Create	-

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C106.1								1	2	1		2	1		
C106.2								1	2	1		2	1		
C106.3								2	2	3		1	1		
C106.4								1	1	1		1	3		
C106.5								1	3	2		2	1		

20MC107 **STRESS MANAGEMENT** **2/0/0/0**

Nature of Course Theory Concept

Pre requisites Nil

Course Objectives:

1. Understand the basic principles of stress management
2. Recognize your stress triggers and how to manage them
3. Develop proactive responses to stressful situations
4. Use coping tips for managing stress both on and off the job
5. Learn to manage stress through diet, sleep and other lifestyle factors
6. Develop a long term action plan to minimize and better manage stress
7. Understand the basic principles of stress management

Course Outcomes:

Upon completion of the course, students shall have ability to

C107.1	Understand the basic principles of stress management	[U]
C107.2	Apply the concept of recognizing your stress triggers and find was to manage them.	[AP]
C107.3	Develop proactive responses to stressful situations	[AN]
C107.4	Develop a long term action plan to minimize and better manage stress	[AP]

Course Contents:

Scientific Foundations of Stress:

What is stress? – Sources of Stress – Types of Stress – Personality Factors and stress – Stress and the college student. Stress Psychophysiology: Stress and nervous system – Hypothalamic – Pituitary – Adrenal (HPA) Axis – Effect of Stress on Immune system – Health risk associated with chronic stress – Stress and Major Psychiatric disorders.

Developing Resilience to Stress:

Understanding you stress level – Role of personality pattern, Self-esteem, Locus of control – Role of Thoughts Beliefs and Emotions – I & II – Life situation Intrapersonal: (Assertiveness, Time Management).

Strategies for Relieving Stress:

Developing cognitive coping skills – Autogenic training, imagery and progressive relaxation – Other relaxation techniques – Exercise and Health – DIY strategies stress management.

Total Hours: 30

Reference Books:

1. Jonathan C. Smith, “Stress Management: A Comprehensive Handbook of Techniques and Strategies”, 1st Edition, Springer Publishing Company, 2011.
2. Bob Stahl, Elisha Goldstein, Jon Kabat-Zinn, “A Mindfulness–based Stress Reduction Workbook”, 2nd Edition, New Harbinger Publications, 2019.
3. Ryan M. Niemiec, “The Strengths-based Workbook for Stress Relief”, 1st Edition, New Harbinger Publications, 2019.

Web References:

1 https://thiswayup.org.au/courses/coping-with-stress-course/
2 https://www.classcentral.com/course/swayam-stress-management-14309

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:40)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C107.1	Remember	Quiz	**10**
C107.2	Understand	Group Discussion	**10**
C107.3	Understand	Class Presentation	**10**
C107.4	Apply	Assignment	**10**

Summative assessment based on Continuous Assessment	
Revised Bloom's Level	**Term End Assessment [60 marks]**
Remember	30
Understand	40
Apply	30
Analyse	-
Evaluate	-
Create	-

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes(PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C107.1								1	3			1	1		
C107.2								1	2	1		1	1		
C107.3								1	3	1		2	2		
C107.4								1	3	1		3	2		

20MC108 **CONSTITUTION OF INDIA** **2/0/0/0**

Nature of Course : Theory

Pre Requisites : Nil

Course Objectives:

1 To familiarize with basic information about Indian constitution

2 To understand the fundamental rights and duties as citizens of India

Course Outcomes:

Upon completion of the course, students shall have ability to

C108.1	Explain the objectives of the Constitution of India and its formation	[U]
C108.2	Recall state and central policies (Union and State Executive), fundamental Rights and their duties.	[R]
C108.3	Make use of legal directions in developing solutions to societal issues	[AP]
C108.4	Utilized for competitive exams that requires knowledge of Indian Constitution	[AP]

Course Contents:

Module 1 **10 Hours**

Historical perspective, The making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, Citizenship Article 5-11.

Module 2 **10 Hours**

Federal structure, Powers of the Union and the states, Centre-State Relations, Union Executive – President, Prime Minister, Union Cabinet, Parliament, Supreme Court of India, State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Elections, Electoral Process, and Election Commission of India, Election Laws. Powers and Functions of Municipalities and Panchayat

Module 3 **10 Hours**

Amendments - Methods, Emergency Provisions, National Emergency, President Rule, Financial Emergency, Provisions for SC & ST, OBC, women, children and backward classes, Right to Property, Freedom of Trade and Commerce. Agricultural Law

Total Hours: 30

Text Books:

1 Dr. D. D. Basu, "Introduction to the Constitution of India", LexisNexis, New Delhi, 22nd Edition, 2016.

2 "Bare act-constitution of India", The universal Publications, LexisNexis 2020, New Delhi, India.

Reference Books:

1 Subhash. C. Kashyap, "Our Constitution: An Introduction to India's Constitution and Constitutional Law", National Book Trust, India, 5th Edition, 2019.

2 M. Laxmikanth, "Constitution of India", Cengage Learning India, 1st Edition 2018.

Web References:

1 https://unacademy.com/course/the-indian-constitution/NSKQ8XXQ

2 https://unacademy.com/goal/upsc-civil-services-examination-ias-preparation/KSCGY

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C108.1	Remember	Test	10
C108.4	Understand	Quiz	10
C108.3	Apply	Presentation	10
C108.2	Apply	Group Assignment	10

Summative assessment based on Continuous Assessment	
Revised Bloom's Level	**Term End Assessment [60 marks]**
Remember	30
Understand	40
Apply	30
Analyse	-
Evaluate	-
Create	-

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C108.1						3	1	1	1			1	1	1	
C108.2						3	1	1	1			1	1	2	
C108.3						3	2	2	1			1	1	2	
C108.4						3	1	1	1			2	1	1	

20MC109 ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE 2/0/0/0

Nature of Course : Theory

Pre Requisites : Nil

Course Objectives:

1. To make understand the contribution of Indian mind in various fields.
2. To cultivate critical appreciation of the thought content and provide insights relevant for promoting cognitive ability, health, good governance, aesthetic appreciation and right values.

Course Outcomes:

Upon completion of the course, students shall have ability to

C109.1 Relate classical Indian traditions with contemporary traditions and culture. [R]

C109.2 Outline the thoughts of Indians in different disciplines. [U]

C109.3 Apply the knowledge to the present context. [AP]

C109.4 Develop a better appreciation and understanding of Indian traditions. [C]

Course Contents:

Indian Ethics: Individual and Social – Society state and Polity (Survey) - Education systems – Agriculture (Survey) – Early & Classical Architecture – Medieval & Colonial Architecture.

Astronomy in India – Martial Arts Traditions (Survey) - Indian Literatures - Indian Philosophical Systems - Indian Traditional Knowledge on Environmental Conservation

Ayurveda for Life, Health and Well-being - The Historical Evolution of Medical Tradition in Ancient India- Music in India - Classical & Folk

Total hours: 30

Text Books:

1. Kapil Kapoor and Michel Danino, “Knowledge Traditions and Practices of India”, Central Board of Secondary Education, 2017.
2. Yogesh Atal, “Indian Society: Continuity and Change”, Pearson Education India, 2016.

Reference Books:

1. Douglas Osto, “An Indian Tantric Tradition and Its Modern Global Revival”, Routledge publications, 2020.
2. Rao C.N. Shankar, “Sociology: Principles of Sociology with an Introduction to Social Thoughts”, S Chand Publisher, 2019.

Web References:

1. http://nopr.niscair.res.in/handle/123456789/43
2. https://nptel.ac.in/courses/109/104/109104102/

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:100)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C109.1	Remember	Quiz	10
C109.2	Understand	Group Assignment	10
C109.3	Apply	Presentation	10
C109.4	Create	Survey	10

Summative assessment based on Continuous Assessment	
Revised Bloom's Level	**Term End Assessment [60 marks]**
Remember	30
Understand	40
Apply	30
Analyse	-
Evaluate	-
Create	-

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C109.1						2	1	1	1			2	3	1	
C109.2						2	1	1	2			1	2	1	
C109.3						1	1	1	1			1	1	1	
C109.4						2	1	1	2			2	1	1	