J.C. Bose University of Science & Technology YMCA, Faridabad
(A Haryana State Government University)
(Established by Haryana State Legislative Act No. 21 of 2009 & Recognized by UGC Act 1956 u/s 22 to Confer Degrees)
Accredited 'A' Grade by NAAC

Scheme & Syllabus

for

BACHELOR OF TECHNOLOGY PROGRAMME
in

ELECTRICAL ENGINEERING

(w.e.f. Session 2020-2021)

DEPARTMENT OF ELECTRICAL ENGINEERING

VISION

J. C. Bose University of Science and Technology aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building.

MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creative activities.
- To provide an enviable research environment and state-of-the-art technological exposure to its scholars.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities.

Department of Electrical Engineering

VISION

Electrical Engineering Department congregates the challenges of new technological advancements to provide comprehensively trained, career focused ,morally strong accomplished graduates, cutting edge researchers by experimental learning which contribute to ever changing global society and serve as competent engineers.

MISSION

- To commit excellence in imparting knowledge through incubation and execution of high quality innovative educational programs.
- To develop the Research oriented culture to build national capabilities for excellent power management.
- To inculcate and harvest the moral values and ethical behavior in the students through exposure of self -discipline and personal integrity.
- To develop a Centre of research and education generating knowledge and technologies which lay ground work in shaping the future in the field of electrical engineering.

Revised in August 2021

J.C. Bose University of Science and Technology, YMCA Faridabad

Department of Electrical Engineering

B.Tech in Electrical Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEO's)

The main objectives of the B.Tech program in Electrical Engineering are:

PEO1	To produce competent electrical engineering graduates with a strong foundation in design, analytics and problem solving skills for successful professional careers in industry, research and public service.
PEO2	To provide a stimulating research environment so as to motivate the students for higher studies and innovation in the specific and allied domains of electrical engineering.
PEO3	To encourage the graduates to practice the profession following ethical codes, social responsibility and accountability.
PEO4	To train students to communicate effectively in multidisciplinary environment.
PEO5	To imbibe an attitude in the graduates for life-long learning process.

Revised in August 2021

J.C. Bose University of Science and Technology, YMCA Faridabad

Department of Electrical Engineering

Program Outcomes of B.Tech in Electrical Engineering

Graduates of the Electrical Engineering program at JCBUST, YMCA will be able to:

PO1	Apply knowledge of mathematics, science, engineering fundamentals, and electrical engineering specialization to the solution of engineering problems.
PO2	Identify, formulate, review literature and analyze electrical engineering problems to design, conduct experiments, analyze data and interpret data.
PO3	Design solution for electrical engineering problems and design system component of processes that meet the desired needs with appropriate consideration for the public health and safety and the cultural, societal and the environmental considerations.
PO4	Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in electrical engineering.
PO5	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to electrical engineering activities with an understanding of the limitations.
PO6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
PO7	Understand the impact of the electrical engineering solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development.
PO8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Function affectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communicate effectively on complex engineering activities with the engineering committee and with society at large, such as, being able to comprehend and write affective reports and design documentation, make effective presentations in electrical engineering.
PO11	Demonstrate knowledge & understanding of the engineering principles and management principles and apply these to one‘s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Recognize the need for, and the preparation and ability to engage in independent research and lifelong learning in the broadest contest of technological changes in electrical engineering.

Revised in August 2021

J.C. Bose University of Science and Technology, YMCA Faridabad

Department of Electrical Engineering

PROGRAM SPECIFIC OUTCOMES (PSO's)

The specific outcomes of the B.Tech program in Electrical Engineering are:

PSO1	To apply state-of-the- art knowledge in analysis design and complex problem solving with effective implementation in the multidisciplinary area of Electrical Engineering with due regard to environment and social concerns.
PSO2	To prepare graduates for continuous self learning to apply technical knowledge and pursue research in advanced areas in the field of Electrical Engineering for successful professional career to serve the society ethically.

4 year Curriculum structure
Undergraduate Degree in Engineering & Technology

Branch / Course: Electrical Engineering
Total credits (4 year course)

Induction Program

Induction program (mandatory)	**3 weeks duration** (Please refer Appendix-A for guidelines & also details available in the curriculum of Mandatory courses)
Induction program for students to be offered right at the start of the first year.	Physical activity Creative Arts Universal Human Values Literary Proficiency Modules Lectures by Eminent People Visits to local Areas Familiarization to Dept./Branch & Innovations

Course code and definition:

Course code	**Definitions**
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
PEC	Professional Elective courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses
PROJ	Project
SEC	Skill Enhancement Courses

Semester-wise structure of curriculum

[L= Lecture, T = Tutorials, P = Practicals& C = Credits]

J. C. Bose University of Science and Technology, YMCA, Faridabad

B.Tech Electrical Engineering

Note: * It is mandatory to pass the MOOC course(s) by all the students as per implementation of credit transfer/ mobility policy of on line courses of the University-as mentioned in Annexure at the end of the syllabus.

SEMESTER WISE SUMMARY OF THE PROGRAMME

S.No.	Semester	No. of Contact Hours	Marks	Credits
1.	I	26	600	18.5
2.	II	25	650	19.5
3.	III	36	950	28
4.	IV	31	900	22
5.	V	32	900	25
6.	VI	32	1000	26
7.	VII/VIII	28	800	23
8.	VIII/VII	One Semester	500	08
	Total	**210**	**6300**	**170**

J. C. Bose University of Science and Technology, YMCA, Faridabad
B.Tech. Electrical Engineering

GRADING SCHEME

Marks %	Grade	Grade points	Category
90-100	O	10	Outstanding
80≤marks<90	A+	9	Excellent
70≤marks< 80	A	8	Very good
60≤marks< 70	B+	7	Good
50≤marks< 60	B	6	Above average
45≤marks< 50	C	5	Average
40≤marks< 45	P	4	Pass
<40	F	0	Fail
	AB	0	Absent

Percentage calculation= CGPA * 9.5

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY
YMCA, FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 1st YEAR (ELECTRICAL ENGG.) SEMESTER-I

Course Notation	Course Code	Course Title	L	T	P	Cr.	Internal Marks	End Sem	Total	Category Code
B	BSC101C	Physics (Waves and Optics)	3	1	-	4	25	75	100	BSC
C	BSC103C	Mathematics-I (Calculus and Differential Equations)	3	1	-	4	25	75	100	BSC
B	ESC102	Engineering Graphics & Design	-	-	4	2	30	70	100	ESC
B	ESC103	Programming for Problem Solving	3	-	-	3	25	75	100	ESC
C	ESC104	Workshop- I	-	-	4	2	30	70	100	ESC
B	BSC104C	Physics lab	-	-	3	1.5	15	35	50	BSC
B	ESC105	Programming for Problem solving Lab	-	-	4	2	15	35	50	ESC

Total Credit- 18.5

Note: Exams duration will be as under

a. Theory exams will be of 03 hours duration.

b. Practical exams will be of 02 hours duration

c. Workshop exam will be of 03 hours duration

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY
YMCA, FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 1st YEAR (ELECTRICAL ENGG.) SEMESTER-II

Course Notation	Course Code	Course Title	L	T	P	Cr	Internal Marks	End Sem	Total	Category Code
C	BSC106C	Mathematics-II (Linear Algebra , Transform Calculus and Numerical methods)	3	1	-	4	25	75	100	BSC
B	ESC101-A	Basic Electrical Technoogy	3	1	-	4	25	75	100	AECC
B	BSC 102	Chemistry	3	1	-	4	25	75	100	BEC
C	ESC106	Workshop- II	-	-	4	2	30	70	100	BEC
B	HSMC101	English	2	-	-	2	25	75	100	HSMC
B	ESC107-A	Basic Electrical Technology Lab	-	-	2	1	15	35	50	BSC
B	BSC 105	Chemistry Lab	-	-	3	1.5	15	35	50	BEC
B	HSMC102	English Lab	-	-	2	1	15	35	50	HSMC

Total Credit- 19.5

Note: Exams duration will be as under

a. Theory exams will be of 03 hours duration.

b. Practical exams will be of 02 hours duration

c. Workshop exam will be of 03 hours duration

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 2nd YEAR (ELECTRICAL ENGINEERING) SEMESTER-III

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Internal Marks	Final Marks	Total	Credits
				L	T	P				
1	PCC	ELPC301	Electrical Circuit Analysis	3	1	0	25	75	100	4
2	PCC	ELPC302	Analog Electronics Circuits	3	0	0	25	75	100	3
3	PCC	ELPC303	Electrical Machines-1	3	0	0	25	75	100	3
4	PCC	ELPC304	Electromagnetic Fields	3	1	0	25	75	100	4
5	ESC	ELES305	Engineering Mechanics	3	1	0	25	75	100	4
6	BSC	ELBS321	Mathematics-III (Probability and Statistics)	3	1	0	25	75	100	4
7	MC		Mandatory Course	2	0	0	25	75	100	0
8	PCC	ELPC352	Analog Electronics Circuit Lab	0	0	2	15	35	50	1
9	PCC	ELPC353	Electrical Machines Lab -1	0	0	2	15	35	50	1
10	SEC	ELSE361	Electrical Workshop-III	0	0	4	30	70	100	2
11	SEC	ELSE362	Project-1	0	0	4	15	35	50	2
			Total	**20**	**4**	**12**	**250**	**700**	**950**	**28**

	Course Code	Course Title
Mandatory Course	MC-01 (Common to all)	Indian Constitution
	MC-02 (Common to all)	Essence of Indian Traditional Knowledge

J.C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 2nd YEAR (ELECTRICAL ENGINEERING) SEMESTER-IV

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Internal Marks	Final Marks	Total	Credits
				L	T	P				
1	PCC	ELPC401	Digital Electronics	3	0	0	25	75	100	3
2	PCC	ELPC402	Electrical Machines – II	3	0	0	25	75	100	3
3	PCC	ELPC403	Power Electronics	3	0	0	25	75	100	3
4	PCC	ELPC404	Signal and Systems	2	1	0	25	75	100	3
5	PEC		Program Elective –I	3	0	0	25	75	100	3
6	MC	MC-03	Environmental Sciences	2	0	0	25	75	100	0
7	PCC	ELPC451	Digital Electronics Lab	0	0	2	15	35	50	1
8	PCC	ELPC452	Electrical Machines Lab– II	0	0	2	15	35	50	1
9	PCC	ELPC453	Power Electronics Lab	0	0	2	15	35	50	1
10	SEC	ELSE461	Electrical Workshop-IV	0	0	4	30	70	100	2
11	SEC	ELSE462	Project-2	0	0	4	15	35	50	2
			Total	**16**	**1**	**14**	**240**	**660**	**900**	**22**

	Course Code	Course Title
Program Elective -1	ELPE411	Electrical Energy Conservation and Auditing
	ELPE412	Industrial Electrical Systems
	ELPE413	Computer Architecture

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD

NEW SCHEME OF STUDIES AND EXAMINATION

B-TECH 3rd YEAR (ELECTRICAL ENGINEERING) SEMESTER-V

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Internal Marks	End Sem	Total	Cr.
				L	T	P				
1	PCC	ELPC501	Power Systems – I (Apparatus and Modelling)	3	0	0	25	75	100	3
2	PCC	ELPC502	Control Systems	3	0	0	25	75	100	3
3	PCC	ELPC503	Microprocessors	3	0	0	25	75	100	3
4	BSC	BSC-01 (Common to all)	Biology	2	1	0	25	75	100	3
5	PEC		Program Elective –II	3	0	0	25	75	100	3
6	OEC		Open Elective –I	3	0	0	25	75	100	3
7	PCC	ELPC551	Power Systems Lab-1	0	0	2	15	35	50	1
8	PCC	ELPC552	Control Systems Lab	0	0	2	15	35	50	1
9	PCC	ELPC553	Microprocessors Lab	0	0	2	15	35	50	1
10	SEC	ELSE561	Electrical Workshop-V	0	0	4	30	70	100	2
11	SEC	ELSE562	Project-3	0	0	4	15	35	50	2
			Total	**17**	**1**	**14**	**240**	**660**	**900**	**25**

	Course Code	Course Title
Program Elective –II	ELPE511	Line Commutated and Active PWM Rectifiers
	ELPE512	Electrical Machine Design
	ELPE513	Electromagnetic Waves

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 3rd YEAR (ELECTRICAL ENGINEERING) SEMESTER-VI

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Internal Marks	Final Marks	Total	Credits
				L	T	P				
1	PCC	ELPC601	Power System-II (Operation and Control)	3	0	0	25	75	100	3
2	PCC	ELPC602	Electrical Measurements and Instrumentation	2	0	0	25	75	100	2
3	PCC	ELPC603	Electronics Design	1	0	0	25	75	100	1
4	PEC		Program Elective-III	3	0	0	25	75	100	3
5	PEC		Program Elective-IV	3	0	0	25	75	100	3
6	OEC		Open Elective –II	3	0	0	25	75	100	3
7	PCC	ELPC651	Power System Lab –II	0	0	2	15	35	50	1
8	PCC	ELPC652	Electrical Measurements and Instrumentation Lab	0	0	2	15	35	50	1
9	PCC	ELPC653	Electronics Design Lab	0	0	4	15	35	50	2
10	SEC	ELSE661	Electrical Workshop-VI	0	0	4	30	70	100	2
11	SEC	ELSE662	Seminar	0	0	1	50	0	50	1
12	SEC	ELSE663	Project-4	0	0	4	15	35	50	2
13	VAC	ELVC670	Social Work*	-	-	-	50	-	50	2
			Total	**15**	**0**	**17**	**340**	**660**	**1000**	**26**

	Course Code	Course Title
Program Elective –III	ELPE611	Electrical Drives
	ELPE612	Electrical and Hybrid Vehicles
	ELPE613	Digital Signal Processing
Program Elective –IV	ELPE614	Wind and Solar Energy System
	ELPE615	Computational Electromagnetics
	ELPE616	Digital Control Systems

* At least one day in fortnight

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD

NEW SCHEME OF STUDIES AND EXAMINATION

B-TECH 4th YEAR (ELECTRICAL ENGINEERING) SEMESTER-VII

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Internal Marks	Final Marks	Total	Credits
				L	T	P				
1	PEC		Program Elective -V	3	0	0	25	75	100	3
2	PEC		Program Elective -VI	3	0	0	25	75	100	3
3	OEC		Open Elective –III	3	0	0	25	75	100	3
4	OEC		Open Elective –IV	3	0	0	25	75	100	3
5	OEC		Open Elective –V	3	0	0	25	75	100	3
6	PROJ/ SEC	ELSE762	Major Project	0	0	6	30	70	100	3
7	HSMC		Slot for HSMC	3	0	0	25	75	100	3
8	SEC	ELSE761	Electrical Workshop-VII	0	0	4	30	70	100	2
			Total	**18**	**0**	**10**	**210**	**590**	**800**	**23**

	Course Code	Course Title
Program Elective –V	ELPE711	Power System Protection
	ELPE 712	HVDC Transmission Systems
	ELPE 713	Power Quality and FACTS
Program Elective –VI	ELPE 714	High Voltage Engineering
	ELPE 715	Advanced Electric Drives
	ELPE 716	Control Systems Design
	ELPE 717	Power System Dynamics and Control

	Course Code	Course Title
Humanities & Social Sciences Including Management Courses	HSMC-03 (Common to all)	Organizational Behaviour
	HSMC-04 (Common to all)	Finance & Accounting
	HSMC-05 (Common to all)	Basics of Operation Research

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 4th YEAR (ELECTRICAL ENGINEERING) SEMESTER-VIII

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Sessional Marks	Final Marks	Total	Credits
				L	T	P				
1	PROJ/SEC	ELSE861	Industrial Training	8 Hrs per Day			300	200	500	8

A) Procedure For Annual Examination And Marks		
Project Evaluation	50 Marks	Total 200 Marks
Project Seminar	50 Marks	
Project Viva	100 Marks	
B) Continuous Assessment Marks		
Assessment By Institute Faculty	100 Marks.	Total 300 Marks
Assessment By Industrial Guide	100 Marks.	
Conduct Marks	100 Marks.	
		Total 500 Marks

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
LIST OF OPEN ELECTIVE COURSES [ELECTRICAL ENGINEERING]

Sr. No	Code No.	Subject	Credits
1.	ELOE-101	Electronic Devices	3
2.	ELOE-102	Data Structures and Algorithms	3
3.	ELOE-103	Analog and Digital Communication	3
4.	ELOE-104	Computer Networks	3
5.	ELOE-106	Power Plant Engineering	3
6.	ELOE-105	Introduction to Embedded Systems	3
7.	ELOE-107	Strength of Materials	3
8.	PEC-ME-328	Automobile Engineering	3
9.	ELOE-109	Manufacturing Processes	3
10.	ELOE-110	Environmental Engineering	3
11.	ELOE-111	Operating System	3
12.	PEC-ME-443	Total Quality Management	3
13.	PEC-ME-451	Mechatronic System	3
14.	ECEL-604	Scientific Computing	3
15.	ELOE-115	Engineering Economics, Estimation & Costing	3
16.	OEL-603	Cyber Law and Security	3
17.	ELOE-117	Intelligent Systems	3
18.	ECEL-704	Fiber Optic Communication	3
19.	ECEL-705	Adaptive Signal Processing	3
20.	ECEL-606	Digital Image & Video Processing	3
21.	ELOE-121	Artificial Intelligence	3
22.	ELOE-122	Programming in Python	3
23.	ELOE-123	Fundamentals of Machine Leaning	3

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD

Department of Electrical Engineering

Scheme 2020-21

Mapping of courses with Employability/ Entrepreneurship/ Skill development

Name of the Course	Course Code	Mapping with Employability/ Entrepreneurship/ Skill development
Physics (Waves and Optics)	BSC101C	Employability
Mathematics-I (Calculus and Differential Equations)	BSC103C	Employability
Engineering Graphics & Design	ESC102	Skill development
Programming for Problem Solving	ESC103	Employability
Workshop- I	ESC104	Skill development
Physics lab	BSC104C	Skill development
Programming for Problem solving Lab	ESC105	Skill development
Mathematics-II (Linear Algebra , Transform Calculus and Numerical methods)	BSC106C	Employability
Basic Electrical Technology	ESC101A	Employability
Chemistry	BSC 102	Employability
Workshop- II	ESC106	Skill development
English	HSMC101	Skill development
Basic Electrical Technology Lab	ESC107A	Employability
Chemistry Lab	BSC 105	Skill development
English Lab	HSMC102	Skill development
Electrical Circuit Analysis	ELPC301	Employability
Analog Electronics Circuits	ELPC302	Employability
Electrical Machines-1	ELPC303	Employability
Electromagnetic Fields	ELPC304	Employability
Engineering Mechanics	ELES305	Employability
Mathematics-III (Probability and Statistics)	ELBS321	Employability
Analog Electronics Circuit Lab	ELPC352	Skill development
Electrical Machines Lab -1	ELPC353	Skill development
Electrical Workshop-III	ELSE361	Skill development
Project-1	ELSE362	Skill development

Indian Constitution	MC-01	Employability
Essence of Indian Traditional Knowledge	MC-02	Employability
Digital Electronics	ELPC401	Employability
Electrical Machines – II	ELPC402	Employability
Power Electronics	ELPC403	Employability
Signal and Systems	ELPC404	Employability
Environmental Sciences	MC-03	Employability
Digital Electronics Lab	ELPC451	Skill development
Electrical Machines Lab– II	ELPC452	Skill development
Power Electronics Lab	ELPC453	Skill development
Electrical Workshop-IV	ELSE461	Skill development
Project-2	ELSE462	Skill development
Electrical Energy Conservation and Auditing	ELPE411	Employability
Industrial Electrical Systems	ELPE412	Employability
Computer Architecture	ELPE413	Employability
Power Systems – I (Apparatus and Modelling)	ELPC501	Employability
Control Systems	ELPC502	Employability
Microprocessors	ELPC503	Employability
Power Systems Lab-1	ELPC551	Skill development
Control Systems Lab	ELPC552	Skill development
Microprocessors Lab	ELPC553	Skill development
Electrical Workshop-V	ELSE561	Skill development
Project-3	ELSE562	Skill development
Line Commutated and Active PWM Rectifiers	ELPE511	Employability
Electrical Machine Design	ELPE512	Employability
Electromagnetic Waves	ELPE513	Employability
Power System-II (Operation and Control)	ELPC601	Employability
Electrical Measurements and Instrumentation	ELPC602	Employability
Electronics Design	ELPC603	Skill development
Power System Lab –II	ELPC651	Skill development
Electrical Measurements and Instrumentation Lab	ELPC652	Skill development

Electronics Design Lab	ELPC653	Skill development
Electrical Workshop-VI	ELSE661	Skill development
Seminar	ELSE662	Skill development
Project-4	ELSE663	Skill development
Social Work	ELVC670	Employability
Electrical Drives	ELPE611	Employability
Electrical and Hybrid Vehicles	ELPE612	Employability
Digital Signal Processing	ELPE613	Employability
Wind and Solar Energy System	ELPE614	Employability
Computational Electromagnetics	ELPE615	Employability
Digital Control Systems	ELPE616	Employability
Power System Protection	ELPE711	Employability
HVDC Transmission Systems	ELPE 712	Employability
Power Quality and FACTS	ELPE 713	Employability
High Voltage Engineering	ELPE 714	Employability
Advanced Electric Drives	ELPE 715	Employability
Control Systems Design	ELPE 716	Employability
Power System Dynamics and Control	ELPE 717	Employability
Organizational Behaviour	HSMC-03	Employability
Finance & Accounting	HSMC-04	Employability
Basics of Operation Research	HSMC-05	Employability
Electronic Devices	ELOE-101	Employability
Data Structures and Algorithms	ELOE-102	Employability
Analog and Digital Communication	ELOE-103	Employability
Computer Networks	ELOE-104	Employability
Power Plant Engineering	ELOE-106	Employability
Embedded Systems	ELOE-105	Employability
Strength of Materials	ELOE-107	Employability
Automobile Engineering	ELOE-108	Employability
Manufacturing Processes	ELOE-109	Employability
Environmental Engineering	ELOE-110	Employability

Operating System	ELOE-111	Employability
Total Quality Management	ELOE-112	Entrepreneurship
Mechatronic System	ELOE-113	Employability
Scientific Computing	ELOE-114	Employability
Engineering Economics, Estimation & Costing	ELOE-115	Entrepreneurship
Cyber Law and Security	ELOE-116	Employability
Intelligent Systems	ELOE-117	Employability
Fiber Optic Communication	ELOE-118	Employability
Adaptive Signal Processing	ELOE-119	Employability
Digital Image & Video Processing	ELOE-120	Employability
Artificial Intelligence	ELOE-121	Employability
Programming in Python	ELOE-122	Employability
Machine Leaning	ELOE-123	Employability

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY
YMCA, FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 1st YEAR (ELECTRICAL ENGG.) SEMESTER-I

Course Notation	Course Code	Course Title	L	T	P	Cr.	Internal Marks	End Sem	Total	Category Code
B	BSC101C	Physics (Waves and Optics)	3	1	-	4	25	75	100	BSC
C	BSC103C	Mathematics-I (Calculus and Differential Equations)	3	1	-	4	25	75	100	BSC
B	ESC102	Engineering Graphics & Design	-	-	4	2	30	70	100	ESC
B	ESC103	Programming for Problem Solving	3	-	-	3	25	75	100	ESC
C	ESC104	Workshop- I	-	-	4	2	30	70	100	ESC
B	BSC104C	Physics lab	-	-	3	1.5	15	35	50	BSC
B	ESC105	Programming for Problem solving Lab	-	-	4	2	15	35	50	ESC

Total Credit- 18.5

Note: Exams duration will be as under

a. Theory exams will be of 03 hours duration.

b. Practical exams will be of 02 hours duration

c. Workshop exam will be of 03 hours duration

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY
YMCA, FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 1st YEAR (ELECTRICAL ENGG.) SEMESTER-II

Course Notation	Course Code	Course Title	L	T	P	Cr	Internal Marks	End Sem	Total	Category Code
C	BSC106C	Mathematics-II (Linear Algebra , Transform Calculus and Numerical methods)	3	1	-	4	25	75	100	BSC
B	ESC101-A	Basic Electrical Technoogy	3	1	-	4	25	75	100	AECC
B	BSC 102	Chemistry	3	1	-	4	25	75	100	BEC
C	ESC106	Workshop- II	-	-	4	2	30	70	100	BEC
B	HSMC101	English	2	-	-	2	25	75	100	HSMC
B	ESC107-A	Basic Electrical Technology Lab	-	-	2	1	15	35	50	BSC
B	BSC 105	Chemistry Lab	-	-	3	1.5	15	35	50	BEC
B	HSMC102	English Lab	-	-	2	1	15	35	50	HSMC

Total Credit- 19.5

Note: Exams duration will be as under

a. Theory exams will be of 03 hours duration.

b. Practical exams will be of 02 hours duration

c. Workshop exam will be of 03 hours duration

BSC101C: Physics (Waves and Optics)
(Electrical, ECE, EIC, Electrical and Electronics Engineering)

Prerequisites:

(i) Mathematics course on Differential equations

(ii) Introduction to Electromagnetic theory

Unit 1: Simple harmonic motion, damped and forced simple harmonic oscillator (7)

Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator

Unit 2: Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion (7)

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves. Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

Unit 3: The propagation of light and geometric optics (10)

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them, transfer formula and the matrix method

Unit 4: Wave optics (6)

Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer. Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power

Unit 5: Lasers (8)

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(ruby,Neodymium), dye lasers; Properties of laser beams: monochromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

Reference books:

(i) Ian G. Main, Oscillations and waves in physics

(ii) H.J. Pain, The physics of vibrations and waves (iii) E. Hecht, Optics (iv) A. Ghatak, Optics (v) O. Svelto, Principles of Lasers

BSC103C: Mathematics-I (Calculus and Differential Equations)

(Electrical Engineering)

Contents

Module 1: Calculus (8 hours)

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.

Module 2: Sequences and Series (7 hours)

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Module 3: Multivariable Calculus: Differentiation (6 hours)

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Module 4: Multivariable Calculus: Integration (7 hours)

Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration) Center of mass and Gravity (constant and variable densities). Theorems of Green, Gauss and Stokes, orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

Module 5: First Order Ordinary Differential Equations (3 hours)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 6: Ordinary Differential Equations of Higher Order (6 hours)

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module 7: Partial Differential Equations: First Order (3 hours)

First order partial differential equations, solutions of first order linear and non-linear PDEs.

Text / References:

1. G.B. Thomas and R.L. Finney, " Calculus and Analytic geometry" , Pearson, 2002.
2. T. Veerarajan, " Engineering Mathematics" , McGraw-Hill, New Delhi, 2008.
3. B. V. Ramana, " Higher Engineering Mathematics", McGraw Hill, New Delhi, 2010.
4. N.P. Bali and M. Goyal, " A text book of Engineering Mathematics" , Laxmi Publications, 2010.
5. B.S. Grewal, " Higher Engineering Mathematics" , Khanna Publishers, 2000.
6. E. Kreyszig, " Advanced Engineering Mathematics", John Wiley & Sons, 2006.
7. W. E. Boyce and R. C. DiPrima, " Elementary Differential Equations and Boundary Value Problems" , Wiley India, 2009.
8. S. L. Ross, " Differential Equations" , Wiley India, 1984.
9. E. A. Coddington, " An Introduction to Ordinary Differential Equations" , Prentice Hall India, 1995.
10. E. L. Ince, " Ordinary Differential Equations" , Dover Publications, 1958.
11. G.F. Simmons and S.G. Krantz, " Differential Equations" , McGraw Hill, 2007

Course code	**ESC103(Th)/ESC105(Lab)**				
Category	**Engineering Science Course**				
Course title	**Programming for Problem Solving (Theory & Lab.)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester – I/II
	3	**0**	**4**	**5**	
Pre-requisites (if any)	**-**				

(i)Programming for Problem Solving ([L : 3; T:0; P : 0 (3 credits)] [contact hrs : 40]

Detailed contents

Unit 1Introduction to Programming **(4 lectures)**
Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - **(1 lecture).**
Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. **(1 lecture)**
From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code- **(2 lectures)**

Unit 2:Arithmetic expressions and precedence **(2 lectures)**
Conditional Branching and Loops **(6 lectures)**
Writing and evaluation of conditionals and consequent branching **(3 lectures)**
Iteration and loops **(3 lectures)**

Unit 3Arrays **(6 lectures)**
Arrays (1-D, 2-D), Character arrays and Strings

Unit 4 Basic Algorithms **(6 lectures)**
Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Unit 5 Function **(5 lectures)**
Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference

Unit 6Recursion **(4 -5 lectures)**
Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Unit 7Structure **(4 lectures)**
Structures, Defining structures and Array of Structures

Unit 8Pointers **(2 lectures)**
Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Unit 9File handling (only if time is available, otherwise should be done as part of the lab)

Suggested Text Books

(i) Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
(ii) E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Suggested Reference Books

(i) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Outcomes

The student will learn

- To formulate simple algorithms for arithmetic and logical problems.
- To translate the algorithms to programs (in C language).
- To test and execute the programs and correct syntax and logical errors.
- To implement conditional branching, iteration and recursion.
- To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
- To use arrays, pointers and structures to formulate algorithms and programs.
- To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
- To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.

(ii) Laboratory - Programming for Problem Solving[L : 0; T:0 ; P : 4 (2credits)]

[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.]

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:
Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures

Tutorial 12: File handling:

Lab 12: File operations

Laboratory Outcomes

- To formulate the algorithms for simple problems
- To translate given algorithms to a working and correct program
- To be able to correct syntax errors as reported by the compilers
- To be able to identify and correct logical errors encountered at run time
- To be able to write iterative as well as recursive programs
- To be able to represent data in arrays, strings and structures and manipulate them through a program
- To be able to declare pointers of different types and use them in defining self-referential structures.
- To be able to create, read and write to and from simple text files.

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BSC106C: MATHEMATICS I1 (Linear Algebra, Transform Calculus and Numerical Methods)

(Electrical Engineering)

Module 1: Matrices (10 hours)

Algebra of matrices, Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

Module 2: Numerical Methods-I (10 hours)

Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

Module 3: Numerical Methods-II (10 hours)

Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Partial differential equations: Finite difference solution two dimensional Laplace equation and Poisson equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.

Module 4: Transform Calculus (10 hours)

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method. Fourier transforms**.**

Text / References:

1. Poole, " Linear Algebra: A Modern Introduction", Brooks/Cole, 2005.
2. N.P. Bali and M. Goyal, " A text book of Engineering Mathematics" , Laxmi Publications, 2008.
3. B.S. Grewal, " Higher Engineering Mathematics" , Khanna Publishers, 2010.

V. Krishnamurthy, V. P. Mainra and J. L. Arora, " An introduction to Linear Algebra" , Affiliated East-West press, 2005

Course code	**ESC 101 A (Th)/ESC107A (Lab)**				
Category	**Engineering Science Course**				
Course title	**Basic Electrical Technology (Theory & Lab.)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester –I/II
	3	**1**	**2**	**5**	
Pre-requisites (if any)	**-**				

[ESC101-A] Basic Electrical Technology (Theory) [L : 3; T : 1; P:0, (4 credit)]

Course Outcomes:

- To analyze and solve D. C. networks by different analysis methods and theorems.
- To formulate and solve complex AC single phase and three circuits
- To identify the type of electrical machines and their applications
- To introduce the components of low voltage electrical installations

Module 1: DC Circuits (8 hours)

Basic definitions, Electrical circuit elements (R, L and C), voltage and current sources, Ohm's law and its limitations, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation by mesh analysis and node analysis, Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems.

Module 2: AC Circuits (8 hours)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance.

Module3: Poly Phase Systems (5 hours)

Advantages of 3-phase systems, generation of 3-phase voltages, three phase connections (star and delta), voltage and current relations in star and delta connections, three phase powers, analysis of 3-phase balanced circuits, measurement of 3-phase power- 2 wattmeter method.

Module 4: Transformers (6 hours)

Magnetic Circuits, construction and working of single phase transformer, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency, Auto-transformer

Module 5: Electrical Machines (8 hours)

*Induction motor***:** Construction, principle and working of a three-phase induction motor, Single-phase induction motor: Construction, principle and working, Applications

*DC machine***:** Construction, principle and working of dc motor and generator. Applications

*Synchronous machine***:** Construction, principle and working of synchronous motor and generators. Applications

Module 6: Electrical Installations (6 hours)

Components of LT Switchgear: Fuses, MCB, ELCB, MCCB, Types of Wires, Earthing, Power factor improvement.

Suggested Text / Reference Books

(i) D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
(ii) D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
(iii) L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
(iv) E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
(v) V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

Online Recourses:

1. **NPTL Web Course, Basic Electrical Technology,** Prof. G. D. Roy, Prof. N. K. De, Prof. T.K. Bhattacharya, IIT Kharagpur **(**https://nptel.ac.in/courses/108/105/108105053/)
2. **NPTL Web Course, Electrical Machines-I,** Prof. P. Sasidhara Rao, Prof. G. Sridhara Rao, Dr. Krishna Vasudevan, IIT Madras **(**https://nptel.ac.in/courses/108/106/108106071/)
3. **NPTL Web Course, Electrical Machines-II,** Prof. P. Sasidhara Rao, Prof. G. Sridhara Rao, Dr. Krishna Vasudevan, IIT Madras https://nptel.ac.in/courses/108/106/108106072/

[ESC107-A] Basic Electrical Technology Laboratory [L : 0; T:0 ; P : 2 (1 credit)]

List of experiments/demonstrations:

- Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- Verification of network theorem in DC circuits, Thevenin's Theorem, Norton's, Theorem, Superposition Theorem etc.
- Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
- Poly phase systems, three phase connections (star and delta), measurement of three phase power
- Transformers: Observation of the no-load current waveform on an oscilloscope (non- sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous

machine (field winging - slip ring arrangement) and single-phase induction machine.

- Torque Speed Characteristic of separately excited dc motor.
- Components of LT switchgear.

Laboratory Outcomes

- Get an exposure to common electrical components and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Understand the usage of common electrical measuring instruments.
- Understand the basic characteristics of transformers and electrical machines.

Course code	**BSC102(Th)/BSC105(Lab)**				
Category	Basic Science Course				
Course title	**Chemistry (Theory & Lab.)** **Contents** (i) Chemistry-I (Concepts in chemistry for engineering) (ii) Chemistry Laboratory				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester –I/II
	3	**1**	**3**	**5.5**	
Pre-requisites (if any)	**-**				

(i)Chemistry (Concepts in chemistry for engineering) [L : 3; T:1; P : 0 (4 credits)]

Detailed contents

(i) *Atomic and molecular structure (12 lectures)*

Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

(ii) Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

(iii) Intermolecular forces and potential energy surfaces (4 lectures)

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.

(iv) Use of free energy in chemical equilibria (6 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion.

Use of free energy considerations in metallurgy through Ellingham diagrams.

(v) Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

(vi) *Stereochemistry (4 lectures)*

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

(vii) Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Suggested Text Books

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition

Course Outcomes

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.

Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalise bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- List major chemical reactions that are used in the synthesis of molecules.

(ii) Chemistry Laboratory[L : 0; T:0 ; P : 3 (1.5 credits)]

Choice of 10-12 experiments from the following:

- Determination of surface tension and viscosity
- Thin layer chromatography
- Ion exchange column for removal of hardness of water
- Determination of chloride content of water
- Colligative properties using freezing point depression
- Determination of the rate constant of a reaction
- Determination of cell constant and conductance of solutions
- Potentiometry - determination of redox potentials and emfs
- Synthesis of a polymer/drug
- Saponification/acid value of an oil
- Chemical analysis of a salt
- Lattice structures and packing of spheres
- Models of potential energy surfaces
- Chemical oscillations- Iodine clock reaction
- Determination of the partition coefficient of a substance between two immiscible liquids
- Adsorption of acetic acid by charcoal
- Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg .

Laboratory Outcomes

- The chemistry laboratory course will consist of experiments illustrating the principles of chemistry

relevant to the study of science and engineering. The students will learn to:

- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Synthesize a small drug molecule and analyse a salt sample

Course code	**ESC 104/ ESC 106**				
Category	Engineering Science Courses				
Course title	**Workshop-I** **Workshop-II**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester-I/II
	-	**0**	**4**	**2**	
Pre-requisites (if any)	**-**				

Workshop-I/II [[L : 0; T:0; P : 4 (2 credits)]

MECHANICAL WORKSHOP (Group –I)

Course Outcomes (COs): After studying this course the students would:

CO 1- Have exposure to mechanical workshop layout and safety aspects.

CO 2- Understand the functions of various machines and cutting tools used in machine shop.

CO 3- Practice real time job preparation using various operations related to machine shop such as filing, drilling, milling & turning.

CO 4 - Practice job preparation in welding shop.

CO 5 - Learn to use different measuring tools like vernier caliper, vernier height gauge and micrometer.

CO 6 - Practice job preparation in sheet metal shop.

List of Exercises:

Fitting, sheet metal and welding workshop:

1. To study layout, safety measures and different engineering materials (mild steel, medium carbon steel, high carbon steel, high speed steel and cast iron etc) used in workshop.
2. To study and use of different types of tools, equipments, devices & machines used in fitting, sheet metal and welding section.
3. To determine the least count of vernier calliper, vernier height gauge, micrometer and take different reading over given metallic pieces using these instruments.
4. To study and demonstrate the parts, specifications & operations performed on lathe machine.
5. To study and demonstrate the parts, specifications & operations performed on milling machine.
6. To study and demonstrate the parts, specifications & operations performed on shaper machine.
7. To prepare a job involving different type of filing practice exercise in specified dimensions.
8. To prepare a job involving multi operational exercise (drilling, counter sinking, tapping, reaming, hack sawing etc.)
9. To prepare a multi operational sheet metal job (self secured single groove joint/ hasp & stay etc.).
10. To practice striking an arc, straight short bead, straight continuous bead and restart of electrode in flat position by arc welding on given M.S. plate as per size.
11. To practice tack weld of two close plate in flat position by arc welding on given M.S. plate as per size.
12. To practice close butt joint in flat position by arc welding on given M.S. plate as per size.

NOTE: - At least nine exercises should be performed from the above list; remaining three may either be performed from above list or designed by the concerned institution as per the scope of the syllabus and facilities available in institute.

(Group –II)

PART-A

Computer Engineering Workshop

Course Outcomes (COs):

After the completion of the course the student will be able to:

CO1- Acquire skills in basic engineering practice.

CO2- Have working knowledge of various equipments used in workshop.

CO3- Have hands on experience about various machines and their components.

CO4- Obtain practical skills of basic operation and working of tools used in the workshop.

1. To study and demonstrate Block diagram of Digital Computer System and brief explanation of each unit.
2. To demonstrate History/ Generation/ classifications and different types of Personnel Computer.To study and demonstrate internal parts of a Computer System (Card level) and other peripheral devices and explanation of POST & BIOS.
3. To study and demonstrate primary memory and secondary memory.
4. To demonstrate CPU Block diagram and other Peripheral chips, Mother Board/ Main Board and its parts, Connectors, Add On Card Slots etc.
5. To study working of various types of monitors: CRT type, LCD type & LED type.
6. To study Keyboard and Mouse: Wired, Wireless, Scroll & Optical with detail working.
7. To study Printers: Dot Matrix Printers, Daisy wheel Printers, Ink-Jet Printers and Laser Jet Printers with detailed working explanation.
8. Assembly / Installation and Maintenance of Personnel Computer Systems: Practical exercise on assembly of Personnel Computer System, Installation of Operating System: Windows & Linux etc, Installation of other Application Softwares and Utility Softwares, Fault finding in Personnel Computers: Software or Hardware wise, Virus: Introduction, its Types & Removal techniques, Data Backup and Restore, Data Recovery Concepts, Typical causes of Data loss.
9. To demonstrate networking concepts: Introduction of Connecting devices: Hub, Switch & Router etc, Networking Cable preparation: Normal & Cross Cables, Data Transferring Techniques from one Computer System to another Computer System, Configuration of Switch/ Routers etc.

PART-B

Electrical Workshop

1. Introduction of Electrical Safety precautions, Electrical Symbols, Electrical Materials, abbreviations commonly used in Electrical Engg. and familiarization with tools used in Electrical Works.
2. To make a Straight Joint & Tee joint on 7/22 PVC wire and Britannia Joint on GI wire.
3. To study fluorescent Tube Light, Sodium Lamp and High Pressure Mercury Vapour Lamp.
4. To study different types of earthing and protection devices e.g. MCBs, ELCBs and fuses.
5. To study different types of domestic and industrial wiring and wire up a circuit used for Stair case and Godown wiring.
6. To make the connection of fan regulator with lamp to study the effect of increasing and decreasing resistance in steps on the lamp.
7. To fabricate half wave and full wave rectifiers with filters on PCB.
8. Maintenance and Repair of Electrical equipment i,e Electric Iron , Electric Toaster ,Water heater, Air coolers and Electric Fans etc.
9. To study soldering process with simple soldering exercises.
10. To make the connection of a three core cable to three pin power plug and connect the other cable end by secured eyes connection using 23/0.0076”or 40/0.0076” cable.

PART- C

Electronics Workshop

1. To study and demonstrate basic electronic components, Diode, Transistor, Resistance, Inductor and capacitor.
2. To study and demonstrate resistance color coding, measurement using color code and multimeter and error calculation considering tolerance of resistance.

3. To study and demonstrate Multimeter and CRO- front panel controls, description of block diagram of CRT and block diagram of CRO.
4. To study and demonstrate Vp(peak voltage),Vpp(peak to peak voltage), Time, frequency and phase using CRO.
5. Introduction to function generator. Functions of front panel controls and measurement of different functions on CRO.
6. To study and demonstrate variable DC regulated power supply, function of controls and DC measurement using multimeter and CRO.
7. Soldering practice on wire mesh or a resistance decade board includes fabrication, soldering, lacing, harnessing forming and observation.
8. Testing of components using multimeter and CRO like diode, transistor, resistance capacitor, Zener diode and LED.
9. To study and demonstrate rectification, half wave, Full wave and bridge rectifier. Fabrication,assembly and waveform observation.
10. To design and fabricate a printed circuit board of a Zener regulated/ series regulated power supply and various measurements, testing of power supply.

Note: At least 8 exercises are to be performed from each part by the students.

Course code	**ESC 102**				
Category	Engineering Science Courses				
Course title	**Engineering Graphics & Design (Theory & Lab.)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester - I
	-	**0**	**4**	**2**	
Pre-requisites (if any)	**-**				

Engineering Graphics & Design
[[L : 0; T:0; P : 4 (2 credits)]

Detailed contents

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

Module 1: Introduction to Engineering Drawing covering,

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Module 2: Orthographic Projections covering,

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Module 3: Projections of Regular Solids covering,

those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Module 4:Sections and Sectional Views of Right Angular Solids covering,

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

Module 5: Isometric Projections **covering,**

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Module 6: Overview of Computer Graphics covering,

listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs,

Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Module 7: Customisation& CAD Drawing
consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Module 8: Annotations, layering & other functions covering
applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

Module 9: Demonstration of a simple team design project *that illustrates*
Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Suggested Text/Reference Books:

(i) Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
(ii) Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
(iii) Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
(iv) Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
(v) (Corresponding set of) CAD Software Theory and User Manuals

Course Outcomes
All phases of manufacturing or construction require the conversion of new ideas and design concepts into the basic line language of graphics. Therefore, there are many areas (civil, mechanical, electrical, architectural and industrial) in which the skills of the CAD technicians play major roles in the design and development of new products or construction. Students prepare for actual work situations through practical training in a new state-of-the-art computer designed CAD laboratory using engineering software. This course is designed to address:

- to prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

- to prepare you to communicate effectively
- to prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice

The student will learn :

- Introduction to engineering design and its place in society
- Exposure to the visual aspects of engineering design
- Exposure to engineering graphics standards
- Exposure to solid modeling
- Exposure to computer-aided geometric design
- Exposure to creating working drawings
- Exposure to engineering communication

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Course code	HSMC 101(Th)/HSMC102(Lab)				
Category	Humanities and Social Sciences including Management courses				
Course title	**English (Theory & Lab.)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester – I/II
	2	**0**	**2**	**3**	
Pre-requisites (if any)	**-**				

English

Detailed contents

1. Vocabulary Building

The concept of Word Formation
Root words from foreign languages and their use in English
Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
Synonyms, antonyms, and standard abbreviations.

2. Basic Writing Skills

Sentence Structures
Use of phrases and clauses in sentences
Importance of proper punctuation
Creating coherence
Organizing principles of paragraphs in documents
Techniques for writing precisely

3. Identifying Common Errors in Writing

Subject-verb agreement
Noun-pronoun agreement
Misplaced modifiers
Articles
Prepositions
Redundancies
Clichés

4. Nature and Style of sensible Writing

Describing
Defining
Classifying
Providing examples or evidence

5. Writing introduction and conclusion

6. Writing Practices

Comprehension
Précis Writing
Essay Writing

7. Oral Communication

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension

- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Suggested Readings:

(i) *Practical English Usage.* Michael Swan. OUP. 1995.
(ii) *Remedial English Grammar.* F.T. Wood. acmillan.2007
(iii) *On Writing Well.* William Zinsser. Harper Resource Book. 2001
(iv) *Study Writing.* Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
(v) *Communication Skills*. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
(vi) *Exercises in Spoken English.* Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Course Outcomes

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 2nd YEAR (ELECTRICAL ENGINEERING) SEMESTER-III

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Internal Marks	Final Marks	Total	Credits
				L	T	P				
1	PCC	ELPC301	Electrical Circuit Analysis	3	1	0	25	75	100	4
2	PCC	ELPC302	Analog Electronics Circuits	3	0	0	25	75	100	3
3	PCC	ELPC303	Electrical Machines-1	3	0	0	25	75	100	3
4	PCC	ELPC304	Electromagnetic Fields	3	1	0	25	75	100	4
5	ESC	ELES305	Engineering Mechanics	3	1	0	25	75	100	4
6	BSC	ELBS321	Mathematics-III (Probability and Statistics)	3	1	0	25	75	100	4
7	MC		Mandatory Course	2	0	0	25	75	100	0
8	PCC	ELPC352	Analog Electronics Circuit Lab	0	0	2	15	35	50	1
9	PCC	ELPC353	Electrical Machines Lab -1	0	0	2	15	35	50	1
10	SEC	ELSE361	Electrical Workshop-III	0	0	4	30	70	100	2
11	SEC	ELSE362	Project-1	0	0	4	15	35	50	2
			Total	**20**	**4**	**12**	**250**	**700**	**950**	**28**

	Course Code	Course Title
Mandatory Course	MC-01 (Common to all)	Indian Constitution
	MC-02 (Common to all)	Essence of Indian Traditional Knowledge

ELPC301	Electrical Circuit Analysis	3L:1T:0P	4 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Apply network theorems for the analysis of electrical circuits.
2. Obtain the transient and steady-state response of electrical circuits.
3. Analyse circuits in the sinusoidal steady-state (single-phase and three-phase). Analyze two port circuit behaviour

Unit 1: Network Theorems (10 Hours)

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem, Analysis with dependent current and voltage sources, Node and Mesh Analysis, Concept of duality and dual networks

Unit 2: Solution of First and Second order networks (8 Hours)

Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Unit 3: Sinusoidal steady state analysis (8 Hours)

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits, Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Unit 4: Electrical Circuit Analysis Using Laplace Transforms (8 Hours)

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

Unit 5: Two Port Network and Network Functions (6 Hours)

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Text / References:

1. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall,2006.
2. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, Mc GrawHill Education,2013.
4. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw HillEducation, 2004.
5. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers,1999.

ELPC302	Analog Electronic Circuits	3L:0T:0P	3 Credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the characteristics of transistors.
2. Design and analyse various rectifier and amplifier circuits. Design sinusoidal and non-sinusoidal oscillators.
3. Understand the functioning of OP-AMP and design OP-AMP based circuits.

Unit 1: Diode circuits (4 Hours)

PN junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits

Unit 2: BJT circuits (8 Hours)

Structure and I-V characteristics of a BJT; BJT as a switch, BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Unit 3: MOSFET circuits (8 Hours)

MOSFET structure and I-V characteristics, MOSFET as a switch, MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Unit 4: Differential, multi-stage and operational amplifiers (8 Hours)

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Unit5: Linear applications of op-amp (8 Hours)

Idealized analysis of op-amp circuits, Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift).Analog to Digital Conversion.

Unit 6: Nonlinear applications of op-amp (6 Hours)

Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

Text/References:

1. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York,Oxford UniversityPress, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S.,1992.
3. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education,1988.
4. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press,1989.
5. P.R.Gray,R.G.MeyerandS.Lewis,“AnalysisandDesignofAnalogIntegrated Circuits”, John Wiley & Sons,2001.

ELPC303	Electrical Machines-I	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of magnetic circuits.
2. Understand the operation of dc machines.
3. Analyse the differences in operation of different dc machine configurations. Analyse single phase and three phase transformers circuits.

Unit 1:Magnetic fields and magnetic circuits (6 Hours)

Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.

Unit 2: Electromagnetic force and torque (9 Hours)

B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency

Unit 3: DC machines (8 Hours)

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

Unit 4: DC machine - motoring and generation (7 Hours)

Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors, Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

Unit 5: Transformers (12 Hours)

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.

Text / References:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, Mc GrawHill Education,2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines",CBS Publishers,2004.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers,2002.
4. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers,2011.
5. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education,2010.

ELPC304	Electromagnetic Fields	3L:1T:0P	4 credits

Course Outcomes:

At the end of the course, students will demonstrate the ability

1. To understand the basic laws of electromagnetism.
2. To obtain the electric and magnetic fields for simple configurations under static conditions.
3. To analyse time varying electric and magnetic fields.
4. To understand Maxwell's equation in different forms and different media. To understand the propagation of EM waves.

This course shall have Lectures and Tutorials. Most of the students find difficult to visualize electric and magnetic fields. Instructors may demonstrate various simulation tools to visualize electric and magnetic fields in practical devices like transformers, transmission lines and machines.

Unit 1: **Review of Vector Calculus (6 hours)**

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus differentiation, partial differentiation, integration, vector operator del, gradient, divergence and Curl ; integral theorems of vectors. Conversion of a vector from one coordinate system to another

Unit 2: Static Electric Field (6 Hours)

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

Unit 3: Conductors, Dielectrics and Capacitance (6 Hours)

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Unit 4: Static Magnetic Fields (6 Hours)

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Unit 5: Magnetic Forces, Materials and Inductance (6 Hours)

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

Unit 6: Time Varying Fields and Maxwell's Equations (6 Hours)

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.

Unit 7: Electromagnetic Waves (6 Hours)

Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

Text / References:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication,2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt.Ltd, New Delhi,2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India,2012.
4. G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans,1954.
5. W. J. Duffin, "Electricity and Magnetism", McGraw Hill Publication,1980.
6. W. J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill,1968.
7. G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge UniversityPress, 1966.
8. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition,1971.
9. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education,2012.

ELES305	Engineering Mechanics	3L:1T:0P	4 credits

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the concepts of co-ordinate systems.
2. Analyse the three-dimensional motion.
3. Understand the concepts of rigid bodies.
4. Analyse the free-body diagrams of different arrangements. Analyse torsional motion and bending moment.

Unit 1: Introduction to vectors and tensors and co-ordinate systems (5 hours) Introduction to vectors and tensors and coordinate systems; Vector and tensor algebra; Indical notation; Symmetric and anti-symmetric tensors; Eigen values and Principal axes.

Unit 2: Three-dimensional Rotation (4 hours)

Three-dimensional rotation: Euler's theorem, Axis-angle formulation and Euler angles; Coordinate transformation of vectors and tensors.

Unit 3: Kinematics of Rigid Body (6 hours)

Kinematics of rigid bodies: Dentition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two-and three-dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.

Unit 4: Kinetics of Rigid Bodies (5 hours)

Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Dentition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler's laws of rigid body motion.

Unit 5: Free Body Diagram (1 hour)

Free body diagrams; Examples on modelling of typical supports and joints and discussion on the kinematic and kinetic constraints that they impose.

Unit 6: General Motion (9 hours)

Examples and problems.General planar motions.General 3-D motions.Free precession, Gyroscopes, Rolling coin.

Unit 7: Bending Moment (5 hours)

Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending momentdiagrams.

Unit 8: Torsional Motion (2 hours)

Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.

Unit 9: Friction (3 hours)

Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.

Text / References:

1. J. L. Meriam and L. G. Kraige, "Engineering Mechanics: Dynamics", Wiley,2011.

2. M. F. Beatty, "Principles of Engineering Mechanics", Springer Science & BusinessMedia, 1986.

ELBS321	Mathematics-III (Probability and Statistics)	3L:1T:0P	4 credits

Unit 1: Basic Probability (12 hours)
Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Unit 2: Continuous Probability Distributions (4 hours)
Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Unit 3: Bivariate Distributions (4 hours)
Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Unit 4: Basic Statistics (8 hours)
Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Unit 5: Applied Statistics (8 hours)
Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Unit 6: Small samples (4 hours)
Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes

Text / References:

1. E. Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons,2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”,Universal Book Stall,2003.
3. S. Ross, “A First Course in Probability”, Pearson Education India,2002.
4. W. Feller, “An Introduction to Probability Theory and its Applications”, Vol. 1,Wiley, 1968.
5. N.P. Bali and M. Goyal, “A text book of Engineering Mathematics”,Laxmi Publications, 2010.
6. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers,2000.
7. T. Veerarajan, “Engineering Mathematics”, Tata McGraw-Hill, New Delhi,2010.

MC-01	Indian Constitution	2L:0T:0P	0 Credits

CONSTITUTION OF INDIA– BASIC FEATURES AND FUNDAMENTAL PRINCIPLES

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950.

The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

COURSE CONTENT

1. Meaning of the constitution law and constitutionalism.
2. Historical perspective of the Constitution of India.
3. Salient features and characteristics of the Constitution of India.
4. Scheme of the fundamental rights.
5. The scheme of the Fundamental Duties and its legal status.
6. The Directive Principles of State Policy – Its importance and implementation.
7. Federal structure and distribution of legislative and financial powers between the Union and the States.
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India

13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

REFERENCES:

1. The Constitutional Law Of India 9th Edition, by Pandey. J. N.
2. The Constitution of India by P.M.Bakshi
3. Constitution Law of India by Narender Kumar
4. Bare Act by P. M. Bakshi

MC-02	Essence of Indian Knowledge Tradition	2L:0T:0P	0 credits

भारतीयविद्यासार

Course objective

The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-I focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

Course Contents

- Basic structure of Indian Knowledge System: अष्टादशविद्या -४वेद,४उपवेद (आयुर्वेद, धनुर्वेद, गन्धर्ववेद, स्थापत्य आदि) ६वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद) ४ उपाङ्ग (धर्मशास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case studies

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, BharatiyaVidyaBhavan, Mumbai. 5thEdition,2014
- Swami Jitatmanand, *Modern Physics and Vedant*, BharatiyaVidyaBhavan
- Swami Jitatmanand, *Holistic Science and Vedant*, BharatiyaVidyaBhavan
- Fritzof Capra, *Tao ofPhysics*
- Fritzof Capra, *The Wave oflife*
- VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad,Arnakulam
- *Yoga Sutra of Patanjali*, Ramakrishna Mission,Kolkata
- GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanamwith VyasaBhashya*, VidyanidhiPrakashan, Delhi2016
- RN Jha, *Science of Consciousness Psychotherapyand Yoga Practices*, VidyanidhiPrakashan, Delhi2016
- P B Sharma (English translation), *ShodashangHridayan*

Pedagogy: Problem based learning, group discussions, collaborative mini projects.

Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

ELPC352	Analog Electronic Circuit Lab	0L:0T:2P	1 Credits

List of Experiments

1. Study the following devices: (a) Analog & digital multimeters (b) Function/ Signal generators (c)Regulated d. c. power supplies (constant voltage and constant current operations) (d) Study ofanalog CRO, measurement of time period, amplitude, frequency & phase angle using Lissajousfigures.
2. Plot V-I characteristic of P-N junction diode & calculate cut-in voltage, reverse Saturation current andstatic & dynamicresistances.
3. PlotV-Icharacteristicofzenerdiodeandstudyofzenerdiodeasvoltageregulator.Observetheeffectofload changes and determine load limits of the voltageregulator.
4. Plot frequency response curve for single stage amplifier and to determine gain bandwidthproduct.
5. Plot drain current - drain voltage and drain current – gate bias characteristics of field effect transistorand measure of Idss&Vp
6. Application of Diode as clipper &clamper
7. Plot gain- frequency characteristic of two stage RC coupled amplifier & calculate its bandwidthand compare it with theoreticalvalue.
8. Plot gain- frequency characteristic of emitter follower & find out its input and outputresistances.
9. Plot input and output characteristics of BJT in CB, CC and CE configurations. Find theirh-parameters.
10. Study half wave rectifier and effect of filters on wave. Also calculate theoretical & practical ripplefactor.
11. Study bridge rectifier and measure the effect of filter network on D.C. voltage output & rippleFactor.
12. To plot the characteristics ofMOSFET.
13. TodeterminethefollowingparametersofOP-AMP.a)InputBiasCurrent.b)InputOffsetCurrent.c)Input Offset Voltage. d) CMRR
14. To plot the frequency response curve of an amplifier with and withoutfeedback
15. To determine the frequency of oscillations of a given RC phase shiftOscillator.
16. Design & realize Wein -bridge oscillator using op amp741.
17. To design & realize zero crossing detector using op amp741

NOTE: At least ten experiments are to be performed; at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

ELPC353	Electrical Machine-1 Lab	0L:0T:2P	1 Credits

List of Experiments

1. To obtain magnetization characteristics of separately excited DC Machine.
2. To obtain magnetization characteristics of self-excited DC Machine.
3. To obtain Load characteristics D.C series generator.
4. To obtain Load characteristics of D.C Shunt Generator.
5. To obtain speed torque, speed current and torque current characteristics of DC shunt motor.
6. Speed control of DC shunt motor.
7. To obtain efficiency of dc machine using Swinburne's Test.
8. To perform polarity test on transformer and also find turn ratio.
9. To perform OC & SC tests on single - phase transformer and draw equivalent circuit.
10. To perform direct load test on single - phase transformer and draw efficiency vs load curve.
11. Sumpner's test on Transformers
12. Scott Connection of Transformers
13. Parallel Operation of Two Single – Phase Transformers.

NOTE: At least ten experiments are to be performed; at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

J.C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 2nd YEAR (ELECTRICAL ENGINEERING) SEMESTER-IV

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Internal Marks	Final Marks	Total	Credits
				L	T	P				
1	PCC	ELPC401	Digital Electronics	3	0	0	25	75	100	3
2	PCC	ELPC402	Electrical Machines – II	3	0	0	25	75	100	3
3	PCC	ELPC403	Power Electronics	3	0	0	25	75	100	3
4	PCC	ELPC404	Signal and Systems	2	1	0	25	75	100	3
5	PEC		Program Elective –I	3	0	0	25	75	100	3
6	MC	MC-03	Environmental Sciences	2	0	0	25	75	100	0
7	PCC	ELPC451	Digital Electronics Lab	0	0	2	15	35	50	1
8	PCC	ELPC452	Electrical Machines Lab– II	0	0	2	15	35	50	1
9	PCC	ELPC453	Power Electronics Lab	0	0	2	15	35	50	1
10	SEC	ELSE461	Electrical Workshop-IV	0	0	4	30	70	100	2
11	SEC	ELSE462	Project-2	0	0	4	15	35	50	2
			Total	**16**	**1**	**14**	**240**	**660**	**900**	**22**

	Course Code	Course Title
Program Elective -1	ELPE411	Electrical Energy Conservation and Auditing
	ELPE412	Industrial Electrical Systems
	ELPE413	Computer Architecture

ELPC401	Digital Electronics	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand working of logic families and logic gates.
2. Design and implement Combinational and Sequential logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. Be able to use PLDs to implement the given logical problem.

Unit 1: Fundamentals of Digital Systems and logic families (7Hours)

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Unit 2: Combinational DigitalCircuits (7Hours)

Standard representation for logic functions, K-map representation, simplification oflogicfunctions using K-map, minimization of logical functions. Don't care conditions, Multiplexer,De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder,serialadder, ALU, elementary ALU design, popular MSI chips, digital comparator,paritychecker/generator, code converters, priority encoders, decoders/drivers for display devices,Q-M method of functionrealization.

Unit 3: Sequential circuits and systems (7Hours)

A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K,Tand D typesflipflops,applicationsofflipflops,shiftregisters,applicationsofshiftregisters,serialto parallel converter, parallelto serial converter, ringcounter, sequence generator,ripple(Asynchronous) counters, synchronous counters, counters design using flipflops,specialcounter IC's, asynchronous sequential counters, applicationsofcounters.

Unit 4: A/D and D/A Converters (7Hours)

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/Dconverterusing Voltage to frequency and voltage to timeco n version, specifications of A/D converters, example of A/D converterICs

Unit 5: Semiconductor memories and Programmable logic devices. (7Hours) Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array(FPGA).

Text/References:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education,2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India,2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India,2016.

ELPC402	Electrical Machines – II	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of rotating magnetic fields.
2. Understand the operation of ac machines.
3. Analyse performance characteristics of ac machines.

Unit: Fundamentals of AC machine windings (8 Hours)

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single- turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding - concentrated and distributed, Sinusoidally distributed winding, winding distribution factor

Unit 2: Pulsating and revolving magnetic fields (4 Hours)

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternatingcurrent

Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Unit 3: Induction Machines (12 Hours)

Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque.Equivalentcircuit.Phasor Diagram, Losses and Efficiency. Effectofparameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors.Generator operation. Self-excitation.Doubly-Fed Induction Machines.

Unit 4: Single-phase induction motors (6 Hours)

Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

Unit 5: Synchronous machines (10 Hours)

Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves.Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics.Parallel operation of alternators - synchronization and load division.

Text/References:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education,2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers,2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers,2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education,2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education,1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley &Sons, 2007.

ELPC403	Power Electronics	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the differences between signal level and power level Devices.
2. Analyse controlled rectifier circuits.
3. Analyse the operation of DC-DC choppers.
4. Analyse the operation of voltage source inverters.

Unit 1: Power switching devices (8Hours)

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

Unit 2: Thyristor rectifiers (7Hours)

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; Input current wave shape and power factor.

Unit 3: DC-DC buck converter (5Hours)

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 outputvoltage.

Unit 4: DC-DC boost converter (5Hours)

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

Unit 5: Single-phase voltage source inverter (10Hours)

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 6: Three-phase voltage source inverter (8Hours)

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation

Text/References:

1. M. H. Rashid, "*Power electronics: circuits, devices, and applications*", Pearson Education India,2009.
2. N.MohanandT.M.Undeland,"PowerElectronics:Converters,ApplicationsandDesign", John Wiley & Sons,2007.
3. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics",Springer Science & Business Media,2007.
4. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India,2009.

ELPC404	Signals and Systems	2L:1T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of continuous time and discrete time systems.
2. Analyse systems in complex frequency domain.
3. Understand sampling theorem and its implications.

Unit 1: Introduction to Signals and Systems (3 hours):

Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

Unit 2: Behavior of continuous and discrete-time LTI systems (8 hours)

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations.State-space Representation of systems.State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Unit 3: Fourier, Laplace and z- Transforms (10 hours)

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Unit 4: Sampling and Reconstruction (4 hours)

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects.Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback controlsystems.

Text/References:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “Signals and systems”, PrenticeHall India,1997.
2. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms,and Applications”, Pearson,2006.
3. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education,2010.
4. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons,2007.
5. A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall, 2009.
6. M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education,2007.
7. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press,2009.

ELPE411	Electrical Energy Conservation and Auditing	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the current energy scenario and importance of energy conservation.
2. Understand the concepts of energy management.
3. Understand the methods of improving energy efficiency indifferent electrical systems.
4. Understand the concepts of different energy efficientdevices.

Unit 1: Energy Scenario (6 Hours)

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Unit 2: Basics of Energy and its various forms (7 Hours)

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units andconversion.

Unit 3: Energy Management & Audit (6 Hours)

Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Unit 4: Energy Efficiency in Electrical Systems (7 Hours)

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficientmotors.

Unit 5: Energy Efficiency in Industrial Systems (8 Hours)

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

Unit 6: Energy Efficient Technologies in Electrical Systems (**8Hours**)

Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Text/Reference Books

1. Guide books for National Certification Examination for Energy Manager / EnergyAuditors Book-1, General Aspects (availableonline)
2. Guide books for National Certification Examination for Energy Manager / EnergyAuditors Book-3, Electrical Utilities (availableonline)
3. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill,1991.
4. Success stories of Energy Conservation by BEE, New Delhi(www.bee-india.org)

ELPE412	Industrial Electrical Systems	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbolsand drawings, SLD.
2. Understand various components of industrial electricalsystems.
3. Analyze and selectthe proper size of various electrical systemcomponents.

Module 1: Electrical System Components (8 Hours)

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

Module 2: Residential and Commercial Electrical Systems (8 Hours)

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.

Module 3: Illumination Systems (6 Hours)

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.

Module 4: Industrial Electrical Systems I (8 Hours)

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.

Module 5: Industrial Electrical Systems II (6 Hours)

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

Module 6: Industrial Electrical System Automation (6 Hours)

Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Text/Reference Books

S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating &Costing”, Khanna publishers, 2008.

K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.

S. Singh and R. D. Singh, “Electrical estimating and costing”, DhanpatRai and Co., 1997.

Web site for IS Standards.

H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.

ELPE413	Computer Architecture	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of microprocessors, their principles andpractices.
2. Write efficient programs in assembly language of the 8086 family of microprocessors. Organize a modern computer system and be able to relate it to realexamples.
3. Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protectedmodes.
4. Implement embedded applications using ATOMprocessor.

Unit 1: Introduction to computer organization (6 hours)

Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization.

Unit 2: Memory organization (6 hours)

System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

Unit 3: Input – output Organization (8 hours)

Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

Unit 4: 16 and 32 microprocessors (8 hours)

80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86

Unit 5: Pipelining(8 hours)

Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set.

Unit 6: Different Architectures (8 hours)

VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming

Text/Refence Books

1. V. Carl, G. Zvonko and S. G. Zaky, **"**Computer organization**"**, McGraw Hill,1978.
2. B. Brey and C. R. Sarma, **"**The Intel microprocessors**"**, Pearson Education,2000.
3. J. L. Hennessy and D. A. Patterson, **"**Computer Architecture A Quantitative Approach**"**, Morgan Kauffman,2011.
4. W. Stallings, **"**Computer organization**"**, PHI,1987.
5. P. Barry and P. Crowley, **"**Modern Embedded Computing**"**, Morgan Kaufmann,2012.
6. N. Mathivanan, **"**Microprocessors, PC Hardware and Interfacing**"**, Prentice Hall,2004.
7. Y. C. Lieu and G. A. Gibson, **"**Microcomputer Systems: The 8086/8088 Family**"**, Prentice Hall India, 1986.
8. J. Uffenbeck, **"**The 8086/8088 Design, Programming, Interfacing**"**, Prentice Hall,1987.
9. B. Govindarajalu, **"**IBM PC and Clones**"**, Tata McGraw Hill,1991.
10. P. Able, **"**8086 Assembly Language Programming**"**, Prentice HallIndia.

MC-03	Environmental Sciences	2L:0T:0P	0 credits

Course Objectives:

The prime objective of the course is to provide the students a detailed knowledge on the threats and challenges to the environment due to developmental activities. The students will be able to identify the natural resources and suitable methods for their conservation and sustainable development. The focus will be on awareness of the students about the importance of ecosystem and biodiversity for maintaining ecological balance. The students will learn about various attributes of pollution management and waste management practices. The course will also describe the social issues both rural and urban environment and environmental legislation

MODULE-1: The Multidisciplinary Nature of Environmental Studies

Definition, scope and importance. Need for public awareness.

MODULE-2: Natural Resources: Renewable and Non-Renewable

Resources Natural resources and associated problems:

Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
Mineral resources: Use and exploitation, environmental effects of extracting and mineral resources, case studies.
Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
Energy resources: Growing energy needs, renewable and non- renewable energy sources, use of alternate energy sources. Case studies.

Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
Role of an individual in conservation of natural resources.Equitable use of resources for sustainable lifestyles.

MODULE-3: Ecosystems

Concept of an ecosystem.Structure and function of an ecosystem.Producers, consumers and decomposers.
Energy flow in the ecosystem.Ecological succession.Food chains, food webs and ecological pyramids.
Introduction, types, characteristic features, structure and function of the following ecosystem: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

MODULE-4: Biodiversity and its Conservation

Introduction – Definition: genetic, species and ecosystem diversity.

Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels.

India as a mega-diversity nation.Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India.

Conservation of biodiversity: insitu and ex-situ conservation of biodiversity

MODULE-5: Environmental Pollution Definition

Causes, effects and control measures of: Air pollution b) Water pollution c) Soil pollution d) Marine pollution e) Noise pollution f) Thermal pollution g) Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban andindustrial wastes. Role of an individual in prevention of pollution.Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.

MODULE-6: Social Issues and the Environment

From Unsustainable to Sustainable development Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns.Case studies.

Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.Wasteland reclamation.Consumerism and waste products.

Environment Protection Act.Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act

Wildlife Protection Act.Forest Conservation Act. Issues involved in enforcement of environmental legislation Public awareness.

MODULE-7: Human Population and the Environment

Population growth, variation among nations.Population explosion – Family Welfare Programme.Environment and human health.Human Rights.Value Education.HIV/AIDS.Women and Child Welfare.Role of Information Technology in Environment and human health.Case Studies.

MODULE-8: Field Work

Visit to a local area to document environmental assets-river / forest / grassland / hill / mountain.

Visit to a local polluted site – Urban / Rural / Industrial / Agricultural. Study of common plants, insects, birds.

Study of simple ecosystems – pond, river, hill slopes, etc.

Course Outcomes:

RERERENCES

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela 2008 PHI Learning Pvt Ltd.
3. Environmental Science by Daniel B. Botkin& Edwards A. Keller, Wiley INDIA edition.
4. Fundamentals of Ecology by Odum, E.P., Barrick, M. and Barret, G.W. Thomson Brooks/Cole Publisher, California, 2005.

ELPC451	Digital Electronics Lab	0L:0T:2P	1 credits

Hands-on experiments related to the course contents of **ELPC401**

List of Experiments

1. Study of TTL gates – AND, OR, NOT, NAND, NOR, EX-OR,EX-NOR.
2. Design & realize a given function using K-maps and verify its performance.
3. To verify the operation of multiplexer & Demultiplexer.
4. To verify the operation of comparator.
5. To verify the truth tables of S-R, J-K, T & D type flipflops.
6. To verify the operation of bi-directional shift register.
7. To design & verify the operation of 3-bit synchronous counter.
8. To design and verify the operation of synchronous UP/DOWN decade counter using J K flip-flops & drive a seven-segment display using the same.
9. To design and verify the operation of asynchronous UP/DOWN decade counter using J K flip-flops & drive a seven-segment display using the same.
10. To design & realize a sequence generator for a given sequence using J-Kflip-flops.
11. Study of CMOS NAND & NOR gates and interfacing between TTL and CMOSgates.
12. Design a 4-bit shift-register and verify its operation . Verify the operation of a ring counter and a Johnson counter.

NOTE : At least ten experiments are to be performed, at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

ELPC452	Electrical Machine-II Lab	0L:0T:2P	1 credits

Hands-on experiments related to the course contents of **ELPC402**

List of Experiments

1. To study starting methods of induction motors.
2. Determination of the effect of rotor resistance on the torque speed curve.
3. Load test on 3 - phase squirrel cage induction motor.
4. Load test on 3 - phase slip ring induction motor.
5. No load and Blocked rotor test on 3 - phase induction motor.
6. Effect of capacitor on the starting and running of single phase induction motor and method of reversing the direction of rotation.
7. Brake test on single - phase induction motor
8. Determination of Equivalent Circuit of Single - Phase Induction Motor
9. To determine voltage regulation of alternator by direct loading.
10. Determination of regulation of an alternator by emf method.
11. Determination of regulation of an alternator by ZPF method.
12. To determine Xd and Xqofa salient pole synchronous machine by slip test.
13. To determine sub transient reactance (Xd'' and Xq'') of synchronous machine.
14. Determination of negative sequence and zero sequence reactance os a synchronous generator.
15. To perform parallel operation of alternators using dark lamp method.
16. To plot V-curve and invert V-curve of synchronous motor.

NOTE: Atleast ten experiments are to be performed; atleast seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

ELPC453	Power Electronics Lab	0L:0T:2P	1 credits

Hands-on experiments related to the course contents of **ELPC403.**

List of Experiments

1. To plot characteristics of Diode , Thyristor and Triac.
2. To plot characteristics of Transistor and MOSFET.
3. To Use R and R-C firing circuits , UJT firing circuit.
4. Study of complementary voltage commutation using a lamp flasher , Ring Counter.
5. Study of Thyristorised DC circuit breaker.
6. Study of AC voltage Regulator.
7. Study of full wave Converter.
8. Study of DC chopper.
9. Study of Series Inverter.
10. Study of Bridge Inverter.
11. Study of Single phase Cycloconverter

NOTE : At least ten experiments are to be performed, at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD

NEW SCHEME OF STUDIES AND EXAMINATION

B-TECH 3rd YEAR (ELECTRICAL ENGINEERING) SEMESTER-V

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Internal Marks	End Sem	Total	Cr.
				L	T	P				
1	PCC	ELPC501	Power Systems – I (Apparatus and Modelling)	3	0	0	25	75	100	3
2	PCC	ELPC502	Control Systems	3	0	0	25	75	100	3
3	PCC	ELPC503	Microprocessors	3	0	0	25	75	100	3
4	BSC	BSC-01 (Common to all)	Biology	2	1	0	25	75	100	3
5	PEC		Program Elective –II	3	0	0	25	75	100	3
6	OEC		Open Elective –I	3	0	0	25	75	100	3
7	PCC	ELPC551	Power Systems Lab-1	0	0	2	15	35	50	1
8	PCC	ELPC552	Control Systems Lab	0	0	2	15	35	50	1
9	PCC	ELPC553	Microprocessors Lab	0	0	2	15	35	50	1
10	SEC	ELSE561	Electrical Workshop-V	0	0	4	30	70	100	2
11	SEC	ELSE562	Project-3	0	0	4	15	35	50	2
			Total	**17**	**1**	**14**	**240**	**660**	**900**	**25**

	Course Code	Course Title
Program Elective –II	ELPE511	Line Commutated and Active PWM Rectifiers
	ELPE512	Electrical Machine Design
	ELPE513	Electromagnetic Waves

ELPC501	Power Systems-1 (Apparatus & Modelling)	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of powersystems.
2. Understand the various power systemcomponents.
3. Evaluate fault currents for different types offaults.
4. Understand the protection against over-voltages and insulation coordination. Understand basic protection schemes.
5. Understand concepts of dc power transmission and renewable energy systems

Unit 1: Basic Concepts (4 hours)

Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids.

Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources.Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Power Transfer in AC circuits and Reactive Power.

Unit 2: Power System Components (15 hours)

Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines.

Loads: Types, Voltage and Frequency Dependence of loads,Per Unit System and Per Unit Calculations

Unit 3: Over-voltages and Insulation Requirements (4 hours)

Protection against Over-voltages, Insulation Coordination.

Unit 4: Fault Analysis and Protection Systems (10 hours)

Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding

Switchgear: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection.

Protection schemes (Over-current, directional, distance protection, differential protection) and their application.

Unit5: Introduction to DC Transmission and Renewable energy systems (9 hours)

HVDC transmission: types of links; Introduction to solar PV systems

Text/References:

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education,1994.
2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education,1995.
3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc.,1999.
4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education,2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric PowerSystems”, Wiley, 2012.

ELPC551	Power Systems-I Lab	0L:0T:2P	1 credits

Hands-on experiments related to the course contents of ELPC-501. Visits to power system installations (generation stations, EHV substations etc.) are suggested.

ELPC502	Control Systems	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will be able to

1. Understand the modeling of linear-time-invariant systems using transfer function and state- space representations.
2. Design specifications for second order systems based on time response.
3. Interpret the Concept of stability and its assessment for linear-time invariant systems using various methods.
4. Design controllers in time and frequency domain.
5. Explain the basic concept of optimal and non linear control systems.

Unit 1: Introduction to control problem (8 hours)

Industrial Control examples, Mathematical models of physical systems, Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback, Transfer Function of control system, impulse response and its relation with transfer function of linear systems. Transfer function from Block diagram reduction technique and signal flow graph, Mason's gain formula.

Unit 2: Time Response Analysis (6 hours)

Standard test signals, Time response of first and second order systems for standard test inputs, Application of initial and final value theorem, Design specifications for second-order systems based on the time-response. Concept of Stability, Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique, Construction of Root-loci

Unit 3: Frequency-response analysis (6 hours)

Relationship between time and frequency response, Polar plots, Bode plots, Nyquist stability criterion, Relative stability using Nyquist criterion – gain and phase margin, Closed-loop frequency response.

Unit 4: Introduction to Controller Design (10 hours)

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems, Root-loci method of feedback controller design, Design specifications in frequency-domain, Frequency-domain methods of design, Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs, Analog and Digital implementation of controllers.

Unit 5: State Variable Analysis of Linear Dynamic Systems (4 hours)

State variables, State variable representation of system, dynamic equations, merits for higher order differential equations and solution, Concept of controllability and observability and techniques to test them

Unit 6: Introduction to Optimal Control and Nonlinear Control (5 hours)

Performance Indices, Regulator problem, Tracking Problem., Nonlinear system–Basic concepts and analysis

Text/References:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.
3. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.

I. J. Nagrath and M.Gopal, "Control Systems Engineering", New Age International, 2009

ELPC552	**Control Systems Lab**	**0L:0T:2P**	**3 credits**

Hands-on/Computer experiments related to the course contents of ELPC502.

ELPC503	Microprocessors	3– 0–0	3 Credits

Course Outcomes: At the end of the course the student will be able to:

CO1	Understand the basic architecture of 8086 microprocessor.
CO2	Write assembly language programs to perform a given task.
CO3	Write interrupt service routines for all interrupt types
CO4	Interface memory and I/O devices to 8086 using peripheral devices
CO5	Write microcontroller programs and interface devices

Detailed syllabus

UNIT-I Introduction: Evolution of Microprocessors, Internal Architecture of 8085/8086, BIU and EU, Registers in of 8085/8086, Memory segmentation

UNIT-II Instruction sets and Addressing modes: Addressing modes-register related, Addressing modes-memory related, Instruction formats, Instruction set of 8086-functional groups, Assembler Directives, assembly language programming.

UNIT-III Pin and timing diagrams of 8086: Pin diagram of 8086 in minimum mode & Maximum mode configuration, Timing diagram of typical read write instructions.

UNIT-IV Interrupts- Steps in interrupt process, Interrupt structure in 8086, Internal and external interrupts-interrupt service routines.

UNIT-V Interfacing the microprocessor- Interfacing of I/O devices, Interfacing I/O-programmable peripheral interface-8255, Interfacing of multi digit seven segment display, Interfacing timer-Programmable interval timer-8254.

UNIT-VI Serial interface and data converters-USART 8251, Serial interface standards-RS 232 C and RS -485, Interfacing of ADCs and DACs,

UNIT-VII Microcontrollers- Introduction to Microcontroller, 8051 Microcontroller, memory and I/ O organization, Applications of Microcontroller.

Reading:

1. Douglas V. Hall : Microprocessors and Interfacing, TMH-Revised Second Edition, 2005
2. A.K. Ray & Burchandi: Advanced Microprocessors and Peripherals, TMH, 2003.

Ajay V. Deshmukh: Microcontrollers –Theory and Applications, TMH, 2009.

ELPC553	Microprocessors Laboratory	0L:0T:2P	1 credits

Hands-on experiments related to the course contents of ELPC503

BSC-01	Biology	2L:1T:0P	3 credits

MODULE 1: INTRODUCTION

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physicsand Chemistry.

Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

MODULE 2: CLASSIFICATION

Purpose: To convey that classificationper seis not what biology is all about. The underlyingcriterion, such as morphological, biochemical or ecological be highlighted.

Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata-acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. Musculus.

MODULE 3: Genetics

Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences"

Mendel's laws, Concept of segregation and independent assortment. Concept of allele.Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring.Concepts of recessiveness and dominance.Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

MODULE 4: BIOMOLECULES

Purpose: To convey that all forms of life has the same building blocks and yet themanifestations are as diverse as one can imagine

Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA.Two carbon units and lipids.

MODULE 5: ENZYMES

Purpose: To convey that without catalysis life would not have existed on earth.

Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalysereactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

MODULE 6: INFORMATION TRANSFER

Purpose: The molecular basis of coding and decoding genetic information is universal

Molecular basis of information transfer.DNA as a genetic material. Hierarchy of DNA structure-from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

MODULE 7: MACROMOLECULAR ANALYSIS

Purpose: How to analyse biological processes at the reductionist level

Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

MODULE 8: METABOLISM

Purpose: The fundamental principles of energy transactions are the same in physical andbiological world.

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of K_{eq} and its relation to standard free energy. Spontaneity.ATP as an energy currency. This should include the breakdown of glucose to CO_2 + H_2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy Charge.

MODULE 9: MICROBIOLOGY

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

Course Outcomes:

After studying the course, the student will be able to:

1. Describe how biological observations of 18_{th} Century that lead to major discoveries.
2. Convey that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological
3. Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring
4. Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine
5. Classify enzymes and distinguish between different mechanisms of enzyme action.
6. Identify DNA as a genetic material in the molecular basis of information transfer.

7. Analyse biological processes at the reductionist level
8. Apply thermodynamic principles to biological systems.
9. Identify and classify microorganisms.

REFERENCES

1. "Biology: A global approach" Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. "Outlines of Biochemistry" , Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons
3. "Principles of Biochemistry (V Edition)", By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. "Molecular Genetics (Second edition)", Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. "Microbiology" , Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

ELPE512	Electrical Machine Design	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will be able to

1. Understand the construction and performance characteristics of electrical machines.
2. Analyze the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
3. Estimate the overall dimensions and operating characteristics of AC/DC machines
4. Explain the concept of computer aided design CAD and optimal design of electrical machines

Unit 1: Introduction

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

Unit 2: Transformers

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

Unit 3: Induction Motors

Sizing of an induction motor, main dimensions, output equation, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

Unit 4: Synchronous Machines

Sizing of a synchronous machine, main dimensions, output equation, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design, cooling of turbo alternators.

Unit-5: DC Machines

Sizing of a direct current machine, main dimensions, output equation, selection of number of poles, core length, armature diameter, Length of air gap, Choice of armature winding, number of armature coils, number of armature slots, slot dimensions, Armature voltage drop, depth of armature core, design of field system, Design of commutator

Unit 6: **Computer aided Design (CAD):**

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to **c**omplex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Text / References:

1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons,1970.
2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.
3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing,2006.
4. K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan,1969.
5. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International,1979.
6. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications,2008.
7. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

ELPE511	Line-Commutated and Active PWM Rectifiers	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Analyse uncontrolled rectifier circuits with various types of loading
- Differentiate the working of different types of line commutated thyristor rectifiers
- Analyse the multi pulse converters and their working
- Examine the output voltage control of rectifier using PWM control
- Evaluate various performance parameters of DC to AC converter and understand their working
- Apply the concept of basic DC to Dc converter in working of isolated DC power supplies

Module 1: Diode rectifiers with passive filtering (6 Hours)

Single phase Half-wave diode rectifier with R Load, RL Load and RC loads, Performance parameter of half wave diode rectifier, single phase full-wave diode rectifier with R load ,RL load and RC loads performance parameters, continuous and discontinuous conduction 3-phase diode rectifier;, input current wave shape, effect of source inductance; commutation overlap.

Module 2: Thyristor rectifiers(6 Hours)

Principle of phase controlled converter operation, single phase Half-wave thyristor rectifier with R load and RL load, performance parameter, 1-phase Full wave thyristor rectifier with R and RL load, thyristor rectifier in inverting mode, Rectification and regenerating modes ,continuous and discontinuous conduction, input current wave shape, Single phase dual converter

Module 3: Multi-Pulse converter (6 Lectures)

3-phase thyristor rectifier, Review of transformer phase shifting,6- pulse converter and 12-pulse converters with inductive loads, output voltage equation

Module 4: Pulse Width Modulated rectifier(6 Hours)

Power factor improvement of controlled rectifier, Pulse width modulated rectifier, power circuit of single-switch ac-dc converter, Single phase sinusoidal pulse width modulation, Three phase PWM rectifier

Module 5: DC to AC converter (6 Hours)

Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase dc to ac converter, performance parameters,3-phase ac-dc converter, Pulse Width Modulated inverter, Single and multiple pulse width modulation, sinusoidal pulse width modulation

Module 6: Isolated single-phase dc-dc fly back converter (10 Hours)

Review of DC to DC converters, Advantages of SMPS over linear power supplies, dc-dc fly back converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of dc-dc forward converter, push pull converter,

Reference/Text Books

1. Rashid "Power Electronics" Prentice Hall India 2007.
2. G. De, "Principles of Thyristorised Converters", Oxford & IBH Publishing Co,1988.
3. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison-Wesley,1991.
4. L. Umanand, " Power Electronics: Essentials and Applications", Wiley India,2009.
5. N. Mohan and T. M. Undeland, " Power Electronics: Converters, Applications and Design", John Wiley & Sons,2007.

ELPE513	Electromagnetic waves	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Analyse transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
- Provide solution to real life plane wave problems for various boundary conditions.
- Analyse the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
- Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide.
- Understand and analyze radiation by antennas.

Module 1: Transmission Lines (6 hours)

Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

Module 2: Maxwell's Equations (6 hours)

Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.

Module 3: Uniform Plane Wave (7 hours)

Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.

Module 4: Plane Waves at Media Interface (7 hours)

Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.

Module 5: Waveguides (7 hours)

Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides.

Module 6: Antennas (7 hours)

Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertz dipole, Near field, Far field, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode.

Text/Reference Books

1. R. K. Shevgaonkar, **"**Electromagnetic Waves**"**, Tata McGraw Hill,2005.
2. D. K. Cheng, " Field and Wave Electromagnetics**"**, Addison-Wesley,1989.
3. M. N.O. Sadiku, " Elements of Electromagnetics**"**, Oxford University Press,2007.
4. C. A. Balanis, " Advanced Engineering Electromagnetics", John Wiley & Sons,2012.
5. C. A. Balanis, " Antenna Theory: Analysis and Design**"**, John Wiley & Sons,2005.

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 3rd YEAR (ELECTRICAL ENGINEERING) SEMESTER-VI

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Internal Marks	Final Marks	Total	Credits
				L	T	P				
1	PCC	ELPC601	Power System-II (Operation and Control)	3	0	0	25	75	100	3
2	PCC	ELPC602	Electrical Measurements and Instrumentation	2	0	0	25	75	100	2
3	PCC	ELPC603	Electronics Design	1	0	0	25	75	100	1
4	PEC		Program Elective-III	3	0	0	25	75	100	3
5	PEC		Program Elective-IV	3	0	0	25	75	100	3
6	OEC		Open Elective –II	3	0	0	25	75	100	3
7	PCC	ELPC651	Power System Lab –II	0	0	2	15	35	50	1
8	PCC	ELPC652	Electrical Measurements and Instrumentation Lab	0	0	2	15	35	50	1
9	PCC	ELPC653	Electronics Design Lab	0	0	4	15	35	50	2
10	SEC	ELSE661	Electrical Workshop-VI	0	0	4	30	70	100	2
11	SEC	ELSE662	Seminar	0	0	1	50	0	50	1
12	SEC	ELSE663	Project-4	0	0	4	15	35	50	2
13	VAC	ELVC670	Social Work*	-	-	-	50	-	50	2
			Total	**15**	**0**	**17**	**340**	**660**	**1000**	**26**

	Course Code	Course Title
Program Elective –III	ELPE611	Electrical Drives
	ELPE612	Electrical and Hybrid Vehicles
	ELPE613	Digital Signal Processing
Program Elective –IV	ELPE614	Wind and Solar Energy System
	ELPE615	Computational Electromagnetics
	ELPE616	Digital Control Systems

* At least one day in fortnight

ELPC601	Power Systems – II	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Use numerical methods to analyse a power system in steady state.
2. Understand stability constraints in a synchronous grid.
3. Understand methods to control the voltage, frequency and powerflow.
4. Understand the monitoring and control of a power system.
5. Understand the basics of power system economics.

Unit 1: Power Flow Analysis (7 hours)

Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of non- linear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.

Unit 2: Stability Constraints in synchronous grids (8 hours)

Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three--phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4^{th}order methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.

Unit 3: Control of Frequency and Voltage (7 hours)

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Power flow control using embedded dc links and phase shifters

Unit 4: Monitoring and Control (6 hours)

Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State- estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control.

Unit 5: Power System Economics and Management (7 hours)

Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services. Regulatory framework.

Text/References:

1. J.GraingerandW.D.Stevenson,"PowerSystemAnalysis",McGrawHillEducation, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education,1995.
3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc.,1999.
4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
5. B.M. Weedy, B.J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley,2012.

ELPC651	Power Systems– II Lab	0L:0T:2P	1 credits

Hands-on and computational experiments related to the course contents of ELPC601. This should include programming of numerical methods for solution of the power flow problem and stability analysis. Visit to load dispatch centre is suggested.

ELPC602	Electrical Measurements and Instrumentation	2L:0T:0P	2 credits

Course outcomes: At the end of this course, the students will be able to:

1. Learn about various measurement instruments for measurement of Voltage, Current, Power, Power Factor & Frequency, their construction, operating principle, limitations, etc.;
2. Understand statistical data analysis & errors in instruments;
3. Analyse the static characteristics of instruments
4. Understand the measurement of parameters & variables with the help of D.C. & A.C. bridges.
5. Analyze the concept and applications of sensors and transducers

UNIT- I- Fundamental Concepts Relating to Measurements: Standards, True Value, Static Characteristic of Instruments (Accuracy, Precision, Resolution, Threshold, Sensitivity, Drift, Hysteresis & Dead-band, Dead Time); Classification of Instruments (Absolute & Secondary Instruments; Indicating, Recording & Integrating instruments); Generalized Instrument (Block diagram, description of blocks); Three forces in Electromechanical indicating instruments; Comparison of damping methods & their suitability; Scale information.
Errors in Measurements (Gross, Systematic, Random); Basic statistical analysis applied to measurements: Mean, standard deviation, Six-sigma estimation, C_p, C_{pk}.

UNIT- II- Measuring Instruments For Voltage & Current: Construction, Operating Principle, torque equation, Shape of scale, use as Ammeter or as Voltmeter (Extension of Range), Use on AC/DC or both, Advantages & disadvantages, Errors (Both on AC/DC) of PMMC types, Electrodynamic Type, Moving iron type (attraction, repulsion & combined types), & Induction type instruments

UNIT- III - Wattmeters Power Factor & Frequency Meters: Construction, operating principle, Torque equation, Shape of scale, Errors, Advantages & Disadvantages of Electro-dynamic& Induction type Wattmeters; Construction, operation, principle, Torque equation, Advantages & disadvantages of Single phase power factor meters (Electro-dynamic& Moving Iron types) & Frequency meters (Electrical Resonance Type: Ferro dynamic & Electro-dynamic types).

UNIT- IV - Measurement of Resistances (Medium, Low & High): Voltmeter-ammeter method & Substitution Method for medium range resistance measurement; Limitations of Wheatstone bridge; Four-terminal resistance; Kelvin's double bridge method for low resistance measurement, Difficulties in high resistance measurements; Measurement of high resistance by direct deflection & loss of charge methods, Meggar.

UNIT- V - Measurement of Inductance (L), Capacitance (C) & Frequency by A.C. Bridges: General balance equation, Circuit diagram, Phasor diagram, Advantages, disadvantages, applications of Maxwell's inductance-capacitance, Hays, Owens, Schering &Wein's bridges. Clamp on meter, Digital Storage Oscilloscope.

UNIT- VI - Sensors and Transducers: Sensors and Transducers for Physical parameters, temperature, pressure, torque, flow, speed and position sensors

TEXT BOOK/REFERENCE BOOKS:

1. A Course in Elect. & Electronic Measurements & Instrumentation by A. K. Sawhney; Khanna Pub.
2. Dr. J.S. Saini, "A Textbook on Measurements & Instrumentation (With Experiments)"; Pub.: New Age International, New Delhi.
3. Electrical Measurements by E.W. Golding & F.C. Widdis; Pub.: Reem Publications
4. Electronic Instrumentation & Measurement Technique, W.D. Cooper & A.D. Helfrick; Pub.: Prentice Hall
5. Measuring Systems by Ernest O. Doebelin & Dhanesh N. Manik; Pub.: McGraw Hill

ELPC652	Electrical Measurements and Instrumentation Lab	0L:0T:2P	1 credits

Hands-on experiments related to the course contents of ELPC602

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ELPC603	Electronics Design	1L:0T:0P	1 credits

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Understand the practical issues related to practical implementation of applications using electronic circuits.
2. Choose appropriate components, software and hardwareplatforms.
3. Design a Printed Circuit Board, get it made and populate/solder it with components. Work as a team with other students to implement an application.

Unit 1:Basic concepts on measurements; Noise in electronic systems; Sensors and signal conditioning circuits;

Unit 2: Introduction to electronic instrumentation and PC based data acquisition;

Unit 3: Electronic system design, Analog system design, Interfacing of analog and digital systems,

Unit 4 :Embedded systems, Electronic system design employing microcontrollers, CPLDs, and FPGAs, PCB design and layout; System assembly considerations. Group projects involving electronic hardware (Analog, Digital, mixed signal) leading to implementation of an application.

Text/Reference Books

1. A. S. Sedra and K. C. Smith, "Microelectronic circuits", Oxford University Press,2007.
2. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press,1997.
3. H.W.Ott, "Noise Reduction Techniques in Electronic Systems", Wiley,1989.
4. W.C. Bosshart, "Printed Circuit Boards: Design and Technology", Tata McGrawHill, 1983.
5. G.L. Ginsberg, "Printed Circuit Design", McGraw Hill, 1991.

ELPC653	Electronics Design Lab	0L:0T:4P	2 credits

Hands-on experiments related to the course contents of ELPC603

ELPE611	Electrical Drives	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the characteristics of dc motors and inductionmotors.
2. Understand the principles of speed-control of dc motors and inductionmotors.
3. Understand the power electronic converters used for dc motor and induction motor speedcontrol.

Unit 1: DC motor characteristics (5 hours)

Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux weakening for high speed operation.

Unit 2: Chopper fed DC drive (5 hours)

Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting.

Unit 3: Multi-quadrant DC drive (6 hours)

Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking.

Unit 4: Closed-loop control of DC Drive (6 hours)

Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design.

Unit 5: Induction motor characteristics (6 hours)

Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation.

Unit 6: Scalar control or constant V/f control of induction motor (6 hours)

Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.

Unit 7: Control of slip ring induction motor (6 hours)

Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery.

Text / References:

1. G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall,1989.
2. R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, PrenticeHall, 2001.
3. G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press,2002.
4. W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media,2001.

ELPE612	Electrical and Hybrid Vehicles	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the models to describe hybrid vehicles and their performance.
2. Understand the different possible ways of energystorage.
3. Understand the different strategies related to energy storagesystems.

Unit 1: Introduction (10 hours)

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

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.

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.

Unit 2: Electric Trains (10 hours)

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. 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.

Unit 3: Energy Storage (10 hours)

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. 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

Unit 4: Energy Management Strategies (9 hours)

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).

References:

1. C.Mi,M.A.MasrurandD.W.Gao,"HybridElectricVehicles:PrinciplesandApplicationswith Practical Perspectives", John Wiley & Sons,2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: EnergyManagement Strategies", Springer,2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press,2004.
4. T. Denton, "Electric and Hybrid Vehicles", Routledge,2016.

ELPE613	Digital Signal Processing	3L:0T:0P	3 credits

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Represent signals mathematically in continuous and discrete-time, and in the frequency domain.
2. Analyse discrete-time systems using z-transform.
3. Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms. Design digital filters for various applications.
4. Apply digital signal processing for the analysis of real-life signals.

Unit 1: Discrete-time signals and systems (6hours)

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

Unit 2: Z-transform (6 hours)

Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z- transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

Unit 3: Discrete Fourier Transform (10 hours)

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Connvolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

Unit 4:Design of Digital filters (12 hours)

Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band-stop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

Unit 5: Applications of Digital Signal Processing (6 hours)

Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

Text/Reference Books:

1. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill,2011.
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall,1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall,1997.
4. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", PrenticeHall, 1992.
5. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall,1992.
6. D. J. DeFatta, J. G. Lucas andW. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons, 1988.

ELPE614	Wind and Solar Energy Systems	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. Understand the basic physics of wind and solar power generation.
3. Understand the power electronic interfaces for wind and solar generation.
4. Understand the issues related to the grid-integration of solar and wind energy systems.

Unit 1: Physics of Wind Power: (5 Hours)

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Unit 2: Wind generator topologies: (12 Hours)

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent- Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Unit 3: The Solar Resource: (3 Hours)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Unit 4: Solar photovoltaic: (8 Hours)

Technologies-Amorphous, mono-crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Unit 5: Network Integration Issues: (8Hours)

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Unit 6: Solar thermal power generation: (3 Hours)

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Text / References:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd.,2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems**",** John Wiley and Sons,2004.
3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill,1984.
4. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd.,2006.
5. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications,2004.
6. J.A.DuffieandW.A.Beckman,"SolarEngineeringofThermalProcesses",JohnWiley&Sons, 1991.

ELPE615	Computational Electromagnetics	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the basic concepts of electro-magnetic.
2. Understand computational techniques for computing fields.
3. Apply the techniques to simple real-life problems.

Unit 1: Introduction (6 hours)

Conventional design methodology, Computer aided design aspects – Advantages. Review of basic fundamentals of Electrostatics and Electromagnetics. Development of Helmhotz equation, energy transformer vectors- Poynting and Slepian, magnetic Diffusion-transients and time-harmonic.

Unit 2: Analytical Methods (6 hours)

Analytical methods of solving field equations, method of separation of variables, Roth's method, integral methods- Green's function, method of images.

Unit 3: Finite Difference Method (FDM) (7 hours)

Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method- Uniqueness and convergence.

Unit 4: Finite Element Method (FEM) (7 hours)

Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

Unit 5: Special Topics(7 hours)

{Background of experimental methods-electrolytic tank, R-C network solution, Field plotting (graphical method)}, hybrid methods, coupled circuit - field computations, electromagnetic - thermal and electromagnetic - structural coupled computations, solution of equations, method of moments, Poisson's fields.

Unit 6: Applications (7 hours)

Low frequency electrical devices, static / time-harmonic / transient problems in transformers, rotating machines, actuators.CAD packages.

Text/Reference Books

2. P. P. Silvester and R. L. Ferrari "Finite Element for Electrical Engineers", Cambridge University press,1996.
3. M. N. O. Sadiku, "Numerical Techniques in Electromagnetics", CRC press,2001.

ELPE616	Digital Control Systems	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Obtain discrete representation of LTI systems.
2. Analyse stability of open loop and closed loop discrete-time systems.
3. Design and analyse digital controllers.
4. Design state feedback and output feedbackcontrollers.

Unit 1: Discrete System Representation and Analysis (12 hours)

Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit, Effects of Sampling and Quantization. Choice of sampling frequency.ZOH equivalent.

Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.

Unit 2: Stability of Discrete Time System (6 hours)

Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design.

Unit 3: State Space Approach for discrete time systems (10 hours)

State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Reconstructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability.

Unit 4: Design of Digital Control System and Discrete output feedback control (8 hours)

Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator. Design of discrete output feedback control. Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems.

Text Books :

1. K. Ogata, “Digital Control Engineering”, Prentice Hall, Englewood Cliffs,1995.
2. M. Gopal, “Digital Control Engineering”, Wiley Eastern,1988.
3. G. F. Franklin, J. D. Powell and M. L. Workman, “Digital Control of Dynamic Systems”, Addison-Wesley,1998.
4. B.C. Kuo, “Digital Control System”, Holt, Rinehart and Winston,1980.

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD

NEW SCHEME OF STUDIES AND EXAMINATION

B-TECH 4th YEAR (ELECTRICAL ENGINEERING) SEMESTER-VII

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Internal Marks	Final Marks	Total	Credits
				L	T	P				
1	PEC		Program Elective -V	3	0	0	25	75	100	3
2	PEC		Program Elective -VI	3	0	0	25	75	100	3
3	OEC		Open Elective –III	3	0	0	25	75	100	3
4	OEC		Open Elective –IV	3	0	0	25	75	100	3
5	OEC		Open Elective –V	3	0	0	25	75	100	3
6	PROJ/ SEC	ELSE762	Major Project	0	0	6	30	70	100	3
7	HSMC		Slot for HSMC	3	0	0	25	75	100	3
8	SEC	ELSE761	Electrical Workshop-VII	0	0	4	30	70	100	2
			Total	**18**	**0**	**10**	**210**	**590**	**800**	**23**

	Course Code	Course Title
Program Elective –V	ELPE711	Power System Protection
	ELPE 712	HVDC Transmission Systems
	ELPE 713	Power Quality and FACTS
Program Elective –VI	ELPE 714	High Voltage Engineering
	ELPE 715	Advanced Electric Drives
	ELPE 716	Control Systems Design
	ELPE 717	Power System Dynamics and Control

	Course Code	Course Title
Humanities & Social Sciences Including Management Courses	HSMC-03 (Common to all)	Organizational Behaviour
	HSMC-04 (Common to all)	Finance & Accounting
	HSMC-05 (Common to all)	Basics of Operation Research

ELPE711	Power System Protection	3L:0T:0P	3 credits

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the different components of a protection system.
2. Evaluate fault current due to different types of fault in a network.
3. Understand the protection schemes for different power system components. Understand the basic principles of digital protection.
4. Understand system protection schemes, and the use of wide-area measurements.

Unit 1: **Introduction and Components of a Protection System (6 hours)**

Principles of Power System Protection, Fuse (Introduction, types and Applications), Relays – operating principle, types, zone of protection and applications, Instrument transformers and modelling, Circuit Breakers- arcing phenomenon, types, characteristics, ratings and applications, surge diverters, absorbers and grounding

Unit 2: Faults and Over-Current Protection (6 hours)

Review of Fault Analysis, Sequence Networks, Introduction to Over current Protection and over current relay co-ordination.

Unit 3: **Equipment Protection Schemes (8 hours)**

Directional, Distance, Differential protection, Transformer and Generator protection, Bus bar Protection, Bus Bar arrangement schemes

Unit4: **Digital Protection (8 hours)**

Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues.

Unit 5:**Modeling and Simulation of Protection Schemes (4 hours)**

Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.

Unit 6: **System Protection (6 hours)**

Effect of Power Swings on Distance Relaying, Under-frequency, under- voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide- Area Measurement Systems (WAMS).Application of WAMS for improving protection systems.

Text/References

1. J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 1987.
2. Y. G.Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, India, 2010.
3. A.G. Phadke and J.S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.
4. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer,2008.
5. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis,2006.

ELPE712	HVDC Transmission Systems	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the advantages of dc transmission over actransmission.
2. Understand the operation of Line Commutated Converters and Voltage SourceConverters.
3. Understand the control strategies used in HVdc transmissionsystem.
4. Understand the improvement of power system stability using an HVdcsystem.

Unit 1:DC Transmission Technology (4 hours)

Comparison of AC and dc Transmission (Economics, Technical Performance and Reliability).Application of DC Transmission. Types of HVDC Systems. Components of aHVdc system. Line Commutated Converter and Voltage Source Converter based systems.

Unit2: Analysis of Line Commutated and Voltage Source Converters (10 hours)

Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap. Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Effect of Commutation Failure, Misfire and Current Extinction in LCC links.

Voltage Source Converters (VSCs): Two and Three-level VSCs. PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six pulse converter. Equations in the rotating frame. Real and Reactive power control using aVSC.

Unit 3:Control of HVdc Converters: (10 hours)

Principles of Link Control in aLCCHVdc system. Control Hierarchy, Firing Angle Controls – Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HVdc system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.

Unit 4:Components of HVdc systems: (8 hours)

Smoothing Reactors, Reactive Power Sources and Filters in LCC HVdc systems DC line: Corona Effects. Insulators, Transient Over-voltages.dc line faults in LCC systems. dc line faults in VSC systems. dc breakers. Mono polar Operation. Ground Electrodes.

Unit5:Stability Enhancement using HVDC Control (4 hours)

Basic Concepts : Power System Angular, Voltage and Frequency Stability.

Power Modulation: basic principles – synchronous and asynchronous links, Voltage Stability Problem in AC/dc systems.

Unit 5:MTDC Links (4 hours)

Multi-Terminal and Multi-Infeed Systems. Series and Parallel MTdc systems using LCCs. MTdc systems using VSCs. Modern Trends in HVDC Technology. Introduction to Modular Multi-level Converters.

Text/References:

1. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers,2011.
2. J. Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd.,1983.
3. E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley-Interscience,1971.

ELPE713	Power Quality and FACTS	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.
2. Understand the working principles of FACTS devices and their operating characteristics.
3. Understand the basic concepts of powerquality.
4. Understand the working principles of devices to improve power quality.

Unit 1: Transmission Lines and Series/Shunt Reactive Power Compensation (4 hours) Basics of AC Transmission Analysis of uncompensated AC transmission lines Passive Reactive Power Compensation Shunt and series compensation at the mid-point of an AC line Comparison of Series and Shunt Compensation.

Unit 2: Thyristor-based Flexible AC Transmission Controllers (FACTS) (6 hours)

Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC, Fault Current Limiter.

Unit 3: Voltage Source Converter based (FACTS) controllers (8 hours)

Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

Unit 4: Application of FACTS (4 hours)

Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC, Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.

Unit 5: Power Quality Problems in Distribution Systems (4 hours)

Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations, Flicker and its measurement. Tolerance of Equipment: CBEMA curve.

Unit 6: DSTATCOM (8 hours)

Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters, Synchronous Reference Frame Extraction of Reference Currents

,Current Control Techniques in for DSTATCOM.

Unit 7: Dynamic Voltage Restorer and Unified Power Quality Conditioner (6 hours)

Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.

Text/References

1. N. G. Hingorani and L. Gyugyi, “Understanding FACTS: Concepts and Technology of FACTS Systems”, Wiley-IEEE Press,1999.
2. K. R. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New AgeInternational (P) Ltd. 2007.
3. T.J.E.Miller,“ReactivePower Control inElectricSystems”,JohnWileyandSons,NewYork,1983.
4. R. C. Dugan, “Electrical Power Systems Quality”, McGraw Hill Education,2012.
5. G. T. Heydt, “Electric Power Quality”, Stars in a Circle Publications,1991

ELPE714	High Voltage Engineering	3L:0T:0P	3 credits

Course outcomes:

At the end of the course, the student will demonstrate

1. Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.
2. KnowledgeofgenerationandmeasurementofD.C.,A.C.,&Impulsevoltages.Knowledgeoftestson H. V. equipment and on insulating materials, as per thestandards.
3. Knowledge of how over-voltages arise in a power system, and protection against these over-voltages.

Unit 1: Breakdown in Gases (8 Hours)

Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge

Unit 2: Breakdown in liquid and solid Insulating materials (7 Hours)

Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

Unit 3: Generation of High Voltages (7 Hours)

Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

Unit 4: Measurements of High Voltages and Currents (7 Hours)

Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

Unit 5: Lightning and Switching Over-voltages (7 Hours)

Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over-voltages, Protection against over-voltages, Surge diverters, Surge modifiers.

Unit 6: High Voltage Testing of Electrical Apparatus and High Voltage Laboratories (7 Hours)

Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

Text/Reference Books

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education,2013.
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers,2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.
4. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2000.
5. R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", John Wiley & Sons, 2011.
6. Various IS standards for HV Laboratory Techniques andTesting

ELPE715	Advanced Electric Drives	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the operation of power electronic converters and their controlstrategies.
2. Understand the vector control strategies for ac motordrives
3. Understand the implementation of the control strategies using digitalsignal processors.

Unit 1: Power Converters for AC drives (10 hours)

PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Qdrive.

Unit 2: Induction motor drives (10 hours)

Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control(DTC).

Unit 3: Synchronous motor drives (6 hours)

Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

Unit 4: Permanent magnet motor drives (6 hours)

Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.

Unit 5: Switched reluctance motor drives (6 hours)

Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM.

Unit 6: DSP based motion control (6hours)

Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motioncontrol.

Text / References:

1. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia,2003.
2. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley & Sons,2013.
3. H. A. Taliyat and S. G. Campbell, "DSP based Electromechanical Motion Control", CRC press,2003.
4. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC motor Drives", CRC Press,2009.

ELPE716	Control Systems Design	3L:0T:0P	3 credits

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand various design specifications.
2. Designcontrollerstosatisfythedesireddesignspecificationsusingsimplecontroller structures(P,PI,PID, compensators).
3. Design controllers using the state-space approach.

Unit 1: Design Specifications (6 hours)
Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response.Effect of addition of pole on system performance. Effect of addition of zero on system response.

Unit 2: Design of Classical Control System in the time domain (8 hours)
Introduction to compensator.Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation.Realization of compensators.

Unit 3: Design of Classical Control System in frequency domain (8 hours) Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram.

Unit 4: Design of PID controllers (6 hours)
Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.

Unit5: Control System Design in state space (8 hours)
Review of state space representation. Concept of controllability &observability, effect of pole zero cancellation on the controllability &observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer. SeparationPrinciple.

Unit 6: Nonlinearities and its effect on system performance (3 hours)
Various types of non-linearities.Effect of various non-linearities on system performance. Singular points. Phase plot analysis.

Text and Reference Books :

1. N. Nise, "Control system Engineering", John Wiley,2000.
2. I. J. Nagrath and M. Gopal, "Control system engineering", Wiley,2000.
3. M. Gopal, "Digital Control Engineering", Wiley Eastern,1988.
4. K. Ogata, "Modern Control Engineering", Prentice Hall,2010.
5. B. C. Kuo, "Automatic Control system", Prentice Hall,1995.
6. J. J. D'Azzo and C. H. Houpis, "Linear control system analysis and design (conventional and modern)", McGraw Hill,1995.
7. R. T. Stefani and G. H. Hostetter, "Design of feedback Control Systems",Saunders College Pub, 1994.

ELPE717	Power System Dynamics and Control	3L:0T:0P	3 credits

Course Outcomes:
At the end of this course, students will demonstrate the ability to

- Understand the problem of power system stability and its impact on the system.
- Analyse linear dynamical systems and use of numerical integration methods.
- Model different power system components for the study of stability.
- Understand the methods to improve stability.

Module 1: Introduction to Power System Operations (4 hours)
Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control.

Module 2 : Analysis of Linear Dynamical System and Numerical Methods (6 hours) Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System, Analysis using Numerical Integration Techniques, Issues in Modeling: Slow and Fast Transients, Stiff System

Module 3 : Modeling of Synchronous Machines and Associated Controllers (12 hours) Modeling of synchronous machine: Physical Characteristics. Rotor position dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modeling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

Module 4 : Modeling of other Power System Components (6 hours)
Modeling of Loads. Load Models - induction machine model. HVDC and FACTS controllers, Wind Energy Systems.

Module 5 : Stability Analysis (12 hours)
Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multi- machine systems – Intra- plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governor droop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools: Transient Stability Programs, Small Signal Analysis Programs.

Module 6 : Enhancing System Stability (5 hours)
Planning Measures. Stabilizing Controllers (Power System Stabilizers).Operational Measures-Preventive Control. Emergency Control.

Text/Reference Books

1. K.R. Padiyar, " Power System Dynamics, Stability and Control", B. S. Publications,2002.
2. P. Kundur, " Power System Stability and Control", McGraw Hill,1995.
3. P. Sauer and M. A. Pai, " Power System Dynamics and Stability" , Prentice Hall,1997.

HSMC-03	Organizational Behaviour	3L:0T:0P	3 credits

Course Objectives:

The objective of this course is to expose the students to basic concepts of management and provide insights necessary to understand behavioural processes at individual, team and organizational level.

MODULE-1

Introduction to management: concept, nature; evolution of management thoughts –traditional, behavioural, system, contingency and quality viewpoints; Managerial levels, skills and roles in an organization; Functions of Management: Planning, Organizing, Directing, Controlling, Problem solving and Decision making; Management control; managerial ethics and social responsibility; Management Information System (MIS).

MODULE-2

Fundamentals of Organizational Behavior: Concept, evolution, importance and relationship with other Fields; Contemporary challenges of OB; Individual Processes and Behavior – differences, Personality concept, determinant, theories and applications; Values, Attitudes and Emotions, Perception- concept, process and applications, Learning and Reinforcement; Motivation: concept, theories and applications; Stress management.

MODULE-3

Interpersonal Processes- Work teams and groups- Definition of Group, Stages of group development, Group cohesiveness, Types of groups, Group processes and Decision Making; Team Building; Conflict- concept, sources, types, management of conflict; Power and Political Behavior; Leadership: concept, function and styles.

MODULE-4

Organizational Processes and structure: organizational design: various organizational structures and their effect on human behavior; Organizational climate; Organizational culture; Organizational change: Concept, Nature, Resistance to Change, Change Management, Implementing Change and Organizational Development

Course Outcomes:

1. The students learn how to influence the human behaviour.
2. Students will be able to understand behavioural dynamics in organizations.
3. Students will be able to apply managerial concepts in practical life.
4. Students will be able to understand organizational culture and change.

REFERENCES:

1. Robbins, S.P. and Decenzo, D.A. Fundamentals of Management, Pearson Education Asia, New Delhi.

2. Stoner, J et. al, Management, New Delhi, PHI, New Delhi
3. SatyaRaju, Management – Text & Cases, PHI, New Delhi
4. Kavita Singh, OrganisationalBehaviour: Text and cases. New Delhi: Pearson Education.
5. Pareek, Udai, Understanding OrganisationalBehaviour, Oxford University Press, New Delhi
6. Robbins, S.P. & Judge, T.A., OrganisationalBehaviour, Prentice Hall of India, New Delhi

HSMC-04	Finance and Accounting	3L:0T:0P	3 credits

Course Objectives:

The purpose of the course is to understand nature of accounting and its interaction with other accounting and their comparison. It also focuses what kind of information the manager need, from where these can be obtained and how this information can be used to carry out important managerial decision.

MODULE-1:
Meaning nature and scope of different types of accounting and their comparison.Accounting principles and Indian accounting standards, IFRS, Preparation of final accounts of company with basic adjustments. Reading and understanding of Annual report.

MODULE-2:
Analysis and interpretation of financial statements – meaning, importance and techniques, ratio analysis; fund flow analysis; cash flow analysis (AS-3)

MODULE-3:
Classification of costs, preparation of cost sheet, inventory valuation, overview of standard costing and variance analysis; material variance and labour variance.

MODULE-4:
Budgetary control- meaning, need, objectives, essentials of budgeting, different types of budgets cash budget, flexible budget zero base budget; marginal costing, BEP analysis, decision making for optimum sales mix, exploring new markets, make/Buy decisions, expand/ contract, accepting and rejecting decisions

Course Outcomes:

1. This course will impart knowledge to the students regarding preparation of financial statements their analysis.
2. The students will be able to understand applications of cost accounting and cost control techniques like standard costing etc.
3. The course will help them to take better managerial decisions.
4. Students will be able to know about budget control techniques.

REFERENCES:

1. Singhal, A.K. and Ghosh Roy, H.J., Accounting for Managers, JBC Publishers and Distributors, New Delhi
2. Pandey, I.M., Management Accounting, Vikas Publishing House, New Delhi
3. Horngren, Sundem and Stratton, Introduction to Management Accounting, Pearson Education, New Delhi.
4. Jain, S.P and Narang, K.L., Advanced Cost Accounting, Kalyani Publishers, Ludhiana.
5. Khan, M.Y. and Jain, P.K., Management Accounting, TMH, New Delhi

HSMC-05	Basics of Operation Research	3L:0T:0P	3 credits

Course Objectives:

1. To introduce the student with Different types of OR Models and Linear Programming Model
2. To introduce the students about Dual Sensitive Method and Sensitive Analysis.
3. To introduce the concept of Assignment Problem.
4. To introduce the students with Network Model
5. To introduce the concept of Dynamic Programming and Queuing Model.

MODULE-1:

The origin of OR, Phases of an O.R. study, Impact of OR, Formulation of Linear-programming model, Graphical solution. Converting the linear programming problem to standard form, Simplex method.

MODULE-2:

Big-M method, Two-phase method, Degeneracy, Alternate optima, unbounded and infeasible solution.

MODULE-3:

Definition of the dual problem, prima-dual relationship, Dual Simplex method, Post optimal and sensitivity analysis.

MODULE-4:

Assignment problem and its mathematical formulation, solution of assignment problem (Hyngarian method), Transportation problem and its mathematical formulation.Initial basic feasible solution of transportation problem by North-West corner rule. Lowest-Cost Entry method and Vogel's Approximation method, Optimal solution of transportation problem.

MODULE-5:

Network models, Minimal spanning tree algorithm, Shortest-route problem (Floyd's Algorithm and Dijkstras algorithm), Maximal flow problem, Introduction to CPM & PERT.

MODULE-6:

Introduction to Dynamic Programming, General inventory Model, Static Economic Order Quantity (EOQ) Models.

MODULE-7:

Elements of a Queuing model, Pure Birth & Death model, Generalized Poisson Queuing, Specialized Poisson Queues.

Course Outcomes:

After completion of the course student will be able to:

1. Understand different types of OR Model and solve Linear programming problems.
2. Understand dual simplex problem and sensitive analysis.
3. Solve Assignment problem.
4. Understand Dynamic Programming and Queuing Model.

REFERENCES:

1. Operations Research by Hamdy A Taha
2. Introduction to Operations Research by Hiller and Dieherman, TMH
3. Optimization Theory and Application: SS Rao, John Wiley.

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
B-TECH 4th YEAR (ELECTRICAL ENGINEERING) SEMESTER-VIII

Sr. No.	Category	Course Code	Course Title	Hours Per Week			Sessional Marks	Final Marks	Total	Credits
				L	T	P				
1	PROJ/SEC	ELSE861	Industrial Training	8 Hrs per Day			300	200	500	8

A) Procedure For Annual Examination And Marks		
Project Evaluation	50 Marks	Total 200 Marks
Project Seminar	50 Marks	
Project Viva	100 Marks	
B) Continuous Assessment Marks		
Assessment By Institute Faculty	100 Marks.	Total 300 Marks
Assessment By Industrial Guide	100 Marks.	
Conduct Marks	100 Marks.	
		Total 500 Marks

J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA FARIDABAD
NEW SCHEME OF STUDIES AND EXAMINATION
LIST OF OPEN ELECTIVE COURSES [ELECTRICAL ENGINEERING]

Sr. No	Code No.	Subject	Credits
1.	ELOE-101	Electronic Devices	3
2.	ELOE-102	Data Structures and Algorithms	3
3.	ELOE-103	Analog and Digital Communication	3
4.	ELOE-104	Computer Networks	3
5.	ELOE-106	Power Plant Engineering	3
6.	ELOE-105	Introduction to Embedded Systems	3
7.	ELOE-107	Strength of Materials	3
8.	PEC-ME-328	Automobile Engineering	3
9.	ELOE-109	Manufacturing Processes	3
10.	ELOE-110	Environmental Engineering	3
11.	ELOE-111	Operating System	3
12.	PEC-ME-443	Total Quality Management	3
13.	PEC-ME-451	Mechatronic System	3
14.	ECEL-604	Scientific Computing	3
15.	ELOE-115	Engineering Economics, Estimation & Costing	3
16.	OEL-603	Cyber Law and Security	3
17.	ELOE-117	Intelligent Systems	3
18.	ECEL-704	Fiber Optic Communication	3
19.	ECEL-705	Adaptive Signal Processing	3
20.	ECEL-606	Digital Image & Video Processing	3
21.	ELOE-121	Artificial Intelligence	3
22.	ELOE-122	Programming in Python	3
23.	ELOE-123	Fundamentals of Machine Leaning	3

ELOE-101	Electronic Devices	3L:0T:0P	3 credits

Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors

Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-Vcharacteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode

Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model,MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, LED, photodiode and solar cell;

Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

Text /Reference Books:

1. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson,2014.
2. D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
3. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley &Sons, 2006.
4. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
5. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the principles of semiconductor Physics
2. Understand and utilize the mathematical models of semiconductor junctions andMOS transistors for circuits and systems.

ELOE-102	Data Structure and Algorithm	3L:0T:0P	3 credits

Objectives of the course:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures

Detailed contents:

Module 1:

Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. **Searching:** Linear Search and Binary Search Techniques and their complexity analysis.

Module 2:

Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Module 3:

Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

Module 4:

Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. **Graph:** Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Suggested books:

1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

Suggested reference books:

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education.

Course outcomes

1. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
2. For a given Search problem (Linear Search and Binary Search) student will able to implement it.
3. For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
4. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
5. Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

ELOE-103	Analog and digita communication	3L:0T:0P	3 credits

Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

Review of probability and random process. Gaussian and white noise characteristics,Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation.

Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM),Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

Elements of Detection Theory, Optimum detection of signals in noise,Coherent communication with waveforms- Probability of Error evaluations. BasebandPulse Transmission- Inter symbol Interference and Nyquist criterion.Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying,Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.

Text/Reference Books:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

ELOE-104	Computer Network	3L:0T:0P	3 credits

Introduction to computer networks and the Internet: Application layer: Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, Electronic ail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering concepts.

Switching in networks: Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical Multiplexing. Transport layer: Connectionless transport - User Datagram Protocol, Connection-oriented transport – Transmission Control Protocol, Remote Procedure Call.

Transport layer: Connectionless transport - User Datagram Protocol, Connection-oriented transport – Transmission Control Protocol, Remote Procedure Call.

Congestion Control and Resource Allocation: Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service.

Network layer: Virtual circuit and Datagram networks, Router, Internet Protocol, Routing algorithms, Broadcast and Multicast routing

Link layer: ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, addressing, Ethernet, Hubs, Switches.

Text Reference books:

1. J.F. Kurose and K. W. Ross, " Computer Networking – A top down approach featuring the Internet", Pearson Education, 5th Edition
2. L. Peterson and B. Davie, " Computer Networks – A Systems Approach" Elsevier Morgan Kaufmann Publisher, 5th Edition.
3. T. Viswanathan, "Telecommunication Switching System and Networks", Prentice Hall
4. S. Keshav, " An Engineering Approach to Computer Networking" , Pearson Education
5. B. A. Forouzan, " Data Communications and Networking", Tata McGraw Hill, 4th Edition
6. Andrew Tanenbaum, " Computer networks", Prentice Hall
7. D. Comer, " Computer Networks and Internet/TCP-IP", Prentice Hall
8. William Stallings, " Data and computer communications" , Prentice Hall

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Understand the concepts of networking thoroughly.
2. Design a network for a particular application.
3. Analyze the performance of the network

ELOE-105	Introduction to Embedded System	3L:0T:0P	3 credits

UNIT1. INTRODUCTION:

Different types of Micro-controllers, embedded micro-controller, external memory micro-controller, Processor architectures: Harvard vs Princeton, CISC vs. RISC, Micro-controller memory types.

Development tools/environment, Intel Hex Format object files, debugging.

UNITS2 ARCHITECTURE OF 8051:

Block diagram, pin Configuration, Functional descriptions of internal

Units-- registers, PSW, internal RAM, ROM, Stack, Oscillator and Clock. **Other features**--I/O Pins, Ports and Circuits, Counters and timers, Serial data transmission /reception.

Interrupts--Timer flag interrupt, serial communication interrupt, External interrupt, software generated interrupts.

UNIT3. PROGRAMMING OF 8051:

Instruction format, addressing modes, Data transfer instructions, logical instructions, arithmetic instructions, Jump and Call instructions. Interrupts and interrupt handler subroutines. Development of assembly Language programs

UNIT4. ARCHITECTURE OF PIC:

Block diagram, pin Configuration, Functional descriptions of internal blocks—program memory considerations, register file structure. registers, oscillators and clock.

Other features--I/O Pins, Counters and timers, Watchdog timer, SPI port USART.

Interrupts—Interrupt structure.

UNIT5. APPLICATION DESIGN & HARDWARE INTERFACING WITH 8051 & PIC:

Hardware Interfacing with LED, Seven segment LED, LCD, Switches and stepper motor.

TEXT BOOKS:

1. Design with PIC Micro-controller by John B. Peatman, Pearson.

2. The 8051 microcontroller and embedded system by M.A.Mazidi, PHI

REFERENCE BOOKS:

1. Programming and customizing the 8051 micro-controller- Predko, TMH.

2. Designing Embedded Hardware: John Catsoulis: Shroff Pub and Dist.
3. Programming embedded systems in C and C++: Michael Barr: Shroff Pub and distr**Course**

ELOE-106	Power Plant Engineering	3L:0T:0P	3 credits

Objectives:
To provide an overview of power plants and the associated energy conversion issues

Contents:
Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam andheating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Course Outcomes:
Upon completion of the course, the students can understand the principles of operation for different power plants and their economics.

Text Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

ELOE-107	Strength of Materials	3L:0T:0P	3 credits

Objectives:

- ☐ To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads
- ☐ To calculate the elastic deformation occurring in various simple geometries for different types of loading

Contents :

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle. **(8)**

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads. **(8)**

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.**(8)**

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs. (**8)**

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure **(8)**

Course Outcomes:

After completing this course, the students should be able to recognise various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components

The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

Text Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGrawHill Publishing Co. Ltd., New Delhi 2005.

PEC-ME-328	Automobile Engineering	3L:0T:0P	3 credits

To understand the construction and working principle of various parts of an automobile

Contents:

Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines- components, function and materials, variable valve timing (VVT). Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).

Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, Over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.

Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells

Course Outcomes:
Upon completion of this course, students will understand the function of each automobile component and also have a clear idea about the overall vehicle performance.

Text books:

1. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.
2. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.
3. Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.
4. Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998.

ELOE-109	Manufacturing Process	3L:0T:0P	5 Credits

Objectives:
To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods

Contents:

Conventional Manufacturing processes:

Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. **(5)**

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming(forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.**(4)**

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.**(8)**

Additive manufacturing: Rapid prototyping and rapid tooling**(3)**

Joining/fastening processes: Physics of welding, brazing and soldering;design considerations in welding,Solid and liquid state joining processes;Adhesive bonding. **(4)**

Unconventional Machining Processes:
Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters **(5)**
Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant &maskant, process parameters, MRR and surface finish. **(8)**
Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining **(3)**

Course Outcomes:
Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products

Text Books:
1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
4. Degarmo, Black &Kohser, Materials and Processes in Manufacturing

ELOE-110	Environmental Engineering	2L:2T:0P	3 credits

Module 1: *Water:* -Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.
Water Treatment: aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes

Module 2: *Sewage*- Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans,Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.

Module 3: *Air* - Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations
Module 4: *Noise*- Basic concept, measurement and various control methods.

Module5:*Solid waste management*-Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods- Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.

Module 6: *Building Plumbing*-Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, Pressure reducing valves, Break pressure tanks, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures and fittings used.

Module 7: Government authorities and their roles in water supply, sewerage disposal. Solid waste management and monitoring/control of environmental pollution.

Practical Work: List of Experiments

1. Physical Characterization of water: Turbidity, Electrical Conductivity, pH
2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, inorganic etc.
3. Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness
4. Analysis of ions: copper, chloride and sulfate
5. Optimum coagulant dose
6. Chemical Oxygen Demand (COD)
7. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD)
8. Break point Chlorination
9. Bacteriological quality measurement: MPN,
10. Ambient Air quality monitoring (TSP, RSPM, SOx, NOx)
11. Ambient noise measurement

Text/Reference Books:

1. Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
2. Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.
3. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. *Environmental Engineering*, Mc-Graw - Hill International Editions, New York 1985.

ELOE-111	Operating Systems	3L:0T:4P	5 Credits

Objectives of the course

To learn the fundamentals of Operating Systems.

1. To learn the mechanisms of OS to handle processes and threads and their communication
2. To learn the mechanisms involved in memory management in contemporary OS
3. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
4. To know the components and management aspects of concurrency management

Detailed contents

Module 1:
Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.

Module 2:
Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads,

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

Module 3:
Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, TheProducer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

Module 4:
Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Module 5:
Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation –Hardware support for paging, Protection and sharing, Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

Module 6:
I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks

Suggested books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

Suggested reference books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

Course Outcomes

1. Create processes and threads.
2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.
3. For a given specification of memory organization developthe techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.
4. Design and implement file management system.
5. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers

PEC-ME-443	Total Quality Management	3L:0T:0P	3 credits

Objectives:
To facilitate the understanding of total quality management principles and processes

Contents:
Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.

TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation,; Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Course Outcomes:
Upon completion of this course, the students will be able to use the tools and techniques of TQM in manufacturing and service sectors.

Text Books:

1. Besterfield D.H. et al., Total qualityManagement, 3rd ed., Pearson Education Asia, 2006.
2. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
3. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.

Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

PEC-ME-451	Mechatronic Systems	3L:0T:0P	3 credits

Description:

(i) To understand the structure of microprocessors and their applications in mechanical devices

(ii) To understand the principle of automatic control and real time motion control systems, with the help of electrical drives and actuators

(iii) To understand the use of micro-sensors and their applications in various fields

Course Contents:

Introduction: Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface;

Sensors and transducers: classification, Development in Transducer technology, Opto-electronics-Shaft encoders, CD Sensors, Vision System, etc.;

Drives and Actuators: Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems;

Smart materials: Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.;

Micromechatronic systems: Microsensors, Microactuators; Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.

Course Outcomes:

Upon completion of this course, students will get an overview of mechatronics applications and the use of micro-sensors and microprocessors.

Text Books:

1) Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.)
2) Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education
3) A Textbook of Mechatronics ,R.K.Rajput, S. Chand & Company Private Limited
4) Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall

ECEL-604	Scientific computing	3L:0T:0P	3 credits

Introduction: Sources of Approximations, Data Error and Computational, Truncation Error and Rounding Error, Absolute Error and Relative Error, Sensitivity and Conditioning, Backward Error Analysis, Stability and Accuracy
Computer Arithmetic: Floating Point Numbers, Normalization, Properties of Floating Point System, Rounding, Machine Precision, Subnormal and Gradual Underflow, Exceptional Values, Floating-Point Arithmetic, Cancellation

System of liner equations: Linear Systems, Solving Linear Systems, Gaussian elimination,Pivoting, Gauss-Jordan, Norms and Condition Numbers, Symmetric Positive Definite Systems and Indefinite System, Iterative Methods for Linear Systems

Linear least squares: Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, QR factorization, Gram-Schmidt Orthogonalization, Rank Deficiency, and Column Pivoting

Eigenvalues and singular values:Eigenvalues and Eigenvectors, Methods for Computing All Eigenvalues, Jacobi Method, Methods for Computing Selected Eigenvalues, Singular Values Decomposition, Application of SVD

Nonlinear equations: Fixed Point Iteration, Newton's Method, Inverse Interpolation Method Optimization: One-Dimensional Optimization, Multidimensional Unconstrained Optimization, Nonlinear Least Squares

Interpolation: Purpose for Interpolation, Choice of Interpolating, Function, Polynomial Interpolation, Piecewise Polynomial Interpolation

Numerical Integration And Differentiation: Quadrature Rule, Newton-Cotes Rule, Gaussian Quadrature Rule, Finite Difference Approximation,

Initial Value Problems for ODES, Euler's Method, Taylor Series Method, Runga-Kutta Method, Extrapolation Methods, Boundary Value Problems For ODES, Finite Difference Methods, Finite Element Method, Eigenvalue Problems

Partial Differential Equations,Time Dependent Problems, Time Independent Problems, Solution for Sparse Linear Systems, Iterative Methods

Fast Fourier Transform, FFT Algorithm, Limitations, DFT, Fast polynomial Multiplication, Wavelets, Random Numbers And Simulation, Stochastic Simulation, Random Number Generators, Quasi-Random Sequences

Text/ Reference Books:

1. Heath Michael T., " Scientific Computing: An Introductory Survey" , McGraw-Hill, 2nd Ed., 2002
2. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", Cambridge University Press, 3rd Ed., 2007
3. Xin-she Yang (Ed.)., " Introduction To Computational Mathematics" , World Scientific Publishing Co., 2nd Ed., 2008
4. Kiryanov D. and Kiryanova E., " Computational Science", Infinity Science Press, 1st Ed., 2006

5. Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, " Scientific Computing With MATLAB And Octave", Springer, 3rd Ed., 2010

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the significance of computing methods, their strengths and application areas.
2. Perform the computations on various data using appropriate computation tools.

ELOE-115	Engineering Economics, Estimation, & Costing	3L:0T:0P	3 credits

Module 1:Basic Principles and Methodology of Economics. Demand/Supply – elasticity – Government Policies and Application. Theory of the Firm and Market Structure. Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes (3 lectures)

Module 2: Public Sector Economics –Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve. (2 lectures)

Module 3: Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control –Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method. (3 lectures)

Module 4: Indian economy - Brief overview of post-independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized, Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors. (2 lectures)

Module 5:*Estimation* / Measurements for various items- Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying (7 lectures)

Module 6: Specifications-Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures. (3 lectures)

Module 7: Rate analysis-Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity. (3 lectures)

Module 8: Tender- Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes,

R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids-Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management (6 lectures)

Module 9: Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights. (1 lecture)

Text/Reference Books:

1. Mankiw Gregory N. (2002), *Principles of Economics,* Thompson Asia
2. V. Mote, S. Paul, G. Gupta(2004), *Managerial Economics,* Tata McGraw Hill
3. Misra, S.K. and Puri (2009), *Indian Economy,* Himalaya

4. Pareek Saroj (2003), *Textbook of Business Economics,* Sunrise Publishers
5. M Chakravarty, Estimating, Costing Specifications & Valuation
6. Joy P K, Handbook of Construction Management, Macmillan
7. B.S. Patil, Building & Engineering Contracts
8. Relevant Indian Standard Specifications.
9. World Bank Approved Contract Documents.
10. FIDIC Contract Conditions.
11. Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration
12. Typical PWD Rate Analysis documents.
13. UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations,2016
14. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016

On completion of the course, the students will:

- Have an idea of Economics in general, Economics of India particularly for public sector agencies and private sector businesses
- Be able to perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives.
- Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.
- Be able to understand the technical specifications for various works to be performed for a project and how they impact the cost of a structure.
- Be able to quantify the worth of a structure by evaluating quantities of constituents, derive their cost rates and build up the overall cost of the structure.
- Be able to understand how competitive bidding works and how to submit a competitive bid proposal.

OEL-603	Cyber Laws and Security	3L:0T:0P	3 credits

UNIT I History of Information Systems and its Importance, basics, Changing Nature of Information Systems, Need of Distributed Information Systems, Role of Internet and Web Services, Information System Threats and attacks, Classification of Threats and Assessing Damages Security in Mobile and Wireless Computing- Security Challenges in Mobile Devices, authentication Service Security, Security Implication for organizations, Laptops Security Basic Principles of Information Security, Confidentiality, Integrity Availability and other terms in Information Security, Information Classification and their Roles.

UNIT II Security Threats to E Commerce, Virtual Organization, Business Transactions on Web, E Governance and EDI, Concepts in Electronics payment systems, E Cash, Credit/Debit Cards. Physical Security- Needs, Disaster and Controls, Basic Tenets of Physical Security and Physical Entry Controls, Access Control- Biometrics, Factors in Biometrics Systems, Benefits, Criteria for selection of biometrics, Design Issues in Biometric Systems, Interoperability Issues, Economic and Social Aspects, Legal Challenges

UNIT III Model of Cryptographic Systems, Issues in Documents Security, System of Keys, Public Key Cryptography, Digital Signature, Requirement of Digital Signature System, Finger Prints, Firewalls, Design and Implementation Issues, Policies Network Security- Basic Concepts, Dimensions, Perimeter for Network Protection, Network Attacks, Need of Intrusion Monitoring and Detection, Intrusion Detection Virtual Private Networks- Need, Use of Tunneling with VPN, Authentication Mechanisms, Types of VPNs and their Usage, Security Concerns in VPN

UNIT IV Security metrics- Classification and their benefits Information Security & Law, IPR, Patent Law, Copyright Law, Legal Issues in Data mIning Security, Building Security into Software Life Cycle Ethics- Ethical Issues, Issues in Data and Software Privacy Cyber Crime Types & overview of Cyber Crimes

References:

1. Godbole,— Information Systems Security‖, Willey
2. Merkov, Breithaupt, — Information Security‖, Pearson Education
3. Yadav, —Foundations of Information Technology‖, New Age, Delhi
4. Schou, Shoemaker, — Information Assurance for the Enterprise‖, Tata McGraw Hill
5. Sood,—Cyber Laws Simplified‖, Mc Graw Hill
6. Furnell, —Computer Insecurity‖, Springer 7. IT Act 2000

ELOE-117	Intelligent Systems	3L:0T:0P	3 credits

UNIT I Fundamental Issues in IS : Definition of AI , History ,Domains AI ,AI problems & State space ,Some examples problems representations like Travelling Salespersons, Syntax analysis Problem. Basic issues to solve AI problems, Underlying assumptions, AI techniques, Level of model, Criteria for success, Control strategies, DFS, BFS

UNIT II Heuristic Search Techniques: Generate & Test, Hill Climbing (simple &stipest), Best first search, A*, AO*, Constraint Satisfaction.

UNIT III Knowledge Representation Issues: Syntax & Semantic for Propositional logic, Syntax & Semantic for FOPL, Properties for WFF's, Resolution Basics : conversion to clausal form ,Resolution of proposition logic, Resolution algorithms for predicates, Problems with FOPL ,Semantic nets ,Frames ,Scripts

UNIT IVReasoning Under Uncertainty: An introduction, Default reasoning & Closed world assumptions, Model & Temporal logic ,Fuzzy logic, Basian Probabilistic inference Dempster Shafer theory ,Heuristic reasoning methods

UNIT V Planning & Learning : Planning, Planning in Situational calculus ,Representation for planning ,Partial order palnning, Partial order palnning algorithm, Learning by Examples, Learning by Analogy, Explanation based learning, Neurals nets, Genetics algorithms

UNIT VIMinimax: Game playing strategy, Natural language processing ,Overview of linguistics , Grammer& Language, Transformation Grammer, Basic Parsing Techniques, Expert System, Architecture of Rule based Expert system ,Non Rule based Expert system.

References:

1. Artificial Intelligence by Elain Rich & Kevin Knight, Tata McGraw Hills Pub.
2. Principals of AI by Nills .J.Nilsson, Pearson Education Pub. 177
3. Artificial Intelligence by DAN. W.Petterson. Printice Hall of India
4. Artificial Intelligence by Petrick Henry Winston,
5. Artificial Intelligence by Russel and Norvig, Pearson Education Pub.

ECEL-704	Fiber Optic Communication	3L:0T:0P	3 credits

Introduction to vector nature of light, propagation of light, propagation of light ina cylindrical dielectric rod, Ray model, wave model.

Different types of optical fibers, Modal analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.

Optical sources - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties. Optical switches - coupled mode analysis of directional couplers, electro-opticswitches.

Optical amplifiers - EDFA, Raman amplifier.

WDM and DWDM systems. Principles of WDM networks.

Nonlinear effects in fiber optic links. Concept of self-phase modulation, groupvelocity dispersion and solition based communication.

Text/Reference Books

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
3. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.
5. G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
6. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997
7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the principles fiber-optic communication, the components and the bandwidth advantages.
2. Understand the properties of the optical fibers and optical components.
3. Understand operation of lasers, LEDs, and detectors
4. Analyze system performance of optical communication systems
5. Design optical networks and understand non-linear effects in optical fibers

ECEL-705	Adaptive Signal Processing	3L:0T:0P	3 credits

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

Optimal FIR (Wiener) filter, Method of steepest descent, extension to complexvalued The LMS algorithm (real, complex), convergence analysis, weight errorcorrelation matrix, excess mean square error and mis-adjustment

Variants of the LMS algorithm: the sign LMS family, normalized LMSalgorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering.

Signal space concepts - introduction to finite dimensional vectorspace theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, Gram- Schmidt orthogonalization, concepts of orthogonal projection,orthogonal decomposition of vector spaces.

Vector space of random variables, correlation as inner product, forward andbackward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

Introduction to recursive least squares (RLS), vector space formulation of RLSestimation, seudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

Text/Reference Books:

1. S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
2. C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the non-linear control and the need and significance of changing the control parameters w.r.t. real-time situation.
2. Mathematically represent the ‘adaptability requirement’.
3. Understand the mathematical treatment for the modeling and design of the signal processing systems.

ECEL-606	Digital Image & Video Processing	3L:0T:0P	3 credits

Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

Image Enhancements and Filtering-Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

Image Segmentation- Detection of discontinuities, edge linking and boundary detection, thresholding – global and adaptive, region-based segmentation.

Wavelets and Multi-resolution image processing- Uncertainty principles of Fourier Transform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.

Image Compression-Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossy compression- predictive and transform coding; Discrete Cosine Transform; Still image compression standards – JPEG and JPEG-2000.

Fundamentals of Video Coding- Inter-frame redundancy, motion estimation techniques – full search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Video Segmentation- Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts;

spatial segmentation – motion-based; Video object detection and tracking.

Text/Reference Books:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004
3. Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Mathematically represent the various types of images and analyze them.
2. Process these images for the enhancement of certain properties or for optimized use of the resources.
3. Develop algorithms for image compression and coding

ELOE 121	Artificial Intelligence	3L-0T-0P	3 Credits

Detailed Syllabus:

I. Artificial Neural Networks:

Introduction, Models of Neuron Network-Architectures –Knowledge representation, Artificial Intelligence and Neural networks–Learning process-Error correction learning, Hebbian learning –Competitive learning-Boltzmann learning, supervised learning Unsupervised learning–Reinforcement learning-Learning tasks.

II. ANN Paradigms:

Multi-layer perceptron using Back propagation Algorithm (BPA), Self –Organizing Map (SOM), Radial Basis Function Network-Functional Link Network (FLN), Hopfield Network.

III. Fuzzy Logic:

Introduction –Fuzzy versus crisp, Fuzzy sets-Membership function –Basic Fuzzy set operations, Properties of Fuzzy sets –Fuzzy cartesion Product, Operations on Fuzzy relations –Fuzzy logic –Fuzzy Quantifiers, Fuzzy Inference-Fuzzy Rule based system, Defuzzification methods

IV. Genetic Algorithms:

Introduction-Encoding –Fitness Function-Reproduction operators, Genetic Modeling –Genetic operators-Cross over-Single site cross over, Two point cross over –Multi point cross over-Uniform cross over, Matrix cross over-Cross over Rate-Inversion & Deletion, Mutation operator –Mutation –Mutation Rate-Bit-wise operators, Generational cycleconvergence of Genetic Algorithm.

V. Applications of AI Techniques:

Load forecasting, Load flow studies, Economic load dispatch, Load frequency control, Single area system and two area system, Small Signal Stability (Dynamic stability), Reactive power control , Speed control of DC and AC Motors.

Reading:

1. S.Rajasekaran and G.A.V.Pai Neural Networks, Fuzzy Logic & Genetic Algorithms, PHI, New Delhi, 2003.

2. Rober J. Schalkoff, Artificial Neural Networks, Tata McGraw Hill Edition, 2011

3. P.D.Wasserman; Neural Computing Theory & Practice, Van Nostrand Reinhold, New York, 1989.

4. Bart Kosko; Neural Network & Fuzzy System, Prentice Hall,1992

5. D.E.Goldberg, Genetic Algorithms, Addison-Wesley 1999.

ELOE 122	PROGRAMMING IN PYTHON	3L-0T-0P	3 Credits

UNIT 1: Introduction To Python & Data Types

Installation and Working with Python, Understanding Python variables, Python basic Operators, Understanding python blocks, Declaring and using Numeric data types: int, float, complex, Using string data type and string operations,

Defining list and list slicing, Use of Tuple data type

UNIT 2: Python Program Flow Control, String, List And Dictionary Manipulations

Conditional blocks using if, else and elif, simple for loops in python, For loop using ranges, string, list and dictionaries, Use of while loops in python, Loop manipulation using pass, continue, break and else Programming using Python conditional and loops block, Understanding string in build methods, List manipulation using in build methods, Dictionary manipulation, Programming using string, list and dictionary in build functions

UNIT 3: Python Functions, Modules, Packages & Python File Operation

Organizing python codes using functions, Organizing python projects into modules Importing own module as well as external modules Understanding Packages, Powerful Lamda function in python, Programming using functions, modules and external packages , reading config files in python, Writing log files in python, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and writelines(), Manipulating file pointer using seek, Programming using file operations

UNIT 4 : Python Object Oriented Programming & Exception handling :

Concept of class, object and instances, Constructor, class attributes and destructors, Real time use of class in live projects, Inheritance , overlapping and overloading operators, Adding and retrieving dynamic attributes of classes, Programming using Oops support, Avoiding code break using exception handling, Safe guarding file operation using exception handling, Handling and helping developer with error code, Programming using Exception handling

UNIT 5 : Data Manipulation using Python

SQL Database connection using python, Creating and searching tables, Reading and storing config information on database, Programming using database connections , **The Basics of NumPy:** NumPy Array Basics , Boolean Selection, Helpful Methods and Shortcuts , Vectorization , Multi-Dimensional Arrays, Querying Slicing, Combining, and Splitting Arrays, P**andas DataFrame Basics:** Reading Files, Plotting, and Basic Methods , More Plotting, Joins, Basic DateTime Indexing, and Writing to Files, Adding & Reseting Columns, Mapping with Functions , More Mapping, Filling NaN values, Plotting, Correlations, and Histograms , More Plotting, Rolling Calculations, Basic DateTime Indexing, Analysis Concepts, Filling NaN Values, Cumulative Sums and Value Counts , Data Maintenance, Adding/ Removing Columns and Rows , Basic Grouping, Concepts of Aggregate Functions.

Suggested Readings :

1. Head First Python , A brain friendly guide – Paul Barry , O reilly, 2nd Edition.
2. A byte of Python- C.H. Swaroop
3. Python Cookbook by David Beazley and Brian K. Jones
4. Introduction to Machine Learning with Python Paperback – by Andreas C. Mueller

ELOE 123	Fundamentals of Machine Learning	3L-0T-0P	3 Credits

UNIT-I

Introduction: Learning, Types of Machine Learning.

Some Basic Statistics: Averages, Variance and Covariance, Gaussian distribution, Bayes theorem.

Concept learning: Introduction, Version Spaces and the Candidate Elimination Algorithm.

Learning with Trees: Constructing Decision Trees, CART, Classification Example

UNIT-II

Time Series : AR, MA, ARMA, ARIMA , ARMAX for predictions using time dependent data.

Linear Discriminants: Linear Separability, Linear Regression ,

Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis

SUPPORT Vector Machines: Optimal Separation, Kernels

The Bias-Variance Tradeoff.

UNIT-III

Bayesian learning: Introduction, Bayes Optimal Classifier, Naive Bayes Classifier, Bayesian networks, Approximate Inference, Making Bayesian Networks, Hidden Markov Models, The Forward Algorithm,

Neural Networks : The Perceptron, Multilayer Perceptron (MLP): Going Forwards, Backwards, MLP in practices, Deriving back Propagation

UNIT-IV

Clustering: Introduction, Similarity and Distance Measures, Outliers, Hierarchical Methods, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes, Comparison

Evolutionary Learning: Genetic Algorithms, Genetic Operators, Genetic Programming

Ensemble learning: Boosting, Bagging

UNIT-V

Case studies : Use of Data sets , Data Pre-processing and application of the suitable algorithms .

Suggested Reading:

1. Tom M. Mitchell, Machine Learning, Mc Graw Hill, 1997
2. Stephen Marsland, Machine Learning - An Algorithmic Perspective, CRC Press, 2009
3. Margaret H Dunham, Data Mining, Pearson Edition., 2003.
4. Galit Shmueli, Nitin R Patel, Peter C Bruce, Data Mining for Business Intelligence, Wiley India Edition, 2007
5. Rajjan Shinghal, Pattern Recognition, Oxford University Press, 2006.

Implementation of Credit Transfer/Mobility Policy of online courses

Reference: Gazette of India (Extraordinary) Part-III, Section-4 No. 295, UGC **(Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016,** dated 19/07/2016.

With reference to 12th Academic Council Meeting dated 03/05/2017 (Agenda Item No. AC/11/12), wherein MOOCs were adopted in the CBCS scheme, In continuation to that, following modalities are proposed to introduce the credit transfer policy in academic curriculum for the Massive Open Online Courses (MOOC's) offered through SWAYAM (Study Webs of Active-Learning for Young Aspiring Minds) Portal.

A. General Guidelines

1. The SWAYAM shall notify in June and November every year, the list of the online learning Courses going to be offered in the forthcoming Semester on its website https://swayam.gov.in.
2. All the UTDs/Affiliated Colleges shall, within 4 weeks from the date of notification by SWAYAM, consider through their Chairperson/Principal the online learning courses being offered through the SWAYAM platform; and keeping in view their academic requirements, decide upon the courses which it shall permit for credit transfer and keeping in view the following points:

    a) There is non-availability of suitable teaching staff for running a course in the Department.
    b) The facilities for offering the elective papers (courses), sought for by the students are not on offer/scheme in the Institution, but are available on the SWAYAM platform.
    c) The courses offered on SWAYAM would supplement the teaching-learning process in the Institution.
    d) Online courses through SWAYAM should not be more than 20% of total courses offered in a particular semester of a programme.
3. The courses offered in a particular semester will be compiled by Digital India Cell as decided and forwarded by concerned UTDs and affiliated colleges in the prescribed format to digitalindia.ymca@gmail.com and compiled set will be put up in Academic Council for approval.
4. Student can opt for 12-16 weeks course equivalent to 3-6 credits under mentorship of faculty (MHRD MOOC's guidelines 11.1(J) issued by the MHRD vide its orders dated 11/03/2016).

5. Every student being offered a particular paper (course) would be required to register for the MOOCs for that course/paper on SWAYAM through University's/Affiliated College's SWAYAM-NPTEL Local Chapter.
6. The UTD/College may designate a faculty member as course coordinator/mentor to guide the students (at least 20 students) throughout the course with 2 hours per week contribution and with mentor addition on the Local Chapter. The mentor Chairperson/Principal will ensure the provision of facilities for smooth running of the course viz. Internet facility and proper venue in the department/college.
7. Digital India Cell of the University will be the Nodal point for keeping track of MOOCs enrolments in the University and the concerned chairpersons/principals are expected to aware their students/faculty about the online courses.
8. Importance of online learning and credit transfer policy must be shared with the students at entry level by the concerned department/college. Same may be incorporated during induction program for newly admitted students.
9. The departmental/college MOOC coordinators appointed by chairpersons of concerned departments/Principals of affiliated colleges will be responsible for identification of relevant MOOCs in the UTDs/Colleges and smooth conduction during the course.

B. Credit Transfer/Mobility of MOOCs

1. The parent Institution (offering the Course) shall give the equivalent credit weightage to the students for the credits earned through online learning courses through SWAYAM platform in the credit plan of the program.
2. Following pattern will be followed for distribution of credits and will be applicable to all students from Jan 2018 onwards:

Program	**Duration**	**Minimum Credits to be earned***
B.Tech	Semester I to VIII	3
M.Tech/MBA/M.Sc./MA	Semester I to IV	3
BBA/BCA/B.Sc./BA	Semester I to VI	3

***All students of UTDs/Affiliated colleges of all courses have to mandatorily earn minimum prescribed credits.**

Note: From session 2019-20 onwards, for B.Tech program, a student has to earn at least 12 credits during the duration of the Degree subject to the passing of at least one MOOC course (carrying minimum 3 credits per year).

3. A student will be eligible to get Under-Graduate/Post-Graduate degree (B.Tech/M.Tech) with Honours if he/she completes additional credits through MOOC's. (AICTE Model Curriculum, Chapter1(B)). Following pattern will be followed for earning additional credits for the award of Honours degree:

Program	Duration	Credits to be earned*	Minimum CGPA
B.Tech	Semester I to VIII	12	8.0
M.Tech	Semester I to IV	6	8.0

*Inclusive of *Minimum credits to be earned* mentioned in clause B(2) above.

4. The earned credits shall be accepted and transferred to the total credits of the concerned students by the University for Completion of his/her degree. Credits earned through MOOCs will be incorporated in the mark sheet issued to the student by Controller of Examination.
5. Credits for MOOC's will be verified by the concerned department/college and will be forwarded to Controller of Examination for further processing.
6. The courses where model curriculum of AICTE is not applicable, pattern laid down as in B(2) will be followed.

NOTE:

1. These guidelines will be applicable to all Affiliating institutions under University along with all UTDs. Affiliating colleges will establish their own Local Chapter on SWAYAM and follow the same process.
2. For further clarifications, Notifications "Credit Framework for Online Learning Courses through SWAYAM" (UGC Regulations dated 19/07/2016) and "MHRD MOOC's guidelines" (MHRD guidelines dated 11/03/2016) may be referred.