GENERAL COURSE STRUCTURE (Modified)

&

CREDIT DISTRIBUTION

MODIFIED GENERAL COURSE STRUCTURE & THEME

A. Definition of Credit*:

1Hr. Lecture(L) per week	1 Credit
1Hr.Tutorial(T)per week	1 Credit
1Hr.Practical(P)per week	0.5 Credit
2Hours Practical(P)per week	1 Credit

*Except for the Manufacturing process workshop, mandatory and value-added courses

B. Range of Credits: The total number of credits proposed for the four-year B.Tech. degree in Electrical and Computer Engineering (ECO) is kept as 172. In addition, for a B.Tech. with Honors & specialization/minor degree, the student must acquire an additional 18-20 credits through MOOC courses offered at the SWAYAM/NPTEL portal.

C. Structure of UG Program in Electrical and Computer Engineering (ECO)**:** The structure of UG program in Electrical and Computer Engineering (ECO) has essentially the following categories of courses with the breakup of credits as given:

Sr. No.	Category	Credit Breakup for ECO
1	HUMANITIES & SOCIAL SCIENCES COURSES [HSC/HSM]	16.5
2	BASIC SCIENCE COURSES [BSC]	24
3	ENGINEERING SCIENCE COURSE[ESC] Engineering Science courses including workshop, drawing, basics of electronics/ electrical/mechanical/computer etc.	13.5
4	PROGRAM CORE COURSES [ECO] Professional core courses	67
5	PROGRAMME ELECTIVE COURSES [EEP] Program Elective courses relevant to chosen specialization/branch	18
6	OPEN ELECTIVE COURSES [EEO] Open subjects–Electives from other technical and/or emerging subjects	03
7	SKILL ENHANCEMENT-BASED PROJECT WORK, SEMINAR AND INTERNSHIP	22
8	VALUE ADDED AND MANDATORY COURSES [VAC/MAC] [IDEA Workshop, IDEA Workshop Lab, Personality Development and Soft Skills, Environmental Studies, Induction Program, Constitution of India, Essence of Indian Knowledge Tradition, NCC/NSS/Sports/ Yoga/ Technical or Cultural Club/ Society Activities]	08
	Total	172

D. Course code and definition:

Course code	Definitions
L:T:P	Lecture: Tutorial: Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSC/HSM	Humanities and Social Sciences including Management courses
ECO	Program Core Courses
EEP	Program Elective Courses
EEO	Open Elective Courses
VAC	Value Added Courses
MAC	Mandatory Courses

- **Category-wise Courses**

HUMANITIES & SOCIAL SCIENCES COURSES [HSC/HSM]

S.No	Course No./ Code	Subject	Semester	Hrs/week			Credits
				Lecture	Tutorial	Practical	
1	B23-HSC-101	English for Technical Writing	II	2	0	2	3
2	B23-HSC-102	Design Thinking	I	0	0	3	1.5
3	B23-HSM-101	Universal Human Values-II: Understanding Harmony And Ethical Human Conduct	I	3	0	0	3
4	B23-HSM-202	Innovation, Start ups and Entrepreneurship	V	3	0	0	3
5	B23-HSM-201	Organizational Behaviour	III	3	0	0	3
6	B23-HSM-302	Humanities–II Intellectual Property Rights (IPR) and Regulatory	IV	3	0	0	3
Total Credits							**16.5**

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BASIC SCIENCE COURSES [BSC]

S. No	Course No./ Code	Subject	Semester	Hrs/week			Credits
				Lecture	Tutorial	Practical	
1	B23-BSC-101	Semiconductor Physics	I	3	1	2	5
2	B23-BSC-107	Mathematics-I	I	3	1	0	4
3	B23-BSC-104	Engineering Chemistry	II	3	0	2	4
4	B23-BSC-108	Mathematics-II	II	3	1	0	4
5	B23-BSC-106	Biology	II	3	0	0	3
6	B23-BSC-203	Mathematics-III	IV	3	1	0	4
Total Credits							**24**

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ENGINEERING SCIENCE COURSE [ESC]

S. No	Course No./ Code	Subject	Semester	Hrs/week			Credits
				Lecture	Tutorial	Practical	
1	B23-ESC-102	Engineering Graphics and Design	I	1	0	4	3
2	B23-ESC-104	Basic Electrical Engineering	I	3	1	2	5
3	B23-ESC-101	Programming for Problem Solving	II	3	0	2	4
4	B23-ESC-107	Manufacturing Practices Workshop	II	0	0	3	1.5
Total Credits							**13.5**

PROGRAM CORE COURSES [ECO]

S. No.	Course No./ Code	Subject	Semester	Hrs/Week L:T:P	Credits
1	B23-ECO-201	Analog and Digital Electronics	III	3:0:2	4
2	B23-ECO-203	Computer Organization and Architecture	III	3:0:0	3
3	B23-ECO-205	Data Structure and Algorithms	III	3:0:2	4
4	B23-ECO-207	Electrical Machine-I	III	3:0:2	4
5	B23-ECO-209	Electric Power Generation	III	3:0:0	3
6	B23-ECO-202	Electrical Measurement and Instrumentation	IV	3:0:2	4
7	B23-ECO-204	Electrical Machine-II	IV	3:0:2	4
8	B23-ECO-206	Network Analysis and Synthesis	IV	4:0:0	4
9	B23-ECO-208	Object Oriented Programming	IV	3:0:2	4
10	B23-ECO-301	Control System	V	3:0:0	3
11	B23-ECO-303	Microprocessor and Microcontroller	V	3:0:2	4
12	B23-ECO-305	Operating System	V	3:0:0	3
13	B23-ECO-307	Power System-I	V	3:0:2	4
14	B23-ECO-309	Python Programming	V	3:0:2	4
15	B23-ECO-302	Data Base Management System	VI	3:0:2	4
16	B23-ECO-304	Introduction to AIML	VI	3:0:2	4
17	B23-ECO-302	Power System-II	VI	3:0:2	4
18	B23-ECO-302	Power System Protection and Relaying	VI	3:0:0	3
Total					**67**

LIST OF PROGRAMME ELECTIVE COURSES [EEP]

S. No.	Course No./ Code	Subject	Semester	Hrs/Week L:T:P	Credits
1	B23-EEP-302	Compiler Design	VI	3:0:0	3
2	B23-EEP-304	Power Electronics and Drives	VI	3:0:0	3
3	B23-EEP-306	Signals and Systems	VI	3:0:0	3
4	B23-EEP-308	Soft Computing	VI	3:0:0	3
5	B23-EEP-310	Computer Networks	VI	3:0:0	3
6	B23-EEP-312	Electromagnetic Theory	VI	3:0:0	3
7	B23-EEP-314	High Voltage Engineering and FACTS Devices	VI	3:0:0	3
8	B23-EEP-316	Internet Technology and Management	VI	3:0:0	3
9	B23-EEP-401	An Introduction to Artificial Intelligence	VII	3:0:0	3
10	B23-EEP-403	Artificial Intelligence, Search Methods for Problem	VII	3:0:0	3
11	B23-EEP-405	Data Analytics	VII	3:0:0	3
12	B23-EEP-407	Distributed Optimization and Machine Learning	VII	3:0:0	3
13	B23-EEP-409	Machine Learning and Deep Learning-Fundamentals	VII	3:0:0	3
14	B23-EEP-411	Optimization Theory and Algorithms	VII	3:0:0	3
15	B23-EEP-413	Software Testing	VII	3:0:0	3
16	B23-EEP-415	Software Verification, Validation and Testing	VII	3:0:0	3
17	B23-EEP-417	Advanced Distribution System Analysis and Operation	VII	3:0:0	3
18	B23-EEP-419	Economic Operation and Control of Power Systems	VII	3:0:0	3
19	B23-EEP-421	Electrical Distribution System Analysis	VII	3:0:0	3
20	B23-EEP-423	Power System Dynamics and Control	VII	3:0:0	3
21	B23-EEP-425	Renewable Energy Resources	VII	3:0:0	3
22	B23-EEP-427	Sustainable Energy Technology	VII	3:0:0	3
23	B23-EEP-429	Sustainable Power Generation System	VII	3:0:0	3
24	B23-EEP-431	Industrial Electrical System	VII	3:0:0	3

25	B23-EEP-402	Blockchain	VIII	3:0:0	3
26	B23-EEP-404	Charging Infrastructure	VIII	3:0:0	3
27	B23-EEP-406	Electric Vehicle	VIII	3:0:0	3
28	B23-EEP-408	Hydrogen Energy: Production, Storage, Transportation	VIII	3:0:0	3
29	B23-EEP-410	Introduction to Electric and Hybrid Electric Vehicle	VIII	3:0:0	3
30	B23-EEP-412	PLC and SCADA System	VIII	3:0:0	3
31	B23-EEP-414	Power System Restructuring and Deregulation	VIII	3:0:0	3
32	B23-EEP-416	Solar Energy Engineering and Technology	VIII	3:0:0	3
33	B23-EEP-418	Energy Audit and Conservation	VIII	3:0:0	3
34	B23-EEP-420	Deep Learning	VIII	3:0:0	3
35	B23-EEP-422	Internet of Things	VIII	3:0:0	3
36	B23-EEP-424	Introduction to Internet of Things	VIII	3:0:0	3
37	B23-EEP-426	Mobile Apps Development	VIII	3:0:0	3
38	B23-EEP-428	Smart Grid	VIII	3:0:0	3
39	B23-EEP-430	Software Engineering	VIII	3:0:0	3
40	B23-EEP-432	Unix and Linux Programming	VIII	3:0:0	3

LIST OF OPEN ELECTIVE COURSES [EEO]

S. No.	Course No./ Code	Subject	Semester	Hrs/Week L:T:P	Credits
1	B23-EEO-401	Advanced Power Electronics and Control	VII	3:0:0	3
2	B23-EEO-403	Biomedical Instrumentation	VII	3:0:0	3
3	B23-EEO-405	Biomedical Signal and Image Processing	VII	3:0:0	3
4	B23-EEO-407	Digital Signal Processing	VII	3:0:0	3
5	B23-EEO-409	Drone Systems and Control	VII	3:0:0	3
6	B23-EEO-411	Embedded System Design	VII	3:0:0	3
7	B23-EEO-413	Ethical Hacking	VII	3:0:0	3
8	B23-EEO-415	Operations Research	VII	3:0:0	3

SKILL ENHANCEMENT-BASED PROJECTWORK, SEMINAR AND INTERNSHIP

S. No.	**Course No./ Code**	**Subject**	**Semester**	**Hrs/Week L:T:P**	**Credits**
1	B23-ECO-316	Project-1	VI	0:0:4	2
2	B23-ECO-402	Major Project / Internship/ Startups/ Research Lab (Part-I)	VII	0:0:16	8
3	B23-ECO-402	Major Project / Internship/ Startups/ Research Lab (Part-II)	VIII	0:0:20	10
4	B23-ECO-317	Industrial Training-I	V	0:0:2	1
5	B23-ECO-413	Industrial Training-II	VII	0:0:2	1
Total					**22**

VALUE ADDED AND MANDATORY COURSES [VAC/MAC]

S. No.	Course No./ Code	Subject	Semester	Hrs/Week	Credits
				L:T:P	
1	B23-VAC-101	Personality Development and Soft Skills	II	2:0:0	1
2	B23-VAC-110	IDEA Workshop	I	2:0:0	1
3	B23-VAC-112	IDEA Project Workshop	I	0:0:2	1
4	B23-VAC-302/304/306/308/310	Hindi Language Skills/ Sanskrit Language Skills/ German Language Skills/ Japanese Language Skills/ French Language Skills	V	2:0:0	1
5	B23-VAC-401/403/405/407/409/411	NCC/NSS/Sports/ Yoga/ Technical or Cultural Club/Society activities	VII	0:0:2	1
6	B23-MAC-201	Environmental Studies	IV	3:0:0	1
7	B23-MAC-202	Essence of Indian Traditional Knowledge	III	2:0:0	1
8	B23-MAC-301	Constitution of India	VI	2:0:0	1
Total					**8**

SEMESTER WISE STRUCTURE

B.Tech. Electrical and Computer Engineering (ECO)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

SEMESTER-V

(Modified Scheme of Examinations/w.e.f. 2025-26 onwards)

S. No.	Course No./ Code	Subject	L:T:P	Hours/Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1	B23-ECO-301	Control System	3:0:0	3	3	70	30	--	100	3
2	B23-ECO-303	Microprocessor and Microcontroller	3:0:0	3	3	70	30	--	100	3
3	B23-ECO-305	Operating System	3:0:0	3	3	70	30	--	100	3
4	B23-ECO-307	Power System-I	3:0:0	3	3	70	30	--	100	3
5	B23-ECO-309	Python Programming	3:0:0	3	3	70	30	--	100	3
6	B23-HSM-202	Innovation, Startups and Entrepreneurship	3:0:0	3	3	70	30	--	100	3
7	B23-ECO-311	Microprocessor and Microcontroller Lab	0:0:2	2	1	--	40	60	100	3
8	B23-ECO-313	Power System-I Lab	0:0:2	2	1	--	40	60	100	3
9	B23-ECO-315	Python Programming Lab	0:0:2	2	1	--	40	60	100	3
10	B23-ECO-317	Industrial Training-I	0:0:2	2	1	--	100	--	100	3
11*	B23-VAC-302/ B23-VAC-304/ B23-VAC-306/ B23-VAC-308/ B23-VAC-310	Hindi Language Skills / Sanskrit Language Skills/ German Language Skills/ Japanese Language Skills/ French Language Skills	2:0:0	2	1	--	100	--	100	3
TOTAL				**28**	**23**	**420**	**500**	**180**	**1100**	

*** B23-VAC** Courses are value-added courses, and the approved content may be offered to the students through the concerned departments (UTDs) or institutes (within the university campus) or the MOOC platform.

B.Tech. Electrical and Computer Engineering (ECO)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

SEMESTER-VI

(Modified Scheme of Examinations/w.e.f. 2025-26 onwards)

S. No.	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hours)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1	B23-ECO-302	Data Base Management System	3:0:0	3	3	70	30	--	100	3
2	B23-ECO-304	Introduction to AIML	3:0:0	3	3	70	30	--	100	3
3	B23-ECO-306	Power System-II	3:0:0	3	3	70	30	--	100	3
4	B23-ECO-308	Power System Protection and Relaying	3:0:0	3	3	70	30	--	100	3
5	--	Program Elective-I	3:0:0	3	3	70	30	--	100	3
6	--	Program Elective-II	3:0:0	3	3	70	30	--	100	3
7	B23-ECO-310	AIML Lab	0:0:2	2	1	--	40	60	100	3
8	B23-ECO-312	DBMS Lab	0:0:2	2	1	--	40	60	100	3
9	B23-ECO-314	Power System-II Lab	0:0:2	2	1	--	40	60	100	3
10	B23-ECO-316	Project-I	0:0:4	4	2	--	40	60	100	3
11	B23-MAC-301	Constitution of India	2:0:0	2	1	--	100	--	100	3
TOTAL				**30**	**24**	**420**	**440**	**240**	**1100**	

Note:

- The course of both Program Elective and Open Elective will be offered at1/3rd strength or 20 students (whichever is smaller) of the section.
- All students have to undertake the industrial training for 6 to 8 weeks after the 6th semester, which will be evaluated in the 7th semester.

Program Elective-I		Program Elective-II	
B23-EEP-302	Compiler Design	B23-EEP-310	Computer Networks
B23-EEP-304	Power Electronics and Drives	B23-EEP-312	Electromagnetic Theory
B23-EEP-306	Signals and Systems	B23-EEP-314	High Voltage Engineering and FACTS Devices
B23-EEP-308	Soft Computing	B23-EEP-316	Internet Technology and Management

B.Tech. Electrical and Computer Engineering (ECO)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

SEMESTER-VII

(Modified Scheme of Examinations/w.e.f. 2026-27 onwards)

S. No.	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hours)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1	--	Program Elective-III	3:0:0	3	3	70	30	--	100	3
2	--	Program Elective-IV	3:0:0	3	3	70	30	--	100	3
3	--	Open Elective-I	3:0:0	3	3	70	30	--	100	3
4	B23-ECO-401	Major Project / Internship/Startups/ Research Lab (Part I)	0:0:16	16	8	--	100	200	300	3
5	B23-ECO-403	Industrial Training-II	0:0:2	2	1	--	100	--	100	3
6	B23-VAC-401/ B23-VAC-403/ B23-VAC-405/ B23-VAC-407/ B23-VAC-409/ B23-VAC-411	NCC/ NSS/ Sports/ Yoga/ Technical or Cultural Club/ Society activities	0:0:2	2	1	--	100	--	100	3
TOTAL				**29**	**19**	**210**	**390**	**200**	**800**	

Note:

- The course of both Program Electives and Open Elective-I will be offered in online mode through MOOC courses offered by the SWAYAM/NPTEL portal. These courses may be done from the 5th semester till completion of the degree.
- B23-VAC-401/403/405/407/409/411 are single credit value added courses in which NCC/NSS/Sports/Yoga/Technical or Cultural Club/Society activities will be joined by students in first year and will be evaluated in 7th semester by the institute based upon continuous evaluation model as per guidelines (Only one best, out of these opted courses, will be considered for evaluation).

Program Elective-III	Program Elective-IV	Open Elective-I
B23-EEP-401 An Introduction to Artificial Intelligence	B23-EEP-417 Advanced Distribution System Analysis and Operation	B23-EEO-401 Advanced Power Electronics and Control
B23-EEP-403 Artificial Intelligence, Search Methods for Problem Solving	B23-EEP-419 Economic Operation and Control of Power Systems	B23-EEO-403 Biomedical Instrumentation
B23-EEP-405 Data Analytics	B23-EEP-421 Electrical Distribution System Analysis	B23-EEO-405 Biomedical Signal and Image Processing
B23-EEP-407 Distributed Optimization and Machine Learning	B23-EEP-423 Power System Dynamics and Control	B23-EEO-407 Digital Signal Processing
B23-EEP-409 Machine Learning and Deep Learning-Fundamentals and Applications	B23-EEP-425 Renewable Energy Resources	B23-EEO-409 Drone Systems and Control
B23-EEP-411 Optimization Theory and Algorithms	B23-EEP-427 Sustainable Energy Technology	B23-EEO-411 Embedded System Design
B23-EEP-413 Software Testing	B23-EEP-429 Sustainable Power Generation System	B23-EEO-413 Ethical Hacking
B23-EEP-415 Software Verification, Validation and Testing	B23-EEP-431 Industrial Electrical System	B23-EEO-415 Operations Research

B.Tech. Electrical and Computer Engineering (ECO)

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SEMESTER-VIII

(Modified Scheme of Examinations/w.e.f. 2026-27 onwards)

S. No.	Course No./Code	Subject	L:T:P	Hours/Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hours)
						End Semester Exam	Internal Assessment	Practical Exam	Total	
1	--	Program Elective-V	3:0:0	3	3	70	30	--	100	3
2	--	Program Elective-VI	3:0:0	3	3	70	30	--	100	3
3	B23-ECO-402	Major Project / Internship/ Startups/ Research Lab (Part-II)	0:0:20	20	10	--	200	200	400	3
TOTAL				**26**	**16**	**140**	**260**	**200**	**600**	

Note:

- The Program Elective- V and Program Elective-VI will be offered in online mode through MOOC courses offered by the SWAYAM/NPTEL portal. These courses may be done from the 5th semester till completion of the degree.

Program Elective -V		Program Elective -VI	
B23-EEP-402	Blockchain	B23-EEP-418	Energy Audit and Conservation
B23-EEP-404	Charging Infrastructure	B23-EEP-420	Deep Learning
B23-EEP-406	Electric Vehicle	B23-EEP-422	Internet of Things
B23-EEP-408	Hydrogen Energy: Production, Storage, Transportation and Safety	B23-EEP-424	Introduction to Internet of Things
B23-EEP-410	Introduction to Electric and Hybrid Electric Vehicle	B23-EEP-426	Mobile Apps Development
B23-EEP-412	PLC and SCADA System	B23-EEP-428	Smart Grid
B23-EEP-414	Power System Restructuring and Deregulation	B23-EEP-430	Software Engineering
B23-EEP-416	Solar Energy Engineering and Technology	B23-EEP-432	Unix and Linux Programming

B.Tech. Electrical and Computer Engineering (ECO)
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Students of Electrical and Computer Engineering are offered to earn Honours with Specialisation/Minor Degree, subject to the condition that "Honours with Specialisation/Minor Degree will cumulatively require an **additional 18 to 20 credits** in the specified area in addition to the credits essential for obtaining the Undergraduate Degree in Major Discipline. The required additional 18-20 credits may be earned by the students from the list of courses mentioned through **NPTEL/MOOC**. The additional certificate will be provided by the COE, UIET/COE, KUK. The main degree will remain the same for all the students; however, the honours/minor degree depends on the choice of domain opted by the student.

The students can get Honours in various domains of Electrical and Computer Engineering, whereas a Minor in all other domains except Electrical and Computer Engineering is offered by NPTEL/MOOC.

Guidelines:

1. For Honours/Minor Engineering, a student must earn at least 18-20 Additional credits from professional courses.
2. For "Honours Engineering", a student must earn additional credits from their own branch/ discipline of study only.
3. For "Minor Engineering", a student must earn additional credits from a discipline other than one's own branch/ discipline of study only.
4. A Student can choose the courses which were not studied earlier in the previous semester. These additional Credit Courses shall not be part of the regular Curriculum, and these courses must be approved by the respective department BoS. Furthermore, the courses should not be present in the curriculum of the forthcoming semesters.
5. Credits for the 4-week course is-1, for 8 weeks course is-2, for 12 weeks course is-3.
6. A student must ensure that he/she earn these additional credits before the completion of the regular course.
7. It is the student's responsibility to register for the courses ONLINE, and the required registration fee shall be borne by the respective student.
8. Students must register for the courses with the approval of the Head of the Department/Department MOOC Coordinator.
9. A student is eligible to opt for either "Honours" or "Minor Engineering", but not for both.
10. The department can propose a new course(s) if any of the listed equivalent courses are not available in MOOCs with the approval of the Board of Studies/Academic Council.

B23-ECO-301		Control System					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3 Hrs.**

Purpose: Students will grasp fundamental concepts of Control systems and will be able to analyze transient, frequency response of these systems and also will be able to tell about the stability of the control systems.

Course Outcomes (CO)

CO1	To understand the basics of open loop and closed loop feedback systems.
CO2	To find steady state time response and stability analysis of a simple control system.
CO3	To plot Root Locus, Bode Plot, Nyquist Plot and to find stability as well error in response.
CO4	To determine the controller or compensator configuration.

UNIT-I

Introduction to control systems: Introduction, classification of control systems, open and closed loop systems. Mathematical models of physical systems**,** Transfer functions for different types of systems, block diagrams; Signal flow graphs.

Signal flow graphs: Signal flow graphs, basic properties of signal flow graph, signal flow graph algebra, signal flow graph for control systems and Mason's gain formula.

UNIT-II

Time Domain Analysis: Time domain performance criterion, time response of first order systems and second order systems, steady state errors and error constants, types of control systems.

Stability analysis: BIBO stability, Necessary conditions for stability, Routh's stability criterion, difficulties in formulation of Routh's table, application of Routh's stability criterion to linear feedback systems, relative stability analysis, root-loci and root contours, sensitivity analysis.

UNIT-III

Frequency Response analysis: Co-relation between time and frequency response – 2nd order systems only.

Bode plots& Nyquist plot: Nyquist plots, Bode Plots, Nyquist stability criterion, Gain margin & Phase margin,relative stability using Nyquist Criterion, frequency response specifications.

UNIT – IV

Design of Control Systems: Introduction, Design with the PD Controller, PI Controller and PID Controller, Design with Phase-Lead Controller, Phase- Lag Controller, and Lead-Lag Controller. Concept of state,state variable and state model, state models for linear continuous time systems, concept of controllability and observability.

Text Book: Control System Engg.: I. J. Nagrath & M. Gopal ; New Age India.

Reference Books:

1. Automatic Control Systems: B.C. Kuo; 8th Ed., Wiley India.
2. Modern Control Engg: K. Ogata; 5th Ed., Pearson Education.
3. Control Systems: Principles & Designing: Madan Gopal; TMH**.**

Note: The paper setter will set the paper as per the question paper templates provided.

B23-ECO-303		Microprocessor and Microcontroller					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: Students will grasp the structure, working and application of 8086 Microprocessor and 8051 Microcontroller.

Course Outcomes (CO)

CO1	To learn the architecture 8086 Microprocessor.
CO2	To learn the instruction set of 8086 Microprocessor and assembly language programming of 8086 Microprocessor.
CO3	To learn about 8051 Microcontroller and interfacing of 8086 with different types of Memories.
CO4	To learn about interfacing of interrupts, basic I/O Interfacing with 8086 Microprocessor.

UNIT-I

8086 CPU ARCHITECTURE: 8086 Block diagram; description of data registers, address registers; pointer and index registers, PSW, Queue, BIU and EU. 8086 Pin diagram descriptions. Generating 8086 CLK and reset signals using 8284. Microprocessor BUS types and buffering techniques, 8086 minimum mode and maximum mode CPU module.

UNIT-II

8086 INSTRUCTION SET: Instruction formats, addressing modes, Data transfer instructions, string instructions, logical instructions, arithmetic instructions, transfer of control instructions; process control instructions; Assembler directives.
8086 PROGRAMMING TECHNIQUES: Writing assembly Language programs for logical processing, arithmetic processing, timing delays; loops, data conversions.

UNIT-III

8051 Microcontroller MAIN MEMORY SYSTEM DESIGN:8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. Memory devices, 8086 CPU Read/Write timing diagrams in minimum mode and maximum mode. Address decoding techniques. Interfacing SRAMS; ROMS/PROMS.

UNIT-IV

BASIC I/O INTERFACE: Intel's 8255 - description and interfacing with 8086. ADCs and DACs, - types, operation and interfacing with 8086. 8086 Interrupt mechanism; interrupt types and interrupt vector table. Applications of interrupts, Intel's 8259.

Text Books:

1. D.V. Hall, Microprocessors and interfacing: programming and hardware., McGraw Hill 3rd ed.
2. A. K. Ray and K.M. Bhurchandi, "Advanced Microprocessors and Peripherals", TMH.
3. Liu, Gibson, "Microcomputer Systems: The 8086/88 Family", 2nd Edition, PHI.
4. Barry B. Brey, "The Intel Microprocessors-Architecture, Programming and Interfacing", 8th Edition, PHI
5. Kenneth Ayala, "The 8086 Microprocessor: Programming & Interfacing the PC", Cengage Learning, Indian Edition, 2008.
6. "The 8051 Microcontroller and Embedded Systems – using assembly and C ", Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006.
7. "The 8051 Microcontroller", Kenneth J. Ayala, 3rd Edition, Thomson/Cengage Learning.

Reference Books:

1. Kip Irvine," Assembly language for IBM PC", PHI, 2nd Edition, 1993
2. Uffenback, "The 8086 Family Design" PHI, 2nd Edition.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-ECO-305		Operating System					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: To familiarize the students with basics, process, memory and file management by operating System.

Course Outcomes (CO)

CO1	Understanding of types of operating system.
CO2	Understanding of process management by Operating System.
CO3	Understanding of memory management by Operating System.
CO4	Understanding of file management by Operating System.

UNIT-I

Evolution of Operating Systems: Types of operating systems - Different views of the operating, systems – Principles of Design and Implementation. The process concept – system programmer's view of processes – operating system's views of processes – operating system services for process management.

UNIT-II

Structural overview, Concept of process and Process synchronization, Process Management and Scheduling, Hardware requirements: protection, context switching, privileged mode; Threads and their Management; Tools and Constructs for Concurrency, Detection and Prevention of deadlocks, Mutual Exclusion: Algorithms, semaphores – concurrent programming using semaphores.

UNIT-III

Memory Management paging, virtual memory management, Contiguous allocation –static, dynamic partitioned memory allocation – segmentation. Non-contiguousallocation – paging –Hardware support – Virtual Memory, Dynamic Resource Allocation.

UNIT – IV

File Systems: A Simple file system – General model of a file system – Symbolic file system –Access control verification – Logical file system – Physical file system – allocation strategy module – Device strategy module, I/O initiators, Device handlers – Disk scheduling, Design of IO systems, File Management.

Text Books:

1. Operating System Concepts – Abraham Silberschatz, Galvin, Greg Gagne, 8th edition, Wiley-India, 2009.
2. Modern Operating Systems – Andrew S. Tanenbaum, 3rd Edition, PHI.
3. Operating Systems: A Spiral Approach – Elmasri, Carrick, Levine, TMH Edition.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-ECO-307		Power System -I					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**
Purpose: To enable students to analyze power system networks, network parameters, modelling of transmission lines							
Course Outcomes (CO)							
CO1	Understand the concepts of power systems.						
CO2	Understand the various power system components.						
CO3	Understand various transmission line modeling.						
CO4	Understand various line insulators and line supports.						

UNIT- I

Evolution of Power Systems: Typical power system. Underground and Overhead system, AC and DC transmission system, Effects of increase in Voltage on transmission line efficiency, Comparisons of the cost of the conductor in the overhead system. Conductor size and Kelvin's Law, Growth of power systems, Indian overview. Brief overview of Radial and ring main system.

UNIT- II

Overhead Transmission Lines: Inductance and capacitance calculation of single-phase and three-phase overhead line, Corona loss, Factors affecting Corona loss, Bundled conductors, Skin effects, Proximity effect.
Underground Cables: General Overview, its composition and grading.

UNIT- III

Transmission line modelling: Short transmission line, Medium transmission line: Nominal-T and Nominal pi model, Generalized circuit constant, Ferranti Effect, Long transmission line, Surge impedance, Surge impedance loading, Power flow through a transmission line.

UNIT IV

Overhead Line Insulator: Introduction, Properties of insulator material, types of Insulators, String efficiency, Methods of improving string efficiency.
Mechanical Design of Overhead Line: Main components of overhead line, Line supports, conductor material, cross arm, Guys and Stays, Tension and Sag, Vibrations and vibration damper.

Text Books/References:

1. Power System analysis and Stability by S.S. Vadhera.
2. Electrical Power System by C.L. Wadhwa.
3. Electrical Power System by Ashfaq Hussain.
4. Elements of Power System Analysis by W.D. Stevenson.
5. Electric Power System by B.M. Weddy.
6. The transmission and Distribution of Electric energy by H. Cotton.
7. Modern Power System Analysis by I.J. Nagrath and D.P. Kothari.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-ECO-309		Python Programming					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**
Purpose: To familiarize the students with Python lists, tuples, dictionaries and simple programming							
Course Outcomes (CO)							
CO1	Develop algorithmic solutions to simple computational problems.						
CO2	Develop and execute simple Python programs.						
CO3	Write simple Python programs using conditionals and looping for solving problems.						
CO4	Read and write data from/to files in Python programs.						

UNIT-I

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables.

UNIT-II

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, sum an array of numbers, linear search, binary search.

UNIT-III

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; Advanced list processing – list comprehension; Illustrative programs: simple sorting, histogram, Students' marks statement, Retail bill preparation.

UNIT – IV

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

Text 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, &Quot; Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data, ‘‘Third Edition, MIT Press 2021. GE3151 Syllabus: Problem Solving and Python Programming
4. Eric Matthes, “Python Crash Course, A Hands–on Project-Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
5. Martin C. Brown, “Python: The Complete Reference”, 4th Edition, McGraw-Hill, 2018.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-HSM-202		Innovation, Startups and Entrepreneurship					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3 Hours**
Purpose	The objective of this Course is to inspire students and help them imbibe an entrepreneurial mindset.						
Course Outcomes (CO)							
CO 1	Understanding the essence of innovation and features of innovative processes, models and methods of innovative entrepreneurship, and the role of innovation as a major factor in creating the value of companies.						
CO 2	Understanding the dynamic role of entrepreneurship and small businesses, types of business structure, organising and managing a Small Business.						
CO 3	Understanding the concept of start-ups, Control Strategic Marketing Planning, concept of incubation and prototype, new Product Development, Business Plan Creation.						
CO 4	Understanding risk analysis in business, financing methods, role of government in supporting entrepreneurship.						

UNIT -I

Introduction to Innovation and Entrepreneurial Idea Generation and Identifying Business Opportunities, Management Skills for Entrepreneurs, Innovations and their forms, Innovation - features and characteristics, Factors initiating innovations, Innovation process and its stages, Statistical measurement of innovation, Model of innovation, Source of innovation, Technological transfer, Information technology to support innovation, difference between technological and non-technological innovation

UNIT-II

Introduction to Entrepreneurship and Start – Ups - Definitions, Traits of an entrepreneur, Intrapreneurship, Entrepreneurial Motivation ,Functions of Entrepreneur, Concept, Growth of Entrepreneurship in India, Types of Business Structures, Similarities /differences between entrepreneurs and managers, Business Ideas and their implementation, Discovering ideas and visualizing the business, Activity map, Types of startups, role of entrepreneurs in economic development, future of entrepreneurs, entrepreneurial process

UNIT -III

Start ups - Initial idea generation and planning stages, and incubation referring to the development process of identifying and developing new ideas for products, services, or processes, and creating a working model or prototype to test the feasibility of the concept.

Market Analysis – Identifying the target market, Competition evaluation and Strategy Development, Five Cs of Opportunity Identification, Market Opportunity Identification in emerging technology companies, Process of creating and growing a new business venture, Business plan of the innovation project.

UNIT -IV

Risk Analysis: Risk management in venture projects, Financing and Protection of Ideas- Financing methods available for start-ups in India, Communication of Ideas to potential investors – Investor Pitch, Patenting and Licenses, Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy, venture capital, angel investment, and crowdfunding.

Government support- programs and initiatives aimed at supporting the development of new ideas, innovations, and startups, funding and mentorship, IPR - legal protection of a person's or organization's rights to their invention, brand, or creative work

Suggested Readings:

1. Shrutin N Shetty, (2018), Design the Future: Simplifying Design Thinking to Help You, Notion Press
2. "Entrepreneurship development small business enterprises", Pearson, Poornima M Charantimath,2013.
3. Roy Rajiv, "Entrepreneurship", Oxford University Press, 2011.
4. "Innovation and Entrepreneurship", HarperBusiness- Drucker, F. Peter, 2006.
5. "Entrepreneurship", Tata McGraw-Hill Publishing Co., Ltd.New Delhi- Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, 8th Edition, 2012
6. The Three-Box Solution: A Strategy for Leading Innovation By Vijay Govindarajan Boutellier, Roman; Gassmann, Oliver; von Zedtwitz, Maximilian (2000). Managing Global Innovation. Berlin: Springer.. ISBN 3-540-66832-2.
7. Brown K. and Stephen P. Osborne (2005) Managing change and innovation in public service organisation. New York: Routledge

8. Cappellin R. and Wink R. (2009). International Knowledge and Innovation Networks: Knowledge Creation and Innovation in Medium-technology Clusters. UK: Edward Elgar Publishing Limited.
9. Eveleens, C. (2010). Innovation management: A literature review of innovation process models and their implications. Working Paper HAN University of Applied Sciences.
10. Enterpreneurship Development- S.Chand & Co.,Delhi- S.S.Khanka 1999
11. Small-Scale Industries and Entrepreneurship. Himalaya Publishing House, Delhi –Vasant Desai 2003.
12. Entrepreneurship Management -Cynthia, Kaulgud, Aruna, Vikas Publishing House, Delhi, 2003.
13. Entrepreneurship Ideas in Action- L. Greene, Thomson Asia Pvt. Ltd., Singapore, 2007.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-ECO-311		Microprocessor and Microcontroller Lab					
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**

Purpose: Write the efficient Assembly Language Program for different problem statements and implement different system interfacing.

Course Outcomes (CO)

CO1	Understand the architecture of the 8086 Microprocessor.
CO2	Learn the instruction set and assembly language programming for the 8086.
CO3	To be able to write program using different implementations for the same problem.
CO4	Use of programming language constructs in program implementation.

LIST OF EXPERIMENTS

1. a) Familiarization with8086TrainerKit.
   b) Familiarization with Turbo Assembler and Debugger S/Ws.
2. Perform addition, subtraction, multiplication, and division using 8086 instructions.
3. Write a program that takes any two numbers as Input from the user through the input device(Keyboard) & Prints their sum on the standard output device (Screen) by giving appropriate messages to the user
4. Write a program to find out any power of number such that $Z=X^N$. Where N is programmable and X is unsigned number.
5. Write a program to Generate the Fibonacci series up to 'n' terms.
6. Write a program to Move data between registers, memory, and ports using MOV, PUSH, POP, etc.
7. Write a program to arrange block of data in
   (i) Ascending and (ii) Descending order.
8. Write a program to Implement AND, OR, XOR, NOT, and shift/rotate operations.
9. Write a program to Convert between BCD and binary formats.
10. Write a program to generate a delay using loops.
11. Write a program to Search for an element in an array and return its position.
12. Write a program to Take a string input and reverse it.
13. Write a program to Convert letters in a string between uppercase and lowercase.
14. Write a program to Convert a decimal number to its hexadecimal equivalent.
15. Write a program to Convert a hexadecimal string to a decimal number.
16. Write a programmable delay routine to cause a minimum delay=2mS and a maximum delay = 20 minutes in the increments of 2mS.

NOTE: At least eight (8) experiments from the above list are mandatory to perform for the students.

B23-ECO-313		Power System-I Lab					
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**

Purpose: The main objective of the course is to impart the students with the knowledge of various relays, insulators and transmission line modelling.

Course Outcomes (CO)

CO1	To understand various types of relays.
CO2	To study the parallel operation of the alternator.
CO3	To understand the concept of various insulators.
CO4	To understand the concept of transmission line modelling.

LIST OF EXPERIMENTS

1. Experiment to find out the dielectric strength of transformer oil.
2. Experiment to find zero sequence component of three phase line.
3. Draw the characteristics of thermal overload relay.
4. Experiment to study an IDMT over current relay & plot, it's characteristic curves i.e. graph between current & time.
5. Experiment to study differential relay characteristics.
6. Experiment to measure the ABCD parameters of a given transmission line, also study Ferranti effect.
7. Experiment to study Parallel operation of two alternators.
8. Experiment to plot the power angle characteristics of given transmission line.
9. Experiment to find the string efficiency of a string insulator with/without guard rings.
10. Experiment to study the characteristics of transmission line for t-network & pie- network.
11. Testing of a current transformer & find Ratio Error & Phase angle error for various burdens.
12. To study various types of distance relay.
13. Experiment to study fault current using sequence impedance network.

NOTE: At least eight (8) experiments from the above list are mandatory to perform for the students.

B23-ECO-315		Python Programming Lab					
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**

Purpose: The students will familiarize themselves with data database system and SQL queries

Course Outcomes (CO)

CO1	To understand the basic structure of Python programming.
O2	To learn about loops, control statements and recursion in Python.
CO3	To understand the different operations on matrices.
CO4	To understand file handling in Python.

List of Experiments

1. Python Program to Print 'Hello world !'
2. Python Program to Add Two Numbers.
3. Python Program to Find the Square Root.
4. Python Program to Calculate the Area of a Triangle.
5. Python Program to Swap Two Variables.
6. Python Program to Generate a Random Number.
7. Python Program to Convert Celsius To Fahrenheit.
8. Python Program to Check if a Number is Odd or Even.
9. Python Program to Check Leap Year.
10. Python Program to Find the Largest Among Three Numbers.
11. Python Program to Check Prime Number.
12. Python Program to Find the Factorial of a Number.
13. Python Program to Display the multiplication Table.
14. Python Program to Print the Fibonacci sequence.
15. Python Program to Find the Sum of Natural Numbers.
16. Python Program to Find Factorial of Number Using Recursion.
17. Python Program to Add Two Matrices.
18. Python Program to Transpose a Matrix.
19. Python Program to Multiply Two Matrices.
20. Python Program to copy data from one file to another file.

Note: At least eight (8) experiments from the above list are mandatory to perform for the students.

B23-ECO-317		Industrial Training-I					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
-	**-**	**2**	**1**	**--**	**100**	**100**	**-**

It is a course in which the students will be evaluated for the industrial training undergone during the semester break after the 4th semester examination, and students will be required to get passing marks to qualify.

B23-VAC-302	Hindi Language Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time**
2	-	**-**	**1**	**--**	**100**	**100**	**3**

This course will be offered through NPTEL/MOOC online courses with the following link - https://onlinecourses.nptel.ac.in/noc23_hs125/preview.
The syllabus of NPTEL/MOOC platform will be acceptable. Students can also learn online from videos and internal assessment can be made in the Institute by taking an internal exam of 100 marks.

B23-VAC-304	Sanskrit Language Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Time**
2	-	**-**	**1**	**--**	**100**	**100**	**3 Hrs**

Course Outcomes (CO) At the end of this course, student will

CO 1	Learn behavioural science from Bhagwat Gita
CO 2	Learn self awareness and spirituality from Bhagwat Gita
CO 3	Learn mind management from Bhagwat Gita
CO 4	Learn responsible behaviour from Bhagwat Gita

SYLLABUS FOR SANSKRIT STUDIES

Unit 1	**BEHAVIOURAL SCIENCE** ● Learning different personality types from Gita. BG 14.6-8 ● Dealing with stress, depression and self-destructive urges. BG 2.14 ● Overcoming procrastination and hyperactivity. BG 18.35-36 ● Developing *sattva* - platform of controlled action. BG 18.33 ● Balancing physical, mental and emotional health. BG 6.16-17, 6.5 ● Increasing productivity in activity through spirituality. BG 2.47 ● Mind Intelligence mechanism. BG 3.42-43 ● Tapping the power of meditation. BG 6.10-15
Unit 2	**SELF-AWARENESS** • Understanding Different Layers of Self - Physical, Mental and Spiritual – BG 2.13 • Becoming Sensitive Towards Other Beings and Nature at Large – BG 5.18, 6.29-32 • Cultivating Culture of Respect – BG 13.8-12 • Dealing with Grief – BG 2.11, 2.27 • Holistic Wellbeing Through Self-Awareness – BG 6.5, 6.7 • Recognizing the Impermanence of the Body – BG 2.14 • Cultivating Detachment for True Self-Awareness – BG 2.71, 5.29 • Connecting with the Higher Self Through Meditation – BG 6.10 • Transcending Ego for Inner Peace – BG 3.27 • Self-Reflection for Personal Growth – BG 6.5 • Overcoming False Identification with the Body – BG 2.30 • Seeing the Divine in All Beings – BG 9.22
Unit 3	**MIND MANAGEMENT - ART OF MIND CONTROL** • The Root of Frustration & Anger – BG 2.62-63 • Discover the Real Reason Behind Lack of Motivation – BG 3.36, 3.41 • Controlling the Uncontrolled Mind – BG 6.26 • Understanding the Mind & Its Power – BG 6.6, 3.42 • Mind Like a Boat in Stormy Waters – BG 2.67 • Learn to Stay Calm Under Pressure – BG 2.14, 2.56 • The Peaceful Mind of a Wise Person – BG 2.70, 2.56 • Freedom from Attachment = Peace – BG 2.71, 5.26 • Peace Through Detachment – BG 2.71, 5.20

Unit 4	**RESPONSIBLE ACTION** • Understanding Intricacies of Action and Reaction - Karma, Vikarma& Akarma – BG 4.17 • Principles of Forbearance and Tolerance – BG 2.14, 12.13-14 • Coping with Adversities and Reversals in Life – BG 2.14-15, 18.11 • Becoming Responsible in Action - Karma Yogi – BG 3.7, 3.19, 3.30, 5.10 • Performing Actions Without Attachment to Results – BG 2.47, 3.19 • Acting in Accordance with Dharma – BG 3.35 • Surrendering the Fruits of Actions to God – BG 9.22, 18.66 • Selflessness in Actions – BG 18.9 • Discerning Between Right and Wrong Actions – BG 18.63 • Balanced Approach to Work and Rest – BG 6.17 • Purifying Intentions Behind Actions – BG 18.11 • Taking Responsibility for One's Actions and Their Impact – BG 3.16

B23-VAC-306	German Language Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**End semester Exam**	**Internal assessment**	**Total**	**Duration of exam (Hours)**
2	**0**	**0**	**1**	**-**	**100**	**100**	**3 Hrs**
Purpose	**To learn about German Language Skills**						
Course Outcomes (CO)							
CO1	Introduce students to basic German language.						
CO2	Enable basic communication in German (self-introduction, daily routine, etc.).						
CO3	Develop foundational skills in vocabulary and grammar.						
CO4	Develop foundational skills in reading, writing, listening, and speaking.						

Unit 1: Introduction & Basics

- German alphabet and pronunciation
- Greetings and farewells
- Introducing oneself and others
- Numbers (0–100)
- Days, months, seasons

Unit 2: Vocabulary Building I

- Family and relationships
- Professions and nationalities
- Countries and cities
- Colors and clothing
- Weather

Unit 3: Grammar I

- Nouns: gender, singular/plural
- Articles: definite (der/die/das), indefinite (ein/eine)
- Personal pronouns (ich, du, er, etc.)
- Verb conjugation (regular verbs in Präsens)
- Sentence structure: main clause word order

Grammar II

- Verbs: haben, sein, modal verbs (möchten, können)
- Question words (wer, was, wo, etc.)
- Negation (nicht, kein)
- Possessive pronouns (mein, dein, etc.)
- Accusative case basics

Unit 4: Vocabulary Building II

- Food and drink
- Daily routine
- Time and date
- House and furniture
- Hobbies and leisure

Communication Practice

- Simple dialogues (in café, at university, at home)
- Role plays (shopping, asking directions, introductions)
- Listening practice (audio exercises)
- Writing practice (short texts, filling forms)

Assessment (Optional/Recommended)

- Vocabulary quizzes
- Short written assignments
- Oral presentation or role-play
- Final test (basic grammar and vocabulary)

B23-VAC-308	Japanese Language Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**End semester Exam**	**Internal assessment**	**Total**	**Duration of exam (Hours)**
2	**0**	**0**	**1**	**-**	**100**	**100**	**3 Hrs**
Purpose	rn about Japanese Language Skills						
Course Outcomes (CO)							
CO1	Introduce students to basic Japanese language.						
CO2	Enable basic communication in Japanese (self-introduction, daily routine, etc.).						
CO3	Develop foundational skills in vocabulary and grammar.						
CO4	Develop foundational skills in reading, writing, listening, and speaking.						

Unit 1: Introduction & Basics

- Alphabet and pronunciation
- Greetings and farewells
- Introducing oneself and others
- Numbers (0–100)
- Days, months, seasons

Unit 2: Vocabulary Building I

- Family and relationships
- Professions and nationalities
- Countries and cities
- Colors and clothing
- Weather

Unit 3: Grammar I

- Nouns: gender, singular/plural
- Articles: definite and indefinite
- Personal pronouns
- Verb conjugation (regular verbs in present tense)
- Sentence structure: main clause word order

Grammar II

- Common verbs (e.g., to be, to have, modal verbs)
- Question words
- Negation
- Possessive pronouns
- Basic cases or particles (as applicable)

Unit 4: Vocabulary Building II

- Food and drink
- Daily routine
- Time and date
- House and furniture
- Hobbies and leisure

Communication Practice

- Simple dialogues (e.g., in café, at university, at home)
- Role plays (shopping, asking directions, introductions)
- Listening practice (audio exercises)
- Writing practice (short texts, filling forms)

Assessment (Optional/Recommended)

- Vocabulary quizzes
- Short written assignments
- Oral presentation or role-play
- Final test (basic grammar and vocabulary)

B23-VAC-310	French Language Skills						
Lecture	**Tutorial**	**Practical**	**Credit**	**End semester Examination**	**Internal assessment**	**Total**	**Duration of exam (Hours)**
2	**0**	**0**	**1**	**-**	**100**	**100**	**3 Hrs**
Purpose	To learn about French Language Skills						
Course Outcomes (CO)							
CO1	Introduce students to basic French language.						
CO2	Enable basic communication in French (self-introduction, daily routine, etc.).						
CO3	Develop foundational skills in vocabulary and grammar.						
CO4	Develop foundational skills in reading, writing, listening, and speaking						

Unit 1: Introduction & Basics

- Alphabet and pronunciation
- Greetings and farewells
- Introducing oneself and others
- Numbers (0–100)
- Days, months, seasons

Unit 2: Vocabulary Building I

- Family and relationships
- Professions and nationalities
- Countries and cities
- Colors and clothing
- Weather

Unit 3: Grammar I

- Nouns: gender, singular/plural
- Articles: definite and indefinite
- Personal pronouns
- Verb conjugation (regular verbs in present tense)
- Sentence structure: main clause word order

Grammar II

- Common verbs (e.g., to be, to have, modal verbs)
- Question words
- Negation
- Possessive pronouns
- Basic cases or particles (as applicable)

Unit 4: Vocabulary Building II

- Food and drink
- Daily routine
- Time and date
- House and furniture
- Hobbies and leisure

Communication Practice

- Simple dialogues (e.g., in café, at university, at home)
- Role plays (shopping, asking directions, introductions)
- Listening practice (audio exercises)
- Writing practice (short texts, filling forms)

Assessment (Optional/Recommended)

- Vocabulary quizzes
- Short written assignments
- Oral presentation or role-play
- Final test (basic grammar and vocabulary)

B23-ECO-302		Data Base Management System					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: To familiarize the students with Data Base Management system

Course Outcomes (CO)

CO1	To provide introduction to relational model and ER diagrams.
CO2	To realize about Relational Model&SQL.
CO3	To comprehend about the concept of functional dependencies& normalization.
CO4	To learn the concept of Transaction Management &and concurrency control.

UNIT-I

Introduction: DBMS an overview, Types of Database¸ Data Models-, Network, Hierarchical, Object Oriented and Relational Model, Levels of abstraction. Database Administrator role, Database Users, Three Schema architecture of DBMS, Advantages of DBMS.

Entity-Relationship Model: : Entities, Attributes and Entity Sets, Relation and Relationships sets, Primary key, Unique keys and Foreign Keys, Entity-Relationship Diagram- Conversion of ER Diagram to Relational Database. Weak Entity Sets.

UNIT-II

Relational Model: Structure of relational Databases, Relational Algebra and Relational Calculus, Operations on Relational Algebra, Operations on Relational Calculus, Tuple Relational Calculus, Domain Relational Calculus.

SQL : Concept of DDL, DML, and DCL. Basic Structure, Set operations, Aggregate Functions, Introduction to views, Nested Sub queries, Stored procedures and triggers.

UNIT-III

Dependencies : Functional Dependencies, Armstrong's axioms for functional dependency, Different anomalies in designing a Database, Normalization using functional dependencies.

Normal Forms-1st Normal form, 2nd Normal form, 3rd Normal form, Boyce-Codd Normal form, 4th normal form, 5th Normal form.

UNIT – IV

Transaction Management & Concurrency Control: ACID Properties, Transaction states, Serializability of Transaction, Testing for Serializability and concurrency control, Lock based concurrency control (2PL, Deadlock), Time stamping methods .

Recovery System: Types of Failures, Recovery Techniques and DeadLock.

Text Books:

1. Ramez Elmasri, Shamkant B. Navathe," Fundamentals of Database systems", Pearson.
2. Korth, Silberschatz, Sudarshan: database concepts, MGH.
3. R. Ramakrishnan and J. Gehrks database management system; MGH, International edition.
4. C. J. Date, Data Base Systems: 7th edition, Addison Wesley, Pearson Education, Chakrabarti, Advance database management systems, Wiley Dreamtech.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-304		Introduction to AIML					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: To introduce the students to signal characteristics and analysis, theory related to systems and its analysis.

Course Outcomes (CO)

CO1	Study of the introduction of Artificial Intelligence and its applications
CO2	Study of basics of Python for machine learning
CO3	Use and study the working of Python packages
CO4	Study the methods and algorithms in machine learning

UNIT-I

Introduction to Artificial Intelligence: Definition of AI, History of AI, Types of AI (Narrow, General, Super AI),Applications of AI, Definition of agents and environments, Rational agents, Tokenization, POS tagging, Syntax vs semantics, Simple chatbots

UNIT-II

Python for Machine Learning: -Python Data Structures, Python Programming Fundamentals, Conditions and Branching, Loops, Functions.
Python Packages: -Working with NUMPY, Working with Pandas.

UNIT-III

Introduction to Data Visualization: Introduction to Matplotlib and Seaborn, Basic Plotting with Matplotlib and Seaborn.
Introduction to Data Pre-Processing, Importing the Dataset, Handling Missing data, Working with Categorical Data, Splitting the data into Train and Test Sets, Feature Scaling

UNIT – IV

Methods and Algorithms in Machine Learning: Supervised Learning.
Regression: Simple Linear Regression, Multiple Linear Regression, Polynomial Regression, Decision Tree, Random Forest.
Classification: -Logistic Regression, K-Nearest Neighbours, Support Vector Machine, Naive Bayes, Decision Tree, Random Forest.

Reference Books:

1. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig
2. AI with Python by Prateek Joshi
3. "Machine Learning for Absolute Beginners: A Plain English Introduction" by Oliver Theobald
4. Introduction to Machine Learning with Python: A Guide for Data Scientists - Andreas C. Müller & Sarah Guido.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-ECO-306		Power System-II					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**
Purpose: To enable students to analyze power system networks, faults in power systems, transient and bus impedance algorithm.							
Course Outcomes (CO)							
CO1	Understand the concepts of per UNIT system.						
CO2	Understand the various faults in the power system.						
CO3	Understand the stability in the power system.						
CO4	Determine methods of impedance matrix calculation.						

UNIT-I

Introduction: Characteristics & representation of components of a power system, synchronous machines, transformers, lines cables & loads. Single line diagram of a power system, zero sequence impedance diagrams of power system with different types of connections of three phase transformers.
Per UNIT system: Per UNIT method of representing quantities, Advantages and disadvantages of per UNIT system, determination of base impedance, Per UNIT impedance of two winding transformers.

UNIT-II

Symmetrical faults: calculation of fault currents, use of current limiting reactors.
Unsymmetrical faults: symmetrical components transformation, sequence impedance of power system elements, Sequence network of power system, analysis of unsymmetrical faults- Single line to ground fault, Line –Line fault and Double line to ground fault.

UNIT-III

Power System Stability:- Steady state stability, methods of improving steady state stability, Transient stability, methods of improving transient stability, Swing equation, power flow in line, Power angle diagram.

UNIT-IV

Power Flow Studies: - Bus classification, Bus admittance matrix, Power flow equation, Load flow solution using Gauss-Seidel and Newton Raphson method, Decoupled and Fast decoupled methods, Comparison of load flow methods

Reference Books:
1. Elements of Power System Analysis by W.D. Stevenson.
2. Electric Power System by B.M. Weddy.
3. The transmission & Distribution of Electric Energy by H. Cotton.
4. Power System & Protection by S.S. VADHERA

Note: The paper setter will set the paper as per the question paper templates provided.

B23-ECO-308		Power System Protection and Relaying					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**
Purpose: The main objective of the course is to impart to the students the knowledge of different types of circuit breakers, relays and different types of protection schemes.							
Course Outcomes (CO)							
CO1	Study the arc formation and interruption.						
CO2	Understand the various types of circuit breakers						
CO3	Understand the different types of relays						
CO4	Study various types of protection schemes.						

UNIT 1

Neutral grounding: Need for neutral grounding, various types of neutral grounding
Circuit Interruption: Circuit interruption, theory of arc formation and it's excitation in DC, AC circuits, restriking & recovery voltage, interruption of capacitive & inductive currents. Resistance switching

UNIT 2

Circuit-Breakers: Classification of circuit-breakers, Oil circuit breaker, Air blast circuit breaker, SF6 circuit breaker, Vacuum circuit breaker, HVDC circuit breaker. Breaker operating mechanisms, Types of circuit breaker mountings and enclosure, comparison between different types of circuit breakers.

UNIT 3

Protective Relaying System: features of good protective system, elements of relay, terms connected with relay, Electromagnetic attraction and induction relays, Over current Relay, Differential relay, distance or impedance relay, static relays: Need, Essential components of static relay, comparison with electromagnetic relay.

UNIT 4

Transformer Protection: Buchholz protection, Differential protection scheme,
Alternator protection: Stator and rotor protection, Merz Price Protection, Balance earth fault protection
Bus bar Protection: Differential over current protection, Frame leakage protection
Transmission line protection: Time graded protection, Current graded protection, and Differential protection

Reference Books:-

1. Power System Protection & Switchgear, Ravinder Nath, New Age
2. Power System Protection & Switchgear, Badri Ram, MGH
3. Protection & Switchgear, Bhalja, Maheshwari, Oxford
4. Switch gear and protection, J.B. Gupta, Katson Books

Note: The paper setter will set the paper as per the question paper templates provided.

B23-ECO-310		AIML Lab					
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**
Purpose: The students will familiarize with the application of Artificial Intelligence & Machine Learning..							
Course Outcomes (CO): As per experiments.							

List of Experiments

1. Write a function that takes a list of numbers and returns the average.
2. Count how many times each number appears in a list using a dictionary.
   # Example input: [1, 2, 2, 3, 3, 3]
   # Output: {1:1, 2:2, 3:3}
3. Multiply two 2x2 matrices using NumPy.
4. Write a program that calculates the standard deviation of a list using NumPy.
5. Replace missing values (NaN) in a column with the column mean.
6. Problem: Predict student scores based on hours studied.
   Dataset:
   Hours = [1, 2, 3, 4, 5]
   Scores = [50, 55, 65, 70, 75]
   Task: Fit a simple linear regression model.
   Predict the score if a student studies for 6.5 hours
7. Problem: Predict house prices based on size, number of rooms, and age.
   Dataset:
   # Features: [Size (sqft), Rooms, Age]
   X = [[1400, 3, 20], [1600, 4, 15], [1700, 4, 10], [1875, 5, 5]]
   y = [250000, 280000, 310000, 340000]f
   Task:Train a multiple linear regression model.
   Predict price for a 1800 sqft, 4-room, 8-year-old house.
8. Predict employee salary based on experience level (in years).
   Experience = [[1], [2], [3], [4], [5]]
   Salary = [35000, 40000, 50000, 55000, 60000]
   Task: Fit a decision tree regressor.
   Predict salary for 3.5 years of experience.
9. Predict sales based on advertisement budgets.
   # Features: [TV, Radio, Newspaper Budget]
   X = [[230, 37, 69], [44, 39, 45], [17, 45, 69], [151, 41, 58]]
   y = [22, 10, 9, 18]
   Task: Train a random forest regressor.
   Predict sales for a budget: TV=100, Radio=30, Newspaper=50.
10. Classify whether a user will buy a product based on Age and Salary.
    # Features: [Age, Salary]
    X = [[25, 50000], [30, 60000], [45, 80000], [35, 120000], [50, 90000]]
    y = [0, 0, 1, 1, 1]
    Task: Train a KNN classifier (k=3).
    Predict if a 40-year-old with ₹85,000 salary will buy the product.
11. Classify emails as spam (1) or not spam (0) based on frequency of key words.
    # Features: [free, click, win]
    X = [[1, 0, 1], [0, 0, 0], [1, 1, 1], [0, 1, 0]]
    y = [1, 0, 1, 0]
    Task: Train an SVM classifier.
    Predict class of email: \[1, 1, 0].

12. Classify news articles into sports or politics using word counts.
    # Features: [goal, election]
    X = [[3, 0], [0, 4], [2, 0], [0, 5]]
    y = ['sports', 'politics', 'sports', 'politics']
13. Predict pass/fail in an exam based on study hours and attendance.
    # Features: [Study_Hours, Attendance %]
    X = [[5, 80], [3, 60], [9, 90], [1, 40], [6, 70]]
    y = ['pass', 'fail', 'pass', 'fail', 'pass']
    Task: Use Decision Tree and Random Forest classifiers.
    Predict result for a student who studied 4 hours and has 75% attendance.

Note: At least eight (8) experiments from the above list are mandatory to perform for the students.

B23-ECO-312		DBMS Lab					
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**

Purpose: The students will familiarize themselves with data base system and SQL queries.

Course Outcomes (CO)

CO1	To understand basic DDL, DML and DCL commands.
CO2	To learn about various integrity constraints & clauses.
CO3	To understand the sub queries, nested queries, views & trigger.
CO4	To learn various queries using different types of operators & functions.

List of Experiments

1. Write the queries for creation of table in RDBMS.
2. Write the queries for data insertion, updation and deletion in RDBMS.
3. Write the queries for adding primary key, Unique keys and foreign keys in RDBMS.
4. To perform various set operations on relational database.
5. Create a database and perform the Group by clause, having clause and Order by Clause.
6. Write SQL queries for extracting data from more than one table.
7. Write SQL queries for sub queries and nested queries.
8. Write SQL queries to implement views.
9. Write trigger for before and after insertion, deletion and updation process.
10. Write a Sql query for Implementation of different types of operations in SQL:
    - Arithmetic Operator
    - Logical Operator
    - Comparison Operator
    - Special Operator
11. Implementation of different types of mathematical functions with suitable examples:
    - Number Function
    - Aggregate Function
    - Character/string Function
    - Date Function

Note: At least eight (8) experiments from the above list are mandatory to perform for the students.

B23-ECO-314		Power System-II Lab					
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
-	**-**	**2**	**1**	**60**	**40**	**100**	**3 Hrs.**

Purpose: The main objective of the course is to impart the students with the knowledge of programming in power system.

Course Outcomes (CO)

CO1	To develop the program for Y-bus and Z-bus.
CO2	To develop the program load flow analysis.
CO3	To develop the program for different mathematical operations.
CO4	To develop the program for Gauss Seidel method.

List of Experiments

1. Develop a program to do the following mathematical operations:
i) Transpose of a matrix
ii) Multiplication of two matrices
iii) Addition & subtraction of two matrices
2. Write a program to formulate Y-Bus by non- singular transformation Y Bus = [A], T[= y] [A].
3. Develop a program to solve a set of 4 simultaneous liner equations using Gaussian Elimination method.
4. Develop a program to calculate Z bus of a given network using building algorithm. Assume that no mutual coupling is involved in between the different elements.
5. The Gauss Seidel method to find the solution of following equations
X1 + X1X2 + X3 = 10
X1 + X2 + X3 = 6
X1 X2 – X3 = 2
6. You have given with a 6 bus system. Apply load flow technique using Gauss Seidel method to solve up to two iterations.
7. Develop a program to find Eigen Values for given Matrix.
8. Develop a program to determine the bus impedance matrices for the given power system network.
9. Develop a program to determine the admittance matrices for the given power system network.
10. To conduct the load flow analysis of power system networks (not more than 6 bus) on any dedicated using Newton Raphson method.

Note: At least eight (8) experiments from the above list are mandatory to perform for the students.

B23-ECO- 316		Project-I					
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
-	**-**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Purpose: To develop teamwork, plan and implement the project, write a comprehensive report and develop effective presentation skills.							
Course Outcomes (CO): Upon completion of the course, students will be able to							
CO1	Identify and define a problem statement from the requirements raised from the literature survey /need analysis						
CO2	Build and Test circuits,/models /prototypes/hardware/software for developing real-life small applications						
CO3	Work in teams, write a comprehensive report and an effective presentation of the project work.						
CO4	Rapid prototyping, which will lead them towards entrepreneurship.						

Project-I Guidelines:

The Project-I is a team activity having 3-5 students in a team. This is circuit building and testing for developing small applications. The project may be a complete hardware or a hardware with a software aspect. It should encompass components, machines, automation and control, power system devices, analogue or digital ICs, microcontroller, software, etc. Based on a comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of Project-I.

B23-MAC-301		Constitution of India					
Lecture	**Tutorial**	**Practical**	**Credit**	**End semester exam**	**Internal Assessment**	**Total**	**Duration of Exam**
2	**-**	**-**	**1**		**100**		

Purpose: This course introduces students to the basic Philosophy of Indian Constitution.

Course Outcomes (CO

CO1	To explain the basic structure of Indian Constitution.
CO2	To understand the structure of Indian Union.
CO3	To write down roles and powers of Governor.
CO4	To explain the election process under Indian Constitution.

UNIT-I

The Constitution - Introduction, The History of the Making of the Indian Constitution, Preamble and the Basic Structure, and its interpretation, Fundamental Rights and Duties, and a Brief overview of the Directive Principles of State Policy.

UNIT-II

Union Government, Structure of the Indian Union, President – Role and Power, Prime Minister and Council of Ministers, Brief overview of Lok Sabha and Rajya Sabha.

UNIT-III

State Government, Governor – Role and Power, Chief Minister and Council of Ministers, State Secretariat, distribution of powers between the state and the centre under the Indian Constitution.

UNIT-IV

Local Administration, District Administration, Municipal Corporation, Zila Panchayat.
Election Commission a. Role and Functioning b. Chief Election Commissioner c. State Election Commission

Suggested Learning Resources:

1. Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008
2 The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)
3 Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Third 2018 edition Suggested Software/Learning Websites:
1. https://www.constitution.org/cons/india/const.html
2. http://www.legislative.gov.in/constitution-of-india
3. https://www.sci.gov.in/constitution
4. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-ofindia/

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-302		Compiler Design					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: To acquaint with the knowledge and application aspects related Compiler Design.

Course Outcomes (CO)

CO1	To get familiarize with the Introduction to Compiler Design, Lexical Analyzer etc.
CO2	To get familiarize with the Syntax Analysis.
CO3	To get familiarize with the further reading of parsing, algorithm and parser.
CO4	To get familiarize with the Intermediate Code Generation & Code Optimization.

UNIT-I

Introduction: -Introduction to Compiler Design, Linker and Loader in Compiler Design, Phases of Compiler, Compiler vs Interpreter, Lexical Analysis.

Role of Lexical Analyzer-Tokens, Lexemes, and Patterns, Regular Expressions

UNIT-II

Syntax Analysis (Parsing) :-Role of the Parser, Context-Free Grammars (CFGs), Parse Trees and Abstract Syntax Trees.

Top-Down Parsing: Recursive Descent Parsing, LL(1) Parsing

Bottom-Up Parsing: Shift-Reduce Parsing, LR(0), SLR(1), LALR(1), and Canonical LR(1)

UNIT-III

Syntax Analysis and Parsing: Introduction to Syntax Analysis, FIRST Set in Syntax Analysis

Follow Set in Syntax Analysis, Classification of Context-Free Grammar, Ambiguous Grammar

Introduction to Parsing: -Types of Parsers: Classification of Top-Down Parsers , Recursive Descent Parser, Predictive Parser, Construction of LL(1) Parsing Table, LL(1) Parsing Algorithm

Classification of Bottom-Up-Parsers: -Shift Reduce (SR) Parser, Operator Precedence Parser, LR Parser, LR(0) Parser, SLR Parser.

UNIT-IV

Intermediate Code Generation: Intermediate Code Generation in Compiler Design, Introduction to Intermediate Representation, Three Address Code, Basic Blocks in Compiler Design, Control Flow Graph, Code Optimization, Code Optimization, Machine Dependent and Machine Independent Code Optimization, Peephole Optimization in Compiler Design.

References/Text:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques, and Tools, Pearson Education
2. Andrew W. Appel, Modern Compiler Implementation in C / Java / ML, Cambridge University Press
3. D. M. Dhamdhere, Compiler Construction, McGraw Hill Education India

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-304		Power Electronics and Drives					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**
Purpose: To familiarize the students with the Converter and Power switching device.							
Course Outcomes (CO)							
CO1	Introduction to Power Electronics and Thyristor Rectifiers will be acquainted.						
CO2	Various converters will be acquainted.						
CO3	Inverters Voltage control in 1-phase inverters will be acquainted.						
CO4	Basic DC & AC Drives will be acquainted.						

UNIT-I

Power switching devices:

Power Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor.

Thyristor rectifiers

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load.

UNIT-II

DC-DC buck converter:

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.

DC-DC boost converter:

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

UNIT-III (Qualitative study only)

Single-phase voltage sourceinverter:

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage.

UNIT-IV (Qualitative study only)

Electric Drives: Introduction to electric drives – Block diagram – advantages of electric drives- types of load – classification of load torque.

DC Drives: Single phase semi converter and single phase fully controlled converter drives. Dual Converters for Speed control of DC motor-1-phase and 3-phase configurations; Chopper controlled DC drives- Single quadrant chopper drives- Regenerative braking control- Two quadrant chopper drives- Four quadrant chopper drives.

AC Drives: Three phase induction motor speed control, Stator voltage control – stator frequency control.

References/Text:

1. Power Electronics, Dr. P.S. Bimbhra, Khanna Pub.
2. Fundamentals of Power Electronics" by Erickson and Maksimovic.
3. Power Electronics: Circuits, Devices, and ApplicationsBy Muhammad H. Rashid.
4. Electric Motor Drives Modeling, Analysis, and Control, Ramu Krishnan
5. Basics of Electrical Drives, S K Pillai, New Academic Science Limited

Note: The paper setter will set the paper as per the question paper templates provided.

B23-ECO-306		Signals and Systems					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**
Purpose: To introduce the students to signal characteristics and analysis, theory related to systems and its analysis.							
Course Outcomes (CO)							
CO1	To understand the basic properties of signal & systems.						
CO2	To know the methods of characterization of LTI systems in time domain						
CO3	To analyse continuous time signals and system in the Fourier and Laplace domain						
CO4	To analyse discrete time signals and system in the Z transform domain						

UNIT-I

Introduction and Classification of signals: Definition of signal and systems, communication and control system as examples Classification of signals, Basic Operations on signals:Amplitude scaling, addition, multiplication, differentiation, integration, time scaling, time shift and time reversal. Exponential, sinusoidal, step,impulse and ramp functions.

System Classification and properties: Linear-nonlinear, Time variant-invariant, causal-noncausal, static-dynamic, stable-unstable, invertible.

UNIT-II

LTI system Properties: Properties of linear, time – invariant systems, convolution, interconnection of LTI systems,Time domain representation of LTI System, zero- input response, zero state response, impulse response, and stability,systems represented by differential and difference equations.

UNIT-III

Fourier Representation of Continuous and Discrete time Signals: Introduction to Fourier Transform & DTFT, Definition and basic problems. Properties of Fourier Transform: Linearity, Time shift, Frequency shift, Scaling, Differentiation and Integration, Convolution and Modulation, Parseval's theorem.

Sampling, discrete – timesignals, models, operations, discrete – time systems, stability, discrete – time Fourier series, discrete – time Fourier transform.

UNIT – IV

Laplace Transform: Introduction to Laplace transform, Region of convergence for Laplace transform, Inverse Laplace transform, Properties of Laplace transform, Analysis and characterization of LTI systems using Laplace transform.

The Z-Transforms: Z transform, properties of the region of convergence, properties of the Z-transform, Inverse Z-transform, Causality and stability, Transform analysis of LTI systems**.**Applications: Modulation, types, benefits, window functions, Filtering, digital filters.

Text Book:

Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, Signals and Systems, Prentice Hall India,

Reference Books:

1.Signals and Systems: Tarun Kumar Rawat, Oxford University Press.

2. Signals and Systems: Haykin S.,VeenB.V., John Wiley.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-308		Soft Computing					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: The main objective of the Soft Computing Techniques to Improve Data Analysis Solutions is to strengthen the dialogue between the statistics and soft computing research communities in order to cross-pollinate both fields and generate mutual improvement activities.

Course Outcomes (CO)

CO1	To learn the basic concepts of Soft Computing.
CO2	Learn the Neural Networks, architecture, functions and various algorithms involved.
CO3	Implementation of the Fuzzy Logic, Various fuzzy systems and their functions.
CO4	Learn the implementation of Genetic algorithms, its applications and advances.

UNIT-I

Soft Computing: Conventional AI to Computational Intelligence; Soft Computing Constituents and Applications.
Introduction to Non-traditional Met heuristic Optimization Techniques: Random Optimization, Simulated Annealing, Tabu Search, Ant Colony Optimization, Particle Swarm Optimization, Harmony Search, Memetic Algorithms, Other Evolutionary Algorithms such as Firefly Algorithm, Bee Algorithm, Shuffled Frog Leap algorithm, Bat algorithm etc.
Data Clustering Algorithms: K-Means, Fuzzy C-Means, Mountain Clustering, Subtractive Clustering.

UNIT-II

Fuzzy Set Theory: Fuzzy Sets & Classical Sets; Operations on Fuzzy Sets, Fuzzy Relations, Linguistic Variables.
Membership Functions: Introduction, Features, & Fuzzification, Methods of Membership Value Assignment; Defuzzification.
Fuzzy Systems: Crisp Logic, Predicate Logic, Fuzzy Logic; Fuzzy Rule Base and Approximate Reasoning, Fuzzy Quantifiers; Fuzzy Inference Systems, Fuzzy Decision Making, Fuzzy Logic Control System; Fuzzy Expert Systems.

UNIT-III

Neural Networks: Fundamental Concepts, Basic Models and Architecture; Machine Learning Using Neural Networks; Associative Memory Networks and their Applications.
Supervised Learning Neural Networks: Perceptron Networks, Radial Basis Function Networks: Back Propagation Neural Network: Architecture, Learning, Applications, & Research Directions; The Boltzman Machine.
Unsupervised Learning Networks: Competitive Learning networks; Kohonen Self-Organizing Networks; Hebbian learning; The Hopfield Network; Counter propagation Networks; Adaptive Resonance Theory: Introduction, Architecture, & Applications; Feed forward Networks; Reinforcement Learning.

UNIT-IV

Genetic Algorithms: Introduction to Genetic Algorithms (GA) and their Terminology; Traditional Optimization and Search Techniques vs. Genetic Algorithm; Operators in Genetic Algorithms; Problem Solving using Genetic Algorithm; Classification of Genetic Algorithms; Holland's Classifier Systems; Genetic Programming; Advantages and Limitations of Genetic Algorithm; Applications of Genetic Algorithm; Applications of GA in Machine Learning.

Text Books:

1. S.N. Sivanandam& S.N. Deepa, Principles of Soft Computing, Wiley Publications, 2nd Edition, 2011.
2. S, Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI Publication, 2009.
3. N. K. Bose, Ping Liang, Neural Network fundamental with Graph, Algorithms & Applications, TMH,1998.
4. Bart Kosko, Neural Network & Fuzzy System, PHI Publication, 1st Edition, 2009.
5. Rich E, Knight K, Artificial Intelligence, TMH, 3rd Edition, 2012.
6. George J Klir, Bo Yuan, Fuzzy sets & Fuzzy Logic, Theory & Applications, PHI Publication, 2009.
7. Martin T Hagen, Neural Network Design, Nelson Candad, 2008, Addison Wesley.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-310		Computer Networks					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: The main objective of the course is to introduce the architecture and layers of computer networks, and protocols used at different layers.

Course Outcomes (CO)

CO1	To introduce the basic concept of networking, types, networking topologies and layered architecture.
CO2	To introduce the Data Link layer and its protocols, MAC and LAN protocols.
CO3	To introduce the packet switching networks, routing algorithms and congestion control techniques.
CO4	To introduce the concept of TCP/IP, its architecture and protocols.

UNIT-I

Introduction: Networking goals, Applications of networking: web, ftp and email, Network Topologies analysis and comparison, Network types, Wireless network architecture, Switching approaches, Transmission media and their performance comparison, ISDN and B-ISDN.

Layered Architectures: Need for a layered architecture, OSI Reference model, TCP/IP architecture, layer protocols.

UNIT-II

Data Link layer: Peer to peer mechanism, Flow and Error control, Flow control mechanism: Stop and Wait, Sliding Window, Error control mechanism: Stop and Wait ARQ, Go Back-N ARQ and Selective repeat, Error detection and correction, Example of Data Link Protocols: PPP, HDLC protocol.

MAC and LAN Protocols: Multiple access protocols: ALOHA- pure and slotted ALOHA, CSMA, CSMA/CD, Channelization protocols: FDMA, TDMA, CDMA. Token ring, Ethernet, LAN standards 802.11, LAN Interconnected devices: Switch/Hub, Bridges, Router, Gateways.

UNIT-III

Packet Switching Networks: Packet Network topology, Methods: Datagrams and Virtual Circuits, Types of virtual circuits: X.25, Frame Relay, ATM. Routing Algorithms(distance vector, link state packet routing), Traffic Management and QoS – FIFO, Priority Queues, Fair Queuing, Congestion control techniques(choke packets, leaky bucket, token bucket).

UNIT-IV

TCP/IP: Architecture, Internet Protocols – IP packet, addressing, Subnet Addressing, IP routing, CIDR, ARP, RARP, ICMP, Reassembly, IPv6, UDP, Transmission Control Protocol – TCP, Reliable Stream Service, Operation Protocol, DHCP, Mobile IP, Internet Routing Protocols, Multicast Routing.

TEXT BOOK:

1. S. Tanenbaum (2003), Computer Networks, 4th edition, Pearson Education/ PHI, New Delhi, India.

REFERENCE BOOKS:

1. Behrouz A. Forouzan (2006), Data Communication and Networking, 4th Edition, McGraw-Hill, India.
2. Kurose, Ross (2010), Computer Networking: A top-down approach, Pearson Education, India.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-312		Electromagnetic Theory					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	-	-	3	70	30	100	**3Hrs.**
Purpose: To familiarize the students with the introductory concepts of Electric and Magnetic Fields and make them understand the phenomenon of propagation of electromagnetic waves and transmission lines.							
Course Outcomes (CO)							
CO1	Review and basics of electrostatics will be covered.						
CO2	Review and basics of Magneto-statics and Maxwell's equations will be covered.						
CO3	Fundamentals of uniform plane waves and their propagation in different mediums will be covered.						
CO4	Fundamentals of Transmission Lines and analysis.						

UNIT-I (With computational methods)

Electrostatics: Relevant Primer: Electrostatics fundamentals, Comparison of Cartesian, Cylindrical & Spherical Coordinate Systems, introductory multivariable calculus.
Divergence, curl and gradient, solenoidal and irrotational fields, basic idea of Stokes' Theorem, Gauss's Theorem and its Applications, Capacitance, Current Density and Continuity Equation.

UNIT-II(Qualitative analysis only)

Magnetic Field: Relevant Primer: Magnetostatics, Biot-Savart's Law, Ampere's circuital Law, Faraday's Law, Ampere's Force Law, Magnetic Circuits, magnetic materials and properties.
Maxwell Equations: Magnetic Vector Potentials, Differential Current Element, Maxwell's Equations in Point and Integral form, their physical interpretation and relation with circuit theory, Retarded Potentials.

UNIT-III (Qualitative analysis only)

The Uniform Plane Wave: Plane Wave, Deduction of Uniform plane wave equation & its Properties, Wave equations from Maxwell's equations, various media, Wave Equation for Free Space and Conducting Medium, Propagation. The Poynting Vector and its theorem.Skin Effect, reflection of Uniform Plane Waves.

UNIT-IV (With computational methods)

Transmission Lines: The Transmission Line Parameters and Equations, Primary & Secondary Constants, Propagation Constant, Phase and Group Velocities.
SC and OC Lines, Input Impedance Relations, Reflection Coefficient, VSWR, Smith Chart –its Configuration and Applications.

Text/Reference Books:

1. David K. Cheng, Field and Wave Electromagnetics, Addison Wesley.
2. K.D. Prasad, Antenna and Wave Propagation, Satya Prakashan.
3. Sadiku, Elements of Electromagnetics, 6th ed., Oxford Press.(Asian Edition).
4. J.D. Kraus, Electromagnetics, McGraw Hill Publications.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-314		High Voltage Engineering and FACTS Devices					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: The main objective of the course is to impart the knowledge of HVE, HVDC & FACTS devices.

Course Outcomes (CO)

CO1	To impart knowledge about Conduction and Break Down in Gases, liquid dielectrics and solid dielectrics.
CO2	To impart knowledge about Generation of High Voltages and Currents.
CO3	To acquaint students with the HVDC Transmission.
CO4	To impart knowledge to students about facts devices.

UNIT-I

Conduction and Break Down in Gases: Ionization processes, Townsend's criterion, breakdown in electronegative gases, time lags for breakdown, streamer theory, Paschen's law.

Break Down in Liquid Dielectrics: Conduction and breakdown in pure liquid and commercial liquid.

Break Down in Solid Dielectrics: Intrinsic breakdown, electromechanical break down, breakdown of solid, dielectric and composite dielectrics.

UNIT-II

Generation of High Voltages and Currents: Generation of high direct current voltages, generation of high alternating voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

UNIT-III

HVDC Transmission: Development of HVDC Technology, Selection of converter configuration. Rectifier and Inverter operation. Control of HVDC converters and Systems. Harmonics in HVDC Systems, Harmonic elimination, AC and DC filters.

UNIT-IV

Introduction of Facts Concepts: Basic of flexible alternating current transmission system (FACTS) controllers, shunt, series, combined and other controllers, HVDC or FACTS, static VAR compensator (SVC) and static synchronous compensator (STATCOM), Static Synchronous Series Compensator (SSSC), Thyristor Controlled Series, Capacitor (TCSC). Solid State Contactors (SSC) and TSSC.

Suggested Books:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering, Tata Mc-Graw Hill.
2. C. L. Wadhwa, "High Voltage Engineering", Wiley Eastern Ltd.
3. E. Kuffel and W. S. Zacngal, High Voltage Engineering", Pergamon Press.
4. Hingorani N.G, "Understanding FACTS (Concepts and Technology of Flexible AC Transmission System)", Standard Publishers.
5. Song Y.H. and Johns A.T., "Flexible AC Transmission Systems", IEEE Press.
6. Ghosh A. and Ledwich G., "Power Quality Enhancement using Custom Power Devices", Kluwer Academic Publishers.
7. Mathur and Verma , "Thyristor-based FACTS controllers for Electrical Transmission Systems", IEEE Press.
8. Bollen M.H.J., "Understanding Power Quality and Voltage Sag", IEEE Press.
9. Padiyar K.R., "FACTS Controllers in Power Transmission and Distribution", New Age International Publisher.
10. Miller T.J.E., "Reactive Power Control in Electric Systems", John Wiley.
11. Kamakshaiah S, Kamaraju V, "HVDC Transmission", McGraw Hill Education.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-316		Internet Technology and Management					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: The main objective of the course is to introduce the protocols used in Internet, its architecture, and security aspect of Internet. Student will have an insight that how a search engine works and web crawls.

Course Outcomes (CO)

CO1	Describe Internet, its architecture, services and protocol.
CO2	Implement a simple search engine.
CO3	Implement a web crawler.
CO4	Use java script technologies to make a website highly responsive, more efficient and user friendly.

UNIT-I

THE INTERNET: Introduction to networks and internet, history, Internet, Intranet and Extranet, Working of Internet, Internet Congestion, Internet culture, business culture on internet, Collaborative computing and the internet, Modes of Connecting to Internet, Internet Service Providers (ISPs), Internet address, standard address, domain name, DNS, IPv6.Modems, Speed and time continuum, communications software, internet tools.

UNIT-II

WORLD WIDE WEB: Introduction, Miscellaneous Web Browser details, searching the www, Directories search engines and meta search engines, search fundamentals, search strategies, working of the search engines, Telnet and FTP, HTTP, Gopher Commands, TCP/IP, Introduction to Browser, Coast-to-coast surfing, hypertext markup language, Web page installation, Web page setup, Basics of HTML and formatting and hyperlink creation. Using FrontPage Express, Plug-ins.

UNIT-III

INTERNET PLATEFORM AND MAILING SYSTEMS: Introduction, advantages and disadvantages, User Ids, Passwords, e-mail addresses, message components, message composition, mailer features, E-mail inner workings, E-mail management, MIME types, Newsgroups, mailing lists, chat rooms, secure mails, SMTP, PICO, Pine, Library cards catalog, online ref. works.

Languages: Basic and advanced HTML, Basics of scripting languages: XML, DHTML, JavaScript.

UNIT-IV

SERVERS: Introduction to Web Servers: PWS, IIS, Apache, Microsoft Personal Web Server, Accessing and using these servers.

Privacy and security topics: Introduction, Software Complexity, Attacks, security and privacy levels, security policy, accessibility and risk analysis, Encryption schemes, Secure Web document, Digital Signatures, Firewalls, Intrusion detection systems.

Text Books:

1. Steven Holzner,"HTML Black Book" Dreamtech press.
2. Web Technologies, Black Book, DreamtechPress
3. Web Applications: Concepts and Real-World Design, Knuckles, Wiley-India.
4. Internet and World Wide Web How to program, P.J. Deitel & H.M. Deitel. Pearson.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-401		An Introduction to Artificial Intelligence					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3 Hrs.**

Purpose: Students will grasp fundamental concepts Artificial Intelligence.

Course Outcomes (CO)

CO1	To understand the basics of AI and the philosophy of AI.
CO2	To model a new problem as an AI problem.
CO3	To learn about variety of models to model a new problem.
CO4	To learn about the algorithms to solve different formulations.

UNIT-I

Introduction: Philosophy of AI, Definitions, Modelling a Problem as Search Problem, Uninformed Search, Heuristic Search, Domain Relaxations.

UNIT-II

Local Search, Genetic Algorithms, Adversarial Search, Constraint Satisfaction.

UNIT-III

Propositional Logic & Satisfiability, Uncertainty in AI, Bayesian Networks, Bayesian Networks Learning & Inference, Decision Theory.

UNIT – IV

Markov Decision Processes, Reinforcement Learning, Introduction to Deep Learning & Deep RL.

Books and references

1. Rich E., Knight K. and Nair B. S., Artificial Intelligence, Tata McGraw Hills (2009) 3rd ed.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-403		Artificial Intelligence: Search Methods for Problem Solving					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**
Purpose: Students will learn how Artificial Intelligence is applied to problem searching and finding solutions.							
Course Outcomes (CO)							
CO1	To learn to behave in an intelligent manner to solve problems.						
CO2	To be able to arrive at decisions that transform a given situation into a desired or goal situation.						
CO3	To imagine the consequence of its decisions.						
CO4	To be able to identify the ones that work.						

UNIT-I

Introduction: Philosophy, Mind, Reasoning, Computation, Dartmouth Conference, The Chess Saga, Epiphenomena, State Space Search: Depth First Search, Breadth First Search, Depth First Iterative Deepening, Heuristic Search: Best First Search, Hill Climbing, Solution Space, TSP, Escaping Local Optima, Stochastic Local Search.

UNIT-II

Population Based Methods: Genetic Algorithms, SAT, TSP, emergent Systems, Ant Colony Optimization, Finding Optimal Paths: Branch & Bound, A*, Admissibility of A*, Informed Heuristic Functions, Space Saving Versions of A*: Weighted A*, IDA*, RBFS, Monotone Condition, Sequence Alignment, DCFS, SMGS, Beam Stack Search.

UNIT-III

Game Playing: Game Theory, Board Games and Game Trees, Algorithm Minimax, AlphaBeta and SSS.
Automated Planning: Domain Independent Planning, Blocks World, Forward &Backward Search, Goal Stack Planning, Plan Space Planning.
Problem Decomposition: Means Ends Analysis, Algorithm Graph-plan, Algorithm AO.

UNIT – IV

Rule Based Expert Systems: Production Systems, Inference Engine, Match-Resolve-Execute, Rete Net.
Deduction as Search: Logic, Soundness, Completeness, First Order Logic, Forward Chaining, Backward Chaining.
Constraint Processing: CSPs, Consistency Based Diagnosis, Algorithm Backtracking, Arc Consistency, Algorithm Forward Checking.

Books and references

1. Luger F. G., Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education Asia (2009) 6th ed.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-405		Data Analytics					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: To introduce the students to Data analytics, clustering techniques, Data visualization and about Machine learning for Data Science.

Course Outcomes (CO)

CO1	To understand the fundamentals of Data analytics.
CO2	To know about the machine learning for data science.
CO3	To have knowledge about performance factor analysis.
CO4	To learn about data visualization.

UNIT-I

Data Analytics – An Overview: Definition of Data Analytics and its relevance; Types of Data – Structure vs Unstructured and Quantitative vs Qualitative; Data Analytics workflow – Collection, Data Cleansing & Transformation, Data Modelling, Data Visualization; Types of Data Analytics; Data Security; Case studies.

Clustering and Classification Techniques: Introduction to Data Science & Methodology, Various Methods of Data Science (Clustering and Classification), Descriptive and Predictive Analytics. A Case Study of use of clustering and classification methods on educational data.

UNIT-II

Machine Learning for Data Science: Introduction to Machine Learning, Neural Network and Deep Learning; A black box approach to Regression Analysis; Popular Data Analytic Tools. Case studies on educational data.

Social Network Analysis: Social Network Analysis in Education, A Simple Case Study of analysing Twitter/Facebook data.

UNIT-III

Educational Data Analytics: Learning Associations – Classification – Regression – role of educational data analytics - Behaviour Detection - Data Synchronization - Feature Engineering - Feature Generation and Feature Selection for behaviour detection.

Performance Factors Analysis: Latent Knowledge Estimation - Bayesian Knowledge Tracing - Performance Factors Analysis - Relationship Mining - Correlation Mining -Students' Interaction Network Analysis.

UNIT – IV

Data Visualization: Visualization - Educational Visualization and Learning Curves- Heat Maps, Parameter Space Maps, State-space Network - Structure Discovery.

Learning from Multiple Representations: Applications of Clustering in EDA, Factor Analysis, Knowledge Inference (Q-matrix and Learning Factor Analysis) - Personalized Recommendation - Topic-based Content Recommendation - Course Recommendation. Case studies on data analytics practices by Google, Amazon, Healthcare, Government etc.

Reference Books:

1. H Almuallim, S Kaneda, Y Akiba, Development and Applications of Decision Trees, Editor(s): Cornelius T. Leondes, Expert Systems, Academic Press, 2002, Pages 53-77.
2. Christopher Bishop, Pattern Recognition and Machine Learning, Springer Pub. (2010).
3. A Webb and KD Copsey, Statistical Pattern Recognition, 3rd Edition, Willey Pub. (2011).
4. Introduction to Statistics and Data Analysis by C Heumann and MS Shalabh, Springer Pub., 2016.
5. Goodfellow, Y. Bengio and A. Courville, "Deep Learning," MIT Press, 2016.

. **Note: The paper setter will set the paper as per the question paper templates provided.**

B23-EEP-407		Distributed Optimization and Machine Learning					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: Students will have the knowledge of distributed optimization techniques and algorithms

Course Outcomes (CO)

CO1	To understand the concept of distributed optimization.
CO2	To learn about algorithms applicable for optimization.
CO3	To have knowledge about Special techniques for optimization problems.
CO4	To learn distributed optimization algorithms.

UNIT-I

Introduction to Distributed Optimization, Mathematical Optimization, Convex Sets and Convex Functions, Strong Convexity and Its Implications, Constrained Optimization Problems: Primal and Lagrangian Dual, KKT Conditions and Primal/Dual Methods, Analysis of Gradient Descent.

UNIT-II

Analysis of Accelerated Optimization Algorithms, Optimization Algorithms as Dynamical Systems and Introduction to Stability Theory, Lyapunov Analysis of Gradient Flows, Gradient Flows for Equality Constrained Optimization and Saddle-Point Problems
Accelerated Gradient Flows, Augmented Lagrangian and Method of Multipliers.

UNIT-III

ADMM (Alternating Direction Method of Multipliers), Dual Ascent and Dual Decomposition, Introduction to Graph Theory, Distributed Consensus.
Continuous-Time Analysis of Consensus Algorithms, Distributed Optimization Problem (Economic Dispatch Problem).

UNIT – IV

Distributed Optimization Algorithms, Introduction to Neural Networks and Ring-All reduce Algorithm, Introduction to Federated Learning, Data Heterogeneity in Federated Learning.
Computational Heterogeneity in Federated Learning, Robustness in Federated Learning.

Books and references:

1. Boyd, Stephen P., and Lieven Vandenberghe. Convex optimization. Cambridge university press, 2004.
2. Nedić, A. (2018). Distributed Optimization Over Networks. In: Facchinei, F., Pang, JS. (eds) Multi-agent Optimization. Lecture Notes in Mathematics, vol 2224. Springer, Cham. https://doi.org/10.1007/978-3-319-97142-1_1.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-409		Machine Learning and Deep Learning – Fundamentals and Applications					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: Students will acquire the knowledge of applying Machine learning and Deep Learning techniques to solve various real-life problems.

Course Outcomes (CO)

CO1	To understand various traditional Machine Learning approaches like Bayesian Classification, Multilayer Perceptron.
CO2	To learn about modern Deep Learning architectures like Convolutional Neural Networks, Autoencoders.
CO3	To learn about the building blocks used in Deep Learning based solutions.
CO4	To learn about feedforward neural networks, convolutional neural networks, recurrent neural networks and attention mechanisms.

UNIT-I

Introduction to ML, Performance Measures, Bias-Variance Trade off, Linear Regression.
Bayes Decision Theory Bayes Decision Theory, Normal Density and Discriminant Function, Bayes Decision Theory - Binary Features, Bayesian Belief Network.
Parametric and Non- Parametric Density Estimation Parametric and Non- Parametric Density Estimation – ML and Bayesian Estimation, Parzen Window and KNN.

UNIT-II

Perceptron Criteria and Discriminative Models Perceptron Criteria, Discriminative models, Support Vector Machines (SVM) Logistic Regression, Decision Trees and Hidden Markov Model Logistic Regression, Decision trees, Hidden Markov Model (HMM).
Ensemble methods Ensemble methods: Ensemble strategies, boosting and bagging, Random Forest.

UNIT-III

Dimensionality Problem Dimensionality Problem, Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA) Mixture Model and Clustering Concept of mixture model, Gaussian mixture model, Expectation Maximization Algorithm, K-means clustering.
Clustering Fuzzy K-means clustering, Hierarchical Agglomerative Clustering, Mean-shift clustering.

UNIT – IV

Neural Network: Perceptron, multilayer network, backpropagation, RBF Neural Network, Applications.
Introduction to Deep Neural Networks: Introduction to Deep Learning, Convolutional Neural Networks (CNN), Vanishing and Exploding Gradients in Deep Neural Networks, LeNet - 5, AlexNet, VGGNet, GoogleNet, and ResNet.
Recent Trends in Deep Learning Generative Adversarial Networks (GAN), Auto Encoders and Relation to PCA, Recurrent Neural Networks, U-Net, Applications and Case studies.

Books and references

1. E. Alpaydin, Introduction to Machine Learning, 3rd Edition, Prentice Hall (India) 2015.
2. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, 2nd Edn., Wiley India, 2007.
3. C. M. Bishop, Pattern Recognition and Machine Learning (Information Science and Statistics),Springer, 2006.
4. M.K. Bhuyan, Computer Vision and Image Processing: Fundamentals and Applications, published by CRC press, 2019.
5. S. O. Haykin, Neural Networks and Learning Machines, 3rd Edition, Pearson Education (India), 2016.
6. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.
7. Michael A. Nielsen, Neural Networks and Deep Learning , Determination Press, 2015.
8. Yoshua Bengio, Learning Deep Architectures for AI, now Publishers Inc., 2009.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-411		Optimization Theory and Algorithms					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**
Purpose: Students will have knowledge of optimization techniques and algorithms.							
Course Outcomes (CO)							
CO1	To learn about unconstrained optimization.						
CO2	To have knowledge of the conjugate gradient method.						
CO3	To have knowledge about the techniques for constrained optimization.						
CO4	To learn the concept of duality in optimization.						

UNIT-I

Introduction and background material-1, Review of Linear Algebra, Background material – 2, Review of Analysis, Calculus, Unconstrained optimization.

Taylor's theorem, 1st and 2nd order conditions on a stationary point, Properties of descent directions.

UNIT-II

Line search theory and analysis, Wolfe conditions, backtracking algorithm, convergence and rate, Conjugate gradient method, Introduction via the conjugate direction's method, geometric interpretations, Formulating the conjugate gradient method, expanding subspace theorem, preconditioned conjugate gradient method

UNIT-III

Nonlinear optimization methods: Nonlinear conjugate gradient method, Convergence and rate for Newton methods, Hessian modification

Linear and nonlinear least squares problems: Formulations and techniques for solving least square problems

Constrained optimization – Introduction, First order formulation for constrained optimization, equality and inequality constraints, constraint qualification

UNIT – IV

Constrained optimization - KKT conditions: First-order necessary conditions (KKT) and a proof sketch of KKT

Constrained optimization - Projected gradient descent: Sub-gradients and projection operators, examples of projected gradient descent

Duality in optimization: Geometric interpretations of duality, and sample problem solving using the Lagrangian dual function formulation.

Books and References.

Numerical Optimization by Jorge Nocedal and Stephen J. Wright, Springer, 2006.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-413		Software Testing					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: Students will have knowledge of all test cases for both white-box and black-box as well.

Course Outcomes (CO)

CO1	To understand various techniques for test case design, as used for testing of software artefacts, including requirements, design and code.
CO2	To learn about algorithms and techniques for test case design based on graphs, logic, syntax of programming languages and on inputs.
CO3	To have knowledge about Special techniques for testing object-oriented features and web applications.
CO4	To learn symbolic testing techniques.

UNIT-I

Techniques and algorithms for test case design: Graphs based testing- structural coverage criteria.
Graphs based testing: Data flow coverage criteria.

UNIT-II

Graphs coverage for source code, design elements and requirements.
Techniques and algorithms for test case design: Logic based testing- Predicates, logic-based coverage criteria. Specification-based logic coverage, logic coverage on finite state machines.

UNIT-III

Input space partitioning: Input domain modeling, combination strategies criteria.
Syntax based testing: Coverage criteria based on syntax, mutation testing.
Test case design applied to object-oriented applications.

UNIT – IV

Test case design applied to web applications, Symbolic testing, Concolic testing.

Books and References

1. Software Engineering – A Practitioner's Approach, 7th Edition, Roger Pressman.
2. Bugzilla (https://www.bugzilla.org/).
3. JIRA (https://www.atlassian.com/software/jira).

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-415		Software Verification, Validation and Testing					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: The objective of this course is to provide the in-depth coverage of software quality models and software testing strategies. It focuses on test case generation techniques and testing levels. It also focuses on testing different kinds of software.

Course Outcomes (CO)	
CO1	To develop test cases for any problem.
CO2	To pursue testing on any level of software design by using different testing strategies.
CO3	To learn the test management and testing activities by using different testing methods.
CO4	To apply testing and quality model of software testing in achieving high quality software.

UNIT-I

Introduction: Overview of software evolution, SDLC, Testing Process, Terminologies in Testing: Error, Fault, Failure, Verification, Validation, Definition of software testing, Test Cases, Test Oracles, Testing Process, Limitations of Testing.

UNIT-II

Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique. Structural Testing: Path testing, DD-Paths, Cyclomatic Complexity, Graph Metrics, Data Flow Testing, Mutation testing.

UNIT-III

Reducing the number of test cases: Prioritization guidelines, Priority category, Scheme, Risk Analysis, Regression Testing, and Slice based testing, Testing Activities: Unit Testing, Levels of Testing, Integration Testing, System Testing, Debugging, Domain Testing.

UNIT – IV

Overview of SQM: Concepts of Software Quality, Quality Attributes, Software Quality Models: McCall, Boehm, ISO-9000, CMM. Miscellaneous topics: Stress Testing, Ad hoc testing: Buddy testing, Exploratory testing, Agile and extreme testing.

Books and References:

1. Naresh Chauhan “Software Testing Principles and Practices” Oxford Publications, 2012.
2. Louise Tamres, “Software Testing”, Pearson Education Asia, 2002.
3. Robert V. Binder, “Testing Object-Oriented Systems-Models, Patterns and Tools”, Addison Wesley.
4. William Perry, “Effective Methods for Software Testing”, John Wiley & Sons, New York.
5. Cem Kaner, Jack Falk, Nguyen Quoc, “Testing Computer Software”, Second Edition, Van Nostrand Reinhold, New York.
6. K.K. Aggarwal & Yogesh Singh, “Software Engineering”, 2nd Ed., New Age International Publishers, New Delhi, 2005.
7. Boris Beizer, “Software Testing Techniques”, Second Volume, Second Edition, Van Nostrand Reinhold, New York.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-417		Advanced Distribution System Analysis and Operation					
Lecture	Tutorial	Practical	Credit	End Semester Exam	Internal Assessment	Total	Duration of Exam
3	-	-	3	70	30	100	3Hrs.

Purpose: This course provides a comprehensive exploration of modern distribution networks, covering key areas such as the fundamentals of network design, integration of Distributed Energy Resources (DER), load flow analysis, and optimal power flow (OPF).

Course Outcomes (CO)

CO1	Understand the basic concept of distribution systems, DERs dynamics, and their analysis.
CO2	Students will analyze the various optimal power flow techniques.
CO3	To have knowledge about system reliability, AI implementation and fault analysis.
CO4	To learn about resiliency, distribution management system, smart meters and data acquisition.

UNIT-I

Introduction, Difference between power transmission and distribution networks, architecture of distribution networks, Impacts of DERs on distribution grids & its hosting capacity assessment, challenges associated with DER integration.

Distribution network circuit elements and their functionalities, Modeling and operation of DERs, Load and volt-VAR controlling device models, Bus injection model of distribution networks, Branch flow model of distribution networks.

Modeling of unbalancing effects, Model relaxation techniques, Simplified linear model of distribution grid, Introduction to distribution network load flow, Sparsity quantification of radial, weakly meshed, and ring distribution networks.

UNIT-II

Graphical load flow analysis of DER integrated distribution networks, Load flow analysis with different load models, Three-phase power flow with unbalanced DER penetration, OPF analysis & Different OPF control approaches.

Mathematical formulation of Three-phase OPF formulation and computational challenges, Convex relaxation and exactness analysis, Centralized and distributed algorithms, Multi-period OPF, Overview of commercial OPF solvers.

Uncertainty quantification and overview of probabilistic OPF, Introduction to reliability analysis, Probabilistic failure analysis of network components, Reliability metrics, Value of loss load calculation.

UNIT-III

System reliability enhancement technologies, Concept of distribution system operator (DSO), Bidding mechanism for DSOs, Ancillary support from distribution grids to transmission networks, T&D market mechanism.

Transmission-distribution co-simulation framework, Introduction to AI and its scope in distribution network control, Physics-informed neural network for OPF problem, Markov decision process for smart inverter coordination and control.

Deep reinforcement learning for demand response, Impact of DER integration on fault currents, Fault detection and classification: classical and AI-based methods, Relay coordination algorithms, Outage management system.

UNIT-IV

Fault ride-through operation of DERs, Introduction to resiliency & causes of distribution system failure, Impact of extreme weather events on distribution grids, Fragility analysis of distribution network circuit elements, Predictive and corrective measures to enhance system resiliency with Grid hardening methods.

Overview of advanced distribution management systems (ADMS), Smart Meters and Advanced Metering Infrastructure (AMI), Time-synchronized data measurement and PMU operation, Distribution network reconfiguration.

Communication requirements, Communication network architecture and mediums, Communication non-idealities and their models, Cyber threats and their impact analysis, Cyber-physical co-simulation framework and case studies.

Books and references

1. W. H. Kresting, “Distribution system modeling and analysis”, CRC Press.
2. Electrical Distribution System Protection, 3rd Edition, Cooper Power Systems, 1990.
3. M. Vadari, Electric System Operations, Evolving to modern grid, Amazon Digital Services LLC, 2012.
4. Recent research articles related to distribution network analysis and operation.
5. Anurag K. Srivastava, Chen-Ching Liu, Sayonsom Chanda, “Resiliency of Power Distribution Systems: Concepts, Implementation and Management,” Wiley, 2023.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-419		Economic Operation and Control of Power Systems					
Lecture	Tutorial	Practical	Credit	End Semester Exam	Internal Assessment	Total	Duration of Exam
3	-	-	3	70	30	100	3Hrs.

Purpose: The primary objective of this course is to analyze efficient and optimum operation of electric power generation system and to provide an overview about the control techniques adopted to ensure the economic operation of a power system.

Course Outcomes (CO)	
CO1	To impart knowledge about power systems, optimization and power flow.
CO2	To acquaint students with economic dispatch, unit commitment and power system economics.
CO3	To impart knowledge to students about power and energy interchange.
CO4	To let students understand demand forecasting, storage and Electric Vehicle.

UNIT-I

Introduction, Evolution of Indian Power System, Control in Power Systems, Optimization Preliminaries, Dynamic Programming, Economic Dispatch of Thermal Units, Economic Dispatch using Numerical Methods, Power Flow Problem on DC Network, Formulation of AC Power Flow, Decoupled Power Flow, Calculation of Transmission Losses.

UNIT-II

Economic Dispatch using Dynamic Programming, Unit Commitment, Unit Commitment using Dynamic Programming, Unit Commitment using Lagrange Relaxation, Hydrothermal Scheduling, Transmission System Effects, Production Cost Model, Economic Scheduling with Unreserved Load Method, Expected Cost Method, Discussion of Practical Problems.

UNIT-III

Power and Energy Interchange: Introduction; Multiple Utility Interchange Transactions; Power Pools, Transmission Effects and Issues, Discussion of Practical Problems, Real-Time Case Study on Reactive Power Dispatch, Power System Security, Optimal Power Flow, State Estimation.

UNIT-IV

Control of Generation, Short-Term Demand Forecasting, Pumped Storage & Gravity Storage, Energy Storage, and Advanced Distribution System Management.
EV Opportunities, Challenges and Impact in Indian Power Sector.

Books and References

1) Power Generation Operation and Control, by Allen J. Wood, Bruce F. Wollenberg.
2) Power System Stability and Control by P. Kundur.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-421		Electrical Distribution System Analysis					
Lecture	Tutorial	Practical	Credit	End Semester Exam	Internal Assessment	Total	Duration of Exam
3	-	-	3	70	30	100	3Hrs.

Purpose: This course offers a comprehensive study of electrical distribution systems, emphasizing the fundamental differences from transmission systems in terms of structure and load patterns.

Course Outcomes (CO)	
CO1	To impart knowledge about distribution network, loads and models of distribution lines and feeders.
CO2	To acquaint students with the modeling of essential components, including feeders, distribution transformers, voltage regulators, capacitors, loads and distributed generation.
CO3	To impart knowledge to students about advanced analysis methods, such as load flow and short-circuit analysis, which are crucial for the effective design, planning, and operation of contemporary distribution networks.
CO4	To let students understand placement of voltage and reactive power (volt-var) control (VVC), utilizing both traditional and advanced technologies.

UNIT-I

Introduction to Electrical distribution system, Components of distribution system substation, busbar layouts, distribution system and feeder configurations, Nature of loads and allocation in a distribution system.

'K' Factors and Their Applications, Analysis of Uniformly Distributed Loads, Lumping Loads in Geometric Configurations: Rectangular, Lumping Loads in Geometric Configurations: Triangular, Series Impedance of Distribution Lines and Feeders-Models of Distribution Lines and Cables.

UNIT-II

Modeling of Single-and three Phase Transformers, Modelling of Step Voltage Regulators, Load Models in Distribution System, Modeling of Distributed Generation, Applications and modeling of Capacitor Banks, Backward/Forward Sweep Load Flow Analysis, Direct Approach Based Load Flow Analysis.

UNIT-III

Gauss Implicit Z-matrix Method, Sequence component-based Short Circuit Analysis, Thevenin's equivalent and phase variable based Short Circuit Analysis.

Direct Approach for short-circuit analysis: Introduction and LG Fault, Direct Approach for short-circuit analysis: LLG and LLLG Fault, Weakly meshed system, Applications of distribution system analysis.

Distributed generation integration issues in distribution system, Distribution system protection issues, Power quality, reliability, and availability, Design and Operation.

UNIT-IV

Definition and objective of Volt-var control (VVC), Traditional approaches of VVC, Distribution Automation, SCADA-Based VVC and Integrated VVC, Advanced technologies for VVC, System Planning, Electricity Forecasting.

Optimization techniques, Optimal location and sizing of battery energy storage systems (BESS), Practical Insights into Electrical Distribution Systems, Field deployment of BESS, Emerging Technologies and Future Trends.

Books and References:

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.
3. J. H. Teng, "A direct approach for distribution system load flow solutions," IEEE Trans. on Power Delivery.
4. Edited by B. Das, Power Distribution Automation, IET Power and Energy Series, 75, London, 2016.
5. R. F. Arritt and R. C. Dugan, "Distribution system analysis and the future smart grid," IEEE Trans. on Industry Applications.
6. M.Resener, P. Pardalos, S. Rebennack, and S. Haner, Handbook of Optimization in Electric Power Distribution Systems. Energy Systems Series, Springer, 2020.
7. R.E. Brown, "Electric Power Distribution Reliability (2nd ed.)," CRC Press, 2009.
8. A. Pabla, "Electric Power Distribution: Sixth Edition," McGraw-Hill Professional, New York, 2011.
9. S. Haben, M. Voss, and W. Holderbaum, Core Concepts and Methods in Load Forecasting: With Applications in Distribution Networks, 1st ed. Cham, Switzerland: Springer, 2023.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-423		Power System Dynamics and Control					
Lecture	Tutorial	Practical	Credit	End Semester Exam	Internal Assessment	Total	Duration of Exam
3	-	-	3	70	30	100	3Hrs.

Purpose: This subject is designed to give a basic understanding of dynamic modeling of synchronous machines and associated governor, turbine and excitation system modeling to the students. This course will help the students to develop in-depth knowledge of modeling & control of large power systems.

Course Outcomes (CO)

CO1	Understand the basic concept of power system dynamics, stability and control.
CO2	Students will learn about development of various types of models used for synchronous machines.
CO3	Understand the concept of modeling of synchronous machines & excitation systems.
CO4	Analyze single machine system.

UNIT- I

Basic Concepts: Introduction to system dynamics, Power system stability states of operation and system security, system dynamics Problems, system model, analysis of steady State stability and transient stability, simplified representation of excitation control.

UNIT- II

Modeling of Synchronous Machine: Synchronous machine – park's Transformation, analysis of steady state performance, per unit quantities, Equivalent circuits of synchronous machine, determination of parameters of equivalent circuits.

UNIT - III

Excitation System: Modeling of excitation system, block diagram of excitation system, system representation by state equations, Dynamics of a synchronous generator connected to infinite bus, system model Synchronous machine model, stator equations, rotor equations, Synchronous machine model with field circuit, one equivalent damper winding on q axis (model 1.1), calculation of Initial conditions.

UNIT- IV

Analysis of Single Machine System: Small signal analysis with block diagram representation, Characteristic equation and application of Routh-Hurwitz criterion, synchronizing and damping torque analysis, small signal model, State equations.

Application of Power System Stabilizers: power system stabilizers, basic concepts in applying PSS, Control signals, Structure and tuning of PSS, Washout circuit, Dynamic compensator analysis of single machine infinite bus system with and without PSS.

Suggested Text / Reference books:

1. K. R. Padiyar," Power system dynamics "- B.S. Publications.
2. P.M. Anderson and A. A. Fouad, "Power system control and stability", IEEE Press
3. R. Ramanujam, "Power Systems Dynamics"- PHI Publications.
4. Padiyar K R, Power System Dynamics, Stability and Control, Interline Publishing, 1996.
5. Machowski J, Bialek J W, and Bumby J R, Power System Dynamics and Stability, John Wiley and Sons, 1997.
6. Prabha Kundur, Power System Stability and Control, Tata McGraw-Hill Edn, 2006.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-425		Renewable Energy Resources					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: The main objective of the course is to impart to the students the knowledge of renewable energy resources and different factors related to them.

Course Outcomes (CO)

CO1	To impart knowledge about renewable energy resources and solar power systems.
CO2	To acquaint students with the phenomenon of wind power systems and their applications with the grid.
CO3	To impart knowledge to students about geothermal and ocean power systems.
CO4	To let students understand fuel cells, hydrogen and hybrid energy systems.

UNIT-I

Introduction (Brief Overview): Energy demand of world and country and gap analysis, Fossil fuel-based energy systems, Impact of fossil fuel based systems, Distributed energy systems and dispersed generation (DG).

Solar thermal systems: Solar radiation, Measurements of Solar Radiation, Flat Plate and Concentrating Collectors, Advantages and Disadvantages of Concentrating Collectors over Flat Plate type collectors.

Solar Photovoltaic systems: Operating principle, Photovoltaic cell concepts, Series and parallel connections, (MPPT) Maximum power point tracking, Solar PV Applications like Battery charging, Pumping, and Lighting. Advantages and Disadvantages of Solar Energy System.

UNIT-II

Wind Energy: Wind turbines and rotors, Wind Energy Extraction, Wind Characteristics, Power Density Duration Curve, Design of Wind Turbine Rotor, Design of Regulating System for Rotor, Wind Power Generation Curve, Sub-systems of a Horizontal Axis Wind Turbine Generator, Modes of Wind Power Generation, Estimation of Wind Energy Potential, Selection of Optimum Wind Energy Generator (WEG), Grid Interfacing of a Wind Farm, Methods of Grid Connection, Grid System and Properties, Capacity of Wind Farms for Penetration into Grid, Control System for Wind Farms.

UNIT-III

Geothermal Energy: Structure of the Earth's Interior, Plate Tectonic Major Test, Geothermal Sites, Geothermal Field, Geothermal Gradients, Geothermal Resources, Geothermal Power Generation, Geothermal Electric Power Plant, Geothermal-Preheat Hybrid with Conventional Plant.

Ocean Energy: Development of a Tidal Power Scheme, Grid Interfacing of Tidal Power, Wave Energy, Mathematical Analysis of Wave Energy, Empirical Formulae on Wave Energy, Wave Energy Conversion, Principle of Wave Energy plant, Wave Energy Conversion Machines.

UNIT-IV

Biomass: Introduction to bio-mass, Biomass conversion technologies, Direct Combustion, Thermochemical conversion, Biochemical conversion, Classification of Biogas Plants, Biodiesel, Environmental benefits.

Fuel Cells: Principle of Operation of Fuel Cell, Fuel Processor, Fuel Cell Types, Energy Output of a Fuel Cell, Efficiency, and EMF of a Fuel Cell, Operating Characteristics of Fuel Cells, Thermal Efficiency of Fuel Cell.

Hydrogen Energy System: Hydrogen Production, Hydrogen Storage, Development of Hydrogen Cartridge, Gas Hydrate.

Suggested Books:

1. Kothari DP, Singal KC, Ranjan Rakesh, "Renewable energy sources and emerging technologies, Prentice Hall (India).
2. Rai G D, "Non-Conventional Sources of Energy, Khanna Publishers.
3. Bansal N K, Kleemann M, Heliss M, "Renewable energy sources and conversion technology", McGraw Hill.
4. Abbasi S A, Abbasi N, "Renewable energy sources and their environmental impact", PHI.
5. Mittal KM, "Renewable energy Systems", Wheelar Publishing.
6. Mukherjee D, "Renewable energy Systems", New Age International.
7. Ashok V Desai, Non-Conventional Energy, Wiley Eastern Ltd, New Delhi.
8. Ramesh R & Kumar K U, Renewable Energy Technologies, Narosa Publishing House, New Delhi.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-427		Sustainable Energy Technology					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: This course attempts to provide a synoptic overview of the rapidly developing ecosystem of sustainable energy technologies that are being developed and deployed to exploit the various carbon-neutral energy sources to improve the efficiency and sustainability of current energy systems.

Course Outcomes (CO)

CO1	To impart knowledge about renewable energy resources and their effect on the modern world.
CO2	To acquaint students with the phenomenon of wind and solar energy and their applications to the grid.
CO3	To impart knowledge to students about bioenergy, geothermal and energy storage.
CO4	To let students understand the recent trends in energy storage, fuel cells and hydrogen energy.

UNIT-I

Introduction and Fundamental Concepts, Energy Scenario in Modern World, Fossil Fuels, Climate Change Impacts and Overview of Renewable Energy Technology, Hydropower.

UNIT-II

Wind Energy: Introduction to characteristics of suitable wind power sites, wind turbines, wind generators, advantages and limitations.

Solar Energy, Detailed discussion on Solar Photovoltaic Systems and applications.

UNIT-III

Bioenergy and Biofuels.

Geothermal Energy, Introduction of Energy Storage Systems.

Mechanical energy storage technologies, Energy storage system through Capacitor.

UNIT-IV

Electrochemical Energy Storage Systems, Thermal Energy Storage Systems.

Trends in Energy Storage Types and their Characteristics.

Fuel Cells and Hydrogen Energy, Carbon Capture and Storage (CCS).

Books and References

1. J. Twidell, T. Weir, Renewable Energy Resources, Taylor and Francis, 4th Edition, 2021.
2. G. Boyle (Editor), Renewable Energy: Power for a Sustainable Future, Oxford University Press, 3rd Edition, 2012.
3. G. N. Tiwari, Solar Energy, Fundamentals, Design, Modeling and Applications, Narosa, 2002.
4. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley, 4th Edition, 2013.
5. R. Gasch, J. Twele, Wind Power Plants: Fundamentals, Design, Construction and Operation, Springer, 2nd Edition, 2012.
6. P. Breeze, Hydropower, Elsevier, 1st Edition, 2018.
7. S. C. Bhattacharyya, Energy Economics Concepts, Issues, Markets and Governance, Springer, 2nd Edition, 2019.
8. Energy, the Environment, and the Sustainability, 1st edition by Efstathios E. Michaelides. ISBN 9781138038448 Published May 9, 2018 by CRC Press.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-429		Sustainable Power Generation System					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: The curriculum encompasses the comprehensive knowledge of various renewable energy systems.

Course Outcomes (CO)

CO1	To impart knowledge about renewable energy resources and solar power systems.
CO2	To acquaint students with the phenomenon of wind, hydro and biomass power systems.
CO3	To impart knowledge to students about hydrogen, geothermal and ocean energy.
CO4	To let students understand wave energy, tidal energy, energy storage and energy economics.

UNIT-I

Introduction to power generation: Global and Indian scenario, an overview of current technologies available for power generation, Concept of the renewable energy- based power plant.

Solar Thermal Power Generation: Fundamentals of Solar thermal energy conversion, solar thermal based power plant design and analysis (flat plate and concentrator), ORC, RC, and Stirling engine.

Solar Photovoltaic Power Generation: Fundamentals of Solar photovoltaic energy conversion, Solar PV power plant design, Performance analysis of standalone and grid connected PV systems.

UNIT-II

Wind Power Generation: Introduction to wind turbine, classification and analysis of different components, Theory, design and analysis of wind turbines (horizontal axis and vertical axis) and wind farms.

Hydro Power Generation: Introduction to hydro power plant, overview of micro, mini and small hydro power plants, hydraulic turbines, Selection and design criteria of pumps and turbines, Brief theory, design and analysis of hydro power plants

Biomass Power Generation: Fundamentals of bioenergy production technologies through different routes, design and analysis of biochemical and thermochemical reactors for clean power generation and value-added products, IGCC.

UNIT-III

Hydrogen energy and fuel cells: Importance, various routes of hydrogen generation, basic principles and design of different types of fuel cells and their applications, future prospects, IGFC.

Geothermal Energy: Fundamentals, classification, theory, design and analysis of geothermal power plants.

Ocean Thermal Energy: Fundamentals, classification, theory, design and analysis of ocean thermal power plant.

UNIT-IV

Wave and Tidal Energy: Fundamentals, classification, theory, design, and analysis of wave and tidal power plants.

Energy Storage: Different modes of energy storage; design and analysis of different technologies for thermal, mechanical, and electrochemical energy storage systems.

Energy Economics: Cost analysis, interest, accounting rate of return, Payback, Discounted cash flow, Net present value, Internal rate of return, Inflation and life cycle analysis of energy systems.

Books and references

1. J. Twidell, T. Weir, Renewable Energy Resources, Taylor and Francis, 4th Edition, 2021.
2. G. Boyle (Editor), Renewable Energy: Power for a Sustainable Future, Oxford University Press, 3rd Edition, 2012.
3. G. N. Tiwari, Solar Energy, Fundamentals, Design, Modeling and Applications, Narosa, 2002.
4. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley, 4th Edition, 2013.
5. R. Gasch, J. Twele, Wind Power Plants: Fundamentals, Design, Construction and Operation, Springer, 2012.
6. P. Breeze, Hydropower, Elsevier, 1st Edition, 2018.
7. S. C. Bhattacharyya, Energy Economics Concepts, Issues, Markets and Governance, Springer, 2nd Edition, 2019.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-431		Industrial Electrical System					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**
Purpose: To provide knowledge about various concepts of industrial electrical systems and their automation.							
Course Outcomes (CO)							
CO1	Understand residential and commercial electrical systems.						
CO2	Understand various types of illumination systems and lighting schemes used for residential and commercial premises.						
CO3	Understand various concepts of industrial electrical systems.						
CO4	Understand the concept related to industrial electrical system automation.						

UNIT- I

Residential and Commercial Electrical Systems: Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

UNIT- II

Illumination Systems: Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

UNIT- III

Industrial Electrical Systems I : HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

UNIT IV

Industrial Electrical Systems II: DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Industrial Electrical System Automation: Study of basic PLC, Role of PLC in automation, advantages of process automation, PLC-based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Text Books/References:

1. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating &Costing”, Khanna Publishers, 2008.
2. K. B. Raina, “Electrical Design, Estimating & Costing”, New Age International, 2007.
3. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997. Website for IS Standards.
4. H. Joshi, “Residential, Commercial and Industrial Systems”, McGraw-Hill Education, 2008.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEO-401		Advanced Power Electronics and Control					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs**
Purpose	This course describes modern topics of Power Electronics in terms of switches, topologies and control.						
Course Outcomes (CO)							
CO1	It deals with advanced switching topology and modem control techniques.						
CO2	To familiarise with different types of converters and rectifiers.						
CO3	It deals with isolated and non-isolated converters and choppers.						
CO4	To familiar with Cycloconverter and linear and nonlinear power electronics.						

UNIT-I

Basic Concept of Switches and Device Physics: Device Physics, Application and Analysis of Switches and Single-Phase Converter.

UNIT-II

Single Phase Converter, Three Phase Converter, Multipulse Converter and Effect of Source Inductance and PWM Rectifiers, PWM Rectifiers and Power Factor Improvement Techniques and non-isolated DC-DC converter.

UNIT-III

Non-isolated and isolated DC-DC Converters and Choppers: Isolated DC-DC Converters IV and VSI & CSI, MLI and ZSI.

UNIT-IV

SVM, AC to AC Converters, Cycloconverter and Matrix Converter.
Linear Control in Power Electronics, Nonlinear Control in Power Electronics, Applications and Conclusions.

References:

1. Bin Wu, “High-Power Converters and AC Drives ”, IEEE press, A John Wiley & Sons, Inc., Publication.
2. Muhammad H. Rashid, “Power Electronics Handbook”, 3rd Edition, Elsevier.
3. Ned Mohan, “Power Electronics and Drives”, Mnpere, 2003.
4. G. K. Dubey, S. R. Doradla, A. Joshi & R. M. K. Sinha, Thyristorised Power Controllers, 2nd Edition, New Age International Publishers.
5. L. Umanand, “Power Electronics: Essentials & Applications”, Wiley.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEO-403		Biomedical Instrumentation					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs**
Purpose: To introduce the concept of Bio Instrumentation like Medical Bio Potential Electrodes and Biomedical Recorders.							
Course Outcomes (CO)							
CO1	To Familiarize with Bio Medical Instrumentation.						
CO2	To understand the cardiac and Respiratory measurement system.						
CO3	To understand Instrumentation for Measuring Nervous Function.						
CO4	To understand the Recent Biomedical devices instrumentation.						

UNIT-I

Characteristics of Transducers and Electrodes for Biological Measurement: Introduction to the human body; block diagram, classification, characteristics, various physiological events and suitable transducers for their recording, bioelectric potentials.

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UNIT-II

Cardiac & System: Cardiac musculature, Electrocardiography, ECG recording, Phonocardiography, Holter recording, ECG lead system, Heart rate meter, vector cardiography, Pacemakers, Defibrillators. Blood Pressure and Blood Flow Measurement: Invasive and non-invasive methods of Blood pressure, Characteristics of blood flow and heart sound, Cardiac output measurement, Plethysmography. Respiratory System: Mechanics of breathing, Parameters of respiration, Respiratory system measurements, Respiratory therapy instruments.

UNIT-III

Instrumentation for Measuring Nervous Function: EEG signal, frequency band classification, Lead systems, EEG recording, Clinical applications of EEG signal, X-ray CT scan, MRI, PET. Musculoskeletal systems: EMG, Clinical applications, and muscle stimulators. Clinical Laboratory Instrumentation: Test on blood cells, Blood cell counters, Blood glucose monitors, auto-analysers, pulse-oximeters.

UNIT-IV

Recent Trends in Biomedical Engg.: Patient care and monitoring, Non-invasive diagnostic instrumentation, Biotelemetry, Telemedicine, Prosthetic devices, Lie detector test, Application of lasers and ultrasonics in the biomedical field. Troubleshooting & Electrical Safety of Biomedical Instruments: Physiological effects of current and safety measurements.

References:

1. Medical instrumentation application & design, John G Webster, John Wiley, 1998.
2. Review of medical physiology, W.F. Ganong, Medical publisher, 1977.
3. Biomedical instrument and measurement, Cromwell, PHI, 2000.
4. Handbook of biomedical instruments, R S Khandpur, TMH.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEO-405		Biomedical Signal and Image Processing					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs**
Purpose: This course will look at Biomedical signals and images for understanding and their processing assessment.							
Course Outcomes (CO)							
CO1	Understand different types of biomedical signals and identify and analyse different biomedical signals.						
CO2	Understand the basics of Image processing and its methods.						
CO3	To emphasize and analysis of Clustering and Classification.						
CO4	To study different types of bio signals and their processing.						

UNIT-I

Signals and Biomedical Signal Processing: Introduction and overview, Analog, discrete and digital signals, Processing and transformation of signals, Signal processing for feature extraction, Characteristics of digital Images, Fourier transform: Properties of One-Dimensional Fourier Transform, Discrete Fourier Transform.

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UNIT-II

Image Processing: Image filtering, Enhancement and Restoration, Point processing, Mask processing: linear filtering in the Space domain, Frequency-domain filtering, Smoothing and sharpening filters in the frequency domain, Wavelet transform, FFT to STFT, One-Dimensional Continuous and discrete Wavelet Transform, Image processing methods.

UNIT-III

Clustering and Classification: Clustering versus Classification, Feature extraction, Biomedical and. biological features, Signal and Image processing features, K-means: A Simple Clustering Method, study of different types of Classifiers for signal processing.

.

UNIT-IV

Processing of Biomedical Signals: Electric activities of Cell, Electric data acquisition, Electrocardiogram: Signal of Cardiovascular system, Processing and feature extraction of ECG.

Electroencephalogram, Signal of the brain, Processing and feature extraction of EEG, Electromyogram: Signal of muscles, Processing and feature extraction of EMG. Frequency and wavelet-domain analysis.

References:

1 Kayvan Najarian & Robert Splinter “Introduction to Biomedical Signal and Image Processing” CRC Press.
2 Metin Akay “Time Frequency & Wavelets in Biomedical signal Processing”, Wiley-IEEE Press.
3. Amine Nait-Ali, “Advanced Biomedical Signal Processing”, Springer.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEO-407		Digital Signal Processing					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs**
Purpose: To Analysis of Signals and Systems, transform techniques and various filters with processing.							
Course Outcomes (CO)							
CO1	To analyze the Discrete Linear Time Invariant systems in Z domain and in frequency domain.						
CO2	To learn the basic of Discrete-Fourier Transform (DFT), Fast Fourier Transform (FFT) algorithms and its applications.						
CO3	To Design digital filters for filtering applications.						
CO4	To apprise with Multi-rate Signal Processing techniques						

UNIT-I

Introduction of Discrete Time Signals and Systems: Discrete time systems, Analysis of discrete time linear time-invariant systems, Discrete time systems described by difference equations, Implementation of discrete systems, Correlation of discrete time signals, Z-transform and properties of Z-transform, Rational Z-transformation, Inverse Z-transform, Analysis of linear time-invariant systems in Z-domain.

Frequency Analysis of Signals and Systems: Frequency analysis of continuous time signals, Frequency analysis of discrete time signals, Properties of Fourier Transform for discrete time signals, Frequency domain characteristics of linear time invariant systems, linear invariant systems as frequency selective filter.

UNIT-II

The Discrete Fourier Transform: Frequency domain sampling, Properties of Discrete Fourier Transform (DFT), discrete Frequency analysis of signals using the DFT.FFT algorithm: Decimation-in-time (DIT) algorithm and Decimation-in-frequency (DIF) algorithm, Linear filtering methods based on DFT.

Realization of digital systems: Structure realizations methods of FIR and IIR systems.

UNIT-III

Design of Digital Filters: Generalized characteristics of discrete filters, Design of Finite Impulse Response (FIR) filters, FIR digital filter design using Fourier series method, window design techniques. Optimal equi-ripple design techniques, frequency sampling design techniques. Design of Infinite Impulse Response (IIR) filters from analog filters, Comparison of IIR and FIR filters.

UNIT-IV

Multirate Digital Signal Processing: Introduction, decimation by a factor D, Interpolation by a factor I, sampling rate conversion by a rational factor I/D, implementation of sampling rate conversion, multistage implementation of sampling rate conversion, sampling rate conversion of band-pass signals, sampling rate conversion by an arbitrary factor, applications of multi-rate signal processing.

References:

1. John G. Proakis and Dimitris G. Manolakis, “Digital Signal Processing”, PHI Pub.
2. Allan Y. Oppenhein & Ronald W. Schater, "Digital Signal Processing”, PHI, 2004.
3. J. R. Jhohnson, “Introduction to Digital Signal Processing”, PHI, 2000.
4. B. Somanthan Nair, “Digital Signal Processing: Theory, Analysis & Digital Filter Design”, PHI, 2004
5. Sanjit K. Mitra, “DSP: A Computer-Based Approach”, TMH, 2nd Ed., 2001.
6. S. Salivahanan, C. Gnanapriya, “Digital Signal Processing”, McGraw-Hill.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEO-409		Drone Systems and Control					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: Students will deal with the knowhow of Drone Systems and Control and applications.

Course Outcomes (CO)

CO1	Students will deal with the basic types, aerodynamics sensor, filtering etc.
CO2	Students will deal with the frequency response, stability, PID, auto stabilization etc.
CO3	Students will acquaint with Basics of PX4 and its interfacing.
CO4	Students will acquaint with maneuvering aspects like trajectory, obstacle avoidance, object detection etc.

UNIT-I

Types of drones, Fundamentals of aerodynamics – lift, thrust and drag, safety requirements, regulations, applications. Rigid body transformation/rotation. Dynamic model of multi-rotor. Sensors: IMU (gyro, accelerometer), GPS, altitude sensors, vision-based sensors. Basics of estimation and Kalman filtering, Extended Kalman filtering. Introduction to control system, Laplace Transforms.

UNIT-II

Control system: Transient response, Frequency response. Control system: Stability. Proportional-integral-derivative controller design, Classical autopilot design: auto-takeoff and landing, Classical autopilot design: auto-stabilisation, attitude hold and position hold.

UNIT-III

Basics of PX4, MATLAB-motors-PX4 interfacing, Design of real-time implementation in flight controller, Experiment: Attitude bench controller tuning, Scenario generation, point-to-point navigation, Global path planning: basic algorithms, RRT algorithm, A* algorithm.

UNIT-IV

Obstacle avoidance, Artificial potential field, Collision cone-based approaches. Control barrier function, Trajectory tracking: PID controller, Trajectory tracking: Model predictive control, Design implementation of sense-and-avoid for multi-rotor aerial vehicle, Introduction to mapping, SLAM, Visual SLAM, visual perception, object detection, Sim2Real: ROS, Air Sim.

Books and references:

1. Modern Control Engineering - Katsuhiko Ogata.
2. Control Systems Engineering - Norman S. Nise.
3. Kalman Filtering: Theory and Practice Using MATLAB - Mohinder S. Grewal and Angus P. Andrews.
4. The Complete Guide to Drones – Adam Juniper.
5. Flight Stability and Automatic Control - Robert C. Nelson.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEO-411		Embedded System Design					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs**
Purpose: To provide an overview of the Design Principles of Embedded Systems and also provide an understanding of the role of firmware and operating systems in correlation with hardware systems.							
Course Outcomes (CO)							
CO1	Expected to understand the selection procedure of Processors in the embedded domain.						
CO2	Design Procedure for Embedded Firmware.						
CO3	Expected to visualize the role of Real-time Operating Systems in Embedded Systems						
CO4	Expected to evaluate the Correlation between task synchronization and latency issues						

UNIT-I

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT-II

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT-III

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT-IV

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

References:

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013.
4. An Embedded Software Primer - David E. Simon, Pearson Education.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEO-413		Ethical Hacking					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs**
Purpose: Ethical Hacking is to identify and fix security vulnerabilities in computer systems, networks, and applications before malicious actors can exploit them.							
Course Outcomes (CO)							
CO1	Learn aspects of security, the importance of data gathering, foot printing and system hacking.						
CO2	Learn tools and techniques to carry out a penetration testing.						
CO3	Students will understand about modes of hacking, service detection and wireless hacking.						
CO4	Compare different types of hacking tools.						

UNIT-I

Casing the Establishment: What is foot printing, Internet Foot printing, Scanning, Enumeration, basic banner grabbing, Enumerating Common Network services. Case study: Network Security Monitoring.

UNIT-II

Securing permission: Securing file and folder permissions, using the Encrypting File System, and securing registry permissions. Securing service: Managing service permission, Default services in Windows 2000 and Windows XP. Unix: The Quest for Root, Remote Access vs Local access, Remote access, Local access, After hacking root.

UNIT-III

Dial-up, PBX, Voicemail and VPN hacking, preparing to dial up, War-Dialling, Brute Force Scripting, PBX hacking, Voice mail hacking, VPN hacking, Network Devices: Discovery, Autonomous System Lookup, Public Newsgroups, Service Detection, Network Vulnerability, Detecting Layer 2 Media.
Wireless Hacking: Wireless Footprinting, Wireless Scanning and Enumeration.

UNIT-IV

Remote Control Insecurities, Discovering Remote Control Software, Connection, Weakness. VNC, Microsoft Terminal Server and Citrix ICA, Advanced Techniques: Session Hijacking, Back Doors, Trojans, Cryptography, Subverting the systems Environment, Social Engineering, Web Hacking, Web server hacking web application hacking, Hacking the internet Use, Malicious Mobile code, SSL fraud, E-mail Hacking, IRC hacking, Global countermeasures to Internet User Hacking.

References:

1. Stuart McClure, Joel Scambray and Goerge Kurtz, “Hacking Exposed Network Security Secrets & Solutions”, 5th Edition, Tata Mc Graw Hill Publishers, 2010.
2. Rafay Baloch, “A Beginner's Guide to Ethical Hacking”.
3. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, “Grey Hat Hacking: The Ethical Hackers Handbook”, 3rd Edition, McGraw-Hill Osborne Media paperback (January 27, 2011).

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEO-415		Operations Research					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs**
Purpose: This course provides an understanding of the fundamental principles and laws of Operations Research to understand Linear Programming, Network Analysis, Queuing, and Replacement Models.							
Course Outcomes (CO)							
CO1	To understand Operations Research and the formulation of LPP.						
CO2	To analyse and formulate the transportation & Assignment problem.						
CO3	To analyse the Network and its methods to complete the project.						
CO4	To study various Game theory problems.						

UNIT-I

Introduction: Evolution of OR, Definitions of OR, Scope of OR, Applications of OR, Phases in OR study. Characteristics and limitations of OR, models used in OR, Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P. Solutions to LPP by graphical method (Two Variables).

LPP: Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by Simplex method, Big-M Method and Two-Phase Simplex Method.

UNIT-II

Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem by Modified Distribution (MODI) method. Unbalanced T.P. Maximization T.P. Degeneracy in transportation problems, application of transportation problem.

Assignment Problem- Formulation, Solutions to assignment problems by Hungarian method, Special cases in assignment problems, unbalanced, Maximization assignment problems. Travelling Salesman Problem (TSP).

UNIT-III

Network analysis: Introduction, Construction of networks, Fulkerson's rule for numbering the nodes, AON and AOA diagrams; Critical path method to find the expected completion time of a project, determination of floats in networks, PERT networks, determining the probability of completing a project, predicting the completion time of project.

Queuing Theory: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), Kendall & Lee's notation of Queuing.

UNIT-IV

Game Theory: Definition, Pure Strategy problems, Saddle point, Max-Min and Min-Max criteria, Principle of Dominance, Solution of games with Saddle point. Mixed Strategy problems. Solution of 2X2 games by Arithmetic method, Solution of 2Xn m and mX2 games by graphical method. Formulation of games.

Sequencing: Basic assumptions, Johnson's algorithm, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines.

References:

1. Operations Research, Theory and Applications, Sixth Edition, J K Sharma, Trinity Press, Laxmi Publications Pvt. Ltd. 2016.
2. Operations Research, Paneerselvan, PHI.
3. Operations Research, A M Natarajan, P Balasubramani, Pearson Education, 2005.
4. Introduction to Operations Research, Hillier and Lieberman, 8th Ed., McGraw-Hill.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-ECO-401		Major Project (Part-I)					
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
-	**-**	**16**	**8**	**200**	**100**	**300**	**3 Hrs.**
Purpose: To develop teamwork, plan and implement the project, write a comprehensive report and develop effective presentation skills.							
Course Outcomes (CO): Upon completion of the course, students will be able to							
CO1	Identify and define a problem statement from the requirements raised from the literature survey /need analysis						
CO2	Build and Test circuits/models /prototypes/hardware/software for developing real-life small applications						
CO3	Work in teams, write a comprehensive report and an effective presentation of the project work.						
CO4	Rapid prototyping, which will lead them towards entrepreneurship.						

The Major Project (Part-I) is a team activity having 3-5 students in a team. This is circuit building and testing for developing small applications. The project may be a complete hardware or a hardware with a software aspect. It should cater to a small system required in a laboratory or in real life. It should encompass components, machines, automation and control, power system devices, analogue or digital ICs, microcontroller, software, etc. Based on a comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of the Project.

Students are expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within the first week of the semester. The student is expected to focus on the design, development, and testing of the proposed work as per the schedule. The layout should be made using simulation software. A detailed project report is to be submitted at the end of the semester.

B23-ECO-403		Industrial Training-II					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
-	**-**	**2**	**1**	**--**	**100**	**100**	**-**

It is a course in which the students will be evaluated for the industrial training undergone during the semester break after the 6th semester examination, and students will be required to get passing marks to qualify.

B23-EEP-402		Blockchain					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**
Purpose: Students will grasp introductory knowledge of Blockchain, crypto currency, Hyperledger and applications.							
Course Outcomes (CO)							
CO1	Students will deal with introduction and classification of Blockchain.						
CO2	Students will deal with the terms Crypto currency, wallet, meta mask and ethereum.						
CO3	Students will acquaint with Hyperledger Fabric.						
CO4	Students will acquaint with various applications and benefits of Blockchain enabled trade.						

UNIT-I

Introduction: Overview of Blockchain, History of Blockchain, Peer to Peer Network, Smart Contract, Wallet, Digital Currency, Ledgers, Types of Blockchain Platform.

Permissioned Blockchain, Permissionless Blockchain, Different Consensus Mechanism- Proof of Work, Proof of Stake, Proof of Activity, Proof of Burn, Proof of Elapsed Time, Proof of Authority, Proof of Importance.

UNIT-II

Cryptocurrency and Wallet: Types of Wallets, Desktop Wallet, App-based Wallet, Browser-based wallet, MetaMask, Creating an account in MetaMask, Use of a faucet to fund the wallet, and transfer of cryptocurrency in MetaMask.

Smart contract and Ethereum: Overview of Ethereum, Writing Smart Contract in Solidity, Remix IDE, Different networks of Ethereum, understanding blocks practically at blockhcain.com, how to compile and deploy a smart contract in Remix.

UNIT-III

Understanding Hyperledger Fabric: Overview of Open source Hyperledger project, Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric.

UNIT-IV

Use Cases: Enterprise application of Blockchain: Cross-border payments, Know Your Customer (KYC), Food Security, Blockchain-enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Blockchain, Blockchain in the energy sector, Blockchain in governance.

Books and references:

1. Blockchain: Blueprint for a New Economy by Melanie Swan.
2. Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks by Imran Bashier.
3. Mastering Ethereum: Building Smart Contracts and DApps by Andrews.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-404		Charging Infrastructure					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: Students will grasp introductory knowledge of Electric charging and mechanisms involved.

Course Outcomes (CO)

CO1	To understand the charging systems and standards.
CO2	To familiarize with AC-DC converters, their modelling and control.
CO3	Students will acquaint with Isolated DC-DC converters.
CO4	Deals with the charging system procedures and protocol.

UNIT- I

Introduction to Charging System: Electric Vehicle Supply Equipment (EVSE) for on-board charger, EVSE for off-board charger, Charging Infrastructure Challenges, Classification and standards.

UNIT- II

AC-DC power converters: Various types of AC-DC converters, Single-phase Boost-derived topologies: operating principles, modelling and control, Single-phase Bridgeless topologies: operating principles, modelling and control, Three-phase AC-DC converter: operating principles, modelling and control.

UNIT- III

Isolated DC-DC converters: Various types of isolated converters, Losses and soft-switching criteria, Phase-shift full bridge: operating principles and control, Dual active bridge: operating principles, modulation and control.

UNIT-IV

Charging procedure, protocols and communication: AC type2, DC CCS2 charging system.

Books and References

1. Tom Denton, “Automotive Electrical and Electronic Systems”, 5th Edition, Routledge, 2018.
2. Iqbal Husain, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2021.
3. Robert W. Erickson, and Dragan Maksimovic “Fundamentals of Power Electronics”, 3rd, Springer, 2020.
4. L.Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2012.
5. Mohan N., Underland T.M. and Robbins W.P., “Power Electronics – Converters, Applications and Design”, 3rd Ed., Wiley India.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-406		Electric Vehicle					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3 Hrs.**

Purpose: Students will grasp fundamental knowledge and working of Electric Vehicle and will be able to acquaint various modelling parameters, relevant accessories, control units, communication and policy parameters.

Course Outcomes (CO)

CO1	To understand the basics of EV technologies, EV classification and testing modules.
CO2	To familiarize with dynamical aspects, charging discharging mechanism and reliability.
CO3	To understand the basics modelling, performance and safety parameters related to EVs.
CO4	Deals with the communication part related to DC Charging, AC interface, national and global policy formulation.

UNIT-I

Introduction to EV technologies, Types of EV architecture, Electric vehicle and environment, Vehicle classification, Usage pattern for electric vehicles, Standardization in e-mobility, Government policies: standards and regulation, Design aerodynamics, Chassis model for battery operated vehicles BMS Design Considerations, Electromagnetic compatibility testing, Efficiency and emissions testing, On-road electric vehicles testing, Battery Electric vehicle safety and crash worthiness.

UNIT-II

Range modelling of EV, Driving cycles. Acceleration performance parameter-based testing (Aerodynamic drag, hill climbing force, total tractive effort), Constant velocity range modelling, Dynamic tests, static tests, Charge and discharge testing, Battery performance, material performance and cell performance modelling, Energy Storage Testing for Safe Electrification of Transport, Range testing based on different types of battery (Li ion and fuel cell-based vehicles). Reliability index investigation on EV – Standards and specifications.

UNIT-III

Modelling of BEV-Forward looking Model-Driver Perspective, Backward Looking Model-Drive Cycle Perspective, Modelling of Driver, Modelling of Brake Control unit, Modelling of Vehicle Control Strategy, and Modelling of Vehicle Chassis. Sizing of Components- Steady State Energy Balance Equation, Powertrain Dimensioning-Peak vs Continuous performance, Type of Drive cycles, Types of Control Strategy, Analysis-Performance, Range, and Consumption Prediction. Safety and security aspects of EV.

UNIT-IV

Communication standards-communication architecture for DC fast charging, communication protocols and verification procedures that support electric vehicle (EV)-grid connectivity, criteria for connecting EV to utility for AC level 1 and level 2 charging. Nature and scope of policies to stimulate widespread EV adoption and support EVCI station implementation; policy formulation and implementation at various levels of government; examples of policies and incentives for EV adoption; replacement of the gasoline tax funding source in an increasingly electrified environment.

Books and References:

1. "Electric Powertrain: energy systems, power electronics & drives for hybrid, electric & fuel cell vehicles", Goodarzi, Gordon A., Hayes, John G, Wiley 2018.
2. Advanced Electric Drives – Analysis, Modeling, Control, RiK De Doncker, Springer publications.
3. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Fundamentals, Theory and Design, Eshani, CRC Press.
4. Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, Second Edition, CRC Press, 2011.
5 Electric Vehicle Technology Explained, James Larminie, John Lowry, Second Edition, Wiley, 2012.
6. Introduction of Hybrid Vehicle System Modelling and Control, Wei Liu, Wiley student edition 2013.
7. Power Electronics Convertor, Applications, and Design, NED MOHAN, Third Edition, Wiley, 2002.
8. Advanced Electrical Drives, De Doncker, Rik, Pulle, Duco W.J., Veltman, Andre, First Edition, CRC Press, 2011.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-408		Hydrogen Energy: Production, Storage, Transportation and Safety					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: Students will grasp the introductory knowledge of production, storage, transportation and safety related to tapping with hydrogen energy.

Course Outcomes (CO)

CO1	To understand the hydrogen properties, its production & reforming.
CO2	To familiarize with separation and purification of Hydrogen, production and storage.
CO3	Students will be acquainted with various hydrogen compressors and absorption.
CO4	Deals with the economics of hydrogen storage.

UNIT -I

Properties of hydrogen, global status of supply and demand, methods of hydrogen production, steam reforming.
Advanced methods of steam reforming, partial oxidation, autothermal reforming, combined reforming, reforming using alternate energy sources. Hydrogen production from methane decomposition, from coal and biomass.

UNIT -II

Hydrogen separation and purification, thermochemical cycles for hydrogen production, fundamentals for electrolysis of water. Components of electrolytic cell, configuration of electrolyzer stack, different electrolyzer technologies, photoelectrochemical hydrogen production, technical and economic comparison of different production methods and global status, cost analysis. Introduction to hydrogen storage, underground hydrogen storage, fundamentals of hydrogen compression and expansion.

UNIT -III

Mechanical and non-mechanical hydrogen compressors; compressed hydrogen tank types and design considerations.
Hydrogen liquefaction, liquid state hydrogen storage tanks, fundamentals of hydrogen storage in adsorption-based materials. Fundamentals and thermodynamics of absorption-based hydrogen storage, metal hydrides, types of metal hydrides, and metal hydride-based systems design.

UNIT -IV

Novel materials for solid state hydrogen storage; economics of storage; long-distance hydrogen transport via pipelines, ships and in the form of LOHC; hydrogen transport via road; hydrogen refueling stations.
Use of hydrogen in internal combustion engines, fuel cells, and hydrogen sensing.
Properties of hydrogen associated with hazards, classification of hydrogen hazards, compressed and liquid hydrogen-related hazards, regulation, codes and standards, utilisation of hydrogen in various sectors, global status and future directions.

Books and references:

1. Gupta, R. B., Hydrogen Fuel: Production, Transport and Storage, CRC Press, Taylor & Francis Group, 2009.
2. Global Hydrogen Review 2021, IEA (2021), Paris, https://www.iea.org/reports/global-hydrogen-review-2021.
3. Agata Godula-Jopek, Hydrogen Production by Electrolysis, Wiley-VCH, Germany, 2015.
4. Tzimas, E., Filiou, C., Peteves, S.D., &Veyret, J.B. "Hydrogen storage: state-of-the-art and future perspective. Netherlands": European Communities, 2003.
5. Michael Hirscher, "Handbook of Hydrogen Storage", Wiley-VCH, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-410		Introduction to Electric and Hybrid Electric Vehicle					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: Students will grasp introductory knowledge related to Electric and Hybrid Electric Vehicles.

Course Outcomes (CO)

CO1	To introduce the students with Hybrid Electric Vehicles.
CO2	To familiarize with the Hybrid Electric Drive-trains, power flow and fuel efficiency analysis.
CO3	Students will acquaint with the Electric Propulsion unit.
CO4	Deals with the sizing mechanism and analysis related to various components of EVs and HEVs.

UNIT -I

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

UNIT -II

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT -III

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency. Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT -IV

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Books and References:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-412		PLC and SCADA System					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: Students will grasp the knowledge and implications of PLC and SCADA systems.

Course Outcomes (CO)

CO1	To understand the basics of Programmable Logic Controllers, their schematic and interface.
CO2	Developing Fundamentals of PLC Wiring Diagrams and Ladder Logic Programs.
CO3	To understand the basics of SCADA, its working mechanism and performance.
CO4	Deals with the Human-Machine Interface related to SCADA.

UNIT -I

Programmable Logic Controllers: Introduction, Parts of a PLC, Principles of Operation, Modifying the Operation, PLCs versus Computers, PLC Size and Application. PLC Hardware Components: The I/O Section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O Specifications, The Central Processing unit (CPU), Memory Design, Memory Types, Programming Terminal Devices, Recording and Retrieving Data, Human Machine Interfaces (HMIs). Basics of PLC Programming: Processor Memory Organization, Program Scan, PLC Programming Languages, Relay-Type Instructions, Instruction Addressing, Branch Instructions, Internal Relay Instructions, Programming Examine If Closed and Examine If Open Instructions, Entering the Ladder Diagram, Modes of operation

UNIT -II

Developing Fundamental PLC Wiring Diagrams and Ladder Logic Programs: Electromagnetic Control Relays, Contactors, Motor Starters, Manually Operated Switches, Mechanically Operated Switches, Sensors, Output Control Devices, Seal-in Circuits, Latching Relays, Converting Relay Schematics into PLC Ladder Programs, Writing a Ladder Logic Program Directly from a Narrative Description. Programming Timers: Mechanical Timing Relays, Timer Instructions, On-Delay Timer Instruction, Off-Delay Timer Instruction, Retentive Timer, Cascading Timers."

UNIT -III

SCADA Fundamentals: Introduction, Open system: Need and advantages, Building blocks of SCADA systems, Remote terminal unit (RTU): Evolution of RTUs, Components of RTU, Communication subsystem, Logic subsystem, Termination subsystem, Testing and human-machine interface (HMI) subsystem, Power supplies, Advanced RTU functionalities, Intelligent electronic devices (IEDs), Data concentrators and merging units, SCADA communication systems, Master Station: Master station software components, Master station hardware components, Server systems in the master station, Small, medium, and large master stations, Global positioning systems (GPS), Master station performance.

UNIT -IV

Human-Machine Interface (HMI): HMI components, HMI software functionalities, Situational awareness, Intelligent alarm filtering: Need and technique, Alarm suppression techniques, Operator needs and requirements, SCADA Systems: Building the SCADA systems, legacy, hybrid, and new systems, Classification of SCADA systems, SCADA implementation: A laboratory model: The SCADA laboratory, System hardware, System software, SCADA lab field design.

Books and References:

1. Programmable Logic Controllers Frank D Petruzella McGraw-Hill 4th Edition, 2011
2. Power System SCADA and Smart Grids Mini S. Thomas CRC Press 3rd Edition,2015.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-414		Power System Restructuring and Deregulation					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: Students will grasp the know-how related to power system restructuring and deregulation.

Course Outcomes (CO)

CO1	To understand the introductory part of power system restructuring.
CO2	To familiarize with the introductory part of deregulation of power sector and various models.
CO3	Students will be acquainted with the market power and its mitigation techniques, including pricing and congestion management.
CO4	Deals with the various terms and modes related to PSRD.

UNIT -I

Introduction: Basic concept and definitions, privatization, restructuring, transmission open access, wheeling, deregulation, components of deregulated system, advantages of competitive system. Power System Restructuring: An overview of the restructured power system, Difference between integrated power system and restructured power system. Explanation with suitable practical examples.

UNIT -II

Deregulation of Power Sector: Separation of ownership and operation, Deregulated models, pool model, pool and bilateral trades model, Multilateral trade model. Competitive electricity market: Independent System Operator activities in pool market, Wholesale electricity market characteristics, central auction, single auction power pool, double auction power pool, market clearing and pricing.

UNIT -III

Market Power and its Mitigation Techniques, Bilateral trading, Ancillary services, Transmission Pricing. Open Access Same Time Information System (OASIS): Introduction, structure, functionality, implementation, posting of information, uses. Congestion Management: Congestion management in normal operation, explanation with suitable example.

UNIT -IV

Total transfer capability (TTC), Available transfer capability (ATC), Transmission Reliability Margin (TRM), Capacity Benefit Margin (CBM), Existing Transmission Commitments (ETC). Different Experiences in deregulation: U.S.A, Canada, U.K, Japan, Switzerland, Australia, Sweden, Germany and Indian power system.

Books and References:

1. Power System Restructuring and Deregulation by Loi Lei Lai, John Wiley & Sons Ltd.
2. Understanding Electric Utilities and Deregulation by Lorrin Philipson and H. Lee Willis, Marcel Dekker Inc, New York, CRC Press.
3. Power System Restructuring Engineering & Economics by Marija Ilic by Francisco Galiana and Lestor Fink, Kulwer Academic Publisher, USA.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-416		Solar Energy Engineering and Technology					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: Students will grasp introductory knowledge of technology to explore Solar Energy and electricity.

Course Outcomes (CO)

CO1	To understand the basic energy scenario, solar radiation to Earth, its measurement and estimation.
CO2	To familiarise with the design of PV cells and systems, their components & grid connection interface.
CO3	Students will become acquainted with basic laws related to solar energy, like transmittivity and absorptivity, with devices.
CO4	Deals with solar thermal power generation, thermal energy storage and applications.

UNIT -I

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.

UNIT -II

Fundamentals of solar PV cells, principles and performance analysis, modules, arrays, theoretical maximum power generation from PV cells. PV standalone system components, Standalone PV-system design. Components of grid-connected PV system, solar power plant design and performance analysis.

UNIT -III

Fundamentals of solar collectors, Snails law, Bougers law, Physical significance of Transmissivity – absorptivity product. Performance anlaysis of Liquid flat plate collectors and testing. Performance anlaysis of Solar Air heaters and testing.

UNIT -IV

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.

Books and references:

1. G. N. Tiwari, Solar Energy, Fundamentals, Design, Modeling and Applications, Narosa, 2002.
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.
4. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley, 2006.
5. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, 1999.
6. H. P. Garg and J. Prakash, Solar Energy: Fundamentals and Applications, Tata McGraw-Hill, 1997.
7. M. A. Green, Third Generation Photovoltaics: Advanced Solar Energy Conversion, Springer, 2003.
8. A. Goetzberger and V. U. Hoffmann, Photovoltaic Solar Energy Generation, Springer- -verlag, 2010.
9. 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.
10. T. C. Kandpal and H.P. Garg, Financial Evaluation of Renewable Energy Technologies, McMillan India Ltd., 2013

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-418		Energy Audit and Conservation					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: To develop the knowledge and skills required to systematically assess energy usage and implement effective conservation measures that reduce energy waste, enhance efficiency, and support sustainable energy practices across sectors.

Course Outcomes (CO)

CO1	Understand global and national energy scenarios, conservation principles, future strategies, and the basics of electrical energy.
CO2	Apply energy auditing techniques and management strategies to analyze costs, enhance system efficiency, and optimize energy use across various sectors.
CO3	Enhance electrical energy efficiency by managing loads, improving power factor, selecting optimal motors, and reducing system losses.
CO4	Evaluate lighting systems and advanced electrical technologies to implement energy-efficient solutions and optimize overall electrical performance.

UNIT-I

Energy Scenario and Basics of Energy: Energy scenario in world and India, Energy Conservation and its Importance, Energy Strategy for the Future, The Energy Conservation Act, 2001 and its Features, Various Forms of Energy, Electrical Energy Basics.

UNIT-II

Energy Management and Audit: Definition & Objectives of Energy Management, Energy Audit: Types and Methodology, Energy Audit Reporting Format, Understanding Energy Costs, Benchmarking and Energy Performance, Matching Energy Usage to Requirement, Maximizing System Efficiency, Fuel and Energy Substitution, Energy Audit Instruments.

UNIT-III

Electrical System and Motors: Electrical Load Management and Maximum Demand Control, Power Factor Improvement and Benefits, Harmonics, Analysis of Electrical Power Systems Motor Selection, Energy Efficient Motors, Factors Affecting Energy Efficiency and Minimizing Motor Losses in Operation, Rewinding Effects on Energy Efficiency.

UNIT-IV

Lighting System: Introduction, Basic Terms in Lighting System and Features, Lamp Types and their Features, Recommended Illuminance Levels for Various Tasks/Activities/Locations, Methodology of Lighting System, Energy Efficiency Study, Case Examples, Some Good Practices in Lighting.

Energy Efficient Technologies in Electrical Systems: Maximum Demand Controllers, Automatic Power Factor Controllers, Energy Efficient Motors, Soft Starters, Variable Speed Drives, Energy Efficient Transformers, Electronic Ballasts, Energy Efficient Lighting Controls.

Text Books:

1. Energy Management: Conservation and Audits by Anil Kumar (Author), Om Prakash (Author), Prashant Singh Chauhan (Author), Samsher Samsher (Author).
2. Energy Conservation and Audit [Print Replica] Kindle Edition by B. P. PATIL (Author) Format: Kindle Edition.
3. Electrical Power Systems: Soni, Gupta, Bhatnagar – Dhanpat Rai & Sons.
4. Direct Energy Conversion George: Sutton -McGraw.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-420		Deep Learning					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs**
Purpose	To introduce deep learning concepts and study various types of networks in deep learning and its applications.						
Course Outcomes (CO)							
CO1	Demonstrate the basic concepts of deep learning and neural networks.						
CO2	To learn the feedforward and deep neural networks.						
CO3	Apply the concepts of RNN, long short-term memory and other gated RNNs.						
CO4	To study applications of deep leaning in various domains.						

UNIT-I

Introduction to Deep Learning: History of Deep learning, Deep learning model, Biological neuron, idea of computational UNITs, McCulloch–Pitts unit and Thresholding logic, Linear perceptron, Perceptron learning algorithm, Linear separability, Convergence theorem for perceptron learning algorithm, Deep learning algorithms.

UNIT-II

Feed forward & Deep Neural Networks: Feed forward neural networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders.
Deep neural networks: Difficulty of training deep neural networks, Greedy layer-wise training.

UNIT-III

Recurrent and Recursive Neural Networks: Newer optimization methods for neural networks (Adagrad, Adadelta, RMSprop, Adam, Nesterov Accelerated Gradient (NAG)), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).
Recurrent Neural Networks (RNNs): Back propagation through time, Long Short Term Memory (LSTM), Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs.

UNIT-IV

Convolutional Neural Networks, Generative Models and Recent Trends: Convolutional Neural Networks: LeNet, AlexNet, ZF-Net, VGGNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks.
Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to Markov Chain Monte Carlo (MCMC) and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines. Recent Trends: Variational Autoencoders, Generative Adversarial Networks, Multi-task deep learning, Multi-view deep learning.

Suggested Books:

1. M Gopal, “Deep Learning, Core Concepts, Methods and Applications”, Pearson Education.
2. Ian J. Goodfellow, Bengio Yoshua, and Aaron Courville, “Deep Learning”, MIT Press.
3. Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer Nature.
4. Seth Weidman, “Deep Learning from Scratch: Building with Python from First Principles”.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-422		Internet of Things					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	0	0	3	70	30	100	3 Hrs.
Purpose: This course introduces the principles of IoT and the basic architecture concepts. The course emphasizes implementation of various logic related to IoT and understanding the concept of data communication among IoT device, data storage, data analytics and data security.							
Course Outcomes (CO)							
CO1	Be familiar with IoT architecture and Communication services related to computer architecture.						
CO2	Be familiar with the design of IoT microcontroller and the concept of applying different logics.						
CO3	Be familiar with understanding the concept of data communication through various IoT devices.						
CO4	Be acquainted with the basic knowledge of data storage, data analytics and security in IoT.						

UNIT-I

IoT: History of IOT, Requirements, Functionalists, and structure of IOT, IoT enabling technologies, IoT Architecture, IoT communication and networking protocols, Role of wired and wireless communication, IoT services and applications, IoT Standards, Fog Computing, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT. Balock chain and IoT, AI and IoT.

UNIT-II

IOT Data Acquisition & Platforms: Micro Controllers (Arduino uno/mega2560, Rasberry-Pi, ARM), Real-time systems, and embedded software, Hardware & Software Requirements.

UNIT-III

IOT Data Communication: Ipv4/Ipv6, Ethernet/GigE, MIPI, M-PHY, UniPro, SPMI, BIF, Super Speed USB Inter-Chip (SSIC), Mobile PCIe (M-PCIe) and SPI, GSM, 2G, 3G, 4G and 5G, IEEE 802.15.4, IEEE 802.15.4e, 802.11ah, Relay Access Point (AP), Grouping of station, Target Wake Time (TWT).

UNIT-IV

IOT Data Storage & Retrieval: Cloud Storage, Databases Connectivity with IOT and uses, Case Study over Cloud Services and Administration, Case Study of Big Data & Hadoop Platforms

IOT Data Analytics & Security: Analysis of data using the Ipython Module, Data Cleaning in IoT, Attack, Defence, and Network Robustness of Internet of Things, Authentication in IoT, Security Protocols for IoT Access Networks.

Books and references:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press).
2. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press).

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-424		Introduction to Internet of Things					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Sem Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**0**	**0**	**3**	**70**	**30**	**100**	**3 Hrs.**
Purpose: This course introduces the principles of IoT, Computing, data analytics and data security.							
Course Outcomes (CO)							
CO1	Be familiar with IoT architecture and Communication services related to computer architecture.						
CO2	Be familiar with IoT and Arduino.						
CO3	Be acquainted with the basic knowledge of SDN, data handling and cloud computing.						
CO4	Be acquainted with the overview of IOT applications in smart cities, smart grid.						

UNIT-I

Introduction to IoT, Sensing, Actuation, Basics of Networking, Basics of Networking, Communication Protocols, Sensor Networks.

UNIT-II

Machine-to-Machine Communications.
Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino.
Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi.

UNIT-III

Introduction to SDN, SDN for IoT, Data Handling and Analytics, Cloud Computing, Sensor-Cloud.

UNIT-IV

Fog Computing, Smart Cities and Smart Homes.
Connected Vehicles, Smart Grid, Industrial IoT.
Case Study: Agriculture, Healthcare, Activity Monitoring.

Books and References

1. S. Misra, A. Mukherjee, and A. Roy, 2020. *Introduction to IoT*. Cambridge University Press. Availability:https://www.amazon.in/Introduction-IoT-Sudip Misra/dp/1108959741/ref=sr_1_1?dchild=1&keywords=sudip+misra&qid=1627359928&sr=8-1
2. S. Misra, C. Roy, and A. Mukherjee, 2020. *Introduction to Industrial Internet of Things and Industry 4.0.* CRC Press. Availability: https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-426		Mobile Apps Development					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**
Purpose: To introduce the concepts of developing the mobile applications.							
Course Outcomes (CO)							
CO1	Be exposed to technology and Mobile apps development aspects.						
CO2	Be competent with the characterization and architecture of mobile applications.						
CO3	Appreciation of nuances such as native hardware play, location awareness, graphics, and multimedia.						
CO4	Perform testing, signing, packaging and distribution of mobile apps.						

UNIT- I

Introduction to Mobility: Mobility landscape, Mobile platforms, Mobile apps development, Overview of Android platform, challenges of Android app development, versions of Android, why develop apps for Android, Setting up the Mobile App Development environment along with an Emulator.

Mobile Platforms: URIs for mobile apps, compare and contrast native mobile platforms such as tightly controlled (iPhone), open (Android), and licensed (Windows Mobile), and web as a mobile application platform.

UNIT- II

Building blocks of Mobile: Activities, Activity life cycle and interaction between activities, App User Interface Designing – User Interaction, user input controls, Mobile UI resources (Layout, UI elements, Drawable, Menu), screen navigation, RecyclerView. App functionality beyond user interface - Threads, Async task, Services – States and Life Cycle, Notifications, Broadcast receivers, Content provider.

Unit III

Sprucing up Mobile Apps: Triggering, scheduling and optimizing background tasks: Notifications, Scheduling Alarms, transferring data efficiently. Graphics and animation – Custom views, Canvas, Animation APIs, Multimedia – Audio/Video playback and record, Location awareness.

Native data handling –file I/O, Shared preferences, shared data through content provider, Mobile databases such as SQLite, and Enterprise data access (via Internet/Intranet).

Unit IV:

Testing and Launching Mobile Apps: Debugging mobile apps, White box testing, Black box testing, and test automation of Mobile apps, JUnit for Android. Loading data using loaders, Permissions, Performance and Security, Firebase and AdMob and publish.

Suggested Books:

1. Barry Burd, *Android Application Development All in one for Dummies*, Wiley publications, 2nd Edition 2015.
2. Android Developer Fundamentals Course– Concepts (Learn to develop Android applications) Concepts Reference *Developed by Google Developer Training Team, 2016.*
3. Valentino Lee, Heather Schneider, and Robbie Schell, Mobile Applications: Architecture, Design, and Development, Prentice Hall, 2004.
4. Rick Boyer, Kyle Mew, Android Application Development Cookbook - Second Edition,2016.
5. Carmen Delessio, Lauren Darcey, Teach Yourself Android Application Development In 24 Hours , SAMS, 2013.
6. Brian Fling, Mobile Design and Development, O'Reilly Media, 2009.
7. Maximiliano Firtman, Programming the Mobile Web, O'Reilly Media, 2010

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-428		Smart Grid					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**

Purpose: To enable the students to acquire knowledge on smart grid, different options of architectural design and communication technology for various aspects of smart grid.

Course Outcomes (CO)

CO1	The various aspects of the smart grid, including technologies, components, architectures and applications.
CO2	System analysis and stability analysis in smart grid, renewable energy sources and storage integration with smart grid.
CO3	Current initiatives in the development of smart grid at national and international level.
CO4	The role of communication and information technology in smart grid.

UNIT-I

Introduction to Smart Grid: Concept, definitions, difference between conventional and smart grid, challenges in smart grid implementation, Overview of the technologies required for the Smart Grid.

UNIT-II

Smart Grid Technologies: Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

UNIT-III

Smart Meters: Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

UNIT-IV

Power Quality Management in Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid-connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web-based Power Quality monitoring, Power Quality Audit.

High Performance Computing: Local Area Network (LAN), Home Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP-based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

Text & Reference:

1. Vehbi C. Güngör, Dilan Sahin, Taskin Kocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, Smart Grid Technologies Communication Technologies and Standards IEEE Transactions on Industrial Informatics, Vol. 7, No. 4, November 2011.
2. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang "Smart Grid – The New and Improved Power Grid: A Survey", IEEE Transaction on Smart Grids, 2011.
3. Stuart Borlase, "Smart Grid: Infrastructure, Technology and Solutions", CRC Press, 2012.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-430		Software Engineering					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**
Purpose: To understand the techniques and methodologies involved in software development, including software process models, design strategies, reliability measures, testing methodologies, and maintenance.							
Course Outcomes (CO)							
CO1	To apply process models and analyze requirement techniques.						
CO2	To understand software design, strategies, and analysis metrics.						
CO3	To design various software reliability measures to assess the quality of software in case of various faults and failures.						
CO4	To develop various testing methodologies, debugging tools, and maintenance models to ensure the accountability of software.						

UNIT-I

Introduction to Software Crisis & Software Processes: Software Life Cycle Models – Build & Fix, waterfall, prototype, evolutionary, spiral model.

Problem Analysis: DFD, Data dictionaries, ER diagrams, object diagrams; approaches to problem analysis; SRS; specifying behavioural & non-behavioural requirements.

UNIT-II

Software Design: What is design? Modularity, strategy of design, function-oriented design, object-oriented design.

Software Metrics: Introduction, size metrics, data structure metrics, information flow metrics, entropy-based measures, metric analysis.

UNIT-III

Reliability: Importance, Software reliability & Hardware reliability, failures & faults, reliability concepts, reliability models – macro, basic, logarithmic Poisson, calendar time component, micro models; estimating number of residual errors; reliability allocation.

UNIT-IV

Software Testing: Introduction, Functional testing, structural testing, activities during testing, debugging, testing tools.

Software Maintenance: Introduction, types of maintenance, maintenance process, maintenance models, reverse engineering, reengineering.

Suggested Books

1. K. K. Aggarwal, Yogesh Singh: Software Engineering, New Age International Ltd, 2001.
2. R.S. Pressman, Software Engineering – A Practitioner's Approach, 5th Ed, TMH, 2000.
3. Ian Sommerville, Software Engineering, 4th Ed., Addison Wesley.
4. Pankaj Jalote, An Integrated Approach to Software Engineering, 2nd Ed, Narosa Publishing.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-EEP-432		Unix and Linux Programming					
Lecture	**Tutorial**	**Practical**	**Credit**	**End Semester Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
3	**-**	**-**	**3**	**70**	**30**	**100**	**3Hrs.**
Purpose: Introduces commands and numerous programming concepts and application domains to cover important topics for implementation of the Unix programming concepts.							
Course Outcomes (CO)							
CO1	To learn basic and advanced Unix Commands.						
CO2	Expose the role of filters and file compression techniques.						
CO3	To explore knowledge of programming language development tools.						
CO4	To expand knowledge of Unix/Linux system administration and networking.						

UNIT-I

Basic Command Usage: Linux Startup: User accounts, accessing Linux - starting and shutting processes, Logging in and Logging out, Unix commands like zip, unzip, pack, unpack, compress, uncompress, Shell Programming, Unix file system: Linux/Unix files, i-nodes and structure, file system related commands, Shell as command processor, shell variables, creating command substitution, scripts, functions, conditionals, loops, customizing environment.

UNIT-II

Filters and File Compression: Regular Expressions and Filters: Introducing regular expressions patterns, syntax, character classes, quantifiers, introduction to grep, egrep, sed, programming with awk and perl, File Compression Techniques: data redundancy elimination using fingerprint generation deduplication and data similarities removal using delta techniques for data reduction storage, parallel compression with Xdelta utility.

UNIT-III

Program Development Tools: The C Environment: C compiler, vi editor, compiler options, managing projects, memory management, use of makefile, cmake, dependency calculations, memory management – static and dynamic memory, static and dynamic libraries, dynamic loader, debugging tools like gdb, fixed-size and variable-size blocks of data files chunks divisor chunking techniques like Frequency Based Chunking and Content Defined Chunking Unix based open source coding.

UNIT-IV

Process Control: Processes in Linux: Processes, starting and stopping processes, initialization processes, rcandinit files, job control - at, batch, cron, time, network files, security, privileges, authentication, password administration, archiving, Signals and signal handlers, Threading, Linux I/O system, Networking tools like ping, telnet, ftp, route, Firewalls, Backup and Restore tar, cpio, dd. Case Study: PCOMPRESS open source free software.

Text & Reference Books:

1. John Goerzen: Linux Programming Bible, IDG Books, New Delhi, 2014.
2. Sumitabha Das: Unix – Concept and Applications, Fourth Edition TMH, 2015.
3. Neil Matthew, Richard Stones: Beginning Linux Programming, 4th. Edition, Wrox-Shroff, 2011.
4. Welsh & Kaufmann: Running Linux, O'Reiley& Associates, 2013.
5. B.M. Harwani, Unix and Shell Programming, Oxford University Press, 2013.

Note: The paper setter will set the paper as per the question paper templates provided.

B23-ECO-402		Major Project (Part-II)					
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical Exam**	**Internal Assessment**	**Total**	**Duration of Exam**
-	**-**	**20**	**10**	**200**	**200**	**400**	**3 Hrs.**
Purpose: To develop teamwork, plan and implement the project, write a comprehensive report and develop effective presentation skills.							
Course Outcomes (CO): Upon completion of the course, students will be able to							
CO1	Identify and define a problem statement from the requirements raised from the literature survey /need analysis						
CO2	Build and Test circuits/models /prototypes/hardware/software for developing real-life small applications						
CO3	Work in teams, write a comprehensive report and an effective presentation of the project work.						
CO4	Rapid prototyping, which will lead them towards entrepreneurship.						

The Major Project (Part-II) is a team activity having 3-5 students in a team, and it will be a continuation of the Major Project (Part-I). This is circuit building and testing for developing small applications. The project may be a complete hardware or a hardware with a software aspect. It should cater to a small system required in a laboratory or in real life. It should encompass components, machines, automation and control, power system devices, analogue or digital ICs, microcontroller, software, etc. Based on a comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of the Project.

Students are expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within the first week of the semester. The student is expected to focus on the design, development, and testing of the proposed work as per the schedule. The layout should be made using simulation software. A detailed project report, along with hardware/software, is to be submitted at the end of the semester.