Sri Krishna College of Engineering and Technology

An Autonomous Institution, Affiliated to Anna University

Coimbatore — 641 008

SRI KRISHNA INSTITUTIONS COIMBATORE

CURRICULUM AND SYLLABI

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Regulation 2022

(For 2023-27 Batch)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To provide the students with high quality technical education in the field of Electrical and Electronics Engineering enabling them to become competent and responsible engineers with employability and entrepreneurial skills.

MISSION

M1: Equip the students with adequate knowledge in the field of Electrical and Electronics Engineering and professional skills necessary to face the future challenges with confidence and courage.

M2: Engineer them to engage in research activities leading to innovative applications of technology.

M3: Enable them to become responsible citizens of the country with a willingness to serve the society.

Programme Outcomes (POs)

At the time of their graduation students of Electrical and Electronics Engineering Programme should be in possession of the following Programme Outcomes

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex electrical engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze electrical engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex electrical engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex electrical engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give andreceive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability toengage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives (PEOs)

PEO1: Graduates will have successful career in industry that meets the needs of Indian and multinational companies.

PEO2: Graduates will have the ability to synthesize data and develop technical concepts for application to product design and to solve contemporary problems

PEO3: Graduates will work as part of teams on multidisciplinary projects with good technical, communication and interpersonal skills.

PEO4: Graduates will fulfill the roles and responsibilities of professional electrical engineers in their chosen career with an attitude to serve the industry and society.

PEO5: Graduates will undertake research, pursuing higher studies, thereby adopting extended learning, keeping pace with the technological developments and codes of professional practice.

Mapping of PO's to PEO's

Programme Educational Objectives	Programme Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO 1	3	3	3	2	3	2	3	2	2	3	2	3
PEO 2	3	3	3	2	3	2	3	2	2	3	3	3
PEO 3	2	2	2	3	2	2	3	2	2	3	2	3
PEO 4	3	3	3	2	3	2	2	2	2	3	3	2
PEO 5	2	2	2	1	1	3	2	3	3	2	2	2

1	Reasonably agreed	2	Moderately agreed	3	Strongly agreed

Program Specific Outcome (PSOs)

After the successful completion of the B.E. Electrical and Electronics Engineering programme,the graduates will be able to:

PSO1: Analyze basic scientific concepts and provide solutions to Electrical and Electronics Engineering problems with a specific focus on emerging energy challenges.

PSO2: Use relevant software apply current techniques for data processing problems in the field of modern electronic systems for sustainable development.

PSO3: Develop products/software to cater to the societal & Industrial needs and adapt ethical values so as to become successful electrical engineering professionals.

Year	Sem	Course Code / Course Title	Program Outcomes												Program Specific Outcomes		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I Year	Semester I	23SB102 - Biology for Engineers	3	1	1	1	1	1	1	0	1	0	0	2	2	1	1
		23EE101 - Basics of Electrical Circuits	3	3	3	3	2	0	0	0	2	0	0	0	3	1	0
		23MA101- Mathemetics I	3	3	3	3	0	0	0	0	2	2	0	0	3	0	0
		23AS101 - Applied Science	3	3	3	3	0	0	0	0	2	2	0	0	3	0	0
		23TA101- Heritage of Tamils	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0
		23IT101 - Application Development Practices	3	2	3	3	3	2	0	0	0	0	0	2	3	3	2
		22CS101 - Problem Solving using C++	3	3	3	2	2	0	0	0	2	1	0	2	3	2	1
		23EE102- Basics of Electrical Circuits Laboratory	3	3	3	3	2	0	0	0	2	0	0	0	3	1	0
		23AS102 - Applied Science Laboratory	3	3	3	3	0	0	0	0	2	2	0	0	3	0	0
		23MC101 - Mandatory Course I: Induction Programme	0	0	0	0	0	3	3	3	3	3	3	3	0	0	1
	Semester II	23EE201- Measuring Instruments and Smart Sensors	3	2	2	2	2	0	0	0	0	0	0	2	3	3	0
		23EE202- Electronic Devices and Integrated Circuits	2	1	2	1	0	0	1	0	0	0	0	0	2	0	0
		23MA201 – Mathematics II	3	3	3	3	0	0	0	0	2	2	0	0	3	0	0
		23TA201- Tamils and Technology	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0
		23EN101 - Oral and Written Communication Skills	0	0	0	0	0	0	0	1	0	3	1	1	0	0	0
		23CD201 - Database Management Systems	3	2	2	0	1	0	0	0	1	1	2	3	2	2	2
		23CY201- Java Programming	3	2	2	0	1	0	0	1	2	1	0	2	0	1	3
		23EE203- Electronic Devices and Integrated Circuits Laboratory	3	2	2	2	2	0	0	0	0	0	0	2	3	3	0
		23MC102 - Mandatory Course II: Environmental Sciences	0	0	0	0	0	3	3	3	2	0	0	3	0	0	3

Year	Sem	Course Code / Course Title	Program Outcomes												Program Specific Outcomes		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
II Year	Semester III	23EE301 - Electrical Machines - I	3	1	1	1	1	1	1	0	1	0	0	2	2	1	1
		23EC202 - Digital System Design	3	3	3	3	2	0	0	0	2	0	0	0	3	1	0
		23MA302 – Mathematics III	3	3	3	3	0	0	0	0	2	2	0	0	3	0	0
		23CS301 - Advanced Java Programming	3	3	3	3	0	0	0	0	2	2	0	0	3	0	0
		23GE301 - Universal Human Values	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0
		23EC302 - Operating Systems for Electronic Devices	3	2	3	3	3	2	0	0	0	0	0	2	3	3	2
		23EE302 - Electrical Machines - I Laboratory	3	3	3	2	2	0	0	0	2	1	0	2	3	2	1
		23EC204 - Digital System Design Laboratory	3	3	3	3	2	0	0	0	2	0	0	0	3	1	0
	Semester IV	23EE401 - Electrical Machines - II	3	2	2	2	2	0	0	0	0	0	0	2	3	3	0
		23EE402 - Control Systems	2	1	2	1	0	0	1	0	0	0	0	0	2	0	0
		23IT211 – Introduction to Python Programming	3	3	3	3	0	0	0	0	2	2	0	0	3	0	0
		23EE9XX - Professional Elective – I	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0
		23EC404 - Embedded C++	0	0	0	0	0	0	0	1	0	3	1	1	0	0	0
		23EE0XX - Open Elective I	3	2	2	0	1	0	0	0	1	1	2	3	2	2	2
		23EE403 - Electrical Machines - II Laboratory	3	2	2	0	1	0	0	1	2	1	0	2	0	1	3
		23EE404 - Control Systems Laboratory	3	2	2	2	2	0	0	0	0	0	0	2	3	3	0
		23MC1XX - Mandatory Course III	0	0	0	0	0	3	3	3	2	0	0	3	0	0	3

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING
REGULATION 2022 (For 2023-2027 Batch)
CHOICE BASED CREDIT SYSTEM
I – VIII SEMESTER CURRICULUM AND SYLLABI

SEMESTER I

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Ext/Int	Cat.
1	23SB102	Biology for Engineers	3/0/0	3	3	60/40	BSC
2	23EE101	Basics of Electrical Circuits	3/1/0	4	4	60/40	ESC
3	23MA101	Mathematics I	3/1/0	4	4	60/40	BSC
4	23AS101	Applied Science	4/0/0	4	4	60/40	BSC
5	23TA101	Heritage of Tamils	1/0/0	1	1	60/40	HSMC
6	23IT101	Application Development Practices	1/0/4	5	3	50/50	ESC
7	23CS101	Problem Solving using C++	1/0/4	5	3	50/50	ESC
8	23EE102	Basics of Electrical Circuits Laboratory	0/0/2	2	1	40/60	ESC
9	23AS102	Applied Science Laboratory	0/0/4	4	2	40/60	BSC
10	23MC101	Mandatory Course I: Induction Programme	3 Weeks		0	0/100	MC
		Total	**16/2/14**	**32**	**25**	**1000**	

SEMESTER II

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Ext/Int	Cat.
1	23EE201	Measuring Instruments and Smart Sensors	3/0/0	3	3	60/40	PCC
2	23EE202	Electronic Devices and Integrated Circuits	3/0/0	3	3	60/40	PCC
3	23MA201	Mathematics II	3/1/0	4	4	60/40	BSC
4	23TA201	Tamils and Technology	1/0/0	1	1	60/40	HSMC
5	23EN101	Oral and Written Communication Skills	2/0/2	4	3	50/50	HSMC
6	23CD201	Database Management Systems	1/0/4	5	3	50/50	ESC
7	23CY201	Java Programming	1/0/4	5	3	50/50	ESC
8	23EE203	Electronic Devices and Integrated Circuits Laboratory	0/0/2	2	1	40/60	PCC
9	23MC102	Mandatory Course II: Environmental Sciences	1/0/0	1	0	0/100	MC
		Total	**15/1/12**	**28**	**21**	**900**	

SEMESTER III

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Ext/Int	Cat.
1	23EE301	Electrical Machines - I	3/0/0	3	3	60/40	PCC
2	23EC202	Digital System Design	3/0/0	3	3	60/40	PCC
3	23MA302	Mathematics III	3/1/0	4	4	60/40	BSC
4	23CS301	Advanced Java Programming	1/0/4	5	3	50/50	PCC
5	23GE301	Universal Human Values	3/0/0	3	3	60/40	HSMC
6	23EC302	Operating Systems for Electronic Devices	3/0/2	5	4	50/50	PCC
7	23EE302	Electrical Machines - I Laboratory	0/0/2	2	1	40/60	PCC
8	23EC204	Digital System Design Laboratory	0/0/2	2	1	40/60	PCC
		Total	**16/1/10**	**27**	**22**	**800**	

SEMESTER IV

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Ext/Int	Cat.
1	23EE401	Electrical Machines - II	3/0/0	3	3	60/40	PCC
2	23EE402	Control Systems	3/0/0	3	3	60/40	PCC
3	23IT211	Introduction to Python Programming	1/0/4	5	3	50/50	PCC
4	23EE9XX	Professional Elective – I	3/0/0	3	3	60/40	PEC
5	23EC404	Embedded C++	3/0/2	5	4	50/50	PCC
6	23EE0XX	Open Elective I	0/0/6 (or) 3/0/0	6 (or) 3	3	40/60 (0r) 60/40	OEC
7	23EE403	Electrical Machines - II Laboratory	0/0/2	2	1	40/60	PCC
8	23EE404	Control Systems Laboratory	0/0/2	2	1	40/60	PCC
9	23MC1XX	Mandatory Course III	1/0/0	1	0	0/100	MC
		Total	**14/0/16 (0r) 17/0/10**	**30 (0r) 27**	**21**	**900**	

SEMESTER V

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Ext/Int	Cat.
1	23EE501	Generation, Transmission and Distribution	3/0/0	3	3	60/40	PCC
2	23EE502	Power Electronics	3/0/0	3	3	60/40	PCC
3	23EE503	Virtual Instrumentation	1/0/4	5	3	50/50	PCC
4	23EE0XX	Open Elective-II	1/0/4 (or) 3/0/0	5 (or) 3	3	50/50 (0r) 60/40	OEC
5	23EE9XX	Professional Elective-II	3/0/0	3	3	60/40	PEC
6	23EC504	Internet of Things	3/0/0	3	3	60/40	PCC
7	23EE504	Power Electronics Laboratory	0/0/2	2	1	40/60	PCC
8	23EE505	Mini Project I	0/0/4	4	2	40/60	PROJ
9	23MC1XX	Mandatory Course IV	1/0/0	1	0	0/100	MC
		Total	**15/0/14 (or) 17/0/10**	**29 (or) 27**	**21**	**900**	

SEMESTER VI

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Ext/Int	Cat.
1	23EE601	Power System Analysis	3/0/0	3	3	60/40	PCC
2	23EE0XX	Emerging Elective-I	3/0/0	3	3	60/40	EEC
3	23EE0XX	Open Elective-III	1/0/4 (or) 3/0/0	5 (or) 3	3	50/50 (or) 60/40	OEC
4	23EE9XX	Professional Elective-III	3/0/0	3	3	60/40	PEC
5	23EE0XX	Open Elective- IV	1/0/4 (or) 3/0/0	5 (or) 3	3	50/50 (or) 60/40	OEC
6	23EC611	Wireless Communication	3/0/2	5	4	50/50	PCC
7	23EE602	Power System Simulation Laboratory	0/0/2	2	1	40/60	PCC
8	23EE603	Mini Project - II	0/0/4	4	2	40/60	PROJ
9	23EES01	Employment Enhancement Skills		-	2	40/60	EES
		Total	**14/0/16 (or) 18/0/08**	**30 (or) 26**	**24**	**900**	

SEMESTER VII

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Ext/Int	Cat.
1	23EE701	Power System Protection and Switchgear	3/0/0	3	3	60/40	PCC
2	23MG701	Engineering Economics	3/0/0	3	3	60/40	HSMC
3	23EE9XX	Professional Elective-IV	3/0/0	3	3	60/40	PEC
4	23EE0XX	Professional Elective-V	3/0/0	3	3	60/40	PEC
5	23EE0XX	Professional Elective-VI	3/0/0	3	3	60/40	PEC
6	23EE702	Digital Simulation of Electrical Systems Laboratory	0/0/2	3	1	40/60	PCC
		Total	**15/0/2**	**18**	**16**	**600**	

SEMESTER VIII

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Ext/Int	Cat.
1	23EE801	Project	0/0/24	24	12	40/60	PROJ
		Total	**0/0/24**	**24**	**12**	**100**	

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

S.No	Stream	Credits/Semester								Credits	Courses			%
		I	II	III	IV	V	VI	VII	VIII		Theory	Theory Cum Lab	Lab	
1.	Humanities and Social Sciences Including Management (HSMC)	1	4	3	-	-	-	3	-	**11**	4	1	-	6.79
2.	Basic Science Courses (BSC)	13	4	4	-	-	-	-	-	**21**	5	-	1	12.96
3.	Engineering Science Courses (ESC)	11	6	-	-	-	-	-	-	**17**	1	4	1	10.49
4.	Professional Core Courses (PCC)	-	7	15	15	13	8	4	-	**62**	11	6	8	38.27
5.	Professional Elective Courses (PEC)	-	-	-	3	3	3	9	-	**18**	6	-	-	11.11
6.	Open Elective Course (OEC) / Emerging Elective Course (EEC)	-	-	-	3	3	9	-	-	**15**	6	-	-	9.26
7.	Project Work (PROJ) / Employability Enhancement Skills (EES)	-	-	-	-	2	4	-	12	**18**	-	-	3	11.11
8.	Mandatory Courses (MC)	0	0	-	0	0	-	-	-	**0**	4	-	-	0.00
	Total	25	21	22	21	21	24	16	12	**162**	37	11	13	100

CURRICULUM STRUCTURE FOR UG DEGREE PROGRAMME

S.No	Course Work – Subject Area	AICTE Suggested Breakdown of Credits	SKCET Credits
1.	Humanities and Social Sciences (HS), including Management Courses	12*	11
2.	Basic Sciences (BS) including Mathematics, Physics, Chemistry, Biology	26*	21
3.	Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/ Electronics / Mechanical/ Computer Engineering, Instrumentation	20*	17
4.	Professional Subjects - Core (PC), relevant to the chosen specialization/branch	53*	62
5.	Professional Subjects - Electives (PE), relevant to the chosen specialization/ branch;	18*	18
6.	Open Subjects - Electives (OE), from other technical and/or emerging subject areas	18*	15
7.	Project Work, Seminar and/or Internship in Industry or elsewhere	11*	16
8.	Employability Enhancement Skills	-	2
9.	Mandatory Courses (MC)	Non-credit	Non-credit
	Total	**158***	**162**

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT (11 Credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
1.	23TA101	Heritage of Tamils	1/0/0	1	1	HSMC
2.	23TA201	Tamils and Technology	1/0/0	1	1	HSMC
3.	23EN101	Oral and Written Communication Skills	2/0/2	4	3	HSMC
4.	23GE301	Universal Human Values	3/0/0	3	3	HSMC
5.	23MG701	Engineering Economics	3/0/0	3	3	HSMC

BASIC SCIENCE COURSES (21 Credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
1.	23SB102	Biology for Engineers	3/0/0	3	3	BSC
2.	23MA101	Mathematics I	3/1/0	4	4	BSC
3.	23AS101	Applied Science	4/0/0	4	4	BSC
4.	23AS103	Applied Science Laboratory	0/0/4	4	2	BSC
5.	23MA201	Mathematics II	3/1/0	4	4	BSC
6.	23MA302	Mathematics III	3/1/0	4	4	BSC

ENGINEERING SCIENCE COURSES (17 Credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
1.	23EE101	Basics of Electrical Circuits	3/1/0	4	4	ESC
2.	23IT101	Application Development Practices	1/0/4	5	3	ESC
3.	23CS101	Problem Solving using C++	1/0/4	5	3	ESC
4.	23EE102	Basics of Electrical Circuits Laboratory	0/0/2	2	1	ESC
5.	23CD201	Database Management Systems	1/0/4	5	3	ESC
6.	23CY201	Java Programming	1/0/4	5	3	ESC

PROFESSIONAL CORE COURSES (62 Credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
1.	23EE201	Measuring Instruments and Smart Sensors	3/0/0	3	3	PCC
2.	23EE202	Electronic Devices and Integrated Circuits	3/0/0	3	3	PCC
3.	23EE203	Electronic Devices and Integrated Circuits Laboratory	0/0/2	2	1	PCC
4.	23EE301	Electrical Machines - I	3/0/0	3	3	PCC
5.	23EC202	Digital System Design	3/0/0	3	3	PCC
6.	23CS301	Advanced Java Programming	1/0/4	5	3	PCC
7.	23EC302	Operating Systems for Electronic Devices	3/0/2	5	4	PCC
8.	23EE302	Electrical Machines- I Laboratory	0/0/2	2	1	PCC
9.	23EC204	Digital System Design Laboratory	0/0/2	2	1	PCC
10.	23EE401	Electrical Machines-II	3/0/0	3	3	PCC
11.	23EE402	Control Systems	3/0/0	3	3	PCC
12.	23IT211	Introduction to Python Programming	1/0/4	5	3	PCC
13.	23EC404	Embedded C++	3/0/2	5	4	PCC
14.	23EE403	Electrical Machines-II Laboratory	0/0/2	2	1	PCC
15.	23EE404	Control Systems Laboratory	0/0/2	2	1	PCC
16.	23EE501	Generation, Transmission and Distribution	3/0/0	3	3	PCC
17.	23EE502	Power Electronics	3/0/0	3	3	PCC
18.	23EE503	Virtual Instrumentation	1/0/4	5	3	PCC
19.	23EC504	Internet of Things	3/0/0	3	3	PCC
20.	23EE504	Power Electronics Laboratory	0/0/2	2	1	PCC
21.	23EE601	Power System Analysis	3/0/0	3	3	PCC
22.	23EC611	Wireless communication	3/0/2	5	4	PCC
23.	23EE602	Power System Simulation Laboratory	0/0/2	2	1	PCC
24.	23EE701	Power System Protection and Switchgear	3/0/0	3	3	PCC
25.	23EE702	Digital Simulation for Electrical Systems Laboratory	0/0/2	2	1	PCC

PROFESSIONAL ELECTIVE COURSES (18 Credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
Elective Stream I – Power Engineering						
1.	23EE901	Electrical Power Fundamentals	3/0/0	3	3	PEC
2.	23EE902	Power System Restructuring	3/0/0	3	3	PEC
3.	23EE903	Power System Management and Monitoring	3/0/0	3	3	PEC
4.	23EE904	Power System Operation and Economics	3/0/0	3	3	PEC
5.	23EE905	Power Quality	3/0/0	3	3	PEC
6.	23EE906	High Voltage Engineering	3/0/0	3	3	PEC
7.	23EE907	Power System Dynamics	3/0/0	3	3	PEC
8.	23EE908	Distribution Automation Systems	3/0/0	3	3	PEC
9.	23EE909	Power System Automation	3/0/0	3	3	PEC
10.	23EE910	Residential and Commercial Electrical Systems	3/0/0	3	3	PEC
Elective Stream II – Applied Electronics						
1.	23EE911	Process Control and Instrumentation	3/0/0	4	3	PEC
2.	23EE912	Avionics Technology	3/0/0	3	3	PEC
3.	23EE913	Nano Technology	3/0/0	3	3	PEC
4.	23EE914	Principles of Communication Engineering	3/0/0	3	3	PEC
5.	23EE915	Green Electronics	3/0/0	3	3	PEC
6.	23EE916	Biomedical Electronic Systems	3/0/0	3	3	PEC
7.	23EE917	Integrated Optoelectronics Devices and Circuits	3/0/0	3	3	PEC
8.	23EE918	Optical Sensor Technology	3/0/0	3	3	PEC
9.	23EE919	Flexible and Stretchable Electronics	3/0/0	3	3	PEC
10.	23MT910	Product Based Design	3/0/0	3	3	PEC
Elective Stream III – Embedded Systems						
1.	23EE921	VLSI Design	3/0/0	3	3	PEC
2.	23EE922	Embedded System Design using ARM	3/0/0	3	3	PEC
3.	23EE923	Machine Learning for Embedded Applications	3/0/0	3	3	PEC
4.	23EE924	Embedded System Programming	3/0/0	3	3	PEC
5.	23EE925	Embedded System design process	3/0/0	3	3	PEC
6.	23EE926	Embedded Systems for Automotive Applications	3/0/0	3	3	PEC
7.	23EE927	Embedded Systems in Smart Grid	3/0/0	3	3	PEC
8.	23EE928	FPGA Based System Design	3/0/0	3	3	PEC
9.	23EE929	Embedded Control for Electrical Drives	3/0/0	3	3	PEC
10.	23EE930	Intelligent Control and Automation	3/0/0	3	3	PEC

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
Elective Stream IV – Converter and Drives						
1.	23EE931	Design of Electrical Machines	3/0/0	3	3	PEC
2.	23EE932	Special Electrical Machines	3/0/0	3	3	PEC
3.	23EE933	PLC, SCADA and Automation	3/0/0	3	3	PEC
4.	23EE934	Servo Drives in Robotics	3/0/0	3	3	PEC
5.	23EE935	Modern Power Converters	3/0/0	3	3	PEC
6.	23EE936	Industrial Management in Power Electronics	3/0/0	3	3	PEC
7.	23EE937	Electric Traction and Control	3/0/0	3	3	PEC
8.	23EE938	Intelligent Controllers for Drone Technology	3/0/0	3	3	PEC
9.	23EE939	Applications of Power Electronics in Power Systems	3/0/0	3	3	PEC
10.	23EE940	Evolutionary Algoithms for Optimal Control Techniques	3/0/0	3	3	PEC
Elective Stream V – Renewable Energy Systems						
1.	23EE941	Optimal Energy Controllers	3/0/0	3	3	PEC
2.	23EE942	Renewable Energy and Storage System	3/0/0	3	3	PEC
3.	23EE943	Power Electronics for Renewable Energy System	3/0/0	3	3	PEC
4.	23EE944	Sustainable Green Energy System	3/0/0	3	3	PEC
5.	23EE945	Design and modeling of RES Components	3/0/0	3	3	PEC
6.	23EE946	Hybrid Smart grid Technology	3/0/0	3	3	PEC
7.	23EE947	Fuel Cell and Biogas System	3/0/0	3	3	PEC
8.	23EE948	Building Integrated PV System	3/0/0	3	3	PEC
9.	23EE949	Industrial Electrification using RES	3/0/0	3	3	PEC
10.	23EE950	Hybrid Wind and Solar Electric Systems	3/0/0	3	3	PEC
Elective Stream VI – E-Mobility						
1.	23EE951	Electric Vehicle Technology	3/0/0	3	3	PEC
2.	23EE952	Vehicle Design and Fabrication	3/0/0	3	3	PEC
3.	23EE953	Vehicle Charging Infrastructure	3/0/0	3	3	PEC
4.	23EE954	Energy Management and Efficiency	3/0/0	3	3	PEC
5.	23EE955	Autonomous Electric Vehicle	3/0/0	3	3	PEC
6.	23EE956	Electric Motor Design and Optimization	3/0/0	3	3	PEC
7.	23EE957	Vehicle-to-Grid Integration	3/0/0	3	3	PEC
8.	23EE958	Renewable Energy Integration with EV Charging	3/0/0	3	3	PEC
9.	23EE959	Plug-in Hybrid Electric Vehicles (PHEV)	3/0/0	3	3	PEC
10.	23EE960	Electric Vehicle Cyber security	3/0/0	3	3	PEC

OPEN ELECTIVE COURSES (12 Credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
		Stream - I				
1.	23EE001	Residential Electrical Systems	3/0/0	3	3	OEC
2.	23EE002	Autonomous Vehicles	3/0/0	3	3	OEC
3.	23EE003	Special Purpose Machines	3/0/0	3	3	OEC
		Stream - II				
4.	23EE004	Renewable Energy Sources	3/0/0	3	3	OEC
5.	23EE005	Servo and Robot Drives	3/0/0	3	3	OEC
6.	23EE006	Industrial Safety Management	3/0/0	3	3	OEC

EMERGING ELECTIVE COURSES (6 Credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
		Stream - I				
1.	23EE007	Machine Learning Applications in Energy Systems	3/0/0	3	3	EEC
2.	23EE008	Big Data Analytics for Smart Grid	3/0/0	3	3	EEC
3.	23EE009	Grid Integration of EV	3/0/0	3	3	EEC
		Stream - II				
4.	23EE010	Real Time Systems	3/0/0	3	3	EEC
5.	23EE011	Rapid System Prototyping with FPGAs	3/0/0	3	3	EEC
6.	23AD007	AR/VR Programming	3/0/0	3	3	EEC

MANDATORY COURSES (0 credits)

S.No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	C	Cat.
1.	23MC101	Induction Program	3 weeks		0	MC
2.	23MC102	Environmental Sciences	2/0/0	2	0	MC
3.	23MC103	Soft Skills	2/0/0	2	0	MC
4.	23MC104	Management Organizational Behavior	2/0/0	2	0	MC
5.	23MC105	General Aptitude	2/0/0	2	0	MC
6.	23MC106	Life Skills and Ethics	2/0/0	2	0	MC
7.	23MC107	Stress Management	2/0/0	2	0	MC
8.	23MC108	Constitution of India	2/0/0	2	0	MC
9.	23MC109	Essence of Indian Traditional Knowledge	2/0/0	2	0	MC
10.	23MC110	Spoken English	2/0/0	2	0	MC

VALUE ADDED COURSES / ONE CREDIT COURSES (4 Credits)

S.No	Course Code	Course Title	Credits
1.	23VA301	Solar Energy Technology	2
2.	23VA302	Industry 4.0 using Industrial Internet of Things	2
3.	23VA303	Microgrid Technology	2
4.	23VA304	FPGA-based Switched Mode Power Converters	2
5.	23VA305	Phase-Locked Loop Circuit Design	2
6.	23VA306	Substation Designing	2
7.	23VA307	Contemporary Digital Techniques	2
8.	23VA308	Recent Power Electronics and Control	2
9.	23VA309	Neuro-Instrumentation	2
10.	23VA504	Massive Open Online Courses (MOOC) / NPTEL	1

EMPLOYABILITY ENHANCEMENT SKILLS (2 Credits)

S.No	Course Code	Name of the Course	L/T/P	Contact Hrs/Wk	C	Cat.
1.	23EES01	Industrial Practice (14 days - 1 Credit) / Publications in Journals(National and International -1 Credit)	-	-	2	EES

SEMESTER WISE CREDIT DISTRIBUTION

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	25	21	22	21	21	24	16	12	162

Total Credits: 162

L: Lecture   **T:** Tutorial   **P:** Practical   **C:** Credit   **Cat.:** Category   **Hrs/Wk:** Hours/Week

HSMC : Humanities and Social Sciences (including Management Courses)

OEC : Open Elective Courses

BSC : Basic Science Courses

PROJ : Project Work

ESC : Engineering Science Courses

EEC : Emerging Elective Courses

PCC : Professional Core Courses

MC : Mandatory Course

PEC : Professional Elective Courses

EES : Employability Enhancement Skills

23SB102		**Biology for Engineers**	3/0/0/3
Nature of Course		C (Theory Concept)	
Course Pre-requisites		NIL	

Course Objectives:

1	To grasp and apply biological engineering principles, procedures needed to solve real-world problems.
2	To give a basic knowledge of the applications of biological systems in relevant Industries.
3	To understand the mutual dependence of modern biology and engineering.
4	To give a basic knowledge of artificial organs and physiological assist devices.
5	To understand about the use of various nanomaterials towards biological applications.

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

C102.1	Understand the structure of human physiology and functioning of artificial organs inside the human being.	[U]
C102.2	Analyse the structures of biological and artificial neural networks.	[A]
C102.3	Apply the concept of Brain computer interface in different applications.	[AP]
C102.4	Integrate the knowledge of Nanomaterials for biotechnology.	[AP]
C102.5	Apply the perceptions of Nano devices for diagnosis and therapy.	[AP]

Course Contents:

Module 1: Human Physiology and Artificial Organs   **15 Hrs**
Cell and their structure - Transport of ions through cell - Respiratory Systems, Cardiovascular systems, Immune System - Introduction and application of Artificial neural networks - Artificial Kidney - Artificial Pancreas - Artificial Liver - Artificial heart valves – Case study on Artificial intelligence artificial organs.

Module 2: Brain Computer Interface   **15 Hrs**
Fundamentals of BCI - Working of BCI - Classification of BCI - Sensory Interface - Cognitive Interface - Measuring of surgical and non-surgical BCI - Neuro feedback Training for BCI Control signal processing and application - Case study on BCI for treatment of brain diseases.

Module 3: Nanobiology   **15 Hrs**
Introduction to Nanobiology - Nanomaterials for antimicrobial coatings - medical implants -medical and defense textiles - Biosensors - Nanomaterials for diagnosis and therapy - Implications of Drug delivery - various forms of nanocarriers - Targeted drug delivery – Case study on nanocarriers in drug delivery.

	Total Hours	**45**

Text Books:

1	Fowler, Samantha, Roush, Rebecca, Wise, James, "Concepts of Biology", Hong Kong: Samurai Media Limited, 2018.
2	Miller, Gerald E, "Artificial Organs", United States: Morgan & Claypool Publishers, 2006.
3	Rao, Rajesh P. N. "Brain-Computer Interfacing: An Introduction". United Kingdom, Cambridge University Press, 2013.
4	Ramsden, Jeremy, and Ramsden, Jeremy, "Nano technology: An Introduction", Elsevier Science, 2016.

Reference Books:

1	Johnson, Arthur T. "Biology for Engineers", Second Edition. United States: CRC Press, 2018.
2	Ertel, Wolfgang "Introduction to Artificial Intelligence", Germany: Springer International Publishing, 2018.
3	Chakraborty, Tanushree, Akhtar, Nasim "Biology for Engineers", PHI learning Pvt. Ltd., 2021.
4	Colomer-Farrarons, Jordi,"Portable Bio-Devices: Design of Electrochemical Instruments

from Miniaturized To Implantable Devices", Croatia, IntechOpen, 2011.	
Web References:	
1	https://ocw.mit.edu/courses/biological-engineering/20-010j-introduction-to-bioengineering-be-010j-spring-2006/videos/Lecture-1-bioengineering/
2	https://www.technicalsymposium.com/alllecturenotes_biomed.html
3	https://ocw.mit.edu/courses/biology/7-28-molecular-biology-spring-2005/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)
Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C102.1	Understand	Online Quiz	20
C102.2	Analyze	Class Presentation	20
C102.3	Apply	Assignment I	20
C102.4	Apply	Mini Project	20
C102.5	Apply		

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	10	20	10
Understand	30	40	40
Apply	30	40	30
Analyse	30	-	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C102.1	3				1	1	1		1			2	2	1	1
C102.2	3	1	1	1	1	1	1		1			2	2	1	1
C102.3	3	1	1	1	1	1	1		1			2	2	1	1
C102.4	3	1	1	1	1	1	1		1			2	2	1	1
C102.5	3	1	1	1	1	1	1		1			2	2	1	1
1	Reasonably Agreed			2		Moderately Agreed				3		Strongly Agreed			

23EE101		**Basics of Electrical Circuits**	**3/1/0/4**
Nature of Course		G (Theory analytical)	
Course Pre-requisites		Nil	

Course Objectives:

1	To understand DC and AC circuits.
2	To learn network theorems and two port networks for circuit analysis.
3	To explore the transient and resonance response of different electrical circuit.

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

C101.1	Analyze the concepts in AC circuit and DC circuits.	[A]
C101.2	Derive the sinusoidal steady-state (single-phase and three-phase) response of AC Circuits	[AP]
C101.3	Apply network theorems for the analysis of DC electrical circuits.	[AP]
C101.4	Examine two port circuit behavior.	[A]
C101.5	Investigate the transient and resonance response of electrical circuits.	[A]

Course Contents:

Module 1: DC Circuits and AC Circuits   **20 Hrs**
DC Circuits : Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's current and voltage laws, Resistor in series and parallel, Voltage division, Current division, Star-delta transformation, Mesh and Nodal analysis. A**C Circuits :** Representation of sinusoidal waveforms, peak and rms values, Phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), Three phase balanced circuits - voltage, current, power relations in star and delta connections.

Module 2: Network Theorems and Two Port Networks   **20 Hrs**
Network Theorems for DC Circuits : Superposition theorem, Thevenin's theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem. Analysis with dependent current and voltage sources. Concept of duality and dual networks. **Two Port Networks :** Basics of two port networks - impedance parameters, admittance parameters, transmission parameters and hybrid parameters.

Module 3: Transients and Resonance Analysis   **20 Hrs**
Transients : Steady State and Transient response - DC and AC Transients response of RL and RC Circuits using Laplace transforms - **Resonance :** Series Resonance - Bandwidth of an RLC circuit - Q factor, Magnification in Resonance. Parallel Resonance - Resonant frequency for a tank circuit factor of parallel resonance, magnification. **Coupled Circuits :** Self and mutually induced emf, coefficient of coupling, dot convention in coupled circuits.

	Total Hours	**60**

Text Books:

1	Joseph A. Edminister, Mahmood Nahvi, "Electric circuits", Schaum"s series, McGraw-Hill, 5th Edition, New Delhi ,2020.
2	William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", TMH publishers, 8th Edition, New Delhi, 2017.
3	M. E. Van Valkenburg, "Network Analysis", Phi Learning, 3/E 3rd Edition, 2014.

Reference Books:

1	Charles K. Alexander, Mathew N.O. Sadik, "Fundamentals of Electric Circuits", 3rd Edition, McGraw Hill, 2017.
2	Robins & Miller, "Circuit analysis theory and practice", Delmar Publishers, 5th Edition, 2012.

3	J Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", Tata McGraw Hill, 2017.
Web References:	
1	http://www.electrical4u.com/circuit-analysis.html
2	http://www.technologystudent.com
3	http://www.allaboutcircuits.com
4	http://www.nptel.ac.in
Online Resources:	
1	http://www.electrical-knowhow.com/
2	https://www.edx.org/course/electricity-magnetism-part-1-ricex-phys102-1x-1
3	https://www.mooc-list.com/course/fundamentals-electrical-engineering-coursera
4	https://nptel.ac.in/course.php

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)				
Formative Assessment based on Capstone Model				
Course Outcome	**Bloom's Level**	**Assessment Component**		**FA (16%) [80 Marks]**
C101.1	Analyze	Assignment		20
C101.2	Apply			20
C101.3	Apply	Simulation		20
C101.4	Analyze	Class Presentation		
C101.5	Analyze	Quiz		20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	**[100 Marks]**
Remember	10	10	10
Understand	30	40	40
Apply	30	30	30
Analyse	30	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination					
Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C101.1	2	1			2							2	3	3	
C101.2	3	2	1	1	2							2	3	3	
C101.3	3	2	1	1	2							2	3	3	
C101.4	2	1			2							2	3	3	
C101.5	2	1			2							2	3	3	
1	Reasonably Agreed		2	Moderately Agreed			3	Strongly Agreed							

23MA101	Mathematics I (Common to all Branches)	3/1/0/4
Nature of Course	J(Problem Analytical)	
Course Pre-requisites	-	

Course Objectives:

1	To use logical notation to define the fundamental data types and structures used in computer algorithms and systems.
2	To use the concepts of graph theory in practical situations.
3	To acquire thorough knowledge of fundamental notions of proof's and its application in Cryptography.
4	To analyse data pertaining to discrete and continuous random variables to interpret the results.
5	To impart the knowledge of counting principles, to think critically and apply it in real world problems.

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

C101.1	Recall the basic concepts of logical laws, structures and probability.	[R]
C101.2	Understand the concepts of proof techniques, structures and random variables.	[U]
C101.3	Apply the logical and foundational structures of mathematics with an emphasis on writing proofs.	[AP]
C101.4	Apply the concepts of graph and number theory in cryptography.	[AP]
C101.5	Apply the probability concepts in transition from real problem to a probabilistic model.	[AP]

Course Contents:

Module 1: Logic Proofs and Functions   20 Hrs

Proofs: Definitions - Proof by cases - Proof by contradiction - Logical formulas - Propositions - Truth table - Logical operators - Tautologies and Contradictions – Contrapositive - Equivalences and implications - Predicates - Free and bound variables – Quantifiers - Universe of discourse - **Sets:** Basic sets - Operations on Sets – Law on Sets (without proof) - Cartesian product of sets. **Relations:** Binary relation -Types of relations and their properties - Relational matrix and graph of a relation - Equivalence relations - Partial ordering relation I **Functions:** Classifications of functions – Induction - Ordinary induction and Strong induction - Recursive data types - Definition of recursive and structural induction.

Module 2: Number Theory and Graph Theory   20 Hrs

Number Theory: Divisibility - Greatest common divisor - Euclid's algorithm - Prime numbers - Fundamental theorem of arithmetic - Modular arithmetic - Remainder arithmetic - Multiplicative inverses and cancelling - Relatively prime - Euler's theorem.- Chinese Reminder Theorem **Graph Theory:** Vertices and Degrees - Types of graphs - Handshaking theorem - Adjacency matrices - Walks and paths - Connectivity - Isomorphism - Directed acyclic graphs and scheduling –Matchings - The Stable marriage problem –Forests and trees - Spanning trees - Minimum weight spanning trees – Prim's algorithm - Kruskal's algorithm.

Module 3: Counting and Probability   20 Hrs

Sums and Asymptotics - Sums of Powers - Harmonic Numbers - Asymptotic Notation -The Division Rule - Counting Subsets - Sequences with Repetitions - The Pigeonhole Principle -Events and Probability Spaces - The Four Step Method - Conditional Probability - The Four-Step Method for Conditional Probability - The Law of Total Probability - Baye's theorem - Random Variables – Discrete and continuous random variables - Distribution Functions - Bernoulli Distribution - Uniform Distribution - Binomial Distribution - Great Expectations - Conditional Expectation - Linearity of Expectation - Infinite Sums - Expectations of Products.

	Total Hours	**60**

Text Books:	
1.	Tremblay J.P and Manohar R, "Discrete Mathematical Structures with applications to Computer Science", Tata McGraw–Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.
2.	Koshy. T, "Elementary Number Theory with Applications", Elsevier Publications, New Delhi, Second Edition, 2007.
3.	Eric Lehman, F. Thomson Leighton and Albert R. Meyer, "Mathematics for Computer Science", 14[th]Edition, MIT Open courseware, 2018.

Reference Books:	
1.	Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, —Discrete Mathematical Structures, sixth edition, Pearson Education Pvt Ltd., New Delhi, 2017
2.	Kenneth H. Rosen, - Discrete Mathematics and its Applications, Eight Edition, Tata McGraw – Hill Pub. Co. Ltd., New Delhi, Eight Edition, 2021.
3.	Thomas Koshy, —Discrete Mathematics with Applications, Elsevier Publications, 2004.
4.	P. Grimaldi, - Discrete and Combinatorial Mathematics: An Applied Introduction, Fifth Edition, Pearson Education sia, New Delhi, Fifth Edition, 2019.

Web References:	
1.	https://onlinecourses.nptel.ac.in/noc23_cs109/preview
2.	https://onlinecourses.nptel.ac.in/noc23_cs120/preview
3.	https://onlinecourses.nptel.ac.in/noc23_ma77/preview
4.	https://onlinecourses.nptel.ac.in/noc23_ma72/preview

Online Resources:	
1	https://www.coursera.org/specializations/discrete-mathematics
2	https://www.cs.ucdavis.edu/~rogaway/classes/20/fall21/mit-book.pdf
3	https://mathworld.wolfram.com/topics/DiscreteMathematics.html
4	https://mathworld.wolfram.com/topics/NumberTheory.html

Assessment Methods & Levels (based on Blooms' Taxonomy)					
Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C101.1	Remember	Quiz	20
C101.2	Understand	Presentation	20
C101.3 – C101.5	Apply	Tutorial	20
C101.3 – C101.5	Apply	Assignment	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C101.1	1	1											1		
C101.2	2	2											1		
C101.3	3	3													
C101.4	3	3											1		
C101.5	3	3													
1	Reasonably Agreed		**2**	Moderately Agreed			**3**	Strongly Agreed							

23AS101	**Applied Science** **(Common to B.E. CSD, CSE, CSE (CYBER SECURITY), ECE, EEE, MCT** **& B.Tech. AI&DS, IT**	4/0/0/4
Nature of Course	E (Theory based)	
Course Pre-requisites	Fundamental knowledge in applied sciences	

Course Objectives:	
1	To learn the fundamental concepts of physics and apply this knowledge to both scientific and engineering problems.
2	To make the students enrich basic knowledge in various fields such as Electrostatics and magnetism.
3	To understand the principle and applications of electrochemistry and Polymer science, and explore the knowledge of various energy sources and storage devices.
4	To understand the concepts of photophysical and photochemical processes in spectroscopy.

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

C101.1	Understand the principles of electrostatics and problems relating to electric field and electric potential.	[U]
C101.2	Realize the nature of magnets, properties and the magnetic effect of electric current.	[U]
C101.3	Describe the nature of electromagnetic wave and its propagation through different media and interfaces involved in different situations.	[AP]
C101.4	Understand the principle and working of reference electrodes, energy storage devices and polymer products in engineering fields.	[U]
C101.5	Interpret the principle and working of analytical techniques.	[AP]

Course Contents:

Module 1: Electrostatics: **15 Hrs**
Charges and their conservation; Coulomb's law - superposition principle. Electric field – electric field due to a point charge, electric field lines; electric dipole, electric field intensity due to a dipole - behaviour of a dipole in a uniform electric field. Electric potential - potential difference - electric potential due to a point charge and dipole - equipotential surfaces – electrical potential energy of a system of two point charges.
Electric flux-Gauss's law and its applications. Electrostatic induction-capacitor and capacitance – dielectrics- electric polarisation – parallel plate capacitor with and without dielectric – applications of capacitor – energy stored in a capacitor - Capacitors in series and in parallel – Van de Graaff generator.

Module 2: Magnetism   **15 Hrs**
Definitions of fundamental terms – Magnetic field around a current carrying conductor – Direction of magnetic field and current – Biot-Savart law and its application: Magnetic field due to Line charge – Ampere's law and its application: magnetic field due to a solenoid.
Electromagnetic Induction and Alternating Current:
Electromagnetic induction - Faraday's law - induced emf and current - Lenz's law. Self-induction - Mutual induction - self-inductance of a long solenoid - mutual inductance of two long solenoids. Methods of inducing emf - (i) by changing magnetic induction (ii) by changing area enclosed by the coil and (iii) by changing the orientation of the coil. AC generator - (Single phase, three phase). Eddy current - applications - transformer - Alternating current - AC circuit with resistance - AC circuit with inductor - AC circuit with capacitor - LCR series circuit - Resonance and Q - factor - power in AC circuits.

Module 3: Chemistry of Batteries and Polymers   **15 Hrs**
Chemistry of batteries-Introduction-Cells and its types-emf series-Nernst equation and its applications. Reference electrodes-standard hydrogen electrode, saturated calomel electrode, glass

electrode-pH-measurement. **Discussion of energy storage-**Lead acid, Nickel cadmium and Lithium-ion batteries-Energy Sources-Fuel cells (H_2-O_2). **Polymers-**Classifications-addition and condensation polymerization-free radical mechanism.

Atomic and molecular Spectroscopy: Beer Lambert's law, principle, instrumentation, and applications of electronic spectroscopy (UV-visible), Vibrational and rotational spectroscopy (IR) and atomic spectrum-Flame emission spectroscopy (FES).

	Total Hours	45

Text Books:

1.	Rajendran, V "Engineering Physics" Mc Graw Hill Publications ltd, New Delhi, 2017.
2.	David Halliday, Robert Resnick, Jearl Walker "Fundamentals of Physics", 11th edition, Wiley, 2018.
3.	Gaur, R.K. and Gupta, S.L., "Engineering Physics", DhanpatRai Publishers, 2017.
4.	Bhattacharya, D.K. and Poonam, T., "Engineering Physics", Oxford University Press, 2017.
5.	Dara S.S, Umare S.S, "Engineering Chemistry", First revised Edition by S. Chand & Company Ltd., New Delhi 2015.
6.	Jain P. C. & Monica Jain., "Engineering Chemistry", 17 th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, Reprint-2020.
7.	Fundamentals of Molecular Spectroscopy, 4 th Edition by C. N. Banwell Publishing McGraw-Hill Book Company (P) Ltd, England, 2001.

Reference Books:

1.	Avadhanulu M.N., Kshirshagar P.G., Arun Murthy TVS "A Text Book of Engineering Physics"S.Chand& Co Ltd, 2018.
2.	Sadiku M H, "Principles of Electromagnetics", Oxford University Press Inc.,New Delhi,2015
3.	R. Wolfson, "Essential University Physics", Volume 1 & 2. Pearson, 2020.
4.	S.O. Kasap, "Principles of Electronic Materials and Devices", McGraw Hill Education, 2017.
5.	David Griffiths 'Introduction to Electrodynamics' 4th Edition, Cambridge University Press 2017.
6.	Perez, Nestor," Electrochemistry and Corrosion Science", Springer, 2016.
7.	Ghazi A.Karim. "Fuels, Energy and the Environment", CRC Press, Taylor and Francis group, 2012.

Web References:

1.	https://nptel.ac.in/courses/115101005
2.	https://www.udemy.com/course/electrostatics-1-electric-charges-fields-and-related-laws/
3.	https://openlearninglibrary.mit.edu/courses/course-v1:MITx+8.02.1x+1T2019/about
4.	https://onlinecourses.nptel.ac.in/noc22_ph31/preview
5.	https://ocw.mit.edu/courses/8-02t-electricity-and-magnetism-spring-2005/
6.	https://unacademy.com/batch/legend-2o-for-jee-main-and-advanced-2022/7IXHRCZE/topics/WQCLD/courses/RAATL
7.	https://archive.nptel.ac.in/courses/108/106/108106073/
8.	https://www.kth.se/.../electrochem/welcome-to-the-division-of-applied-electrochemistry
9.	www.corrosionsource.com/
10.	https://www.sciencedirect.com/book/9780750646253/battery
11.	http://www.rnlkwc.ac.in/pdf/study-material/chemistry/Spectroscopy
12.	https://ocw.mit.edu/courses/chemistry
13.	nptel.ac.in/courses/105106112/1_introduction/5_corrosion.pdf
14.	https://ocw.mit.edu/courses/chemistry

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	Summative Assessment	Total			
80	120	200	40	60	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	Bloom's Level	Assessment Component	FA (10%) [80 Marks]
C101.1	Understand	Assignment - I	20
C101.2	Understand	Quiz - I	20
C101.3	Apply	Assignment - II	20
C101.4	Understand		
C101.5	Apply	Quiz - II	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C101.1	3	2	2		1							1			
C101.2	3	2	2		1							1			
C101.3	3	2	2	1	1							1			
C101.4	3	2	2		1							1			
C101.5	3	2	2	1	1							1			
1	Reasonably Agreed			2		Moderately Agreed				3			Strongly Agreed		

23TA101	Heritage of Tamils	1/0/0/1
Nature of Course	C (Theory Concept)	
Pre requisites	NIL	

Course Objectives:

1	To know various concepts of Tamil Language families.
2	To know about the essentialities of Heritage.
3	To understand the Aram concepts of Tamils and the cultural influence.

Course Outcomes :

Upon completion of the course, students shall have ability to

C101.1	Know about the language families in India, impact of religions and the contribution of Bharathiyar and Bharathidhasan.	[U]
C101.2	Observe the growth of sculpture, making of musical instruments and the role of temples in socio and economic lives.	[U]
C101.3	Understand the significance of folklore and martial arts.	[U]
C101.4	Learn the sangam literature, sangam age and overseas conquest of Cholas.	[U]
C101.5	Understand the contribution of Tamils to Indian Freedom Struggle, role of Siddha medicine and print history of Tamil Books.	[U]

Course Contents:

Module – I: Language and Literature   **5 Hours**

 Language Families in India - Dravidian Languages - Tamil as a Classical Language - Classical Literature in Tamil - Secular Nature of Sangam Literature - Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

Module – II: Heritage - Rock Art Paintings to Modern Art – Sculpture   **5 Hours**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils. **Folk And Martial Arts:** Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

Module – III : Thinai Concept of Tamils   **5 Hours**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas. Contribution of Tamils to Indian national movement and indianculture: Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

	Total Hours	**15**

Text Books:

1.	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2.	கணினித் தமிழ் – முனைவர் இல. சுந்தரம் . (விகடன் பிரசுரம்).
3.	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

5.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6.	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
10.	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author).
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
Reference Books:	
1.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**			
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C101.1	Understand	Quiz	20
C101.2	Understand	Seminar	20
C101.3	Understand	Seminar	20
C101.4	Understand	Quiz	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	40	40	40
Understand	60	60	60
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

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	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
C101.2	-	-	-	-	-	-	-	1	1	-	-	1	-	-	-
C101.3	-	-	-	-	-	-	-	1	1	-	-	1	-	-	-
C101.4	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
C101.5	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-

23IT101	**Application Development Practices**	1/0/4/3
Nature of Course	F (Theory programming)	
Course Pre-requisites	Nil	

Course Objectives:

1	To discuss the essence of agile development methods.
2	Ability to understand and apply Scrum framework.
3	To set up and create a GitHub repository.
4	To impart the knowledge of web application development platforms.
5	To create interactive websites using HTML, CSS.
6	To recognize the user experience design methodologies like Java script for responsive web design.

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

C101.1	Relate the concepts of agile software engineering and its advantages in software development.	[R]
C101.2	Demonstrate the roles and responsibilities of Scrum, Lean Software Development and how to setup the GitHub repository.	[U]
C101.3	Analyze the working model and learn basic web concepts to develop Static and Dynamic websites.	[A]
C101.4	Utilize the knowledge of HTML, CSS and Bootstrap using forms to build modern interactive web applications.	[AP]
C101.5	Develop dynamic web pages using HTML5 with validation using Java Script objects and by applying different event handling mechanisms.	[AP]

Course Contents:

Module 1:   **15 Hrs**

History of Traditional Software Development Model, Software Development Model and SDLC, "Waterfall Model" – An Overview, Waterfall or Sequential Based Development Model, "Real Life" – Waterfall Model, "Waterfall Model" – Advantages, "Waterfall Model" – Disadvantages, Agile Software Development – Definition, Agile Development Model, Graphical Illustration of Agile Development Model, Why use Agile?, Agile Manifesto and Principles, 12 Principles of Agile Methods, Agile Values, What is NOT an Agile software development?, Foundation of an Agile software development Method, Common Characteristics of Agile Methods, Agile Methods and Practices, When to use Agile Model?, Advantages of Agile Model, Disadvantages of Agile Model, Difference between Agile and Waterfall Model, Agile – Myths and Reality, Agile Market Insight. Introduction to SCRUM, Scrum Roles and Responsibilities, Scrum Core Practices and Artifacts, User Story, Sprint, Release Planning Meeting, Sprint Planning Meeting, Daily Scrum Meeting (Daily Stand up), Sprint Review Meeting, Retrospective, Product Backlog, Sprint Backlog, Burn-Down Chart, Velocity, Impediment Backlog. Definition of "Done", Splitting User Story into Task, Why to Split User Story into Task?, Guidelines for Breaking Down a User Story into Tasks, Examples of Scrum Task Board, Planning Poker®, Planning Poker - Process/Steps, What are Story Points?, How do We Estimate in Story Points?, What Goes into Story Points? Introduction to Extreme Programming, The Rules of Extreme Programming, Extreme Programming (XP) – Principles, Extreme Programming (XP) – Key Terms, Introduction to Lean Software Development, Principles of Lean Software Development, What is Kanban? Introduction to Git - Getting a Git Repository, Recording Changes to the Repository, Viewing the Commit History, Undoing Things, Working with Remotes, Tagging, Git Aliases, Git Branching, Branches in a Nutshell, Basic Branching and Merging, Branch Management, Remote Branches, Rebasing. Introduction to GitHub – Introduction, Set up Git, Create a repository, GitHub Flow, Contribution to Projects, Communicating on GitHub. Linux Basic Commands - Linux Basic Commands, Linux File Permissions, Basic System Administration,

Process Management, Archival. Linux Shell Script - Shell Basics, Writing first script, Conditional statements, Loops, Command line arguments, Functions & file manipulations, Background processes, Scheduling processes -At, batch & Cron -Networking.

Module 2:   **15 Hrs**

HTML Basics - Understand the structure of an HTML page, New Semantic Elements in HTML 5, Learn to apply physical/logical character effects, Learn to manage document spacing. Tables - Understand the structure of an HTML table, Learn to control table format like cell spanning, cell spacing, border. List - Numbered List, Bulleted List, Working with Links, Understand the working of hyperlinks in web pages, Learn to create hyperlinks in web pages, Add hyperlinks to list items and table contents. Image Handling - Understand the role of images in web pages, Learn to add images to web pages, Learn to use images as hyperlinks. Frames - Understand the need for frames in web pages, Learn to create and work with frames. HTML Forms for User Input - Understand the role of forms in web pages, Understand various HTML elements used in forms, Single line text field, Text area, Check box, Radio buttons, Password fields, Pull-down menus, File selector dialog box. New Form Elements - Understand the new HTML form elements such as date, number, range, email, search and data list, Understand audio, video, article tags.

Module 3:   **15 Hrs**

Introduction to Cascading Style Sheets - What CSS can do, CSS Syntax, Types of CSS. Working with Text and Fonts - Text Formatting, Text Effects, Fonts. CSS Selectors - Type Selector, Universal Selector, ID Selector, Class selector. Colors and Borders – Background, Multiple Background, Colors RGB and RGBA, HSL and HSLA, Borders, Rounded Corners, Applying Shadows in border, Implementing CSS3 in the "Real World" – Modernizr, HTML5 Shims, SASS, and Other CSS Preprocessors, CSS Grid Systems, CSS Frameworks. Introduction to Bootstrap – Introduction, Getting Started with Bootstrap, Bootstrap Basics, Bootstrap grid system, Bootstrap Basic Components, Bootstrap Components, Page Header, Breadcrumb, Button Groups, Dropdown, Nav & Navbars. JavaScript Essentials - Var, Let and Const keyword, Arrow functions, default arguments, Template Strings, String methods, Object de-structuring, Create, apply, prototype, bind method, Spread and Rest operator, Typescript Fundamentals, Types & type assertions, Creating custom object types, function types, Typescript OOPS - Classes, Interfaces, Constructor, Decorator & Spread Operator, Difference == & === , Asynchronous Programming in ES6, Promise Constructor, Promise with Chain, Promise Race

	Total Theory Hours	45

Lab Components

S.No	List of Experiments
1	Design a web page using HTML basic tags.
2	Develop web site with suitable contents and links.
3	Design web pages using lists and tables.
4	Build a web client-side Login, Registration form and Dashboard with drop down menus.
5	Develop a HTML form and validation using HTML5 features.
6	Create a website using HTML: To embed an image map in a web page. To fix the hot spots. Show all the related information when the hot spots are clicked.
7	Apply style specification in HTML page using CSS.
8	Develop dynamic web application using HTML, CSS and JavaScript.

	Total lab Hours	30
	Total Hours	**75**

	Text Books:	
1.	Roman Pichler, "Agile Product Management with Scrum Creating Products that Customers Love", Pearson Education, 1st Edition, 2010.
2.	Jeff Sutherland, "Scrum the Art of Doing Twice the Work in Half the Time", Random House Publisher, 1st Edition, 2014.
3.	Scott Chacon, Ben Straub, "Pro GIT", Apress Publisher, 3rd Edition, 2014.
4.	Richard Blum, Christine Bresnahan, "Linux Command Line and Shell Scripting BIBLE", Wiley India Pvt. Limited, 5th Edition, 2008.
5.	Jennifer Niederst Robbins., "Learning Web Design, A beginner's guide to HTML, CSS, JavaScript, and Web Graphics", O'Reilly Media, 5th Edition,2018.
6.	Jennifer Smith and the AGI Creative Team, "Web Design with HTML and CSS", Wiley Publisher, 1st Edition, 2011.
7.	Stephen Blumenthal, "JavaScript: JavaScript for Beginners - Learn JavaScript Programming with ease",1st Edition, 2017.
	Reference Books:	
1.	Robert C. Martin, "Agile Software Development, Principles, Patterns and Practices", Prentice Hall, 2nd Edition, 2014.
2.	Mike Cohn, "User Stories Applied: For Agile Software", Addison Wesley, 2nd Edition, 2016.
3.	Thomas a Powell, "HTML & CSS: The Complete Reference", 5th Edition, Tata McGraw Hill Education Private Limited, 2010.
4.	Russ Ferguson, "Beginning JavaScript: The Ultimate Guide to Modern JavaScript Development", Apress Publishers, 3rd Edition, 2019.
5.	Deitel, Deitel, Goldberg, "Internet and World Wide Web – How to program", 5th Edition, Prentice Hall Publishers, 2012.
	Web References:	
1.	https://www.coursera.org/specializations/agile-development
2.	https://www.edx.org/learn/agile
3.	https://nptel.ac.in/courses/106/105/106105182/
4.	https://developer.mozilla.org/en-US/docs/Web/HTML
5.	https://developer.mozilla.org/en-US/docs/Web/CSS
6.	https://developer.mozilla.org/en-US/docs/Web/JavaScript
	Online Resources:	
1.	http://www.agilenutshell.com/
2.	https://www.atlassian.com/agile/scrum
3.	https://www.youtube.com/user/AgileMikeCohn
4.	https://www.coursera.org/learn/html-css-javascript-for-web-developers
5.	https://online-learning.harvard.edu/subject/javascript

Continuous Assessment									End Semester Examination	Total
Theory				**Practical**			Total (A+B)	Total Continuous Assessment		
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**	**50**	**100**

Formative Assessment based on Capstone Model – Theory			
Course Outcome	Bloom's Level	Assessment Component	FA (10%) [80 Marks]
C101.1	Apply	Assignment – I	**20**
C101.2	Understand	Quiz	**20**

C101.3	Remember		**20**
C101.4	Apply	Case Study	**20**
C101.5	Apply	Assignment – II	

Assessment based on Summative and End Semester Examination - Theory

Bloom's Level	Summative Assessment (15%) [120 Marks]	
	CIA1: (60 Marks)	**CIA2: (60 Marks)**
Remember	40	20
Understand	30	30
Apply	30	50
Analyse	-	-
Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (50%) [100 Marks]
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	30	30	30
Understand	20	20	20
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)							End Semester Practical Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)	
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C101.1	2	2	1	1								2	3	2	2
C101.2	3	2	3	3	3	2						2	3	3	2
C101.3	3	2	3	3	3	2						2	3	3	2
C101.4	3	2	3	3	3	2						2	3	3	2
C101.5	3	2	3	3	3	2						1	3	3	2
1	Reasonably Agreed		2		Moderately Agreed			3			Strongly Agreed				

23CS101	Problem Solving using C++	1/0/4/3
Nature of Course	C (Theory Concept), K (Problem Programming)	
Course Pre-requisites	NIL	

Course Objectives:

1	To learn the fundamental programming concepts and methodologies which are essential to build good C++ programs.
2	To gain knowledge on control structures and functions in C++
3	To provide the basic object oriented programming concepts and apply them in problem solving.
4	To introduce file streams and operations for storing data permanently.
5	To know generic programming paradigm.

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

C101.1	Illustrate the fundamental concepts and methodologies required to develop a program for given problems.	[U]
C101.2	Develop a program for real-time problems with pointers and objects.	[AP]
C101.3	Apply the Constructors, destructors, and Overloading concepts to solve the solve.	[AP]
C101.4	Develop C++ programs with Interfaces, Exception and File processing	[AP]
C101.5	Implement the concepts on file streams, I/O and Lambda Expression.	[AP]

Course Contents:

Module 1: C++ Programming Fundamentals   **15 Hrs**
C vs C++, Basic of OOPS, the main () function, Header files, Basic Input and Output (I/O) using cin and cout, Variable, Constant. **Operators:** Arithmetic Operators, Assignment Operators, Relational Operators, Logical Operators, Bitwise Operators, Other Operators, Operator Precedence. Control Statements: if, if...else and Nested if...else, switch case, break and continue, Loops - for loop, while loop, do while loop, goto. **Arrays and Strings:** 1D array, 2D array, Strings, String functions. **Function:** Basics, call by value, call by reference & return by reference, Inline function, overloading Functions, inline Functions, Recursive Functions. **Pointers:** Pointer, Dynamic Memory Allocation.

Module 2: Object Oriented Concepts   **15 Hrs**
Classes and Objects, public, private, protected. **Constructors and destructors:** Overloaded Constructor, Copy Constructor, Shallow Copying Deep Copying. **Overloading:** this' Pointer, structs vs Classes, Friends of a class, Operator Overloading, Inheritance, Overloading vs overriding, Polymorphism, Virtual Functions, Pure Virtual Functions and Abstract Classes.

Module 3: Files and Generic Programming   **15 Hrs**
Abstract Classes as Interfaces, Exception, Files, Streams and I/O, STL, Generic Programming, Lambda Expression.

	Total Hours (Theory)	**45**

Lab Component

S.No	List of Experiments
1	Practice of C Programming using Branching and Iterative constructs.
2	Programs using arrays and strings
3	Programs using Functions
4	Programs using Structures and Pointers.
5	Programs using classes and objects

6	Programs using constructor and destructor
7	Programs using method overloading, operator overloading and polymorphism concepts.
8	Programs using friend class
9	Programs using virtual functions and abstract class.
10	Programs using inheritance concepts
11	Programs using exception handling concept
12	Programs using Files
13	Mini project

	Total Hours (Lab)	30
	Total Hours(45+30)	75

Text Books:

1	E Balagurusamy ,"Object Oriented Programming With C++", 4th Edition, Tata McGraw-Hill Education, 2008.
2	YashavantP. Kanetkar, "Let us C++", BPB Publications, 2020.
3	M. Sprankle, "Problem Solving and Programming Concepts", 9th Edition, Pearson Education, New Delhi, 2011

Reference Books:

1	Herbert Schildt, "The Complete Reference C++", 4th edition ,MH,2015
2	John Hubbard, "Schaum's Outline of Programming with C++", MH,2016

Web References:

1	https://www.geeksforgeeks.org/c-plus-plus/
2	http://web.stanford.edu/class/cs106l/

Online Resources:

1	https://nptel.ac.in/courses/106101208
2	https://www.hackerrank.com/domains/cpp
3	https://codeforces.com/blog/entry/74684
4	https://www.hackerearth.com/practice/notes/tricky-and-fun-programming-in-c/

Continuous Assessment									**End Semester Examination**	**Total**
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**		
Formative Assessment	**Summative Assessment**	**Total**	**Total (A)**	**Formative Assessment**	**Summative Assessment**	**Total (B)**				
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**	**50**	**100**

Formative Assessment based on Capstone Model – Theory			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (10%) [80 Marks]**
C101.1	Apply	Quiz	**20**
C101.2 & C101.3	Apply	Assignment I	**20**
C101.4	Analyze	Assignment II	**20**
C101.5	Apply	Case study	**20**

Assessment based on Summative and End Semester Examination - Theory		
Bloom's Level	**Summative Assessment (15%)** **[120 Marks]**	
	CIA1: (60 Marks)	**CIA2: (60 Marks)**
Remember	20	20
Understand	40	30
Apply	40	50
Analyse	-	-
Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	**Continuous Assessment (25%)** **[100 Marks]**		**End Semester Examination (50%)** **[100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	10	20	20
Understand	30	20	20
Apply	50	60	60
Analyse	10	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination							
Continuous Assessment (50%)							**End Semester Practical Examination (50%)**
CA 1 (100 Marks)			**CA 2 (100 Marks)**			**Practical Exam (100 Marks)**	
	FA 1			**FA 2**			
SA 1 (60M)	**Component-I (20 Marks)**	**Component-II (20 Marks)**	**SA 2 (60M)**	**Component-I (20 Marks)**	**Component-II (20 Marks)**	**FA (75M)** / **SA (25M)**	

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C101.1	3	3											3		
C101.2	3	3	3	2	2				2	1		3	3	2	1
C101.3	3	3	3	2	3				2	1		3	3	2	1
C101.4	3	3	3	3	3				3	2		3	3	2	2
C101.5	3	3	3	3	3				2	2		2	3	2	1
C101	**3**	**3**	**3**	**3**	**3**				**3**	**2**		**2**	**3**	**2**	**2**
1	Reasonably Agreed			2		Moderately Agreed			3			Strongly Agreed			

23EE102	Basics of Electrical Circuits Laboratory	0/0/2/1
Nature of Course	M (Practical application)	
Pre-requisites	Nil	

Course Objectives:

1	To implement the basic DC and AC Electric Circuits.
2	To estimate the current flow and voltage across the circuit elements using different theorems.
3	To understand the frequency and transient response of electric circuit.

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

C102.1	Estimate voltage and current by KVL and KCL in an Electric Circuit.	[A]
C102.2	Verify the current flow and voltage across the circuit elements using different analysis method.	[A]
C102.3	Determine frequency and transient response of electric circuit.	[U]
C102.4	Analyze the different electrical circuits by simulation	[A]
C102.5	Measure three phase power in a three phase AC circuits.	[AP]

Course Contents:

S.No	List of Experiments	CO Mapping	RBT
1	Estimation of voltage and current by KVL and KCL in an Electric Circuit.	C102.1	[A]
2	Determination of mesh current and node voltage by Mesh and Nodal Analysis	C102.1	[A]
3	Apply Superposition Theorem in Electrical Circuits	C102.3	[AP]
4	Apply Reciprocity Theorem in Electrical Circuits	C102.3	[AP]
5	Application of Thevenin's theorem for Maximum Power Transfer	C102.3	[AP]
6	Apply Norton Theorem in Electrical Circuits	C102.3	[AP]
7	Determination of series and parallel resonance frequency response of circuits.	C102.5	[U]
8	Determination of transient current in RL, RC and RLC circuits	C102.5	[U]
9	Verification of circuit analysis by simulation	C102.4	[A]
10	Measurement of three phase power	C102.5	[AP]
	Total Hours	**30**	

Text Books:

1	Joseph A. Edminister, Mahmood Nahvi, "Electric circuits", Schaum"s series, McGraw- Hill, 5th Edition, New Delhi ,2020.
2	William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", TMH publishers, 8th Edition, New Delhi, 2017.
3	M. E. Van Valkenburg, "Network Analysis", Phi Learning, 3/E 3rd Edition, 2014.

Reference Books:

1	Charles K. Alexander, Mathew N.O. Sadik, "Fundamentals of Electric Circuits", 3rd Edition, McGraw Hill, 2017.
2	Robins & Miller, "Circuit analysis theory and practice", Delmar Publishers, 5th Edition, 2012.
3	J Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", Tata McGraw Hill, 2017.

Web References:

1	http://www.electrical4u.com/circuit-analysis.html
2	http://www.technologystudent.com
3	http://www.allaboutcircuits.com
4	http://www.nptel.ac.in

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember	0	0	0
Understand	20	20	20
Apply	30	30	30
Analyse	30	30	30
Evaluate	20	20	20
Create	0	0	0

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C102.1	3	2	1	1			1	2	2	2			3		3
C102.2	3	2	1	1			1	2	2	2			3		3
C102.3	3	3	2	2			1	2	2	2			3		3
C102.4	3	2	1	1			1	2	2	2			3		3
C102.5	2	1			3								3	2	
1	Reasonably Agreed		2		Moderately Agreed			3		Strongly Agreed					

23AS102	**Applied Science Laboratory** **(Common to B.E. CSD, CSE, CSE (CYBER SECURITY), ECE, EEE, MCT &** **B.Tech. AI&DS, IT**	0/0/4/2

Nature of Course	E (Skill based)
Pre-requisites	Basic Applied Science laboratory skills

Course Objectives:

1	To carry out experiments to understand the basic laws of magnetism.
2	To Understand of how objects become electrically charged and how electrical charge is transferred from one object to another.
3	To understand the principles and applications of electrochemistry and learning electro-analytical methods, and explore the knowledge of various energy sources and storage devices.
4	To understand the concepts of photo-physical and photochemical processes in spectroscopy.

Course Outcomes:

Upon completion of the course, students shall have ability to

C102.1	To determine the magnetic field around a current carrying conductor	[E]
C102.2	To determine the rate of growth or decay in a resistor -capacitor circuit and to estimate the resonant frequency and Q-factor.	[E]
C102.3	To determine the relationship between the magnetic flux density and the magnetizing field strength and to find the specific resistance of the wire.	[E]
C102.4	To determine the pH, single electrode potential using reference electrodes and Electroplating process based on electrolytic cell.	[E]
C102.5	Interpret the principle and working of Spectroscopic technique.	[E]

Course Contents:

S.No	**List of Experiments**	RBT
1	Determination of Magnetic field along the axis of current carrying coil- Stewart and Gee method.	[E]
2	Determination of characteristics of RC circuit to find the time constant.	[E]
3	Determination of characteristics of LCR circuits.	[E]
4	Determination of Hysteresis loss.	[E]
5	Determine the Specific resistance- Carey fosters bridge	[E]
6	Determination of strength of strong acid by pH metry.	[E]
7	Estimation of dissolved oxygen in waste water using Winkler's method.	[E]
8	Determination of single electrode potential of Zinc and Copper by Potentiometric method.	[E]
9	Determination of cathode efficiency of Nickel using electroplating process.	[E]
10	Spectrophotometry-Estimation of iron in sample water.	[E]
	Total Hours	**30**

Text Books:

1	Anoop Sing Yadav "Applied Physics Lab Manual" Vayu Education of India Publisher, 2018.
2	Sesha Sai Kumar Vemula, Manual for Experiments in Engineering Physics, LAP LAMBERT Academic Publishing 2017
3	C. S. Robinson, Dr. Ruby Das, "A text book of Engineering practical physics", Laxmi Publications Pvt. Ltd., 2016.
4	S.L.Gupta and V Kumar "Practical Physics Volume -II", Pragati Prakashan ., 2023.
5	Method of Sampling and Test (Physical and Chemical) for Water and Wastewater- Iron, 2003, Part-53; First Revision.
6	Method of Sampling and Test (Physical and Chemical) for Water and Wastewater: pH Value (2001; Part-50; Coagulation Test).

7	Method of Sampling and Test (Physical and Chemical) for Water and Wastewater, Chemical Oxygen Demand, 2012, Part-58.
8	Science and Technology Laboratory Manual. E-Book. NIOS, 2012.

Reference Books:

1	Dr. Ruby Das and Prashant Kumar Sahu,A Textbook of Engineering Physics Practical , 2016,2nd Edition
2	S.L.Gupta and Dr.V.Kumar, "Practical physics with viva voice", PragatiPrakashan Publishers, Revised Edition, 2009.
3	M.N.Avadhanulu, A.A.Dani and Pokely P.M, "Experiments in Engineering Physics", S.Chand&Co,2008.
4	Sawyer, C. N., McCarty, P. L., and Parkin, G. F. 2000. Chemistry for Environmental Engineering. Fourth Edition, McGraw-Hill, Inc., New York.
5	American Public Health Association et al, Standard Methods for the Examinations of Water and Waste Water, APHA. 1998.
6	AWWA, WEF, APHA, 1998, Standard Methods for the Examination of Water and Wastewater (Method: 5210B,BOD).

Web References:

1	https://vlab.amrita.edu/
2	https://bop-iitk.vlabs.ac.in/basics-of-physics/
3	http://vlabs.iitb.ac.in/
4	https://www.iitg.ac.in/
5	https://ee1-nitk.vlabs.ac.in/exp/determination-of-ph/simulation.html
6	https://ee1-nitk.vlabs.ac.in/exp/determination-of-biological-oxygen/simulation.html
7	https://www.youtube.com/watch?v=pORJQyP-2j8
8	https://ee1-nitk.vlabs.ac.in/exp/determination-of-ph/simulation.html
9	https://ee1-nitk.vlabs.ac.in/exp/determination-of-ph/simulation.html

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

ssessment based on Continuous and End Semester Examination			
Bloom's Level	Continuous Assessment (60%) [100 Marks]		End SemesterPractical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember	0	0	0
Understand	10	10	10
Apply	30	30	30
Analyze	30	30	30
Evaluate	30	30	30
Create	0	0	0

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C102.1	3	2	1	2					2			1	1		
C102.2	3	2	1	2					2			1	1		
C102.3	3	2	1	2					2			1	1		
C102.4	3	2	1	2					2			1	1		
C102.5	3	2	1	2					2			1	1		
1	Reasonably Agreed				2	Moderately Agreed					3	Strongly Agreed			

23EE201		**Measuring Instruments and Smart Sensors**	**3/0/0/3**
Nature of Course		D (Theory Application)	
Course Pre-requisites		Nil	
Course Objectives:			
1		To state the fundamental concepts of measurements and instruments.	
2		To explore the operation of different bridges and transducers in real time.	
3		To design aspects and performance criterion of optical and advanced sensors and instruments employed in industry.	
Course Outcomes:			
Upon completion of the course, students shall have ability to			
C201.1		Summarize the general measurement instruments techniques.	[U]
C201.2		Identify the instruments for measuring various electrical parameters.	[U]
C201.3		Analyze the operating principle of different bridges and transducers.	[A]
C201.4		Analyze the functioning of various optical sensors in real time.	[A]
C201.5		Apply suitable advanced sensors in industry based applications.	[AP]
Course Contents:			

Module 1: Introduction to Measurements and Instruments   15 Hrs

Introduction to measurements and Instruments - Elements of a generalized measurement system, Static and dynamic characteristics, Analog and Digital Instruments - PMMC, Attraction and Repulsion type Moving Iron Instruments, Induction type- Instrumentation Transformers **–** Tachometer**-** CT & PT), Digital type - Voltmeter, Ammeter, Energy Meter, Tachometer**.** ICs for measuring current, voltage, phase, power and energy.

Module 2: Industrial Transducers   10 Hrs

DC and AC Bridges - Wheatstone bridge, Wien bridges - Megger. Transducers - Characteristics, Requirements, Classifications, Selection Criteria, Displacement Transducers - Potentiometers, Pressure Transducers - Strain Gauge, Temperature Transducers - Thermistors, Thermocouples- Proximity sensor, Pyrometers, Ultrasonic Sensor, Vibration measurement sensor.

Module 3: Optical devices and Advanced Sensors   20 Hrs

Oscilloscopes - Basic principle, Block diagram, Types, Digital storage oscilloscope, Mixed storage oscilloscope, UV and IR spectrometry, RFID sensor, Microelectromechanical systems, Metal Oxide (MOS) gas sensor, Moisture Sensor, Piezo Electric Sensor, Collision Detection Sensor, Irradiance measurement sensor, Introduction to Source measure unit. Case Studies - Inertial Sensor (Accelerometer and gyroscope). Introduction to Integration of AI in sensors.

		Total Hours	**45**
Text Books:			
1	A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation",Dhanpatrai & Co., 19**th** Edition, 2016.		
2	A.D.Helfrick and W.D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2016.		
3	D.V.S. Murthy, "Transducers and Instrumentation", PHI Learning, 2nd Edition,2013.		
Reference Books:			
1	H.S Kalsi, "Electronics Instrumentation", Tata McGraw Hill, Higher education,3rd edition,2010.		
2	E. O. Doebelin and D. N. Manik, "Measurement Systems — Application and Design", Tata McGraw-Hill, New Delhi, 2011.		
3	M.M.S. Anand, 'Electronics Instruments and Instrumentation Technology',Prentice Hall India, New Delhi, 2009.		

4	J.J. Carr, "Elements of Electronic Instrumentation and Measurement", Pearson Education India, New Delhi, 2011.
Web References:	
1	https://nptel.ac.in/courses/108/105/108105153/
2	https://www.bosch-sensortec.com/
3	http://www.shortcoursesportal.com
4	https://learn.ni.com/teach/resources/1014/measurements-and-instrumentation
5	https://the-eye.eu/public/Books/Electronic%20Archive/OliverCageElectronic MeasurementsAndInstrumentation-text.pdf

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)
Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C201.1	Understand	Online Quiz	20
C201.2	Understand	Technical Presentation	20
C201.3	Analyze	Assignment	20
C201.4	Analyze		
C201.5	Apply	Case Study	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	10	20
Understand	40	20	40
Apply	20	30	20
Analyse	30	40	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C201.1	3	2	1	1									2	2	
C201.2	2	1	1	1	2							2	2		
C201.3	3	3	2	2	2							2		2	
C201.4	2	1	1	1	2							1		2	
C201.5	3	3	3	2	1							1		2	
1	Reasonably Agreed				2	Moderately Agreed				3	Strongly Agreed				

23EE202		**Electronic Devices and Integrated Circuits**	3/0/0/3
Nature of Course		E (Theory skill based)	
Course Pre-requisites		NIL	

Course Objectives:

1	To understand the basic structure, operation and characteristics of Electronic Devices and apply BJT to act as amplifier.
2	To gain knowledge about differential amplifiers.
3	To design and construct application circuits with ICs as Op-amp and 555 ICs.

Course Outcomes:

Upon completion of the course, students shall have ability to

C202.1	Describe the basic operation of diode and its applications	[U]
C202.2	Analyse the basic structure, operation and characteristics of Electronic Devices.	[A]
C202.3	Illustrate the IC Manufacturing Process.	[U]
C202.4	Analyse Op-amps and its various applications.	[A]
C202.5	Analyse the various conversion circuits, waveform generation and 555 Timer.	[A]

Course Contents:

Module 1: Diode and Electronic Devices Characteristics   15 Hrs

Intoduction to semiconductor diodes and its apllications - Theory of PN junction – PN Junction Diode – Structure, Operation and V–I Characteristics - Operation and V-I Characteristics of Zener diode – Bipolar Junction Transistors (BJT) – Types (NPN&PNP) -Structure and Operation- Input and Output Characteristics – Voltage divider bias and its application - Junction Field Effect Transistors (JFET)- Structure, Operation of N–Channel JFET- Drain and Transfer Characteristics of N–Channel JFET- Metal Oxide Semiconductor Field Effect Transistor (MOSFET) – Enhancement MOSFET(n-channel) – Structure, Operation and V-I Characteristics of n-channel MOSFET.

Module 2: IC Fabrication and Operational Amplifier Application   15 Hrs

IC classification, IC fabrication - Manufacturing process of monolithic ICs - Operational amplifier: characteristics, parameters of Op-amp, Inverting and Non- inverting amplifier - Applications of Op-amp: summer, voltage follower, Differential amplifier, differentiator and integrator, Instrumentation amplifier, V/I and I/V converters.

Module 3: Analog and Digital Data Conversions and Waveform Generators   15 Hrs

D/A converter – specifications - weighted resistortype, R-2R Ladder type, sample-and-hold circuits, A/D Converters – specifications - Flash type- Successive Approximation type.Sine-wave generators, Triangular wave generator - Function generator circuit, Harmonic Distortion Analyzer. Timer IC 555: Functional block diagram, characteristics, applications - Astable and monostable multivibrator.

	Total Hours	**45**

Text Books:

1	David A. Bell, 'Electronic Devices and Circuits', Oxford University Press, 5th Edition, reprint**,** 2015.
2	Floyd, Thomas.L 'Electronic Devices, Prentice Hall,9th Edition, 2012
3	S. Salivahanan, N.Suresh Kumar, 'Electronic Devices and Circuits' Tata McGraw Hill , 6th edition, 2015

Reference Books:

1	Robert Diffenderfer, 'Electronic Devices: Systems and Applications', Cengage Learning, 2010.
2	Robert L.Boylestad, 'Electronic Devices and Circuit theory', Pearson Education, 2013,
3	Jacob Millman, Christos.C.Halkias and SatyabrataJit, 'Electronic Devices and Circuits', Tata McGraw Hill, 2010.
4	Theodore F. Bogart, Jeffery S. Beasley and Guilermo Rico, 'Electronic Devices and Circuits', Pearson Education , 6th edition, 2019.

Web References:

1	https://nptel.iitg.ernet.in/Elec_Comm_Engg/.../Video-ECE.pdf
2	https://nptel.ac.in/video.php?subjectId=117103063

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)
Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C202.1	Understand	Online Quiz	20
C202.2	Analyse	Assignment	20
C202.3	Understand	Presentation	20
C202.4	Analyse		
C202.5	Analyse	Case Study	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	10	10	10
Understand	10	20	20
Apply	40	40	40
Analyse	40	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C202.1	2	1			2							2	3	3	
C202.2	3	3	2	2	2							2	3	3	
C202.3	3	2	1	1	2							2	3	3	
C202.4	3	3	2	2	2							2	3	3	
C202.5	2	1			2							2	3	3	
1	Reasonably Agreed				2		Moderately Agreed				3		Strongly Agreed		

23MA201	Mathematics II CSE/IT/AI&DS/CSD/CYBER/EEE/ECE/MCT	3/1/0/4
Nature of Course	J (Problem analytical)	
Course Pre-requisites	Nil	

Course Objectives:

1	To study the basic probability concepts
2	To apply mathematical linear programming techniques to solve constrained problems.
3	To formalize the notion of strategic thinking and rational choice by using the tools of game theory
4	To acquaint the student with transform techniques which are used in variety of engineering fields.
5	To introduce the concepts of Group theory

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

C201.1	Recall the concepts of basic probability	[R]
C201.2	Formulate and analyze the existence of solutions to optimization problems	[U]
C201.3	Formulation of modern Probability Theory and think of random variables as an intrinsic need for the analysis of random phenomena.	[AP]
C201.4	To apply game theory in searching, auctioning and trading.	[AP]
C201.5	Apply Fourier transform to discrete time sequence and use of group theory and coding theory in communication.	[AP]

Course Contents:

MODULE 1: Probability theory **(20 hrs)**

Deviation from mean - Markov's inequality - Chebyshev's theorem - properties of variance - sums of random variables - Gambler's ruin - Random walk on graphs - Chebyshev's inequality - Deviation on sum of independent random variables - weak law of large numbers - Van der Waerden's theorem (Statement only) - Chernoff bounds - above the mean and under the mean of Chernoff Bound.

MODULE 2: Linear Programming and Game Theory **(20 hrs)**

Basics of Linear Programming - Formulations of Linear Programming Problems - Graphical method - Simplex Method - Linear Programming in Matrix Form - Two phase method - Duality - Transportation Problem - Initial Basic Feasible solutions - Optimal solution by MODI method. Game theory: Introduction - Zero-Sum Matrix Games - payoff matrix - The Minimax and Maximin theorem - mixed strategies - graphic solution of games.

MODULE 3: Fourier Analysis & Group Codes **(20 hrs)**

Fourier series: Half range series - Discrete Fourier transform - Properties: Statement and Problems - Computing using convolution of sequences using Fast Fourier transform - Fourier transforms modulo p and faster integer multiplication. Concept and simple Applications of Groups, subgroups, cosets - linear codes - error correcting codes - hamming codes - perfect codes.

	Total Hours	**60**

Text Books:

1	H. Pishro-Nik, "Introduction to probability, statistics, and random processes", Kappa Research LLC, 2014.
2	Hamdy A. Taha, Operations Research: An Introduction, 10th Edition, Pearson,2019.
3	T Veerarajan, Discrete Mathematics with Graph Theory and Combinatorics, Tata McGrawHill, New Delhi, 2007.
4	Erwin Kreyszig, "Advanced Engineering Mathematics", 13th Edition, John Wiley & Sons, Inc.

Reference Books:

1	S.C. Gupta and V.K.Kapoor, Fundamentals of Mathematical Statistics, twelth edition, Sulthan Chand and sons,2014.
2	Eric Lehman, F.Thomson Leighton and Albert R.Meyer, Mathematics for Computer Science, 14thEdition, MIT Open courseware, 2018.

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

Web References:

1	https://archive.nptel.ac.in/courses/111/105/111105090/
2	https://archive.nptel.ac.in/courses/110/104/110104063/
3	https://archive.nptel.ac.in/courses/111/101/111101164/
4	https://archive.nptel.ac.in/courses/111/106/111106113/

Online Resources:

1	http://discrete.openmathbooks.org/dmoi3.html
2	https://www.csie.ntu.edu.tw/~sylee/courses/dm/resources.htm
3	https://www.maa.org/press/ebooks/resources-for-teaching-discrete-mathematics
4	https://see.stanford.edu/Course/EE261/137

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C201.1	Remember	Quiz	20
C201.2	Understand	Seminar	20
C201.3	Apply	Tutorial	20
C201.4			
C201.5	Apply	Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination				

Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C201.1	1	1	1										1		
C201.2	1	2	1										2		
C201.3	3	3	2										2		
C201.4	1	1	2										1		
C201.5	2	1	2										2		
1	Reasonably Agreed			2	Moderately Agreed				3	Strongly Agreed					

23TA201	Tamils and Technology	1/0/0/1
Nature of Course	C (Theory Concept)	
Pre requisites	NIL	

Course Objectives:

1	To know about weaving, ceramic, design and construction technologies in sangam age.
2	To know the significance of technologies such as manufacturing, agriculture and irrigation.
3	To understand the development of Scientific Tamils and Tamil Computing.

Course Outcomes :

Upon completion of the course, students shall have ability to

C201.1	Describe about the weaving industry in sangam age and ceramic technology.	[U]
C201.2	Observe the design of houses, sculptures and construction of temples.	[U]
C201.3	Relate the various manufacturing materials and stone types in Silappathikaram.	[U]
C201.4	Understand the significance of agriculture and irrigation technology in ancient period.	[U]
C201.5	Explain the growth of scientific Tamil, Tamil computing and digitization of Tamil books.	[U]

Course Contents:

Module 1: 5 Hours

Weaving and Ceramic Technology: Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries. **Design and Construction Technology:** Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple) - Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

Module 2: 5 Hours

Manufacturing Technology: Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel - Copper and gold - Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads - Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram. **Agriculture and Irrigation Technology:** Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

Module 3 : 5 Hours

Scientific Tamil & Tamil Computing: Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

	Total Hours	**15**

Text Books:

1.	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2.	கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்).

3.	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6.	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
10.	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author).
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
Reference Books:	
1.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C201.1	Understand	Seminar	20
C201.2	Understand	Quiz	20
C201.3, C201.4	Understand	Quiz	20
C201.5	Understand	Seminar	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	40	40	40
Understand	60	60	60
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

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
C201.1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
C201.2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
C201.3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
C201.4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1
C201.5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1

23EN101	**Oral and Written Communication Skills** **CSE/CSD/CY/IT/AI&DS - SEMESTER I)** **(ECE/EEE/MCT/MECH/CIVIL - SEMESTER II)**	**2/0/2/3**

Nature of Course	Theory Skill Based
Course Pre-requisites	Basics of English Language

Course Objectives:

1	To empower students to comprehend different aspects of communication using LSRW skills.
2	To highlight the essential aspects of effective oral & written communication necessary for professional success.
3	To expand the skills of the students in preparing job search artefacts and negotiating their use in GDs and interviews.
4	To enable students to communicate contextually in specific, personal and professional situations with courtesy.
5	To enrich students to carry out day to day communication at the work place to facilitate efficient interpersonal communication.

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

C101.1	Remember and expand writing skills through guided activities.	[R]
C101.2	Apply communication skills in a corporate environment.	[AP]
C101.3	Analyse and collaborate better with colleagues, building stronger professional and personal relationships.	[A]
C101.4	Apply technical writing skills to write letters, emails and prepare technical documents.	[AP]
C101.5	Analyze and communicate effectively in personal and professional situations.	[A]

Course Contents:

Module 1: **10 Hrs**
Reading : Reading techniques -Skimming and Scanning - Cloze Reading - Reading and understanding technical articles – Reading for detailed comprehension: Email and letters - Reading Advertisements - Table completion: Interpreting Charts and Graphs - Verbal Reasoning – Comprehending reviews – Reading and responding to instant messages.

Module 2: **10 Hrs**
Writing : Formal letters (Sales letter, Calling for quotations, seeking clarification, placing an order, complaint letter, Inviting, accepting and declining letters) - Emails - Minutes of meeting - Professional Report Writing - Proposal writing - Resume / job application letter - Case study.

Module 3: **10 Hrs**
Listening : Situational listening - Listening about an experience - Listening about short extracts - Listening an interview - Conversational speaking. Speaking : Conversational speaking - Decipher the picture given and answer the question posed along with it - Decipher the mind map given and speak about it - Listen to the questions posed and answer them appropriately.

	Total Theory Hours	**30**

Lab Component

S.No	**List of Experiments**	
1	Conversational listening	[U]
2	Speaking - Pictography	[AP]
3	Listening about an experience	[U]

4	Listening to short extracts	[U]
5	Writing - Resume Writing, Job application letter	[AP]
6	Mock interview	[AP]
	Total Lab Hours	**30**
	Total Hours	**30+30=60**

Text Books:

1.	Jay Sullivan, "Simply Said: Communicating Better at Work and Beyond", Wiley Publication, 2018.
2.	Alred J Gerald, Brusaw T Charles,. Oliu E Walter, "Handbook of Technical Writing", Bedford/St. Martin's Boston publication, New York, 2012.
3.	Liz Hamp-Lyons and Ben Heasly, "Study Writing :A Course in Written English for Academic Purposes", Updated Edition, Cambridge University Press, 2006.
4.	Dr.Praveen Sam and K N Shoba - A Course in Technical English by Cambridge University press, 2020.

Reference Books:

1.	Rutherfoord J Andrea, " Basic Communication Skills for Technology", Upper Saddle River, N.J. : Prentice Hall, 2001.
2.	Singh Hardeep (Author), Kothari (Author), "Written & Oral Technical Communication Skills For Engineers/Scientists" - LAMBERT Publications, 2019.

Web References:

1.	http://www.academiccourses.com/Courses/English/Business-English
2.	https://www.liveworksheets.com/worksheets/en/English_as_a_Second_Language_(ESL)/Technical_English

Online Resources:

1.	https://www.coursera.org/specializations/business-english
2.	https://www.businessenglishresources.com/learn-english-for-business/student-section/practice-exercises-new/

Continuous Assessment									End Semester Examination	Total
Theory				**Practical**			Total (A+B)	Total Continuous Assessment		
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	Bloom's Level	Assessment Component	FA (10%) [80 Marks]
C101.1	Remember	Listening to Short Extracts	20
C101.2	Apply	Speaking - Pictography	
C101.3	Analyze	Mock Interview	20
C101.4	Apply	Assignment	20
C101.5	Analyze	Listening to Short Extracts	20

Bloom's Level	Summative Assessment (15%) [120 Marks]		End Semester Examination (25%) [100 Marks]
	CIA1: (60 Marks)	CIA2: (60 Marks)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Summative and End Semester Examination - Theory

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (25%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C101.1										3					
C101.2								2		3					
C101.3								2		3	2				
C101.4										3					
C101.5										3		3			
1	Reasonably Agreed			2		Moderately Agreed				3		Strongly Agreed			

23CD201	Database Management Systems	1/0/4/3

Nature of Course	D (Theory Application)
Course Pre-requisites	Nil

Course Objectives:

1	To introduce fundamental concepts of Data Base Management Systems and concepts of Relational Data Models.
2	To explain Relational algebra, Relational calculus and Normalization.
3	To implement different relational model constraints and SQL queries.
4	To manage Database using transactions, concurrency and query optimization.

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

C201.1	Discuss the basic concepts and various data models used in database design	[U]
C201.2	Illustrate Relational algebra, Relational calculus and Normalization.	[AP]
C201.3	Write SQL commands and Subqueries with Constraints.	[AP]
C201.4	Determine Appropriate transactions, views, cursors and triggers to perform the given task.	[AP]
C201.5	Analyze database storage structures, query processing and recovery system.	[A]

Course Contents:

Module 1: Introduction   15 Hrs
Introduction to DBMS, Characteristics of DBMS, DBMS vs File Systems, need for DBMS, Three Level DBMS Architecture, Data Models – Introduction, Benefits, and Phases, ER Diagrams – Symbols, Components, Relationships, Weak entities, Attributes, Cardinality, Relational Algebra, Domain Relational Calculus, Tuple Relational Calculus, Normalization - 1NF, 2NF, 3NF, BCNF, 4NF

Module 2: Constraints and SQL Commands   15 Hrs
DDL Commands - Create, Drop, Alter, Truncate, Rename, Keys - primary Key, Foreign Key DML Commands - Select, Insert, Update, Delete, Any, All, In, Exists, Non Exists, Union, Intersection, Subqueries - nested, correlated, Joins- Inner, Outer, and Equi, Functions - SUM, COUNT, AVG, MIN, MAX, Clauses - Group By, Having By, Embedded SQL, Dynamic SQL, Transaction Concepts – Transaction model – ACID Properties – Serializability –Transactions as SQL statements.

Module 3: Queries and Transactions   15 Hrs
Creation and Dropping of Views, Creation and Execution of Stored Procedures Cursors and Triggers - Opening, Fetching and Closing, Creation , Insertion, Deletion and Updating Database Applications: Payroll Processing Systems, Railway Reservation Systems, Bank Management System Introduction, Storage media and file structures, B+ Tree Hashing – static and dynamic, Introduction to Query Processing – Issues in query optimization – Steps in query processing, Concurrency control and transactions, Lock based protocols Recovery System – Failure classification.

Lab Components

S.No	List of Experiments
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	Mini Project (Application Development) i) IT Training Group Database ii) Blood Donation System iii) Salary Management System iv) Traffic Light Information System	
	Total Hours	**45+30**

Text Books:	
1	Abraham Silberschatz, Henry F Korth, S Sudarshan, "Data base System Concepts", 7th Edition, McGraw hill, 2020.
2	Vijay Krishna Pallaw, "Database Management Systems", 2nd Edition Asian Books Private Limited, 2010.
3	Mark L. Gillenson, "Fundamentals of Database Systems", 7th Edition, Wiley India Pvt. Limited, 2008.
Reference Books:	
1	Raghu Ramakrishnan, Johannes Gehrke, Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", McGraw-Hill Education, 2017
2	C. Date, "SQL and Relational Theory", O'Reilly Media, Incorporated, 2011.
Web References:	
1	http://www.sqlcourse.com/
2	https://www.w3schools.com/sql/
3	https://www.geeksforgeeks.org/dbms/
Online Resources:	
1	https://www.coursera.org/learn/database-management
2	https://www.udemy.com/database-management-system/
3	https://onlinecourses.swayam2.ac.in/cec22_cs18/preview

Continuous Assessment									**End Semester Examination**	**Total**
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**		
Formative Assessment	**Summative Assessment**	**Total**	**Total (A)**	**Formative Assessment**	**Summative Assessment**	**Total (B)**				
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**	**50**	**100**

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (10%) [80 Marks]**
C201.1	Understand	Quiz	**20**
C201.2	Apply	Case Study	**20**
C201.3, C201.4	Apply	Tutorial	**20**
C201.5	Analyse	Assignment	**20**

Assessment based on Summative and End Semester Examination - Theory

Bloom's Level	Summative Assessment (15%) [120 Marks]	
	CIA1: (60 Marks)	CIA2: (60 Marks)
Remember	10	10
Understand	40	30
Apply	50	40
Analyse	-	20
Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (50%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	20	10	10
Understand	20	20	20
Apply	40	40	40
Analyse	20	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)								End Semester Practical Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C201.1	3	3	2	2								2	3	2	2
C201.2	3	3	2	2	2				2	2	2	3	3	2	3
C201.3	3	3	2	2	2				2	2	2	3	3	2	3
C201.4	3	3	2	2	2				2	2	2	3	3	2	3
C201.5	3	3	2	2								3	3	2	3
1	Reasonably Agreed		2		Moderately Agreed			3			Strongly Agreed				

23CY201	Java Programming	1/0/4/3
Nature of Course	F (Theory Programming)	
Course Pre-requisites	-	

Course Objectives:

1	To understand the basic concepts of core java.
2	To employ different types of modifiers and Control statements
3	To implement and interpret Arrays and Strings concepts
4	To implement streams and java console formatting features

Course Outcomes:

Upon completion of the course, students shall have ability to

C201.1	Infer the basic concepts of java programming.	[U]
C201.2	Illustrate the usage of different aspects of Controls statements in real world scenarios.	[AP]
C201.3	Apply Array and strings in real time environment.	[AP]
C201.4	Analyse and Interpret StringBuffer and StringBuilder Classes	[A]
C201.5	Utilize the functionalities of streams and java console class.	[AP]

Course Contents:

Module 1: Introduction to Java   **15 Hrs**

Introduction to Java: Java Architecture- JVM, JRE & JDK, Keywords, Features of Java, Console input and output statements, variables and Identifiers, Scope of Variables, Data types, Type Conversion, Comments, Command Line Arguments, Access Modifiers Operators - Unary Operator- Arithmetic Operator- Shift Operator - Relational Operator - Bitwise Operator - Logical Operator - Ternary Operator and Assignment Operator. Decision Statements - if Statements, if-else Branching, switch Statements.

Module 2: Loops, Array & Strings   **15 Hrs**

Looping Statements : using for loop, using while Loops, Using do Loops. Jump Statements: using break and continue, Unlabelled Statements, Labelled Statements. Arrays: Declaration, Instantiation and Initialization of Java Array, Types of Array - Single Dimension array, Multi-dimension array Strings: String, StringBuilder, and StringBuffer, The String Class, Important Facts About Strings and Memory, Important Methods in the String Class, The StringBuffer and StringBuilder Classes, Important Methods in the StringBuffer and StringBuilder Classes, File Navigation and I/O.

Module 3: Java I/O   **15 Hrs**

Streams: Types of Streams, The Byte-stream I/O hierarchy, Character Stream Hierarchy, Random Access File class, The java.io.Console Class, Serialization, Dates, Numbers, and Currency, Working with Dates, Numbers, and Currencies, Parsing, Tokenizing, and Formatting, Locating Data via Pattern Matching, Tokenizing.

	Total Theory Hours	**45**

Lab Components

S.No	List of Experiments
1.	Implementation of simple java program using Command Line Arguments
2.	Implementation of simple java programs using decision making statements
3.	Implementation of simple java programs using Looping statements
4.	Implementation of Simple java programs using Jump statements
5.	Implementation of 1D Array
6.	Implementation of 2D Array

7.	Implementation of String functions	
8.	Implementation of simple java program using Streams	
9.	Implementation of simple java program using Date and Number classes	
10.	Implementation of simple java program using Tokenizing	

	Total Lab Hours	30
	Total Hours	75

Text Books:

1	Herbert Schildt, "Java: The Complete Reference", 9th edition, Tata McGraw Hill, 2014.
2	Kathy Sierra, "Head First Java: A Brain-Friendly Guide, 2nd Edition, Oreilly, 2009.
3	Herbert Schildt, "Java A Beginner's Guide, Create, Compile and Run Java Programs Today", 8th edition, Tata McGraw Hill, 2020.

Reference Books:

1	Paul Deitel, Harvey Deitel, "Java How To Program", 10th Edition, Prentice Hall Publications, 2014.
2	Y. Daniel Liang, "Introduction to Java Programming", 9th Edition, Prentice Hall Publications, 2015.
3	Ed Roman, RIma Patel, Sriganesh, Gerald Brose, "Mastering Enterprise JavaBeans" 3rd edition, Wikely, 2005.

Web References:

1	http://www.nptel.ac.in
2	http://www.javaworld.com
3	https://www.learnjavaonline.org/
4	https://www.codecademy.com/learn/learn-java

Continuous Assessment									Total Continuous Assessment	End Semester Examination	Total
Theory				Practical			Total (A+B)				
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)					
80	120	200	100	75	25	100	200	50	50	100	

Formative Assessment based on Capstone Model - Theory			
Course Outcome	Bloom's Level	Assessment Component	FA (10%) [80 Marks]
C201.1	Apply	Quiz & Assignment	20
C201.2	Apply	Assignment	20
C201.3	Apply	Case study	20
C201.4	Analyze	Group Assignment	20
C201.5	Analyze		20

Assessment based on Summative and End Semester Examination - Theory		
Bloom's Level	**Summative Assessment (15%) [120 Marks]**	
	CIA1: (60 Marks)	**CIA2: (60 Marks)**
Remember	-	-
Understand	20	-
Apply	80	80
Analyse	-	20
Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (50%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	-	-	-
Understand	20	-	10
Apply	80	80	80
Analyse	-	20	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (50%)						**End Semester Practical Examination (50%)**
CA 1 (100 Marks)			**CA 2 (100 Marks)**			**Practical Exam (100 Marks)**
SA 1 (60M)	**FA 1**		**SA 2 (60M)**	**FA 2**		**FA (75M)**	**SA (25M)**	
	Component-I (20 Marks)	**Component-II (20 Marks)**		**Component-I (20 Marks)**	**Component-II (20 Marks)**			

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C201.1	2	2	2						2			2	2		2
C201.2	3	3	3					2	2	2		2	2	2	2
C201.3	2	2	3		2				2			3			3
C201.4	3	2	2		2			2	2	2		3		2	3
C201.5	3	2	2		2			2	2	2		3		2	3
1	**Reasonably Agreed**			**2**		**Moderately Agreed**				**3**		**Strongly Agreed**			

23EE203	Electronic Devices and Integrated Circuits Laboratory	0/0/2/1

Nature of Course	: M (Practical application)
Pre-requisites	: Nil

Course Objectives:

1	To understand the basic structure, operation and characteristics of Electronic Devices and apply BJT to act as amplifier.
2	To gain knowledge about operational amplifiers.

Course Outcomes:

Upon completion of the course, students shall have ability to

C203.1	Analyse the characteristics of basic electronic devices such as Diode ,BJT,FET.	[A]
C203.2	To analyse the input-output characteristics of CE and CB amplifiers.	[A]
C203.3	Evaluate the linear and non-linear applications of Op-amp circuits.	[A]
C203.4	Examine the Integrator and Differentiator using Op-amp circuits.	[U]
C203.5	Design Waveform generator using OPAMP circuits.	[A]

Course Contents:

S.No	List of Experiments	CO Mapping	RBT
1	Analyse the Characteristics of PN Junction Diode	C203.1	[A]
2	Analyse the Characteristics of Zener diode and design a Regulator using Zener diode	C203.1	[A]
3	Design of half wave, full wave and bridge rectifier circuits.	C203.1	[A]
4	Analyse the Input and Output Characteristics of BJT in CE Configuration	C203.1	[A]
5	Analyse the JFET Drain and Transfer Characteristics	C203.1	[A]
6	Implementation of Inverting and Non inverting Amplifier using Op-amp	C203.2	[U]
7	Implementation of Adder ,Subtractor, Integrator and Differentiator using Op-amp	C203.3	[U]
8	Design of square wave generator for a specified frequency and duty cycle using Op-amp.	C203.5	[U]
9	Determine the type and percentage of harmonic for the given waveshape.	C203.5	[A]
10	Design of Astable and Monostable multivibrators using 555 timers	C203.5	[A]
	Total Hours	**30**	

Text Books:

1	Donald .A. Neamen, Electronic Circuit Analysis and Design, 2nd Edition reprint, Tata Mc Graw Hill, 2013
2	D. Roy Choudary, S.B. Jain, " Linear Integrated Circuits", Third edition, New Age publishers, 2014.
3	James M.Fiore, 'Opamps and Linear Integrated Circuits', Cengage Learning India Pvt Ltd, 1st edition, 2010.

Reference Books:

1	Robert F. Coughlin, and Driscoll," Operational Amplifiers and Linear Integrated Circuits", 6/e, Pearson Education. Reprint 2007.
2	P. R. Gray and R. G. Meyer," Analysis and Design of Analog Integrated Circuit, John Wiley, 4th Ed, Reprint 2009.

3	Sergio Franco, " Design with operational amplifiers and Analog Integrated circuits", Tata McGraw Hill 3rd Edition 2002.	

Web References:

1	Ron Manchini, "Op-Amps for Everyone ", Design Reference-Texas Instruments, August 2002, Available from: http://www.ti.com/lit/an/slod006b/slod006b.pdf
2	www.ti.com/amplifier-circuit/overview.html
3	https://www.ti.com/seclit/ml/ssqu016/ssqu016.pdf

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember	0	0	0
Understand	30	30	30
Apply	30	30	30
Analyse	40	40	40
Evaluate	0	0	0
Create	0	0	0

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C203.1	3	1		3	1								3	1	
C203.2	3	1		3	1								3	1	
C203.3	3	1		3	1								3	1	
C203.4	3	2		3	2								3	2	
C203.5	3	1		3	1								3	1	
1	Reasonably Agreed		2		Moderately Agreed			3			Strongly Agreed				

23EE301		**Electrical Machines - I**	**3/0/0/3**
Nature of Course		G (Theory and Analytical)	
Course Pre-requisites		Basics of Electrical Circuits	
Course Objectives:			
1		To study the basic concepts of magnetic field.	
2		To understand the construction, working principle of DC machines and analyse their performance.	
3		To familiarize with the construction details of different types of transformers, working	

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

C301.1	Interpret the basic concepts of magnetic circuits and infer the different magnetic excited system.	[U]
C301.2	Analyse the operation of various DC machine configurations.	[A]
C301.3	Choose an appropriate DC motor for any industrial application and appraise its significance.	[AP]
C301.4	Interpret the constructional details of different type of transformers, working principle and their performance	[U]
C301.5	Analyse the performance of single-phase and three -phase transformer operations.	[A]

Course Contents:

Module 1: Magnetic Fields and Magnetic Circuits   **15 Hrs**
Nature of magnetic field – Electromagnetism - Leakage flux and fringing effect - Reluctance and Permeance - BH Characteristics - Analysis of series and parallel magnetic circuit - Properties of magnetic material - Faraday's law of electromagnetic induction - Induced voltage and Induction - Eddy current and hysteresis losses - Estimation of magnetic flux and magnetic field of semi opened circuit- Singly and Double excited magnetic system.

Module 2: DC Machines   **15 Hrs**
DC Generator - Construction, Principle of Operation – EMF equation - Types, Characteristics, commutation - Interpoles - Armature reaction - Armature circuit equation for motoring and generation.
DC Motor - Principle of operation - Torque equation - Types - Electrical and mechanical characteristics - Need for starters - Types of starters - Soft starters - Braking - Speed control methods - Testing of DC motors - Case study: selection of DC motors for various industrial application.

Module 3: Single Phase and Three Phase Transformers   **15 Hrs**
Single Phase Transformers - Principle of operation - Types - Basic construction - Equivalent circuit – Phasor diagram - Regulation and efficiency - Separation of Hysteresis and Eddy current losses - Testing of Transformers - Open circuit and short circuit tests, polarity test, back-to-back test. Three - phase Transformers - Construction - Types of connection and their comparative features - Auto transformer - All day efficiency - Parallel operation of transformers.

	Total Hours	**45**

Text Books:		
1.	A.E. Fitzgerald, Charles Kingsley, JR., Stephen D. Umans, "Electric Machinery", 6th Edition, McGraw Hill International Edition, New York, 2017.
2.	P.C.Sen, "Principles of Electric Machines and Power Electronics", Wiley, 2013.
3	D.P. Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill Publishing Company Ltd, 2017.
Reference Books:	
1	I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 5th Edition, 2017.
2	P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

Web References:

1	https://courses.lumenlearning.com/boundless-physics/chapter/magnetism-and-magnetic-fields/
2	https://library.automationdirect.com/selecting-motors-industrial-applications/
3	https://electrical-engineering-portal.com/erection-procedure-for-power-transformer

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C301.1	Understand	Online Quiz	20
C301.2	Analyze	Class Presentation	20
C301.3	Apply	Assignment	20
C301.4	Understand	Case Study	20
C301.5	Analyze		

Assessment based on Continuous and End Semester Examination			
Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [12 Marks]	CIA2 : [12 Marks]	
Remember	20	20	20
Understand	30	30	20
Apply	10	20	30
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C301.1	3	1	1	1										2	
C301.2	3	2	2	1										2	
C301.3	3	2	1									3		2	
C301.4	3	3	3	2		1	1					2		3	
C301.5	3	3	3	2		1	1					2		3	
1	**Reasonably Agreed**				**2**		**Moderately Agreed**				**3**		**Strongly Agreed**		

23EC202		**Digital System Design**	**3/0/0/3**
Nature of Course		G (Theory & Analytical)	
Course Pre-requisites			

Course Objectives:

1	To introduce the principles of Canonical forms to minimize the logic expression
2	To enable the students to understand the operation of various combinational and sequential logic circuits.
3	To allow students to analyze synchronous sequential circuits.
4	To enable the students to construct PLD's and their roles in digital systems
5	To enable the students to write verilog code for combinational logical circuits.

Course Outcomes:

Upon completion of the course, students shall have ability to

C202.1	Demonstrate knowledge on canonical forms and their realization using logic gates	[U]
C202.2	Applying K- Map and Tabulation method to minimize the Boolean functions.	[AP]
C202.3	Understand various combinational logic and sequential logic circuits and their implementation	[AP]
C202.4	Apply synchronous sequential logic for reducing state reduction.	[AP]
C202.5	Understanding Programmable logic devices and applying for logical function implementation.	[AP]
C202.6	Apply verilog code for realization of combinational logical circuits.	[AP]

Course Contents:

Module 1: Canonical Forms and Minimization   **15 Hrs**

Minterms, Maxterms, Complements, Implementation using universal logic gates, Minimizing functions using Karnaugh maps – 2,3 & 4 Variables, Minimization using Quine McClusky method – 4 Variables.

Module 2: Combinational and Sequential logic circuits   **15 Hrs**

Adders and Subtractors, Multiplexer, Demultiplexer, Encoders, Decoders, Two Bit Magnitude comparator, Carry Look-ahead adder, Code converters, – Binary to Gray, BCD to Excess-3 Parity generator and Checker. **Sequential logic circuits:** Latches and flip flops, Realization of one flip flop using other flip flops, Asynchronous Up counter and Synchronous counters, Shift registers – SISO,SIPO,PISO,PIPO, Application of Shift registers. Case Study: DTMF Decoder.

Module 3: Synchronous Sequential logic   **15 Hrs**

Analysis of Synchronous Sequential Circuits, Sequence generator, State transition diagrams and state transition tables. PLD's - PLA, PAL, Modelling basic combinational circuits using Verilog**.**

	Total Hours	**45**

Text Books:

1	M. Morris Mano, Michael D.Ciletti., "Digital Design",6th Edition, Pearson education, 2018
2	Donald D. Givone, "Digital principles and Design", 2004, McGraw Hill Education India Private Ltd., 29th Reprint, 2018
3	Samir Palnitkar,"Verilog HDL: A Guide to Digital Design and Synthesis" Prentice Hall, Second Edition, 2018

Reference Books:	
1	J. F. Wakerly, "Digital Design - principles and practices", 4th Edition, Pearson Education, 2008.
2	Thomas L. Floyd, Digital Fundamentals, 10th Edition, Pearson Education, New Delhi, 2017
3	John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.

Web References:	
1	https://www.tutorialspoint.com/digital_circuits/digital_circuits_useful_resources.htm
2	http://www.technologystudent.com/elec1/dig1.htm
3	https://www.electronicsforu.com/technology-trends/learn-electronics/digital-electronics-basics
4	https://www.electrical4u.com/digital-electronics/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C202.1	Understand	Quiz	20
C202.2	Apply	Assignment	20
C202.3			
C202.4	Apply	Assignment	20
C202.5			
C202.6	Apply	Simulation using Logisim	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	10	10
Understand	40	40	40
Apply	40	40	30
Analyse	-	10	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C202.1	3	2	1	1					1				2		3
C202.2	3	2	1	1									2		3
C202.3	3	2	1	1									2		3
C202.4	3	2	2	1									2		3
C202.5	3	2	2	1									2		3
C202.6	3	2	2	1									2		3
1	Reasonably Agreed			2		Moderately Agreed			3			Strongly Agreed			

23MA302		**Mathematics III** **(ECE/EEE/MCT)**	**3/1/0/4**

Nature of Course	B (100% Analytical)
Pre requisites	-

Course Objectives:

1	To define a subspace of a vector space and to discuss the existence of a basis of an abstract vector space.
2	To determine a basis and the dimension of a finite-dimensional space.
3	To develop the skill to use matrix algebra techniques that are needed by engineers for practical applications.
4	To familiarize with determinants and eigenvalues applicable in many branches of engineering.
5	To acquaint with knowledge of Positive definite matrices used in wide applications.

Course Outcomes(Theory)
Upon completion of the course, students shall have ability to

C302.1	Understand the concepts of vector spaces, subspaces, bases, dimension and their properties.	[R]
C302.2	Relate matrices and linear transformations, compute Eigen values and Eigen vectors of linear transformations.	[U]
C302.3	Apply the properties of inner product spaces and determine orthogonality.	[AP]
C302.4	Obtain the matrix of linear transformation and its eigenvalues and eigenvectors	[AP]
C302.5	Apply the concepts of positive definite matrices and its properties to perform matrix decomposition.	[AP]

Course Contents:

MODULE I : Ax = b and the Four Subspaces
The Geometry of Linear equations: Linear combination – Dependence and Independence vectors – Basis and Dimension – Solving Ax=0: Rank of a matrix – Elimination and Solving Ax=b in matrices: Gauss Elimination method – Gauss Jordan method – Multiplication and Inverse Matrices: Inverse of a matrix using Gauss Jordan method – Solving system of equations using LU Decomposition method – The Four Fundamental Subspaces – Column Space, Row Space, Null space and Left hand null space.

MODULE II :Orthogonality, Determinants and Eigenvalues
Orthogonal vectors – Projections– Orthogonal Matrices and Gram Schmidt Orthogonalization process – Determinants: Properties of Determinants – Determinant Formulas and Cofactors – Solving system of linear equations using Cramer's Rule, Inverse of a Matrix using determinant – Eigenvalues and Eigenvectors – Inverse and Powers of a matrix using Cayley Hamilton theorem.

MODULE III : Positive Definite Matrices and Applications
Symmetric Matrices and Positive Definiteness – Positive Definite Matrices – Diagonalization – Quadratic form to Canonical Form by orthogonal Transformation - Similar Matrices and Jordan Form – QR Decomposition – Singular value Decomposition – Linear transformations and their matrices – Change of basis: Image compression.

	Total Hours:	**60**

Text Books:

1	Gilbert Strang, "Introduction to Linear Algebra", Sixth Edition, Wellesley-Cambridge Press, 2023.
2	Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2018.

3	Grewal. B.S, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, Delhi, 2018.
4	Howard Anton and Chris Rorrs, "Elementary Linear Algebra", 9th Edition, John Wiley & Sons, 2000.
5	G.B.Thomas and R.L.Finney, Calculus and Analytic Geometry, 14thEdition,Pearson, Reprint,2018

Reference Books:

1	Kenneth Hoffman and Ray Kunze, Linear Algebra, Pearsons, 2015.
2	Veerarajan. T, "Engineering Mathematics I", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018.
3	Glyn James, —Advanced Modern Engineering Mathematics, Pearson Education, 4th edition, 2012.
4	N.P.Bali and Dr.ManishGoyal,"A Textbook of Engineering Mathematics" 9th edition, Laxmi publications ltd, 2014.
5	D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

Web References:

1	https://archive.nptel.ac.in/courses/111/104/111104137/
2	https://onlinecourses.nptel.ac.in/noc21_ma16/preview
3	https://archive.nptel.ac.in/courses/111/106/111106046/

Online Resources:

1	https://www.coursera.org/learn/linearalgebra1
2	https://www.coursera.org/learn/linearalgebra2/
3	https://see.stanford.edu/course/ee261/

Assessment Methods & Levels (based on Blooms' Taxonomy)

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C302.1	Remember	Quiz	20
C302.2	Understand	Presentation	20
C302.3 – C302.5	Apply	Tutorial	20
C302.3 – C302.5	Apply	Assignment	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	30	30	30

Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1: 100 Marks			CA 2: 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)(Theory)

COs	POs												PSOs		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
C302.1	1	1											1		
C302.2	2	2											1		
C302.3	3	3											1		
C302.4	3	3											1		
C302.5	3	3											1		

	3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

23CS301		Advanced Java Programming	1/0/4/3
Nature of Course		F (Theory Programming)	
Course Pre-requisites		Java Programming	

Course Objectives:

1	To provide insight knowledge of OOP concepts and usage of this, static, super and final keywords.
2	To discuss about different type of Collection Frameworks.
3	To demonstrate threads, JDBC & exception handling with real world examples.
4	To illustrate designing of GUI applications using swing component.

Course Outcomes:

Upon completion of the course, students shall have ability to

C301.1	Illustrate the OOPs concepts like Constructors, Inheritance, Polymorphism and the usage of this, static, super and final keywords.	[AP]
C301.2	Apply the concepts of Exception Handling in real world applications and usage of collection frameworks.	[AP]
C301.3	Develop Multithreaded applications.	[AP]
C301.4	Develop GUI Applications using swing component and to explain the concept of Servlets.	[AP]
C301.5	Develop java application to interact with database by using relevant JDBC Driver.	[AP]

Course Contents:

Module 1: Introduction to OOPS 15 Hrs

Class and Object, Encapsulation and Abstraction, Inheritance, Polymorphism, Message Passing, Keywords : this, super, static, final, extends and implements. Method Signature and Prototype, Mutator Methods and Accessor Methods, Var-Arg Method, hashCode() and toString() methods. Immutable Objects Vs Mutable Objects, User defined Immutable Class, Constructors : Introduction, Default Constructor, User Defined Constructors, Constructor Overloading, Instance Variable, Instance Methods, Instance Block and Instance Flow Of Execution. Regular Expressions (RegEx).

Inheritance Introduction, Types of Inheritance, Up Casting, Down Casting, IS-A Relationship & HAS-A Relationship, Composition Vs Aggregation, Polymorphism: Method Overloading, & Method Overriding.

Module 2: Abstraction, Exception Handling & Collections 15 Hrs

Abstraction: Abstract Methods and Abstract classes. Interfaces, abstract classes and Interfaces, Concrete Methods Vs Abstract Methods, Differences between classes, abstract classes and Interfaces, Marker Interfaces

Exception - try catch block, Finally Block, Exception Hierarchy, Multiple Exceptions In a Catch Block, Parameterized Try Block, Overriding Methods And Exception. Creating Your Own Exception, The Assert Keyword, The Generics Framework, Collections: Set, List, Map & Tree, The Iterator Interface. Working with Hashtable Collection Threads: Introduction to Threads, Creating And Starting Threads, Basic Thread Control Methods. Multithreading, Working with Multiple, threads, Thread Life Cycle, Thread Priorities, Synchronizing Methods.

Module 3: Swings, Servlets & JDBC 15 Hrs

Swings: Introduction, JLabel, JButton, JTextField ,JTextArea, JPasswordField, JCheckbox, JComboBox, JRadioButton, JScrollBar, JMenuItem and JMenu.
JDBC: Drivers, CURD operations, Database connectivity
Servlets : Overview of Servlets , Servlet Life Cycle, Servlet Request and Response , web.xml and its need, Servlet Configuration, Session Tracking.

	Total Theory Hours	**45**

Lab Components

S.No	**List of Experiments**

1.	Implementation of default and parameterized constructors.	
2.	Implementation of method overloading and overriding	
3.	Implementation of Inheritance.	
4.	Implementation of Abstract and Interface concepts	
5.	Programs using collection Interface.	
6.	Implementation of multithreading Concepts.	
7.	Program to handle multiple exception using try, catch and finally block.	
8.	Implementation of swing components.	
9.	Implement Simple application using servlets.	
10.	Implement CURD operation using JDBC.	
	Total Lab Hours	**30**
	Total Hours	**75**

Text Books:

1	Herbert Schildt,"Java:TheCompleteReference",12th edition, Mc craw Hill, 2021.
2	Robert Liguori, Patricia Liguori, "Java 8 Pocket Guide", O'Reilly Media, 2014.
3	ShagunBakliwal, Hands-on Application Development using Spring Boot, bpb publisher, 2021.

Reference Books:

1	Paul Deitel, Harvey Deitel, "Java How To Program",10th Edition, Prentice Hall Publications,2014.
2	Cay S.Horstmann and GaryCornell, "Core Java, Vol.2: Advanced Features", 9th Edition, Prentice Hall,2013.
3	Paul Deitel, Harvey Deitel, "Java How To Program",10th Edition, Prentice Hall Publications,2014.

Web References:

1	https://www.javatpoint.com/java-tutorial
2	https://www.geeksforgeeks.org/java/
3	http://www.javatpoint.com/java-tutorial

Continuous Assessment									End Semester Examination	Total
Theory				Practical			Total (A+B)	Total Continuous Assessment		
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (10%) [80 Marks]**
C301.1 & C301.3	Apply	Quiz	20
C301.2	Apply	Assignment	20
C301.4 & C301.5	Apply	Case Study	40

Assessment based on Summative and End Semester Examination - Theory		
Bloom's Level	**Summative Assessment (15%) [120 Marks]**	
	CIA1: (60 Marks)	**CIA2: (60 Marks)**
Remember	20	20
Understand	40	40
Apply	40	40
Analyse	-	-
Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (50%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	10	10	10
Understand	30	30	30
Apply	40	40	40
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination								
Continuous Assessment (50%)								**End Semester Practical Examination (50%)**
CA 1 (100 Marks)			**CA 2 (100 Marks)**			**Practical Exam (100 Marks)**		
SA 1 (60M)	**FA 1**		**SA 2 (60M)**	**FA 2**		**FA (75M)**	**SA (25M)**	
	Component-I (20 Marks)	**Component-II (20 Marks)**		**Component-I (20 Marks)**	**Component-II (20 Marks)**			

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C301.1	3	3	3	1					2	2		2	3	2	3
C301.2	3	3	3	3	2				3	2		2	3	2	2
C301.3	3	3	3	2	3				2	2		2	3	3	3
C301.4	3	3	3	2	3				2	2		2	3	3	3
C301.5	3	3	3	2	3				2	2		2	3	3	3
1	**Reasonably Agreed**		**2**		**Moderately Agreed**			**3**			**Strongly Agreed**				

23GE301		Universal Human Values (Common to all branches)	3/0/0/3
Nature of Course		Descriptive	
Course Pre-requisites		Interpersonal Communication and Value Sciences	

Course Objectives:

1	Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2	Understanding (or developing clarity) of the harmony in the human being ,family, society and nature/existence.
3	Strengthening of self-reflection.
4	Development of commitment and courage to act.
5	Helping the students to appreciate the essential complementarity between 'VALUES' and' SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings.
6	Highlighting plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcomes:

Upon completion of the course, students shall have ability to

C301.1	Understand and take responsibilities in life and handle problems to attain sustainable solutions while keeping human relationships and human nature in mind.	[U]
C301.2	Apply responsibilities towards their commitments (human values , human relationship and human society).	[AP]
C301.3	Apply what they have learnt to their own self indifferent day-to-day settings in real life, at least a beginning would be made in this direction.	[AP]
C301.4	Analyze ethical and unethical practices, and formulate strategies to actualize a harmonious environment wherever they work.	[AN]
C301.5	Understand the harmony in nature and existence, and work out mutually on fulfilling participation in nature.	[U]

Course Contents:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education, Understanding Harmony in the Human Being-Harmony in Myself!   15 Hrs

Self-evaluation of the students – Pre – test of UHV – Purpose and motivation for the course.Self-Exploration–Its content and process- A look at basic Human Aspirations. Understanding Happiness and Prosperity correctly-Understanding the needs of Self('I') and 'Body'-Understanding the Body as an instrument of 'I'(being the doer, seer and enjoyer)-Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding the harmony of I' with the Body- Social activities – Waste Management - Water Conservation-Soil Pollution - Physical Health and related activities -Lectures by eminent persons- Literary activities.

Module 2: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship, Understanding Harmony in the Nature and Existence- Whole existence as Coexistence   15 Hrs

Understanding values in human relationship - Understanding the harmony in the society (society being an extension of family): - Visualizing a universal harmonious order in society-Understanding the harmony in Nature.-Understanding Existence as Coexistence of mutually Interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence-Buddy program-Relationships-Homesickness- Managing peer pressure-Projects-Socially responsible engineers-Visit to local areas (orphanages, special children)- Physical Activities(games).

Module 3: Implications of the above Holistic Understanding of Harmony on Professional Ethics   15 Hrs

Natural acceptance of human values- Definitiveness of Ethical Human Conduct- Basis for Humanistic Education-Humanistic Constitution and Humanistic Universal Order-Competence in professional ethics-Case studies of typical holistic technologies, management models and eco-friendly production systems - Strategy for transition from the present state to Universal Human Order-Sum up: Self-evaluation of the students-Post test of UHV.

		Total Hours	45

Text Books:

1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, ExcelBooks, New Delhi, 2010
2	Rajni Setia, Priyanka Sharma, "Human Values", Genius Publication", Jaipur, 2019.

Reference Books:

1	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
2	The Story of My Experiments with Truth –by Mohandas Karamchand Gandhi
3	IndiaWins Freedom-MaulanaAbdulKalamAzad.

Web References:

1	https://examupdates.in/professional-ethics-and-human-values/
2	http://hvpe1.blogspot.com/2016/06/notes-human-values-and-professional.html
3	https://www.yourmorals.org/schwartz.2006.basic%20human%20values.pdf

Online Resources:

1	https://nptel.ac.in/courses/109/104/109104068/
2	https://medium.com/the-mission/the-12-important-life-skills-i-wish-id-learned-in-school-f4593b49445b
3	https://www.thebalancecareers.com/life-skills-list-and-examples-4147222

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C301.1	Understand & Apply	Pre-Test and Post - Test	20
C301.2	Understand & Apply	Online Quiz	20
C301.3	Understand	Buddy Program	20
C301.4	Apply		
C301.5	Apply	Seminar	20

Assessment based on Summative and End Semester Examination		
Bloom's Level	Summative Assessment (24%) [120 Marks]	End Semester Examination (60%)

	CIA1 : [60 Marks]	CIA2 : [60 Marks]	[100 Marks]
Remember	10	10	10
Understand	10	20	20
Apply	40	40	40
Analyse	40	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C301.1						3									
C301.2						3			3						
C301.3						3		3							
C301.4						3	3	3			2				
C301.5						3	3								
1	Reasonably Agreed		**2**	Moderately Agreed			**3**	Strongly Agreed							

23EC302	Operating Systems for Electronic Devices	3/0/2/4

Nature of Course	E (Theory skill Based)
Course Pre-requisites	NIL

Course Objectives:

1	To introduce list data structure and understand Microcontroller programming.
2	To Understanding the role of the kernel in an OS
3	To Understanding the role of Signals, System Calls, and Shell Scripting in Linux
4	To design embedded system using embedded Linux platform

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

C302.1	Introduce data structure and microcontroller programming	[A]
C302.2	Describe the architecture of the Linux operating system, including the role of the kernel, shell, and system libraries.	[A]
C302.3	Apply Linux knowledge and skills to solve practical problems encountered in system administration and development.	[AP]
C302.4	Analyse the various concepts in RTOS and its Programming concepts	[AP]
C302.5	Create Simple programs in Embedded Linux Platform and Debug	[A]

Course Contents:

Module 1: Microcontroller   15 Hrs
Programming General - Data Structures - Basics, Built-in Data types, Derived Data Types (Array, Lists, Stack, Queue, Map, Tree). **Design -** Design - Architecture, High level design, Low level design Introduction to UML representation - Usecase Diagram Component Diagram Class Diagram Sequence Diagram Activity Diagram. **Microcontroller Programming -** Introduction to Microcontrollers (Based on Architecture Selected) - Instruction set architecture - pipelines - Registers banks/mode and states - Clock and reset systems, timers and Memory Organisation - IDE Configuration, Linker Script, Compiler Optimization Options - Exception/Interrupt handling - C and Embedded C Migration - Memory /IO and peripherals - (I2C/SPI/UART/GPIO/Timer/PWM/ADC) - Debugging using JTAG debuggers, CRO - Stack concept - MMU (Optional For ARM Architecture if Applicable) - MISRA Guideline and Analysis.

Module 2: Embedded Linux   15 Hrs
Introduction to Linux - OS Organisation, Kernel, Kernel types, Booting Sequence and Modes **-** Operating System components - Intro to Process management sub system. Intro to Memory management sub system, Intro to File sub system, Intro to Device drivers , Signals and System calls - Linux shell commands & shell scripting - Linux File system - accessing of files/different filesystems - proc/sys etc. - Linux directory structure - File system security - Linux groups ,Read, write, and execute access ,Changing permissions with chmod chown,chgrp - Build Tools - yocto/bitbakes, Concept on Cross Tool Chains ; Yocto setup/ image creation/ download trial -Basics of Char Driver - Boot Loader Concept- Device Tree structure - Linux system programming I - syscalls/signals/uevents/sockets - Process, Thread, task and Event Concept - Scheduler concept - Thread programming - Linux System programming II - fork, use of semaphore/mutex/spinlocks - IPC -shared memory, Message Queue,socket, fifo, pipe - Linux Device driver architecture - IRQ programming.

Module 3: Device Interaction and Peripheral Handling - RTOS and Embedded Systems   15 Hrs
RTOS Introduction - Scheduler Algortihms overview - Co-operative and PreEmptive - Memory organisation and Porting on Microcontroller - Task and IPC handling API in RTOS - Peripheral Programming and Application on Controller using RTOS - **Testing -**Levels of testing and methodologies - Unit Testing using G-Test Framework - **Automotive Embedded -** Introduction to Automotive Electronics and Controllers - CAN Overview - Functional Safety and Cyber Secuirty Overview - Bootloader concepts overview - **Project in Embedded Linux Platform (C Language) -**

Project - Req. analysis, Design, Implementation, UT, IT and Traceability with V lifecycle process using C programming language. **Debugging -** Debugging Using GDB

		Total Theory Hours	45

Lab Components

S.No	List of Experiments	CO Mapping	BT
1	Study the instruction set of the microcontroller and execute simple instructions. (Arithmetic and code conversions)	C302.1	[A]
2	Write Embedded C code to control LEDs, buttons, or other simple peripherals.	C302.1	[AP]
3	Develop a small embedded systems project adhering to MISRA C guidelines.	C302.1	[AP]
4	Study basic & User status Unix/Linux Commands.	C302.2	[U]
5	Study & use of commands for performing arithmetic operations with Unix/Linux.	C302.2	[A]
6	Execute shell commands through VI editor.	C302.3	[AP]
7	Study and use of the Command for changing file permissions.	C302.3	[A]
8	Develop scheduling algorithm for Real time Applications.	C302.4	[AP]
9	Keypad and Display Interfacing using Bootloader Concepts.	C302.5	[AP]
10	Mini project using Embedded Linux Platform.	C302.5	[AP]
		Total Lab Hours	30
		Total Hours	75

Text Books:

1	Michael T. Goodrich, "Data Structures and Algorithms in C++", 2nd Edition, Wiley Publication, 2011
2	Subrata Ghoshal, 8051 Microcontroller Internals, Instructions, Programming and Interfacing, Second edition, Pearson Education Asia, 2014.
3	Richard Peterson, 'Linux Fundamentals', TataMcGrawHill, 6th Edition, reprint**,**2018.
4	J. W. S. Liu, Real-time Systems, Pearson Education, 2018.

Reference Books:

1	Narasimha Karumanchi, "Data Structures and Algorithms Made Easy: Data Structures andAlgorithmic Puzzles", 5th Edition, CareerMonk,2016
2	Muhammad Tahir and Kashif Javed, „ARM Microprocessor Systems - Cortex-M Architecture, Programming, and Interfacing", CRC Press, 2011.
3	Richard Fox,'Linux with Operating System Concepts ',CRC Press,2017.
4	D.M.Dhamdhere," Operating Systems,A Concept-Based Approch,TMH,2008.
5	Kopetz H. Real-time Systems: Design Principles for Distributed Embedded Applications. Springer Science & Business Media; 2011 Apr 15.

Web References:

1	https://www.codingninjas.com/courses/c-plus-plus-data-structures-and-algorithms
2	https://nptel.ac.in/courses/108107029/
3	https://archive.nptel.ac.in/courses/117/106/117106113/

Continuous Assessment				End Semester Examinatio	Tota l
Theory	Practical	Total	Total		

Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)	(A+B)	Continuous Assessment	n	
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory

Course Outcome	Bloom's Level	Assessment Component	FA (10%) [80 Marks]
C202.1	Analyze	Quiz	20
C202.2	Analyze	Class Presentation	20
C202.3	Apply	Assignment	20
C202.4	Analyze	Case Study	20
C202.5	Analyze		

Assessment based on Summative and End Semester Examination - Theory

Bloom's Level	Summative Assessment (15%) [120 Marks]		End Semester Examination (35%) [100 Marks]
	CIA1: (60 Marks)	CIA2: (60 Marks)	
Remember	20	20	20
Understand	20	20	20
Apply	30	30	30
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (15%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	0	0	0
Understand	40	40	40
Apply	30	30	30
Analyse	30	30	30
Evaluate	0	0	0
Create	0	0	0

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)							End Semester Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)	Theory Examination (35%) Practical Examination (15%)
	FA 1			FA 2			
SA 1 (60M)	Component-I (20 Marks)	Component-II (20 Marks)	SA 2 (60 M)	Component-I (20 Marks)	Component-II (20 Marks)	FA (75M) / SA (25M)	

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C302.1	3	2	2	2									3	1	
C302.2	3	2	2	2									3	1	
C302.3	3	2	2	2									3	1	
C302.4	3	2	2	2									3	1	
C302.5	2	2	2	2	3				1	2		2	3	1	
1	Reasonably Agreed				2	Moderately Agreed					3	Strongly Agreed			

23EE302		Electrical Machines – I Laboratory	0/0/2/1

Nature of Course	M (Practical application)	
Pre-requisites	Basics of Electrical Circuits	

Course Objectives:

1	To determine the characteristics of DC machines by using simulation and experimental methods.
2	To know the performance characteristics of transformers based on various tests underno load, loading conditions, open circuit and short circuit conditions.
3	To analyse the equivalent circuit parameters of transformers.

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

C302.1	Analyze the no load and load characteristics of DC Separately excited D C generator.	[A]
C302.2	Illustrate the mechanical and electrical characteristics of Shunt ,Series and Compound motor.	[U]
C302.3	Sketch the equivalent circuit of Single phase Transformer and calculate the parameters of equivalent circuit.	[AP]
C302.4	Analyze the different types of three phase transformer Connections.	[AP]
C302.5	Demonstrate the indirect method of testing of DC machine to determine its efficiency.	[A]

Course Contents:

S.No	List of Experiments	CO Mapping	RBT
1.	Estimate the magnetic flux and field of semi opened Electrical Machine using DL OPENLAB	C302.1	[A]
2.	Analysis of no-load and load characteristics of separately excited DC generator.	C302.1	[A]
3.	Examine the effective efficiency and speed-torque characteristic of DC shuntmotor, DC series motor.	C302.2	[U]
4.	Determination the load characteristics of DC compound motor.	C302.2	[U]
5.	Predetermination of Efficiency using Swinburne's test	C302.2	[U]
6.	Examine the Speed Control methods of DC shunt motor by following methods i) Field Control ii) Armature control iii) Voltage Control Method / Chopper based Control	C302.2	[A]
7.	Sketching of the equivalent circuit parameters of a single phase transformer.	C302.3	[AP]
8.	Verification of Three phase Transformer connections.	C302.4	[A]
9.	Separation of No load losses in single phase transformers.	C302.4	[U]
10.	Testing of transformers using Sumpner's Test.	C302.5	[AP]
	Total Hours	**30**	

Text Books:

1.	A.E. Fitzgerald, Charles Kingsley, JR., Stephen D. Umans, "Electric Machinery", 6th Edition, McGraw Hill International Edition, New York, 2017.
2.	P.C.Sen, "Principles of Electric Machines and Power Electronics", Wiley, 2013.
3	D.P. Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill Publishing Company Ltd, 2017.

Reference Books:

1	I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 5th Edition, 2017.
2	P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
Web References:	
1	https://courses.lumenlearning.com/boundless-physics/chapter/magnetism-and- magnetic-fields/
2	https://library.automationdirect.com/selecting-motors-industrial-applications/
3	https://electrical-engineering-portal.com/erection-procedure-for-power-transformer

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment (60%) [100 Marks]**		**End Semester Practical Examination (40%) [100 Marks]**
	FA (75 Marks)	SA (25 Marks)	
Remember	0	0	0
Understand	20	20	20
Apply	30	30	30
Analyse	30	30	30
Evaluate	0	0	0
Create	20	20	20

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C302.1	3	3	2	2			1	2	2	2			3		3
C302.2	3	2	1	1			1	2	2	2			3		3
C302.3	3	3	2	2	3		1	2	2	2			3		3
C302.4	3	2	1	1			1	2	2	2			3		3
C302.5	3	2	1	1			1	2	2	2			3		3
1	**Reasonably Agreed**			**2**		**Moderately Agreed**			**3**		**Strongly Agreed**				

23EC204	Digital System Design Laboratory	0/0/2/1

Nature of Course	M (Practical Application)

Course Pre-requisites	

Course Objectives:

1	To design, construct and debug combinational and sequential circuits based on an abstract functional specification.
2	To simulate and design Digital logic circuits using software Tools.

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

C204.1	Ability to design and analyze various combinational and sequential circuits.	[AP]
C204.2	Analyzing and implementing the various combinational logic circuits and verifying its truth table.	[AN]
C204.3	Analyzing the various sequential logic circuits and its characterization.	[AN]
C204.4	Design of any Digital display using digital IC's.	[AP]
C204.5	Simulation of digital circuits using simulation Tool.	[AP]

Course Contents

S.No	List of Experiments	CO Mapping	BT
1	Analysis and Synthesis of Arithmetic Expressions using Adders/Subtractors	C204.1	[AN]
2	Analysis and Synthesis of Logic Functions using 4 x 1 Multiplexers & 1 x 4 Demultiplexer	C204.2	[AN]
3	Analysis and Synthesis of Logic Functions using Decoders & Encoders	C204.2	[AN]
4	Analysis and Synthesis of Boolean Relations using two bit Digital Comparator	C204.2	[AN]
5	Analysis and synthesis of Code Converter (Binary to Gray and BCD to Excess-3)	C204.2	[AN]
6	Analysis and Synthesis of Multi-bit Sequential Circuits using Shift Registers (SISO,SIPO,PIPO)	C204.3	[AN]
7	Analysis and Synthesis of Multi-bit Sequential Circuits using Asynchronous Counter	C204.3	[AN]
8	Combinational logic circuits design using Verilog	C204.5	[AN]
9	Design a seven segment Electronic clock / Name display.	C204.4	[AN]
10	Design of an Arithmetic and Logical Unit using simulation Tool.	C204.5	[AN]
		Total Hours	30

Reference Books:	
1.	M. Morris Mano, Michael D.Ciletti., "Digital Design",4th Edition Pearson education,2018
2.	C. H. Roth Jr., Larry L. Kinney "Fundamentals of Logic Design", 7th Edition, Cengage Learning, 2019
3.	Thomas L. Floyd, Digital Fundamentals, 10th Edition, Pearson Education, New Delhi, 2011
Web References:	
1.	http://www.electrical4u.com/digital-electronics.htm
2.	http://www.technologystudent.com/elec1/dig1.htm
3.	http://www.allaboutcircuits.com/education/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember	-	-	-
Understand	-	-	-
Apply	-	-	-
Analyse	30	20	20
Evaluate	30	40	40
Create	40	40	40

Course Articulation Matrix (Laboratory)

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C204.1	3	2	1	1					1	1			3		3
C204.2	2	3	1	1					1	1			3		2
C204.3	2	2	1	1					1	1			3		2
C204.4	2	2	1	2					1	1			3		2
C204.5	2	2	1	1	1				1	1			3		2
1	Reasonably agreed			**2**	Moderately agreed			**3**	Strongly agreed						

23EE401		Electrical Machines- II	3/0/0/3
Nature of Course		G (Theory & Analytical)	
Course Pre-requisites		Electrical Machines - I	

Course Objectives:

1	To know the concepts of Rotating Magnetic Field.
2	To impart the knowledge of Synchronous and Induction Machines.
3	To analyze the performance of Synchronous and Induction Machines.

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

C401.1	Illustrate the Construction and Operation of Salient and Non-Salient Pole Alternators and Synchronous Motors.	[U]
C401.2	Examine the Performance of Synchronous Machines by various Methods	[A]
C401.3	Interpret the Construction and Operation of Single and Three Phase Induction Motor.	[U]
C401.4	Analyze the Performance of Induction Machines by various Methods.	[A]
C401.5	Investigate the Operation of various Starters and Speed Control methods of Induction Motor.	[A]

Course Contents:

Module 1: Synchronous Machines   20 Hrs

Introduction - MMF distribution - Rotating Magnetic Field. **Alternators:** Constructional details-Principle of operation and types of Rotor- EMF equation- Armature reaction - Voltage regulation - EMF, MMF and ZPF- Two Reaction Theory - Synchronization and Synchronizing Power - Parallel operation. **Synchronous motors:** Starting methods, Phasor diagram, V and Inverted - V Curves, Hunting and its suppression, Effect of change in Excitation, Synchronous Condenser. **Case study:** Synchronous motor industrial applications.

Module 2: Induction Machines   15 Hrs

Three phase induction motors: Constructional details - Principle of operation and types of Rotor - Slip - Starting and Maximum torque - Slip-Torque Characteristics, No Load and Blocked Rotor test - Equivalent Circuit- Circle Diagram - Crawling and Cogging.
Single- Phase Induction Motors: Constructional details - Principle of Operation and types - Double Field Revolving Theory - Equivalent Circuit and its applications. Types of Motors used in Electric Vehicles. **Case study:** Induction Generator as a Wind Power Generator,Maglev in transportation,

Module 3: Starting and Speed Control Methods of Induction Motors   10 Hrs

Need for Starting - Types of Starters - Rotor Resistance, Star- Delta, Autotransformer and Soft Starters, Speed control - Change of Voltage, Frequency, Number of Poles, V/F Control - Braking Methods, Motor Configuration in EV, **Case study** on Industry based Soft Starters.

	Total Hours	**45**

Text Books:

1.	A.E. Fitzgerald, Charles Kingsley, JR., Stephen D. Umans, "Electric Machinery", 6th Edition, McGraw Hill International Edition, New York, 2017.
2.	P.C.Sen, "Principles of Electric Machines and Power Electronics", Wiley, 2013.
3	D.P. Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill Publishing Company Ltd, 2017.

Reference Books:

1	I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 5th Edition, 2017.
2	P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

Web References:

1	http://nptel.ac.in/syllabus/syllabus.php?subjectId=108105018
2	http://freevideolectures.com/Course/2335/Basic-Electrical-Technology/23
3	https://www.electrical4u.com/deep-bar-double-cage-induction-motor/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total IA		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model (16 Marks)

Course Outcome	Bloom's Level	Assessment Component	Marks
C401.1	Understand	Online Quiz	20
C401.2	Analyze	Case Study	20
C401.3	Understand	Assignment	20
C401.4	Analyze		
C401.5	Analyze	Technical Presentation	20

Assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment (120)		End Semester Examination [60 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Summative Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%)						End Semester Examination (60%)
CA 1 : 100 Marks			CA 2 : 100 Marks			Theory Examination (100 Marks)
SA 1 (60 Marks)	FA 1 (8 Marks)		SA 2 (60 Marks)	FA 2 (8 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C401.1	2	1							2			1	3		3
C401.2	3	3	2	2					2			1	3		3
C401.3	2	1							2	2		1	3		3
C401.4	3	3	2	2					2			1	3		3
C401.5	2	1							2	2		1	3		3
1	Reasonably Agreed				**2**	Moderately Agreed				**3**	Strongly Agreed				

23EE402	Control Systems	3/0/0/3
Nature of Course	G (Theory Analytical)	
Course Pre-requisites	Transforms and Numerical Methods	

Course Objectives:

1	To understand the methods of systems representation and to derive their transfer function models.
2	To provide an adequate knowledge of systems in time domain and its stability analysis.
3	To accord basic knowledge in obtaining the open loop and closed loop frequency responses of systems.
4	To introduce the design of controllers and compensators

Course Outcomes:

Upon completion of the course, students shall have ability to

C402.1	Construct the mathematical models of various control systems and obtain the transfer function of a system.	[AP]
C402.2	Analyze the first and second order systems in time domain and frequency domain.	[A]
C402.3	Analyze the frequency responses using Bode Plot and Polar plot and examine the stability of the control systems using Root locus, Routh-Hurwitz Criteria methods.	[A]
C402.4	Design and realize the controllers and compensators.	[C]
C402.5	Calculate the controllers and compensators of the system and to apply basic concepts of discrete system.	[AP]

Course Contents:

Module 1: System Modelling **15 Hrs**

Basic elements of control systems - Open loop and closed loop systems - Transfer function modelling: Electrical systems and Mechanical system - Translational, Rotational. State-space modeling : Electrical systems and Mechanical system - Signal flow graph. Case Study : Modelling of Inverted Pendulum-Cart Systems.

Module 2: Time and Frequency Response Analysis **15 Hrs**

Time domain specifications - Types of test signals - Step response of first and second order system - Steady state error - Generalized error coefficients - Concept of stability - Routh Hurwitz criterion - Root locus technique - Frequency domain specifications - Bode plot - Polar plot - Gain margin and Phase margin. Case Study : Stability analysis of Inverted Pendulum-Cart Systems.

Module 3: Controllers and Compensators **15 Hrs**

Controllers: Design of P, PI, PD and PID controllers - **Compensators:** Introduction to lag, lead and lag-lead networks - Lag compensator design using Bode plot - Controllability and Observability - Electro-Mechanical Systems: Introduction - problem setup and design requirements, optimal control of electro-mechanical systems using PID controller - Introduction to Fuzzy Logic Controllers : Architecture, major components and design steps. Case Study : Closed loop performance analysis of Inverted Pendulum-Cartl Systems.

	Total Hours	**45**

Text Books:

1	I. J. Nagrath and M. Gopal, „Control Systems Engineering„, 6th Edition, New Age International Publishers, 2017.
2	Katsuhiko Ogata, „Modern Control Engineering", 5th edition, Pearson, New Delhi, 2015.
3	Farid Golnaraghi and Benjamin C. Kuo, „Automatic Control systems", 9th Edition, Wiley,2014.

Reference Books:

1	Norman S. Nise, „Control Systems Engineering", Wiley, New Delhi, 2018.

2	Richard Poley, „Control Theory Fundamentals", 2nd Edison, Createspace, 2014.
3	Richard C. Dorf, Robert H.Bishop, „Modern Control Engineering", 13th Edition, Pearson Education, New Delhi, 2016.
4	A.Nagoorkani, "Control Systems Engineering", RBA Publications 2014.
Web References:	
1	http://www.nptel.ac.in/courses/108101037/
2	https://nptel.ac.in/courses/108101037/14

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**			
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C402.1	Apply	Quiz	20
C402.2	Analyze	Class Presentation	20
C402.3	Analyze	Assignment	20
C402.4	Create		
C402.5	Apply	Case Study	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	20	20	20
Apply	30	30	30
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C402.1	3	2	1	1						1		2	3		
C402.2	3	3	2	2						1		2	3		
C402.3	3	3	2	2								1	3		
C402.4	3	3	3	3	3			1	2	1		3	3		1
C402.5	3	2	1	1								2	3		
1	Reasonably Agreed				**2**		Moderately Agreed				**3**		Strongly Agreed		

23IT211	Introduction To Python Programming	1/0/4/3
Nature of Course	F (Theory Programming)	
Course Pre-requisites		

Course Objectives:

1	To understand and execute Python script using types and expressions.
2	To understand the difference between expressions & statements and to understand the concept of assignment semantics.
3	To utilize high level data types such as lists and dictionaries.
4	To import and utilize a module and to perform read & write operations on files.

Course Outcomes:

Upon completion of the course, students shall have ability to

C211.1	Demonstrate expressions.	[U]
C211.2	Build control flow and string concept in python for solving problems.	[AP]
C211.3	Develop python programs using functions.	[AP]
C211.4	Analyze compound data using python lists, tuples and dictionaries.	[A]
C211.5	Apply python programs using files, exception, modules and packages.	[AP]

Course Contents:

Module 1: Data, Expressions, Statements   **15 Hrs**

Data Types, Variables and Identifiers, Operators and Expression, Conditional Branching Statements, Iterative statements Nested Loops, Break, Continue, Pass statements, Function- definition and function call, arguments, return statements, Lambda Function and Recursive Function.

Module 2: String, Lists, Functions   **15 Hrs**

Strings – Concatenation, Append, Comparing Strings, Iterating Strings, Strings Modules and Functions, Modules – NumPy, Math, List: Operations, Nested list, Cloning, Methods, Looping, Tuple: Operations, Nested Tuple, Tuple assignments, Checking the index, Dictionary: Operations, looping over and Nested Dictionary, Built in functions and Methods.

Module 3: Files, Inheritance   **15 Hrs**

Classes and Objects, Inheritance, Polymorphism, File Handling and Exception Handling.

	Total Theory Hours	**45**

Lab Components

S.No	List of Experiments
1.	Compute the GCD of two numbers.
2.	Find the square root of a number (Newton's method).
3.	Exponentiation (power of a number).
4.	Find the maximum of a list of numbers.
5.	Linear search and Binary search.
6.	First n prime numbers.
7.	Multiply matrices.
8.	Programs that take command line arguments (word count).
9.	Extract the functionality of Book class in Library class.
10.	File Handling

	Total Lab Hours	**30**
	Total Hours	**75**

Text Books:

1	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist'', 2nd Edition, Updated for Python 3, Shroff / O'Reilly, Publishers, 2016. (http://greenteapress.com/wp/think-python/).
2	Tony Gaddis, "Starting out with Python'', 4th Edition, Addison Wesley, Pearson, 2017.

Reference Books:	
1	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2	G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists",1st Edition, Notion Press, 2021.
3	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", 3rd Edition, MIT Press, 2021.

Web References:	
1	http://nptel.ac.in/courses/106106145/
2	https://www.codecademy.com/learn/learn-python
3	https://www.coursera.org/learn/python-data-analysis#syllabus

Online Resources:	
1	https://www.programiz.com/python-programming
2	https://www.fullstackpython.com/best-python-resources
3	https://www.udemy.com/course/easy-way-to-learn-python-for-beginners-2021/
4	https://stackify.com/learn-python-tutorials/

Continuous Assessment									**End Semester Examination**	**Total**
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**		
Formative Assessment	**Summative Assessment**	**Total**	**Total (A)**	**Formative Assessment**	**Summative Assessment**	**Total (B)**				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (10%) [80 Marks]**
C211.1	Understand	Assignment - 1	20
C211.2	Apply	Quiz	20
C211.3	Apply	Assignment - 2	20
C211.4	Analyze	Case Study	20
C211.5	Apply		

Assessment based on Summative and End Semester Examination - Theory		
Bloom's Level	**Summative Assessment (15%) [120 Marks]**	
	CIA1: (60 Marks)	**CIA2: (60 Marks)**
Remember	10	10
Understand	40	40
Apply	40	40
Analyse	10	10

Evaluate	-	-
Create	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (50%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	10	10	10
Understand	30	30	30
Apply	40	40	40
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)							End Semester Practical Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)	
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)		

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C211.1	1	2	1	1								2	1	2	1
C211.2	3	3	3	3	2							2	3	3	2
C211.3	3	3	3	3								2	3	3	2
C211.4	3	3	3	3	3							2	3	3	2
C211.5	3	2	3	3	3							1	3	3	2
1	Reasonably Agreed		2	Moderately Agreed			3	Strongly Agreed							

23EC404		Embedded C++	3/0/2/4
Nature of Course		F (Theory Programming)	
Course Pre-requisites		Digital System Design, Problem Solving using C++	

Course Objectives:

1	To introduce the requirements of embedded system design.
2	To set the embedded environment and handle the interrupts.
3	To write real time C++ programmes with their build processes.
4	To understand real time embedded operating systems.
5	To apply embedded C++ and build real time projects.

Course Outcomes:

Upon completion of the course, students shall have ability to

C404.1	Understand the fundamentals of embedded system design.	[U]
C404.2	Understand the embedded environment and handling interrupts	[U]
C404.3	Understand the basics of real time C++ programming.	[U]
C404.4	Apply the real time C++ program on embedded board.	[AP]
C404.5	Understand the embedded operating systems and peripherals.	[U]
C404.6	To build real time projects using embedded C++ programming.	[AP]

Course Contents:

Module 1: Fundamentals of Embedded Systems**15 Hrs**

Exploring embedded systems - Working with limited resources - Working with different architectures - Working with hardware errors - Setting Up the Environment - Handling Interrupts Data polling.

Module 2: Real Time C++**15 Hrs**

C++ as an Embedded Language - Getting Started with Real-Time C++. - Working with a Real-Time C++ Program on a Board - Optimized C++ Programming for Microcontrollers - Components for Real-Time C++ - Accessing Microcontroller Registers - Low-Level Hardware Drivers in C++

Module 3: Embedded Programming and Applications**15 Hrs**

Embedded operating systems - Real-time OSes - Custom peripherals and drivers - Resource limitations - Monitoring System - Resource-Restricted Embedded Systems - Embedded IDEs and frameworks - Programming MCUs - Soil Humidity Monitor with Wi-Fi

	Total Theory Hours	**45**

Lab Components

S.No	List of Experiments
1.	Interface LED using Embedded C++
2.	Interface seven segment Display using Embedded C++
3.	Interface LCD using Embedded C++
4.	Interface Temperature Sensor using Embedded C++
5.	Interface Gas Sensor using Embedded C++
6.	Interface ADC and DAC using Embedded C++
7.	Interface UART using Embedded C++
8.	Interface Bluetooth using Embedded C++

	Total Lab Hours	**30**
	Total Hours	**75**

Text Books:

1	Igor Viarheichyk, "Embedded Programming with Modern C++ Cookbook", Packt Publishing Ltd., 1st Edition, 2020.
2	Christopher Kormanyos, "Real-Time C++ - Efficient Object-Oriented and Template Microcontroller Programming", 4th Edition, 2021.
3	Maya Posch, "Hands-On Embedded Programming with C++17", Packt Publishing Ltd., 1st Edition, 2019.

4	Lyla B. Das," Embedded Systems an Integrated Approach", Pearson Education, 2013
Reference Books:	
1	Shibu K V," Introduction to Embedded Systems", McGraw Hill Education(India) Private Limited, 2014
2	Steve Heath, "Embedded Systems Design", EDN Series, 2013.
3	Herma K., Real Time Systems, Design for distributed Embedded Applications, 2011, 2nd edition, Springer, USA
Web References:	
1	https://www.tutorialspoint.com/embedded_systems/es_overview.htm
2	https://www.electronics-notes.com/articles/digital-embedded-processing/embeddedsystems/basics-primer.php
3	https://www.mathworks.com/solutions/embedded-systems.html
Online Resources:	
1	https://www.coursera.org/specializations/real-time-embedded-systems
2	https://onlinecourses.nptel.ac.in/noc20_ee98
3	https://www.udemy.com/course/master-cembedded-c-for-embedded-system-learn-in-depth-com/
4	https://www.edx.org/course/embedded-systems-shape-the-world-microcontroller-inputoutput

Continuous Assessment										End Semester Examination	Total
Theory				**Practical**			Total (A+B)	Total Continuous Assessment			
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)					
80	120	200	100	75	25	100	200	50		50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	Bloom's Level	Assessment Component	FA (10%) [80 Marks]
C404.1	Understand	Coding 1	20
C404.2			
C404.3	Understand	Coding 2	20
C404.4	Apply	Assignment	20
C404.5	Apply	Group Assignment	20
C404.6			

Assessment based on Summative and End Semester Examination - Theory		
Bloom's Level	Summative Assessment (15%) [120 Marks]	
	CIA1: (60 Marks)	CIA2: (60 Marks)
Remember	20	20
Understand	40	30
Apply	40	50
Analyse	-	-
Evaluate	-	-

Create	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (50%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	10	20	20
Understand	30	20	20
Apply	50	50	50
Analyse	10	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)								End Semester Practical Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C404.1	3	3												3	3
C404.2	3	3	3	2	2				2	1		3	3	2	3
C404.3	3	3	3	2	3				2	1		3	3	2	3
C404.4	3	3	3	3	3				3	2		3	3	2	3
C404.5	3	3	3	3	3				2	2		2	3	2	3
C404.6	3	3	3	3	3				3	2		2	3	2	3
1	Reasonably Agreed		2	Moderately Agreed			3	Strongly Agreed							

23EE403	Electrical Machines - II Laboratory	0/0/2/1
Nature of Course	M (Practical Application)	
Pre-requisites	Electrical Machines - I Laboratory	

Course Objectives:

1	To expose the operation of Synchronous and Induction Machines and give them experimental skills.

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

C403.1	Inspect the performance of Synchronous Generator by conducting various tests.	[AP]
C403.2	Examine the characteristics of V and inverted V curves in Synchronous	[A]
C403.3	Analyze the performance of Induction Machines.	[A]
C403.4	Investigate the performance of Induction Machines using Simulation Software.	[A]
C403.5	Demonstrate a specific Braking operation on an Induction Machine.	[AP]

Course Contents:

S.No	List of Experiments	CO Mapping	RBT
1.	Performance characteristics of Three Phase Alternator by direct loading.	C403.1	[A]
2.	Regulation of Three Phase Alternator by EMF method.	C403.1	[AP]
3.	Regulation of Three Phase Alternator by MMF method.	C403.1	[AP]
4.	Regulation of Three Phase Alternator by ZPF method.	C403.1	[AP]
5.	Regulation of Three Phase Salient Pole Alternator by Slip test.	C403.1	[A]
6.	V and Inverted V curves of Three Phase Synchronous Motor.	C403.2	[A]
7.	Load test on Single and Three Phase Induction Motor.	C403.3	[A]
8.	No Load and Blocked Rotor tests on Single Phase and Three PhaseInduction Motor (Determination of Equivalent Circuit parameters).	C403.3	[A]
9.	Performance characteristics of Single Phase and Three Phase Induction Motors using Simulation.Compare it with real time results.	C403.4	[A]
10.	Speed control of 3 phase Induction motor using VFD and Programming of AC drive for required parameters.	C403.5	[A]
	Total Hours	**30**	

Text Books:

1	I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education 5th Edition,2017.
2	A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
3	P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

Reference Books:

1	P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, Third Edition, 2013.
2	M.G. Say," Alternating Current Machines", Pitman Publishing Ltd., 4th edition, 2013.
3	A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 2010.

Web References:

1	http://nptel.ac.in/syllabus/syllabus.php?subjectId=108105018
2	http://freevideolectures.com/Course/2335/Basic-Electrical-Technology/23
3	https://www.electrical4u.com/deep-bar-double-cage-induction-motor/
4	https://www.youtube.com/watch?v=b24jORRoxEc
5	http://www.engineeringmatters.com/EngineeringMatters_Project_Maglev.pdf

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember	-	-	-
Understand	-	-	-
Apply	60	60	60
Analyse	30	30	30
Evaluate	10	10	10
Create	-	-	-

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C403.1	2	1							2			1	3		3
C403.2	2	1							2			1	3		3
C403.3	2	3	2	2					2			1	3		3
C403.4	2	1			3				2			1	3		3
C403.5	3	2	1	1					2			1	3		3
1	Reasonably Agreed		2		Moderately Agreed			3			Strongly Agreed				

23EE404		Control Systems Laboratory		0/0/2/1
Nature of Course		M (Practical application)		
Pre-requisites		Control Systems		

Course Objectives:

1	To enable the students to strengthen their understanding of the design and analysis of control systems using modern software resources.

Course Outcomes:

Upon completion of the course, students shall have ability to

C404.1	Construct the transfer function a DC separately excited generator and obtain its characteristics	[AP]
C404.2	Construct the transfer function of the given DC Motor for Armature controlled and Field controlled cases	[AP]
C404.3	Demonstrate Servo and stepper motor System also to set up a closed loop position control system and study the system performance.	[U]
C404.4	Analyze the time response and stability of first and second order Systems	[A]
C404.5	Design a Controllers and lag compensator for uncompensated system using simulation software	[A]

Course Contents:

S.No	List of Experiments	CO Mapping	BT
1	Determination of transfer function of separately excited DC Generator	C404.1	[AP]
2	Determination of transfer function of Armature Controlled DC Motor	C404.2	[AP]
3	Determination of transfer function of Field Controlled DC Motor	C404.2	[AP]
4	Servo and Stepper motor position control systems	C404.3	[U]
5	Simulation of first and Second order system for different test inputs.	C404.4	[A]
6	Time response analysis for a second order system using simulation software.	C404.4	[A]
7	Stability analysis of linear systems using simulation software	C404.4	[A]
8	Design of P, PI, PD and PID controllers for type-0 and type-1 system using simulation software.	C404.5	[AP]
9	Design of lag, lead and lag-lead compensator for uncompensated system using simulation software.	C404.5	[AP]
10	Design of Controller for a inverted pendulum-cart system.	C404.5	[AP]
	Total Hours	**30**	

Text Books:

1	I. J. Nagrath and M. Gopal, "Control Systems Engineering", 6th Edition, New Age International Publishers, 2017
2	Katsuhiko Ogata, "Modern Control Engineering", 5th edition, Pearson, New Delhi, 2015.
3	Farid Golnaraghi and Benjamin C. Kuo, "Automatic Control systems", 9th Edition, Wiley,2014.

Reference Books:

1	Norman S. Nise, "Control Systems Engineering", Wiley, New Delhi, 2018.
2	Richard Poley, "Control Theory Fundamentals", 2nd Edison, Createspace, 2014.
3	Richard C. Dorf, Robert H.Bishop, "Modern Control Engineering", 13th Edition, Pearson Education, New Delhi, 2016.
4	A.Nagoorkani, "Control Systems Engineering", RBA Publications 2014.
5	S.Palani, "Control Systems Engineering", 2nd Edition, Tata McGraw-Hill Education,2010.

Web References:

1	http://www.nptel.ac.in/courses/108101037/
2	http://www.nptel.ac.in/courses/108102043/
3	https://nptel.ac.in/courses/108101037/14

Continuous Assessment			Total Continuous Assessment	End Semester Examination	Total
Formative Assessment	Summative Assessment	Total			
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember	0	0	0
Understand	20	20	20
Apply	30	30	30
Analyse	30	30	30
Evaluate	0	0	0
Create	20	20	20

No. of the CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C404.1	3	2	1	1						2			3		
C404.2	3	2	1	1						2			3	1	
C404.3	2	1											2	1	
C404.4	3	3	2	2	3			2	2	1		2	2	1	
C404.5	3	3	3	3	3			2		1	1	2	2		2
1	Reasonably Agreed			2		Moderately Agreed			3			Strongly Agreed			

PROFESSIONAL ELECTIVE COURSES

23MT910		**Product Design**	3/0/0/3
Nature of Course		Theory	
Course Pre-requisites		-	

Course Objectives:

1	To develop a better understanding of the perspective of Industrial Design and to gain experience regarding the role of an industrial designer.
2	To apply appropriate design methods and tools to design and develop innovative products.
3	To learn the key considerations for embodying an electronic product concept to make it suitable for manufacturing and production.

Course Outcomes:

Upon completion of the course, students shall have ability to

C910.1	Examine the design history, philosophy, and diverse approaches.	[R]
C910.2	Apply varied product design methods for user-centered outcomes.	[AP]
C910.3	Infer the consumer products, design perspectives, and innovation modes.	[U]
C910.4	Understand electronic product design, manufacturing, and automation.	[U]
C910.5	Apply PCB guidelines, control systems, and electromechanical principles.	[AP]

Course Contents:

Module 1:   **15 Hrs**

Introduction to Product Design, Evolution of Design - industrial revolution; Design philosophy; Interrelationship of and engineering; User centered considerations in Design; Diversity of design approaches; Design thinking; Material-driven design; Prototype-driven design; Brand driven design; Industry approaches to Product Design. Types of consumer products; Design space; User's perspective to products; Designer's perspective to products; New product development processes and methods.

Module 2:   **15 Hrs**

Design Innovation, Modes of innovation by design and exploring problem structure; Methods to understand design intent, design context and users; Methods to frame insights, generate creative concepts, frame solutions and realize offerings. Introduction to electronic product design; Principles of Embodiment Design: Product architecture development, Steps and guidelines, Product modularity; Introduction to manufacturing.

Module 3:   **15 Hrs**

Processes for Electronic Product Design - Die casting, Injection molding, Sheet metal fabrication, PCB manufacturing, Automation. Guidelines for PCB Design - Batch and mass production, High speed automation, Robotic assembly, EM shielding. Design for X: Guidelines for aesthetics, Corrosion, Manual handling, Assembly, Disassembly. Design for Quality: Quality function deployment, FMEA, Product reliability, Standards and certification in electronic product design.

	Total Hours	**45**

Text Books:

1	V. Kumar, 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization, John Wiley & Sons, 2012.
2	K. T. Ulrich and S. D. Eppinger, Product Design and Development, 7th Edition, McGraw Hill, 2020.
3	G. Pahl, W. Beitz, J. Feldhusen, and K. Grote, Engineering Design: A Systematic Approach, 3rd Edition, Berlin, Springer, 2007.

Reference Books:		
1	D. Norman, The Design of Everyday Things: Revised and Expanded Edition, Basic Books, New York, 2013.	
2	R.G. Kaduskar and V.B. Baru, Electronic Product Design, 2nd Edition, Wiley, 2011.	
Web References:		
1	https://onlinecourses.nptel.ac.in/noc21_ee90/preview	
2	https://onlinecourses.nptel.ac.in/noc21_me83/preview	
3	https://www.udemy.com/course/drawing-for-product-design/	
4	https://www.pluralsight.com/courses/electronic-product-design-rhino-1169	

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			

Course Outcome	Bloom's Level	Assessment Component	FA (16%) [80 Marks]
C910.1	Remember	Technical Quiz	20
C910.2	Apply	Seminar Presentation	20
C910.5			
C910.3	Understand	Assignment	20
C910.4	Understand	Test	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination					
Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C910.1	3	3	3									3	3	3	3
C910.2	3	3	3									3	3	3	3
C910.3	3	3	3									3	3	3	3
C910.4	3	3	3									3	3	3	3
C910.5	3	3	3									3	3	3	3
1	Reasonably Agreed			**2**		Moderately Agreed			**3**			Strongly Agreed			

MANDATORY COURSES

23MC101	Induction Programme	1/0/0/0
Nature of Course	Induction Programme	
Course 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:

Module 1: 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)

Module 2: 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)

Module 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)

| | | | | | | | | | | | | | | | Total Hours | 15 |

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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
1	Reasonably Agreed			**2**		Moderately Agreed					**3**		Strongly Agreed		

23MC102	**Environmental Sciences**	1/0/0/0
Nature of Course	C (Theory Concept)	
Course Pre-requisites	NIL	

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 　　　　　　　　　　　　　　　　　　　　　　　　**05 Hrs**

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 　　　　　　　　　　　　　　　　　　　　　**05 Hrs**

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. Soil pollution - 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 　　　　　　　　　　　　　　　　　**05 Hrs**

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.

	Total Hours	**15**

Text Books:

1	AnubhaKaushik and C P Kaushik "Perspectives in Environmental Studies"4th Edition, Newage 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
6	https://www.edx.org/course/subject/environmental-studies

Continuous Assessment		End Semester Examination	Total
Formative Assessment	**Summative Assessment**		
50	**-**	**50**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model (16 Marks)

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case study, Seminar, Group Assignment)	Marks
C102.1	Remember	Quiz	**10**
C102.2	Understand	Mini project based on environmental aspect	**20**
C102.3	Understand	Class Presentation	**10**
C102.4 & 5	Apply	Group Assignment	**10**

Assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment (24%)**		**End Semester Examination (60%) [50 Marks]**
	CIA1 : [0 Marks]	**CIA2 : [0 Marks]**	
Remember	-	-	30
Understand	-	-	40
Apply	-	-	30
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Summative Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%)						**End Semester Examination (60%)**
CA 1 : 0 Marks			**CA 2 : 0 Marks**			**Theory Examination (60 Marks)**
SA 1 (12 Marks)	**FA 1 (8 Marks)**		**SA 2 (12 Marks)**	**FA 2 (8 Marks)**		
	Component - I (4 Marks)	**Component - II (4 Marks)**		**Component - I (4 Marks)**	**Component - II (4 Marks)**	

No. of the CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C102.1	0	0	0	0	0	3	3	3	2	0	0	3	0	0	3
C102.2	0	0	0	0	0	3	3	3	2	0	0	3	0	0	3
C102.3	0	0	0	0	0	3	3	3	2	0	0	3	0	0	3
C102.4 &5	0	0	0	0	0	3	3	3	2	0	0	3	0	0	3
1	**Reasonably Agreed**		**2**	**Moderately Agreed**			**3**	**Strongly Agreed**							

23MC103	Soft Skills	1/0/0/0
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	Analyze and apply creativity skills, critical thinking skills and problem solving skills.	[A]
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 **05 Hrs**

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 **05 Hrs**

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 **05 Hrs**

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

Reference Books:

1.	Reason and professional ethics by Peter Davson-Galle. Ashgate Publishing, Ltd., 2009.
2.	Cross Cultural and Inter Cultural Communication. by William B. Gudykunst. Sage Publications India Pvt Ltd, New Delhi.2003.
3.	Corporate Communications: Theory and Practice. By JoepCornelissen. 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 and Levels (based on Revised Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Revised Bloom's Level	Assessment Component	Marks
C103.1	Remember	Group Discussion	30
C103.2 and C103.3	Understand and Apply	Listening Skills	20
C103.4	Analyze	Interview	20
C103.5 and C103.6	Apply	Formal Presentation	30

23MC104	**Management Organizational Behaviour**	**1/0/0/0**

Nature of Course	Theory Concept
Pre requisites	Nil

Course Objectives:

1.	The objective of the course is to provide basic knowledge about management to familiarize the students with the management principles and organizational behavior.
2.	The course is designed to enable the students to adapt and apply theoretical concepts in business
3.	To know about the role of manager in the area of management.
4.	To create and implement team building strategies for organization building.

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

C104.1	Identify and understand different management principles techniques in business environment.	[U]
C104.2	Apply management fundamentals and planning to solve organization problems and make effective decisions.	[AP]
C104.3	Understand and analyze the changes within an individual will change the group as well as the organization	[A]
C104.4	Understand and analyze the leadership style and organization theories to create a productive environment to workforce.	[A]
C104.5	Analyze the organizational climate and change management strategies and tactics	[A]
C104.6	Apply the empowerment strategy and tactics for productivity	[AP]

Course Contents:

Module 1: Fundamentals of Management, Planning and Decision Making   05 Hrs
Introduction to Management- Concept and functions- Thought Managerial roles and styles- Principles of Management - Levels of Management- Theories of Management - Classical, Scientific, Administrative, Behavioral, Management Sciences Theories. Organizational planning - Vision, Mission and goals, Types of plans, steps in planning process, Approaches to planning, Planning in Dynamic Environment. Decision making process, types of decisions, decision making styles, Behavioural influences on decision making - Group decision making - Vroom's Participative decision-making model.

Module 2: Individual, interpersonal and group behavior   05 Hrs
Definition, need and importance of Organizational behavior –Learning-Nature -Importance of Learning- Introduction and theories Motivation: Content and process theories-Leadership: Styles and Theories - Perception-Personality — Attitudes- Definition, need and importance - Nature and scope-Importance of Groups and Teams- Role relationships and conflict-Group dynamics- Work values. Organization Theories: Maslow's needs hierarchy theory, two factor theory of motivation, McGregor's theory, ERG theory, McClelland's needs theory, Valance Theory.

Module 3: Organizational Development   05 Hrs
Organizational culture: Elements - Organizational climate– Factors affecting organizational climate-Organizational Commitment, Organizational change- Importance- Stability Vs Change- Proactive Vs Reaction change- Change process– Resistance to change- Managing changes- Managing International Workforce - Productivity- Alternative change management approaches and cultural contingencies - power to manage effectively; Empowerment and Participation strategies and tactics.

	Total Hours:	**15 Hrs**

Text Books:	
1.	Nelson, Quick, Khandelwal, "Organizational Behavior", 2nd edition, Cengage Learning, 2016.
2.	Williams, Tripathy, "Principles of Management", Cengage Learning, 2016.
3.	Aswathappa, K, "Organizational Behavior", 12th Edition, Himalaya Publication, 2016.
4.	Stephen Robbins, Timothy A. Judge, "Organizational Behavior", 16th edition, Prentice Hall India Pvt. Ltd, 2014.

Reference Books:	
1.	Chandrani Singh, Aditi Khatri, "Principles and Practices of Management and Organizational Behavior", Sage Publications, 2016.
2.	Richard L. Daft, "Understanding the Theory and Design of Organizations", 11th edition, Cengage Learning, 2013.
3.	John M Ivancevich and Robert Konopaske, "Organizational Behavior and Management", McGraw-Hill Education, 2013.
4.	UdaiPareek, Sushama Khanna, "Organization Behavior", 3rd edition, Oxford Publishing, 2012.

Web References:	
1.	https://iedunote.com/fundamental-concepts-of-organizational-behavior
2.	https://nscpolteksby.ac.id/ebook/
3.	https://ebooks.lpude.in/management/mba/term_1/DMGT402_MANAGEMENT PRACTICES_AND_ORGANIZATIONAL_BEHAVIOUR.pdf
4.	https://www.studocu.com/in/document/vellore-institute-of-technology/organizational-behaviour/lecture-notes/ob-notes/3208134/view

Online Resources:	
1.	https://nptel.ac.in/syllabus/110105034/
2.	https://nptel.ac.in/courses/110/105/110105033/
3.	https://freevideolectures.com/course/3502/organizational-behaviour-i
4.	https://nptel.ac.in/courses/110/106/110106145/

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

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Revised Bloom's Level	Assessment Component	Marks
C104.1	Understand	Online Quiz	30
C104.2 C104.3	Apply and Analyze	Listening Skills	20
C104.4	Analyze	Group Discussion	20
C104.5 C104.6	Analyze and Apply	Formal Presentation	30

23MC105	General Aptitude	1/0 /0 /0
Nature of Course	Theory Concept	
Pre requisites	NIL	

Course Objectives:

1	To improve the verbal ability.
2	To improve the mathematical skills.
3	To develop problem solving skills.
4	To equip them to face interview and Group Discussion.
5	To inculcate critical thinking process.

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 now 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 Statistic	**05 Hrs**

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 Equationsand 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	**05 Hrs**

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	**05 Hrs**

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 – RuleDetection.

	Total Hours:	**15**

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 and 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
Reference Books:	
1	R.S. Aggarwal,"Quantitative Aptitude", S.Chand Publishers
2	R.S. Aggarwal,"A Modern Approach to Verbal and Non-verbal reasoning", S.Chand Publishers
3	Face Aptipedia - Aptitude Encyclopedia - Wiley
4	Dinesh Khattar, "The pearson guide to Quantitative Aptitude for Competitiveexaminations, Pearson Education
Web References:	
1	https://www.geeksforgeeks.org/placements-gq/
2	https://www.indiabix.com/aptitude/questions-and-answers/
Assessment Methods and Levels (based on Bloom's Taxonomy)	
Formative assessment based on Capstone Model (Max. Marks:100)	

Course Outcome	Bloom's Level	Assessment Component	Marks
C105.1	Remember	Quiz	30
C105.2 C105.3	Understand and Apply	Formal presentation	20
C105.4, C105.5 and C105.6	Apply	Formal interview tests	50

23MC106	Life Skills and Ethics	1/0 /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 and 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 professionallife.	[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.	[A]
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:

Module 1 **05 Hrs**
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.

Module 2 **05 Hrs**
Critical Thinking and Problem Solving: Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats Mind Mapping and Analytical Thinking. Teamwork: Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance and Team Conflicts.

Module 3 **05 Hrs**
Ethics, Moral and 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 and leadership Formulation

	Total Hours	**15**

Reference Books:

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

Web References:

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

Assessment Methods and Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Bloom's Level	Assessment Component	Marks
C106.1	Understand	Online Quiz	**20**
C106.2	Apply	Assignment	**20**
C106.3	Analyse	Technical Presentation	**30**
C106.4 C106.5	Apply Understand	Group Discussion	**30**

23MC107	Stress Management	1 /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	[A]
C107.4	Develop a long term action plan to minimize and better manage stress	[AP]

Course Contents:

Module 1   **05 Hrs**
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.

Module 2   **05 Hrs**
Developing Resilience to Stress: Understanding you stress level – Role of personality pattern, Self-esteem, Locus of control – Role of Thoughts Beliefs and Emotions – I and II – Lifesituation Intrapersonal: (Assertiveness, Time Management).

Module 3   **05 Hrs**
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	**15**

Reference Books:

1	Jonathan C. Smith; (2011), "Stress Management: A Comprehensive Handbook of Techniques and Strategies", First Edition; Springer Publishing Company.
2	Bob Stahl, Elisha Goldstein, Jon Kabat-Zinn (2019); "A mindfulness–based stress reduction workbook"; Second Edition; New Harbinger Publications.
3	Ryan M. Niemiec (2019), " The Strengths-based workbook for stress relief", First edition, New Harbinger Publications.

Web References:

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

Assessment Methods and Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Bloom's Level	Assessment Component	Marks
C107.1	Understand	Online Quiz	**20**
C107.2	Apply	Group Discussion	**30**
C107.3	Analyse	Class Presentation	**30**
C107.4	Apply	Assignment	**20**

23MC108	Constitution of India	1/0/0/0

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   **05 Hrs**

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   **05 Hrs**

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   **05 Hrs**

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

	Total Hours:	15

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 and Levels (based on Blooms' Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Bloom'sLevel	Assessment Component	Marks
C108.1	Understand	Online Quiz	60
C108.4	Remember		
C108.3	Apply	Class Presentation	20
C108.2	Apply	Assignment	20

23MC109	Essence of Indian Traditional Knowledge	1/0/0/0

Nature of Course	Theory Concept	
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:

Module 1 **05 Hrs**

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

Module 2 **05 Hrs**

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

Module 3 **05 Hrs**

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

	Total hours	**15**

Text Books:

1	Kapil Kapoor and Michel Danino, Textbook of "Knowledge Traditions and Practicesof India", Central Board of Secondary Education, 2017.
2	Yogesh Atal, "Indian Society: Continuity and Change", Pearson EducationIndia, 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 toSocial 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 and 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	Online Quiz	**20**
C109.2	Understand	Assignment	**20**
C109.3	Apply	Class Presentation	**20**
C109.4	Create	Survey	**40**

VALUE ADDED COURSES

23VA301		Solar Energy Technology	2/0/0/2
Nature of Course		Theory Practical	
Pre requisites		Nil	

Course Objectives:

1.	To provide comprehensive knowledge on solar radiation, analysis of solar radiation data, fundamentals of the solar thermal and photovoltaic system along with storage of energy required for effective design of efficient solar energy conversion devices.
2.	To illustrate the concept with practical examples, schematics and block diagrams wherever required

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

C301.1	Understand the solar energy scenario and PV cells.	[U]
C301.2	Analyze the working principle of stand alone system.	[AN]
C301.3	Distinguish the standalone and grid connected system	[AP]
C301.4	Apply the concepts of solar energy conversion system in practical applications.	[AP]

Course Contents:

Module 1: Solar Energy   **10 Hrs**

Energy Scenario, overview of solar energy conversion devices and applications, physics of propagation of solar radiation from the sun to earth. Sun-Earth Geometry, Extra-Terrestrial and Terrestrial Radiation, Solar energy measuring instruments. Estimation of solar radiation under different climatic conditions, Estimation of total radiation. Fundamentals of solar PV cells, principles and performance analysis, modules, arrays, theoretical maximum power generation from PV cells.

Module 2: PV system   **12 Hrs**

PV standalone system components, Standalone PV-system design. Components of grid-connected PV system, solar power plant design and performance analysis. Fundamentals of solar collectors, Snails law, Bougers law, Physical significance of Transmissivity - absorptivity product. Performance anlaysis of Liquid flat plate collectors and testing.

Module 3: Distribution system analysis   **8 Hrs**

Performance analysis of Solar Air heaters and testing. Solar thermal power generation (Solar concentrators). Thermal Energy Storage (sensible, latent and thermochemical) and solar pond-Applications: Solar Refrigeration, Passive architecture, solar distillation, and emerging technologies.

	Total Hours	**30**

Text Books:

1.	G. N. Tiwari, Solar Energy, Fundamentals, Design, Modeling and Applications, Narosa, 2016.
2.	S. P. Sukhatme and J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill, 2006.
3.	C. S. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, Prentice Hall India, 2nd Edition, 2011.

Suggested Readings:

1.	J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley, 2006.
2.	A. Goetzberger and V. U. Hoffmann, Photovoltaic Solar Energy Generation, Springer- -verlag, 2010.
3.	T. C. Kandpal and H.P. Garg, Financial Evaluation of Renewable Energy Technologies, McMillan India Ltd., 2013
4.	K. Jager, O. Isabella, A. H. M. Smets, R.A.C.M.M. Van Swaaij, and M. Zeman, Solar Energy – fundamentals, technology and systems, Delft University of Technology, 2014.

Web References:	
1.	https://www.edx.org/course/solar-energy-delftx-et3034x-0
2.	https://www.nrel.gov/research/re-solar.html
3.	https://www.azocleantech.com/article.aspx?ArticleID=1593
Online Resources:	
1.	https://onlinecourses.nptel.ac.in/noc20_ph14

23VA302	Industry 4.0 using Industrial Internet of Things	2/0/0/2
Nature of Course	Theory Practical	
Pre requisites	NIL	

Course Objectives:

1.	To provide knowledge about Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing.
2.	To apply IoT data for business solution in various domain in secured manner.

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

C302.1	Identify the IoT networking components with respect to OSI layer.	[U]
C302.2	Design and develop IT based sensor systems.	[AP]
C302.3	Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems.	[E]
C302.4	IoT links the automation system with enterprise, planning and product lifecycle	[AP]

Course Contents:

Module 1: Introduction	**10 Hrs**

Sensing and actuation, Communication, Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories. Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis.

Module 2: Cybersecurity in Industry 4.0	**12 Hrs**

Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.

Module 3: Industrial IoT	**8 Hrs**

Layers: IIoT Sensing-IIoT Processing Introduction, Machine Learning and Data Science. Case study - I : Milk Processing and Packaging Industries.

	Total Hours	**30**

Text Books:

1.	S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
2.	S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.

Suggested Readings:

1.	Vijay Madisetti , Arshdeep Bahga, Adrian McEwen (Author), Hakim Cassimally "Internet of Things A Hands-on-Approach" Arshdeep Bahga & Vijay Madisetti, 2014.
2.	Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, "From Machine to Machine to Internet of Things", Elsevier Publications, 2014.
3.	LuYan, Yan Zhang, Laurence T. Yang, Huansheng Ning, The Internet of Things: From RFID to the Next-Generation Pervasive Network, Aurbach publications, March, 2008.

Web References:

1.	https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3
2.	https://www.amazon.in/Introduction-IoT-Sudip Misra / dp / 1108959741 /ref = sr _1 _1 ? dchild = 1&keywords=sudip+misra&qid=1627359928&sr=8-1

Online Resources:

1.	https://onlinecourses.nptel.ac.in/noc22_cs95/preview

23VA303		Microgrid Technology	2/0/0/2
Nature of Course		Theory Practical	
Pre requisites		NIL	

Course Objectives:

1. To know Advanced modeling, control, resilience and security technologies useful for the grid modernization from a unique angle of microgrid design, analysis and operation.
2. To develop Smart inverters, microgrid architectures, distributed energy resources modeling, microgrid hierachical control, microgrid stability, fault management, resilient microgrids through programmable networks, reliable networked microgrids, and cyber security.

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

C303.1	Understand the concepts of microgrids, and networked microgrids;.	[U]
C303.2	Model PV power systems and standard grid-tied inverter;	[A]
C303.3	Analyze distribution grid power flow;	[A]
C303.4	Understand centralized control and distributed control in microgrids, especially primary, secondary and tertiary control;	[U]
C303.5	Conduct power flow analysis for droop-control-based microgrids and networked microgrids;	[AP]
C303.6	Understand basics of cybersecurity in microgrids and active defense strategy.	[U]

Course Contents:

Module 1: Microgrid Modelling and Analysis **10 Hrs**

Introduction - The concept of microgrids - Distributed energy resources (DERs) modelling I: PV system, MPPT, and grid-tied interface - Distributed energy resources modelling II: Microturbine, energy storage and other DERs - Microgrid inverter structures - Distribution power flow - Stability modelling and computation.

Module 2: Microgrid Control and Enhanced Microgrid Power Flow **12 Hrs**

Centralized control - Hierarchical principle: Primary, secondary and tertiary control – Distributed control - Microgrid power flow – Networked microgrid power flow - Formal analysis of microgrid dynamics - Stability margin analysis on networked microgrids.

Module 3: Cyber Security in Microgrids **8 Hrs**

Introduction to cyber-attacks - Active detection of cyber attacks

	Total Hours:	**30 Hrs.**

Text Books:

1.	P. Zhang, Networked Microgrids. Cambridge University Press, 2020.
2.	Fusheng Li, Ruisheng Li, Fengquan Zhou, Microgrid Technology and Engineering Application, Elsevier, 2015

Suggested Readings:

1.	Manuela Sechilariu, Fabrice Locment, Urban DC Microgrid: Intelligent Control and Power Flow Optimization, Butterworth-Heinemann, 2016
2.	Hassan Bevrani, BrunoFrançois, Toshifumi Ise, Microgrid Dynamics and Control John Wiley Sons, 2017
3.	Gevork B. Gharehpetian, S. Mohammad Mousavi Agah, Distributed Generation Systems: Design, Operation and Grid Integration, Butterworth Heinemann, 2017

Web References:

1.	https://www.sgrwin.com/basic-understanding-iec-61850/.
2.	https://www.alstom.com/press-releases-news/2015/1/alstoms-substation-automation-solutions-sas-business-unveils-new-dap-io-modules-for-smart-grid-applications.

Online Resources:

1.	https://indianinstituteofsolarenergy.com/courses/microgrid-certification-training/
2.	https://onlinecourses.nptel.ac.in/noc20_ee84/preview

23VA304	**FPGA-based Switched Mode Power Converters**	**2/0/0/2**

Nature of Course	Theory Practical
Pre requisites	Nil

Course Objectives:

1.	To develop skilled manpower and to facilitate academic as well as corporate research and development.
2.	To know about latest digital control trends in power electronics industries.

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

C304.1	Understand the digital control in switched mode power converters.	[U]
C304.2	Analyze frequency and time domain digital control design approaches	[AN]
C304.3	Model Digital control implementation blocks.	[AP]
C304.4	Apply modeling concepts of Verilog HDL programming for the design of digital circuits.	[AP]

Course Contents:

Module 1: Introduction   **10 Hrs**

Introduction to digital control in switched mode power converters - Fixed and variable frequency digital control architectures - MATLAB custom model development for simulation under digital control.

Module 2: Modeling Techniques   **12 Hrs**

Modeling techniques and model validation using MATLAB - Frequency and time domain digital control design approaches - Digital control implementation blocks and steps for FPGA based prototyping

Module 3: Verilog HDL   **8 Hrs**

Introduction to Verilog HDL and simulation using Xilinx Webpack - Digital controller implementation using fixed point arithmetic and Verilog HDL - Digital Control Implementation using STM32 and C2000 Series Microcontrollers - Hardware case studies of advanced digital control techniques

	Total Hours:	**30 Hrs.**

Text Books:

1.	S. Kapat and P. T. Krein, ""A Tutorial and Review Discussion of Modulation, Control and Tuning of High Performance DC-DC Converters based on Small-Signal and Large-Signal Approaches"" IEEE Open Journal of Power Electronics , vol. 1, pp. 339 - 371, Aug. 2020.
2.	R. W. Erickson and D. Maksimovic, Fundamentals of Power Electronics, 3rd Ed., Springer, 2020

Suggested Readings:

1.	Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", 2ndedition, Pearson 2013.
2.	Volnei A. Pedroni, "Circuit Design and Simulation with VHDL", MIT Press,2nd edition 2010.
3.	S.H.Gerez,"Algorithms for VLSI Design Automation", John Wiley &Sons, 2011.

Web References:

1.	https://nptel.ac.in/courses/117101058
2.	https://www.tutorialspoint.com/vlsi_design/index.htm
3.	https://www.edaplayground.com/

Online Resources:

1.	VLSI Classroom Training | Online VLSI Course -VLSIGuru.com

23VA305		**Phase-Locked Loop Circuit Design**	**2/0/0/2**
Nature of Course		Theory Practical	
Pre requisites		Nil	

Course Objectives:

1.	To expose the state-of-the-art frequency synthesis techniques used in analog/digital integer-N PLLs.
2.	To equip students with skills to analyze, debug, and evaluate a PLL design at analytical and transistor levels both.

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

C305.1	Understand the Basic concepts in PLL.	[U]
C305.2	Design of PLL building blocks for charge pump	[AN]
C305.3	Design of PLL building blocks for supply regulated oscillators	[AP]
C305.4	Analyze Noise analysis in digital PLLs	[AP]

Course Contents:

Module 1: Introduction	**10 Hrs**

Basic concepts in PLL, Type-I PLL - Frequency acquisition in PLLs - Phase/frequency error detectors, Charge-pump based type-II PLLs.

Module 2: PLL building Blocks	**12 Hrs**

Design of PLL building blocks: PFD - Design of PLL building blocks: Charge-pump - Design of PLL building blocks: Ring oscillators - Design of PLL building blocks: Supply regulated oscillators.

Module 3: Digital PLLs	**8 Hrs**

Introduction of Digital PLLs - Noise analysis in digital PLLs.

	Total Hours:	**30 Hrs.**

Text Books:

1.	R.E. Best, "Phase Locked Loops Design, Simulation and Applications," McGraw-Hill Publication, 6th Edition,Revised edition 2017.
2.	W. Egan, Phase-Lock Basics, John Wiley & Sons, 2008.

Suggested Readings:

1.	F. Gardner, Phaselock Techniques, John Wiley & Sons, 2005.
2.	Dan H Wolaver, "Phase-Locked Loop Circuit Design," Prentice hall,2001

Web References:

1.	https://web.ece.ucsb.edu/~long/ece594a/PLL_intro_594a_s05
2.	https://ewh.ieee.org/r5/denver/sscs/Presentations/2007_05_Fischette

Online Resources:

1.	https://onlinecourses.nptel.ac.in/noc22_ee92/

23VA306	Substation Designing	2/0/0/2
Nature of Course	Theory Practical	
Pre requisites	Power System Analysis	

Course Objectives:

1.	To model the components (feeders, distribution transformer, regulators, capacitors, loads, distributed generation, storage, etc.)
2.	To analyze the methods (load flow, short-circuit, etc.), specially developed for the distribution system.

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

C306.1	Understand the structure of a distribution system.	[U]
C306.2	Illustrate the concept of distribution, Feeders, Substation layout.	[U]
C306.3	Analyze the role of single and three phase transformers in distribution system.	[AP]
C306.4	Analyze the load duration curve, economic aspects and power tariff calculation methods.	[AP]

Course Contents:

Module 1: Structure of a distribution system   **10 Hrs**

Distribution feeder configurations and substation layouts. Nature of loads, Approximate methods of analysis, Computation of transformer and feeder loading, K Factors, voltage drop and power loss calculations, Distribution of loads and various geometric configurations.

Module 2: Modeling of distribution system components   **8 Hrs**

Overhead lines, feeders and cables - Single and three phase distribution transformers-Voltage regulators - Load models - Capacitor banks-Distributed generation.

Module 3: Distribution system analysis   **12 Hrs**

Load flow analysis: Backward/forward sweep, Load flow analysis: Direct approach, Load flow analysis: Direct approach for weakly meshed systems, Load flow analysis: Gauss Implicit Z-matrix Method. Applications of distribution system analysis.

	Total Hours:	**30 Hrs.**

Text Books:

1.	B. Das, Power Distribution Automation, IET Power and Energy Series, 75, London, 2016
2.	A. A. Sallam and O. P. Malik, Electric Distribution System, IEEE Press, Piscataway, NJ, 2011.

Suggested Readings:

1.	W. H. Kresting, Distribution System Modeling and Analysis, CRC Press, New York, 2002.
2.	A. A. Sallam and O. P. Malik, Electric Distribution System, IEEE Press, Piscataway, NJ, 2011

Web References:

1.	http://nptel.ac.in/video.php?subjectId=108102047
2.	http://textofvideo.nptel.iitm.ac.in/108102047/lec20.pdf

Online Resources:

1.	https://onlinecourses.nptel.ac.in/noc19_ee61

23VA307		**Contemporary Digital Techniques**	**2/0/0/2**
Nature of Course		Theory Practical	
Pre requisites		Analog and Digital Electronics	

Course Objectives:

1.	To present the engineering principles, theories and practices, which are fundamental to the successful design of a digital communication system.
2.	To equip the methods of systematic representation, analysis and design of a digital communication.

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

C307.1	Understand the concepts of microgrids, and networked microgrids.	[U]
C307.2	Model PV power systems and standard grid-tied inverter.	[A]
C307.3	Analyze distribution grid power flow.	[A]
C307.4	Understand centralized control and distributed control in microgrids, especially primary, secondary and tertiary control.	[U]
C307.5	Conduct power flow analysis for droop-control-based microgrids and networked microgrids.	[AP]
C307.6	Understand basics of cybersecurity in microgrids and active defense strategy.	[U]

Course Contents:

Module 1: Introduction   **10 Hrs**
Introduction to digital communication systems - Source Coding - Characterization of Communication Signals & Systems

Module 2: Signal representation   **10 Hrs**
Representation of Memory less Modulation Methods - Nonlinear modulation methods - Optimal receivers of AWGN - Receiver for non-ideal channel - Probability of error of different modulation schemes.

Module 3: Synchronization Techniques   **10 Hrs**
Carrier phase and symbol timing synchronization techniques - Channel estimation and equalization techniques, Power Adaptation methods for colored noise channel.

	Total Hours:	**30 Hrs.**

Text Books:

1.	M. Morris R. Mano, Michael D. Ciletti, "Digital Logic Design", Prentice Hall,5th Edition,2013.
2.	Floyd, "Digital Fundamentals", Pearson education, 11th edition, 2015.
3.	A.Anand kumar, "Fundamental of Digital Circuits", PHI Learning Private Ltd, 4th edition, 2016.

Suggested Readings:

1.	R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 4th Edition, 2009.
2.	Tocci R.J., Neal S. Widmer, "Digital Systems: Principles and Applications", Pearson Education Asia, 2014.
3.	Donald P Leach, Albert Paul Malvino, Goutam Sha, "Digital Principles and Applications", Tata McGraw Hill, 7th Edition, 2010.

Web References:

1.	http://www.ni.com/example/14493/en/
2.	http://electronics-course.com/

Online Resources:

1.	https://onlinecourses.nptel.ac.in/noc21_ee11

23VA308		Recent Power Electronics and Control	2/0/0/2
Nature of Course		Theory Practical	
Pre requisites		Power Electronics	

Course Objectives:

1.	To provide current updates in DC choppers.
2.	To impart the concepts of PWM inverters and controllers.

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

C308.1	Understand the multiphase converters and effect of source impedance.	[U]
C308.2	Examine the operation of DC-DC converter and isolated converters.	[A]
C308.3	Examine the operation of VSI, CSI, MLI and ZSI converters.	[A]
C308.4	Design the suitable controller for power converters.	[A]

Course Contents:

Module 1: Introduction **10 Hrs**
Device Physics, Application and Analysis of Switches and Single-Phase Converter - Single Phase Converter, Three Phase Converter, Multipulse Converter and Effect of Source Inductance and PWM Rectifiers.

Module 2: DC-DC Converters **10 Hrs**
PWM Rectifiers and Power Factor Improvement Techniques and non- isolated DC- DC converters - Non- isolated and isolated DC- DC Converters and Choppers - Isolated DC- DC Converters IV and VSI & CSI, MLI and ZSI.

Module 3: Controllers **10 Hrs**
SVM, AC to AC Converters, Cycloconverter and Matrix Converter - Linear Control in Power Electronics, Nonlinear Control in Power Electronics, Applications.

	Total Hours:	**30 Hrs**

Text Books:

1.	Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics- Converters, Applications and Design", John Wiley & Sons edition 2011.
2.	M.H. Rashid, "Power Electronics Circuits, devices and applications", Pearson Education, Inc. Edition 2014.
3.	P.S. Bhimbra, "Power Electronics", Khanna Publishers edition 2018.

Suggested Readings:

1.	Vedam Subramanian, "Power Electronics" New age international Second edition 2018.
2.	M.D.Singh, "Power Electronics", Tata McGraw-Hill, 2 nd Edition 2014.
3.	Bimal K. Bose, "Modern Power Electronics & AC Drives", Pearson,2015.

Web References:

1.	https://www.tutorialspoint.com/power_electronics/index.htm
2.	https://in.mathworks.com/videos/developing-dc-dc-converter-control-with-
3.	https://in.mathworks.com/videos/developing-dc-dc-converter-control-with-simulinkautomatically-generating-controller-code-for-implementation-on-embedded-processor1535540362783.html

Online Resources:

1.	https://onlinecourses.nptel.ac.in/noc20_ee28

23VA309	Neuro-Instrumentation	2/0/0/2
Nature of Course	Theory Practical	
Pre requisites	Nil	

Course Objectives:

1.	To provide exposure to Neuroscience and its importance in the real world

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

C309.1	Understand EEG and Event-Related Potentials (ERPs).	[U]
C309.2	Understand n to Brain-Computer Interface (BCI) and its applications.	[U]
C309.3	Apply ERPs to screen for disorders of Cognition.	[AP]
C309.4	Understand ERP stimulators and signal conditioning circuits.	[U]
C309.5	Demonstrate EEGLab and ERPLab for EEG and ERP signal processing	[AP]

Course Contents:

Module 1: Introduction **10 Hrs**

Introduction to Neurophysiology, Basic Operation of Human Brain - EEG introduction, EEG recording systems, Understanding EEG waveforms, Applications of EEG analysis - Epilepsy a classic Neurophysiological disorder, Types of Epilepsy, Role of EEG Signal Processing for Epilepsy Classification/ Screening.

Module 2: Signal Processing **10 Hrs**

Signal Conditioning for EEG and ECG signal processing with demonstration of ECG signal processing circuits - Cortical Auditory Event Potential (CAEP), Different Event Related Potentials and their applications: MMN and P300. EEGLAB and ERPLAB Signal Processing Demo using MATLAB - Brain Computer Interface: Introduction, Applications, Existing BCI Sensors

Module 3: Electrodes **10 Hrs**

Completing the BCI Loop in Humans without Neurosurgery: Designing Magnetic stimulators -: Invasive Techniques to acquire neurological signals, Types of implants and signal conditioning systems - Tetrodes Fabrication, Microneedle Fabrication, Implanting Tetrodes and microneedles on a rat model.

	Total Hours	**30**

Text Books:

1.	The Art of Electronics 3rd Edition , 2015 Horowitz & Hill.
2.	Principles Of Neural Science, 2012 Kandel & Schwartz.

Suggested Readings:

1.	Samson Wright's Applied Physiology, 2008 Keele A. Cyril.
2.	Matews G.G, Neurobiology, Second Edition, Blackwell Science,UK,2000.

Web References:

1.	https://www.technicalsymposium.com/alllecturenotes_biomed.html.
2.	https://ocw.mit.edu/courses/biology/7-28-molecular-biology-spring-2005/

Online Resources:

1.	https://onlinecourses.nptel.ac.in/noc20_ee95