NARULA INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRICAL ENGINEERING

CURRICULUM & SYLLABUS BOOKLET
OF
BACHELOR OF TECHNOLOGY

AUTONOMY REGULATION 2018

DEPARTMENT OF ELECTRICAL ENGINEERING

Departmental Vision

To develop responsible citizens who would 'think global and act local' and become the change agents of society to meet the challenges of future.

Departmental Mission

M1: To impart comprehensive and quality education and to develop innovative, entrepreneurial and ethical professionals, suitable for, sustainable environment.

M2: To develop a reservoir of experience and knowledge and to share it with the stake holders in education for mutual enrichment.

M3: To promote, product oriented and dedicated research for establishing a self-sustaining and wealth-creating centre to serve, the social needs.

M4: To prepare the students for new challenges in the field of electrical engineering.

M5: To create and sustain an environment, for critical thinking and problem solving.

M6: To strive to be at the forefront of Research and maintain intensive interaction with Industry and leading Research Centers, where students can be engaged in Projects, Training and Internships.

M7: To undertake collaborative projects which offer opportunities for long term interaction with academia and industry.

M8: To develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

Program Educational Objectives (PEOs)

PEO 1: (Social contribution)

To train the students to solve real world problem through intensive practice, to guide the students to work on industry-oriented projects and to provide support for vocational training and visits to factories which will develop a sense of social contribution among the students and will motivate and inspire them for value addition to the society for each and every Endeavour.

PEO 2: (Tech and ICT skills)

To train the students on fabrication, assembly, operation, maintenance of all kinds of electrical machines and systems as well as on various programming languages as C, C++ so that they are able to develop suitable hardware and software interface to integrate electrical equipment.

PEO 3: (Communication and professional skills)

To develop competence in written communication, project documentation and paper writing as well as develop good verbal communication. To help them in developing public speaking skills along with accountability, profitability, values and ethics & professional behavior to survive in a multidisciplinary environment.

PEO 4: (Industry orientation with social awareness)

To provide the students with opportunities for vocational training, industry visits, to make them aware of the industry and accustoming them with social concerns and professional responsibility.

PEO 5: (Higher study and research with lifelong learning)

To create the opportunity to work in major or minor projects with reputed academicians as well as industry professionals and encourage them for research, continued professional training to make them aware and adaptive to changes in workplace through formal and informal training throughout their lifetime.

Program Outcomes (POs)

PO1. ENGINEERING KNOWLEDGE:

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

PO2. PROBLEM ANALYSIS:

Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. DESIGN/DEVELOPMENT OF SOLUTIONS:

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

PO4. CONDUCT INVESTIGATIONS OF COMPLEX PROBLEMS:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. MODERN TOOL USAGE:

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. THE ENGINEER AND SOCIETY:

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

Program Outcomes (POs)

PO7. ENVIRONMENT AND SUSTAINABILITY:

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

PO8. ETHICS:

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

PO9. INDIVIDUAL AND TEAM WORK:

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. COMMUNICATION:

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

PO11. PROJECT MANAGEMENT AND FINANCE:

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

PO12. LIFE-LONG LEARNING:

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO 1. Use engineering knowledge to model and analyze the components of electrical power systems.

PSO 2. Apply the knowledge of science and engineering to develop sustainable electrical systems for social and industrial need

CONTENTS

B.TECH CURRICULUM

DEPARTMENT OF ELECTRICAL ENGINEERING

B.Tech First Semester Curriculum

Note: Under Autonomy (Gr A: ECE, EE, EIE; Gr B: CSE, IT, ME, CE)

Acronym	Department
ECE	Electronics and Telecommunication Engineering
EE	Electrical Engineering
EIE	Electronics & Instrumentation Engineering
CSE	Computer Science Engineering
IT	Information Technology
ME	Mechanical Engineering
CE	Civil Engineering

A. THEORY							
Sl No	Paper Code	Course Name	Contact Hours /Week				Credit Points
			L	T	P	Total	
1	M 101	Mathematics -I	3	1	0	4	4
2	CH 101/ PH 101	Chemistry (Gr. A) / Physics - I(Gr. B)	3	0	0	3	3
3	EE 101/ EC 101	Basic Electrical Engineering (Gr. A) / Basic Electronics Engineering (Gr. B)	3	0	0	3	3
4	HU 101	English	2	0	0	2	2
Total of Theory						**12**	**12**

B. PRACTICAL							
5	CH 191/ PH191	Chemistry Laboratory (Gr.A) / Physics -I Laboratory (Gr.B)	0	0	3	3	1.5
6	EE 191/ EC 191	Basic Electrical Engineering Laboratory (Gr. A) /Basic Electronics Engineering Laboratory (Gr. B)	0	0	3	3	1.5
7	ME 191/ ME 192	Engineering Graphics & Design (Gr A)/ Workshop Manufacturing Practices (Gr-B)	0	0	3	3	1.5
8	PR 191	Project-1A	0	0	1	1	0.5
9	PR 192	Project-1B	0	0	1	1	0.5
Total of Practical						**11**	**5.5**
C. **MANDATORY ACTIVITIES / COURSES**							
10	MC 181	Induction Program	0	0	0	0	0
Total of Theory, Practical & Mandatory Activities/ Course						**23**	**17.5**

B.Tech Second Semester Curriculum

Note: Under Autonomy (Gr A: ECE, EE, EIE; Gr B: CSE, IT, ME, CE)

Acronym	Department
ECE	Electronics and Telecommunication Engineering
EE	Electrical Engineering
EIE	Electronics & Instrumentation Engineering
CSE	Computer Science Engineering
IT	Information Technology
ME	Mechanical Engineering
CE	Civil Engineering

A. THEORY							
Sl No	**Paper Code**	**Course Name**	**Contact Hours /Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	M 201	Mathematics -II	3	1	0	4	4
2	CH 201/ PH 201	Chemistry (Gr. B) / Physics – I (Gr. A)	3	0	0	3	3
3	EE 201/ EC 201	Basic Electrical Engineering (Gr. B) / Basic Electronics Engineering (Gr. A)	3	0	0	3	3
4	CS 201	Programming for Problem Solving	3	0	0	3	3
5	ME 201	Engineering Mechanics	3	0	0	3	3
Total of Theory						**16**	**16**

B. PRACTICAL							
Sl No	**Paper Code**	**Course Name**	**Contact Hours /Week**				**Credit Points**
			L	**T**	**P**	**Total**	
6	CS291	Programming for Problem Solving Laboratory	0	0	3	3	1.5
7	CH 291/ PH291	Chemistry Lab (Gr. B) / Physics -I Lab (Gr. A)	0	0	3	3	1.5
8	EE 291/ EC 291	Basic Electrical Engineering Lab (Gr. B) /Basic Electronics Engineering Lab (Gr. A)	0	0	3	3	1.5
9	ME 291/ ME292	Engineering Graphics & Design (Gr. B) / Workshop/Manufacturing Practices (Gr. A)	0	0	3	3	1.5
10	HU 291	Language Laboratory	0	0	2	2	1
11	PR 291	Project II	0	0	1	1	0.5
12	PR 292	*Innovative Activities – I	0	0	0	0	0.5
Total of Practical						**15**	**8**
C. MANDATORY ACTIVITIES / COURSES							
13	MC 281	NSS / Physical Activities / Meditation & Yoga / Photography / Nature Club	0	0	0	3	0
Total of Theory, Practical & Mandatory Activities / Courses						**34**	**24**

* Inter/ Intra Institutional Activities viz; Training with higher Institutions; Soft skill training organized by Training and Placement Cell of the respective institutions; contribution at incubation / innovation / entrepreneurship cell of the institute; participation in conferences / workshops / competitions etc.; Learning at Departmental Lab / Tinkering Lab / Institutional workshop; Working in all the activities of Institute's Innovation Council for e.g., IPR workshop / Leadership Talks / Idea / Design / Innovation / Business Completion / Technical Expos etc. (evaluation by Programme Head through certification) Innovative activities to be evaluated by the Programme Head / Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

B.Tech Third Semester Curriculum

A. THEORY							
Sl. No.	**Paper Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	EE 301	Electrical Circuit Analysis	3	1	0	4	4
2	EE 302	Measurement and Instrumentation	3	0	0	3	3
3	EE 303	Analog Electronics	3	0	0	3	3
4	M(EE) 301	Mathematics – III	3	1	0	4	4
Total of Theory						**14**	**14**
B. PRACTICAL							
5	EE 391	Electrical Circuit Analysis Laboratory	0	0	3	3	1.5
6	EE 392	Measurement and Instrumentation Laboratory	0	0	3	3	1.5
7	EE 393	Analog Electronics Laboratory	0	0	2	2	1
8	PR 391	Project – III	0	0	2	2	1
9	PR 392	*Innovative Activities – II	0	0	0	0	0.5
Total of Practical						10	5.5
C. MANDATORY ACTIVITIES / COURSES							
10	MC 301	Environmental Science	3	0	0	**3**	**0**
Total of Theory, Practical & Mandatory Activities / Courses						**27**	**19.5**

* Students may choose either to work on participation in all the activities of Institute's Innovation Council for e.g., IPR workshop/ Leadership Talks / Idea / Design / Innovation / Business Completion / Technical Exposetc.
Innovative activities to be evaluated by the Programme Head / Event coordinator based on the viva voceand submission of necessary certificates as evidence of activities.

B.Tech Fourth Semester Curriculum

A. THEORY							
Sl. No.	**Paper Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	PH 401	Physics – II	3	0	0	3	3
2	EE 401	Electrical Machines – I	3	0	0	3	3
3	EE 402	Power Electronics	3	0	0	3	3
4	EE 403	Digital Electronics	3	0	0	3	3
5	EE 404	Electromagnetic Fields	2	0	0	2	2
6	HU 401	Values and Ethics in Profession	2	0	0	2	2
Total of Theory						**16**	**16**
B. PRACTICAL							
7	PH 491	Physics – II Laboratory	0	0	3	3	1.5
8	EE 491	Electrical Machines – I Laboratory	0	0	3	3	1.5
9	EE 492	Power Electronics Laboratory	0	0	3	3	1.5
10	EE 493	Digital Electronics Laboratory	0	0	2	2	1
11	PR 491	Project – IV	0	0	2	2	1
12	PR 492	*Innovative Activities – III	0	0	0	0	0.5
Total of Practical						**13**	**07**
C. MANDATORY ACTIVITIES / COURSES							
13	MC481	Behavioural & Interpersonal Skills	0	0	3	3	0
Total of Theory, Practical & Mandatory Activities / Courses						**32**	**23**

* Students may choose either to work on participation in all the activities of Institute's Innovation Council for e.g., IPR workshop / Leadership Talks / Idea / Design / Innovation / Business Completion /Technical Expos etc.
Innovative activities to be evaluated by the Programme Head / Event coordinator based on the vivavoce and submission of necessary certificates as evidence of activities.

B.Tech Fifth Semester Curriculum

A. THEORY							
Sl. No.	**Paper Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	EE 501	Electrical Machines – II	3	0	0	3	3
2	EE 502	Power System – I	3	0	0	3	3
3	EE 503	Control System – I	3	0	0	3	3
4	EE 504	A. Data Structure B. Computer Network C. Internet of Things	3	0	0	3	3
5	EE 505	A. Electrical Energy Conservation and Auditing B. Electromagnetic Waves C. Illumination Engineering D. Power Plant Engineering	3	0	0	3	3
Total of Theory						**15**	**15**
B. PRACTICAL							
6	EE 591	Electrical Machines – II Laboratory	0	0	3	3	1.5
7	EE 592	Power System – I Laboratory	0	0	3	3	1.5
8	EE 593	Control System – I Laboratory	0	0	3	3	1.5
9	EE 594	A. Data Structure Laboratory B. Computer Network Laboratory C. Internet of Things Laboratory	0	0	3	3	1.5
10	PR 591	Project – V	0	0	2	2	1
11	PR 592	Innovative Activities – IV	0	0	0	0	0.5
Total of Practical						**14**	**7.5**

C. MANDATORY ACTIVITIES / COURSES							
Sl. No.	**Paper Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
			L	**T**	**P**	**Total**	
12	MC 501	Constitution of India	3	0	0	3	0
Total of Theory, Practical & Mandatory Activities / Courses						**32**	**22.5**

* Students may choose either to work on participation in Hackathons etc. Development of new product /Business Plan / registration of start-up.
Students may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry / NGO's / Government organizations / Micro / Small / Medium enterprises to make themselves ready for the industry / Long Term goals under rural Internship. (Duration 4-6 weeks)

Innovative activities to be evaluated by the Programme Head / Event coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

B.Tech Sixth Semester Curriculum

A. THEORY							
Sl. No.	**Paper Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	EE 601	Microprocessor and Microcontroller	3	0	0	3	3
2	EE 602	Power System – II	3	0	0	3	3
3	EE 603	Control System – II	3	0	0	3	3
4	EE 604	A. Data Base Management System B. Embedded Systems C. Software Engineering	3	0	0	3	3
5	EE 605	A. Digital Signal Processing B. High Voltage Engineering C. Computer Architecture	3	0	0	3	3
Total of Theory						**15**	**15**
B. PRACTICAL							
6	EE 691	Microprocessor and Microcontroller Laboratory	0	0	2	2	1
7	EE 692	Power System – II Laboratory	0	0	3	3	1.5
8	EE 693	Control System – II Laboratory	0	0	3	3	1.5
9	EE 694	A. Data Base Management System Lab B. Embedded Systems Lab C. Software Engineering Lab	0	0	3	3	1.5
10	PR 691	Project – VI	0	0	2	2	1
11	PR 692	Innovative Activities – V	0	0	0	0	0.5
Total of Practical						**13**	**7**

C. MANDATORY ACTIVITIES / COURSES							
Sl. No.	**Paper Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1 2	MC 681	*Technical Lecture Presentation & Group Discussion – I	0	0	3	3	0
Total of Theory, Practical & Mandatory Activities / Courses						**31**	**22**

* Students may choose either to work on participation in all the activities of Institute's Innovation Council fore.g., IPR workshop / Leadership Talks / Idea / Design / Innovation / Business Completion / Technical Expos etc.

  Innovative activities to be evaluated by the Programme Head / Event coordinator based on the viva voceand submission of necessary certificates as evidence of activities.

B.Tech Seventh Semester Curriculum

A. THEORY							
Sl. No.	**Paper Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	EE 701	Electrical Drives	3	0	0	3	3
2	EE 702	A. Object Oriented Programming using JAVA B. Big Data Analysis C. Digital Image Processing	3	0	0	3	3
3	EE 703	A. Power System – III B. Restructured Electrical Power System C. Computer Applications in Power System	3	0	0	3	3
4	EE 704	A. Power System Dynamics and Control B. Power Quality and FACTS C. HVDC Transmission Systems	3	0	0	3	3
5	HU 703	Industrial and Financial Management	2	0	0	2	2
Total of Theory						**14**	**14**
B. PRACTICAL							
6	EE 791	Electrical Drives Laboratory	0	0	3	3	1.5
7	EE 792	A. Object Oriented Programming Laboratory B. Big Data Analysis Laboratory C. Digital Image Processing Laboratory	0	0	3	3	1.5
8	PR 791	Project – VII	0	0	0	6	3
9	PR 792	Innovative Activities – VI	0	0	0	0	0.5
Total of Practical						**12**	**6.5**

C. MANDATORY ACTIVITIES / COURSES							
Sl. No.	**Paper Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
			L	**T**	**P**	**Total**	
10	MC 781	*Technical Lecture Presentation & Group Discussion – II	0	0	3	3	0
Total of Theory, Practical & Mandatory Activities / Courses						**29**	**20.5**

* Students may choose either to work on participation in Hackathons etc. Development of new product /Business Plan / registration of start-up.

Students may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students maychoose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry / NGO's / Government organizations / Micro / Small / Medium enterprises to make themselves ready for the industry / Long Term goals under rural Internship. (Duration 4-6 weeks)

Innovative activities to be evaluated by the Programme Head / Event Coordinator based on the viva voce and submission of necessary certificates as evidence of activities.

B.Tech Eighth Semester Curriculum

A. THEORY							
SlNo	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	EE 801	A. Wind and Solar Energy Systems B. Utilization of Electric Power C. Line Commutated and Active Rectifiers	2	0	0	2	2
2	EE 802	A. Advanced Electric Drives B. Control Systems Design C. Industrial Electrical System	3	0	0	3	3
3	HU 801	Principles of Management	2	0	0	2	2
Total of Theory						**7**	**7**
B. PRACTICAL							
4	PR 891	Project – VIII	0	0	8	8	4
Total of Practical						**8**	**4**
C. MANDATORY ACTIVITIES / COURSES							
5	MC 804	Essence of Indian Knowledge Tradition	3	0	0	3	0
Total of Theory, Practical & Mandatory Activities / Courses						**18**	**11**

Mandatory Credit Point = 160

For Honors additional 20 Credit Point is to be earned (1st Sem to 8th Sem) through MOOCs courses. All the Certificates received by the students across all semester for MOOCs Courses from approved organization (Appendix A) is to be submitted to CoE office prior to 8th Semester Examination.

DETAILS

OF

CATEGORY OF B.TECH COURSES

Credit Distribution Ratio

Category	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester	7th Semester	8th Semester	Total Credit (Category Wise)	Credit Allocation as per AICTE
Humanities, Social Sciences & Management Courses (HS)	2	1	0	2	0	0	2	2	**9**	12*
Basic Science courses (BS)	8.5	8.5	4	4.5	0	0	0	0	**25.5**	25*
Engineering Science courses including Workshop, Drawing, Basics of Electrical / Mechanical / Computer etc (ES)	6	13.5	5.5	0	0	0	0	0	**25**	24*
Professional Core Courses (PC)	0	0	8.5	15	13.5	13	4.5	0	**54.5**	48*
Professional Elective Courses relevant to chosen specialization / branch (PE)	0	0	0	0	3	3	6	5	**17**	18*
Open subjects – Electives from other technical and /or emerging subjects (OE)	0	0	0	0	4.5	4.5	4.5	0	**13.5**	18*
Project work, seminar and internship in industry or elsewhere (PROJ)	1	1	1.5	1.5	1.5	1.5	3.5	4	**15.5**	15*
Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition] (MC)	0	0	0	0	0	0	0	0	**Non-Credit**	
Total Credit (Semester Wise)	**17.5**	**24**	**19.5**	**23**	**22.5**	**22**	**20.5**	**11**	**160**	

**Minor variation is allowed as per need of the respective disciplines.*

BASIC SCIENCE COUSES (BS)

Sl. No.	Subject Code	Subject Name	Hrs. / Week L:T:P	Credit	Semester
1.	M 101	Mathematics – I	3:1:0	4	1st
2.	CH 101	Chemistry	3:0:0	3	1st
3.	CH 191	Chemistry Laboratory	0:0:3	1.5	1st
4.	M 201	Mathematics – II	3:1:0	4	2nd
5.	PH 201	Physics – I	3:0:0	3	2nd
6.	PH 291	Physics – I Laboratory	0:0:3	1.5	2nd
7.	M(EE) 301	Mathematics – III	3:1:0	4	3rd
8.	PH 401	Physics – II	3:0:0	3	4th
9.	PH 491	Physics – II Laboratory	0:0:3	1.5	4th
		Total		**25.5**	

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT (HS)

Sl. No.	Subject Code	Subject Name	Hrs. / Week L:T:P	Credit	Semester
1.	HU 101	English	2:0:0	2	1st
2.	HU 291	Language Laboratory	0:0:2	1	2nd
3.	HU 401	Values and Ethics in Profession	2:0:0	2	4th
3.	HU 703	Industrial and Financial Management	2:0:0	2	7th
4.	HU 802	Principles of Management	2:0:0	2	8th
		Total		**9**	

ENGINEERING SCIENCE COURSES (ES)

Sl. No.	Subject Code	Subject Name	Hrs. / Week L:T:P	Credit	Semester
1.	EE 101	Basic Electrical Engineering	3:0:0	3	1st
2.	EE 191	Basic Electrical Engineering Laboratory	0:0:3	1.5	1st
3.	ME 191	Engineering Graphics & Design	0:0:3	1.5	1st
4.	EC 201	Basic Electronics Engineering	3:0:0	3	2nd
5.	CS 201	Programming for Problem Solving	3:0:0	3	2nd
6.	ME 201	Engineering Mechanics	3:0:0	3	2nd
7.	EC 291	Basic Electronics Engineering Laboratory	0:0:3	1.5	2nd
8.	CS 291	Programming for Problem Solving Laboratory	0:0:3	1.5	2nd
9.	ME 292	Workshop / Manufacturing Practice	0:0:3	1.5	2nd
10.	EE 301	Electrical Circuit Analysis	3:1:0	4	3rd
11.	EE 391	Electrical Circuit Analysis Laboratory	0:0:3	1.5	3rd
		Total		**25**	

MANDATORY COURSES (MC)

Sl. No.	Subject Code	Subject Name	Hrs. / Week L:T:P	Credit	Semester
1.	MC 181	Induction Program	0:0:0	0	1st
2.	MC 281	NSS / Physical Activities / Meditation & Yoga / Photography / Nature Club	0:0:3	0	2nd
3.	MC 301	Environmental Science	3:0:0	0	3rd
4.	MC 481	Behavioural & Interpersonal Skills	0:0:3	0	4th
5.	MC 501	Constitution of India	3:0:0	0	5th
6.	MC 681	Technical Lecture Presentation & Group Discussion – I	0:0:3	0	6th
7.	MC 781	Technical Lecture Presentation & Group Discussion – II	0:0:3	0	7th
8.	MC 801	Essence of Indian Knowledge Tradition	3:0:0	0	8th
		Total		**0**	

PROFESSIONAL CORE COURSES (PC)

Sl. No.	Subject Code	Subject Name	Hrs. / Week L:T:P	Credit	Semester
1.	EE 302	Measurement and Instrumentation	3:0:0	3	3rd
2.	EE 303	Analog Electronics	3:0:0	3	3rd
3.	EE 392	Measurement and Instrumentation Laboratory	0:0:3	1.5	3rd
4.	EE 393	Analog Electronics Laboratory	0:0:2	1	3rd
5.	EE 401	Electrical Machines – I	3:0:0	3	4th
6.	EE 402	Power Electronics	3:0:0	3	4th
7.	EE 403	Digital Electronics	3:0:0	3	4th
8.	EE 404	Electromagnetic Fields	2:0:0	2	4th
9.	EE 491	Electrical Machines – I Laboratory	0:0:3	1.5	4th
10.	EE 492	Power Electronics Laboratory	0:0:3	1.5	4th
11.	EE 493	Digital Electronics Laboratory	0:0:2	1	4th
12.	EE 501	Electrical Machines – II	3:0:0	3	5th
13.	EE 502	Power System – I	3:0:0	3	5th
14.	EE 503	Control System – I	3:0:0	3	5th
15.	EE 591	Electrical Machines – II Laboratory	0:0:3	1.5	5th
16.	EE 592	Power System – I Laboratory	0:0:3	1.5	5th
17.	EE 593	Control System – I Laboratory	0:0:3	1.5	5th
18.	EE 601	Microprocessor and Microcontroller	3:0:0	3	6th
19.	EE 602	Power System – II	3:0:0	3	6th
20.	EE 603	Control System – II	3:0:0	3	6th
21.	EE 691	Microprocessor and Microcontroller Laboratory	0:0:2	1	6th
22.	EE 692	Power System – II Laboratory	0:0:3	1.5	6th
23.	EE 693	Control System – II Laboratory	0:0:3	1.5	6th
24.	EE 701	Electrical Drives	3:0:0	3	7th
25.	EE 791	Electrical Drives Laboratory	0:0:3	1.5	7th
		Total		**54.5**	

PROFESSIONAL ELECTIVE COURSES (PE)

Sl. No.	Subject Code	Subject Name	Hrs. / Week L:T:P	Credit	Semester
1.	EE 505	A. Electrical Energy Conservation and Auditing B. Electromagnetic Waves C. Illumination Engineering	3:0:0	3	5th
2.	EE 605	A. Digital Signal Processing B. High Voltage Engineering C. Computer Architecture	3:0:0	3	6th
3.	EE 703	A. Power System-III B. Restructured Electrical Power System C. Computer Applications in Power System	3:0:0	3	7th
4.	EE 704	A. Power System Dynamics and Control B. Power Quality and FACTS C. HVDC Transmission Systems	3:0:0	3	7th
5.	EE 801	A. Wind and Solar Energy Systems B. Utilization of Electric Power C. Line Commutated and Active Rectifiers	2:0:0	2	8th
6.	EE 802	A. Advanced Electric Drives B. Control Systems Design C. Industrial Electrical System	3:0:0	3	8th
		Total		**17**	

OPEN ELECTIVE COURSES (OE)

Sl. No.	Subject Code	Subject Name	Hrs. / Week L:T:P	Credit	Semester
1.	EE 504	A. Data Structure B. Computer Network C. Internet of Things	3:0:0	3	5th
2.	EE 594	A. Data Structure Laboratory B. Computer Network Laboratory C. Internet of Things Laboratory	0:0:3	1.5	5th
3.	EE 604	A. Data Base Management System B. Embedded Systems C. Software Engineering	3:0:0	3	6th
4.	EE 694	A. Data Base Management System Laboratory B. Embedded Systems Laboratory C. Software Engineering Laboratory	0:0:3	1.5	6th
5.	EE 702	A. Object oriented programming using JAVA B. Big Data Analysis C. Digital Image Processing	3:0:0	3	7th
6.	EE 792	A. Object Oriented Programming Laboratory B. Big Data Analysis Laboratory C. Digital Image Processing Laboratory	0:0:3	1.5	7th
		Total		**13.5**	

PROJECT WORK, SEMINAR, INTERNSHIP (PROJ)

Sl. No.	Subject Code	Subject Name	Hrs. / Week L:T:P	Credit	Semester
1.	PR 191	Project – IA	0:0:1	0.5	1st
2.	PR 192	Project – IB	0:0:1	0.5	1st
3.	PR 291	Project – II	0:0:1	0.5	2nd
4.	PR 292	Innovative Activities – I	0:0:0	0.5	2nd
5.	PR 391	Project – III	0:0:2	1	3rd
6.	PR 392	Innovative Activities – II	0:0:0	0.5	3rd
7.	PR 491	Project - IV	0:0:2	1	4th
8.	PR 492	Innovative Activities – III	0:0:0	0.5	4th
9.	PR 591	Project – V	0:0:2	1	5th
10.	PR 592	Innovative Activities – IV	0:0:0	0.5	5th
11.	PR 691	Project – VI	0:0:2	1	6th
12.	PR 692	Innovative Activities – V	0:0:0	0.5	6th
13.	PR 791	Project – VII	0:0:6	3	7th
14.	PR 792	Innovative Activities – VI	0:0:0	0.5	7th
15.	PR 891	Project – VIII	0:0:8	4	8th
		Total		**15.5**	

Format for Project Work Evaluation (B.Tech)

College Name: **Department :**

Paper Name : **Paper Code :**

STREAM : **Semester :**

University Roll No.	Name of the Student	Title of the Project	Semester Examination								
			Project Report (10)	Development of Mathematical Modeling / Prototype (20)	Power point presentation (15)	Viva-Voce (15)	Usage of Modern Tool / Technology (10)	Innovative -ness (10)	Individual contribution (10)	Group activity (10)	Total (100)

(Signature of the Project Supervisor(s)) (Signature of the HoD)

Appendix – A

MOOCs Courses
For B.Tech Students for AY 2018-19
(1st Semester to 8th Semester)

Total Credit for MOOCs Subjects will be 10.

List of websites which offers online certification Courses

Sl. No.	Online Cerification Courses	Website
1.	Swayam	https://swayam.gov.in/
2.	NPTEL	https://onlinecourses.nptel.ac.in/
3.	MOOC	http://mooc.org/
4.	Edx	https://www.edx.org/
5.	Coursera	https://www.coursera.org/
6.	Udacity	https://in.udacity.com/
7.	Udemy	https://www.udemy.com/
8.	Khan Academy	https://www.khanacademy.org/
9.	Skillsahre	https://www.skillshare.com/
10.	Harvard University	https://online-learning.harvard.edu/
11.	Ted	https://ed.ted.com/
12.	Alison	https://alison.com/
13.	Futurelearn	https://www.futurelearn.com/
14.	Web Development	https://digitaldefynd.com/best-free-web-development-courses-tutorials-certification/
15.	Digital Marketing	https://digitaldefynd.com/best-free-digital-marketing-certifications/
16.	ios app development	https://digitaldefynd.com/best-ios-app-development-course-tutorial/
17.	Open Learn	http://www.open.edu/openlearn/
18.	Future Learn	https://www.futurelearn.com/
19.	Tuts Plus	https://tutsplus.com/
20.	Open Culture	http://www.openculture.com/

For Honors additional 20 Credit Point is to be earned (1st Sem to 8th Sem) through MOOCs courses. All the Certificates received by the students across all semester for MOOCs Courses from approved organization, should be submitted to CoE office prior to 8th Semester Examination.

Distribution of the credit with respect to weeks are as follows:
4 to 6 weeks: 2 Credit
8 to 10 weeks: 3 Credits
12 to 14 weeks: 4 Credits
16 or more than that: 6 Credits

20 credit for Honors, should be earned by the students from the MOOC Basket and any other subjects related to the specific program of the respective departments.

MOOCs Basket for Electrical Engineering

Sl. No.	MOOC Courses	Applicable Students (Semester wise)
1	Environmental Science & Studies	I/II
2	Introduction to Environmental Science	I/II
3	Computer Fundamentals	II/III
4	Fundamental Concepts of Electricity	II/III
5	Basic Electrical Engineering	II/III
6	Basic Electric Circuits	II/III
7	Fundamentals of Electrical Engineering	II/III
8	Engineering Mechanics	II/III
9	Basic Electronics Engineering	II/III/IV
10	Engineering Calculus and Differential Equations	II/III/IV
11	C Programming	II/III/IV
12	C Programming: Getting Started	II/III/IV
13	C Programming: Language Foundations	II/III/IV
14	C Programming: Modular Programming and Memory Management	II/III/IV
15	C Programming: Pointers and Memory Management	II/III/IV
16	C Programming: Advanced Data Types	II/III/IV
17	Fundamentals of Semiconductor Devices	II/III/IV
18	Programming of C++	III/IV
19	Numerical Methods	III/IV
20	Circuit Theory & Network	III/IV
21	Network Analysis	III/IV
22	Electrotechnical I	III/IV
23	Measurement and Instrumentation	III/IV
24	Electrical Measurement and Electronic Instruments	III/IV
25	Analog Electronics	III/IV
26	Analog Electronic Circuits	III/IV
27	Analog Circuits	III/IV
28	Analog Circuits and Systems through SPICE Simulation	III/IV
29	Op-Amp Practical Applications: Design, Simulation and Implementation	III/IV
30	MATLAB Programming and Simulink	III/IV
31	Circuits and Electronics 1: Basic Circuit Analysis	III/IV
32	Circuits and Electronics 2: Amplification, Speed, and Delay	III/IV
33	Circuits and Electronics 3: Applications	III/IV
34	Introduction to Engineering and Design	III/IV
35	Introduction to Design Thinking	III/IV
36	Design Thinking Fundamentals	III/IV
37	Design Thinking: Empathizing to Understand the Problem	III/IV
38	Design Thinking: Ideation, Iteration and Communication	III/IV
39	Design Thinking: Prototyping and User Testing	III/IV
40	Structure of Materials	III/IV

41	Digital Electronics	IV/V
42	Digital Electronic Circuits	IV/V
43	Digital Circuits	IV/V
44	xMinor in Materials for Electronic, Optical, and Magnetic Devices	IV/V
45	Circuits and Electronics	IV/V
46	Electromagnetic Field Theory	IV/V
47	Computational Electromagnetics	IV/V
48	Fourier Analysis and Its Applications	IV/V
49	Integrated Circuits: MOSFETs, Op-Amp and their Applications	IV/V
50	Electrical Machines – I	IV/V
51	Electrical Machines	IV/V/VI
52	Power Electronics	V/VI
53	Data Structure	V/VI
54	Data Structures and Software Design	V/VI
55	Computer Network	V/VI
56	Internet of Things	V/VI
57	Energy Conservation and Auditing	V/VI
58	Electromagnetic Waves	V/VI
59	Illumination Engineering	V/VI
60	Power Plant Engineering	V/VI
61	Microprocessors and Microcontrollers	V/VI
62	Microprocessors and Interfacing	V/VI
63	Architectural Design of Digital Integrated Circuits	V/VI
64	Linear and/or Non-linear System Theory	V/VI
65	Analog IC Design	V/VI
66	Digital IC Design	V/VI
67	Photonic Integrated Circuits 1	V/VI
68	Stochastic Processes: Data Analysis and Computer Simulation	V/VI
69	Introduction to Computer Numerical Control	V/VI
70	Software Development Fundamentals	V/VI
71	Formal Software Verification	V/VI
72	Software Testing Fundamentals	V/VI
73	Linux Basics: The Command Line Interface	V/VI
74	C Programming: Using Linux Tools and Libraries	V/VI
75	A Hands-on Introduction to Engineering Simulations	V/VI
76	Introduction to Analytics Modeling	V/VI
77	Innovation Strategies for Electric Mobility: The StreetScooter Case	V/VI/VII
78	Autonomous Mobile Robots	V/VI/VII
79	Real-Time Bluetooth Networks – Shape the World	V/VI/VII
80	Power System	V/VI/VII
81	Power System Engineering	V/VI/VII
82	Power System Analysis	V/VI/VII
83	Recent Advances in Transmission Insulators	V/VI/VII
84	Control System	V/VI/VII

85	Control Engineering	V/VI/VII
86	Linear Dynamical Systems	V/VI/VII
87	Linear System Theory	V/VI/VII
88	Non Linear Adaptive Control	VI/VII
89	Non Linear System Analysis	VI/VII
90	Zero-Energy Design: an approach to make your building sustainable	VI/VII
91	Inclusive Energy Systems – Exploring Sustainable Energy for All	VI/VII
92	Energy Systems Integration: A Trend or a Revolution?	VI/VII
93	Data Base Management System	VI/VII
94	Embedded Systems	VI/VII
95	Embedded Systems – Shape The World: Microcontroller Input/Output	VI/VII
96	Embedded Systems – Shape The World: Multi-Threaded Interfacing	VI/VII
97	Algorithm Design and Analysis	VI/VII
98	Hands-on training on Solar Study Lamp Assembly	VI/VII
99	Software Engineering	VI/VII
100	Digital Signal Processing	VI/VII
101	Signals and Systems	VI/VII
102	Principles of Signals and Systems	VI/VII
103	Discrete Time Signal Processing	VI/VII
104	Mathematical Methods and Techniques in Signal Processing	VI/VII
105	Statistical Signal Processing	VI/VII
106	VLSI Signal Processing	VI/VII
107	High Voltage Engineering	VI/VII
108	Computer Architecture	VI/VII
109	Components and Applications of Internet of Things	VI/VII
110	Analog Communication	VI/VII
111	Digital Communication Systems	VI/VII
112	Optical Engineering	VI/VII
113	Fiber-Optic Communication	VI/VII
114	Fiber-Optic Communication Systems and Techniques	VI/VII
115	Principles of Communication Systems	VI/VII
116	Principles of Communication Systems Part – II	VI/VII
117	Principles of Digital Communication	VI/VII
118	A System View of Communications: From Signals to Packets (Part 1)	VI/VII
119	A System View of Communications: From Signals to Packets (Part 2)	VI/VII
120	A System View of Communications: From Signals to Packets (Part 3)	VI/VII
121	CDMA / MIMO / OFDM Wireless Communications	VI/VII
122	Fundamentals of MIMO Wireless Communications	VI/VII
123	Introduction to Wireless and Cellular Communications	VI/VII
124	Microwave Engineering	VI/VII
125	Design and Simulation of Power Conversion using Open Source Tools	VI/VII
126	Digital Switching	VI/VII
127	Microelectronics: Devices to Circuits	VI/VII
128	Robotics	VI/VII

129	Robotics: Kinematics and Mathematical Foundations	VI/VII
130	Robotics: Vision Intelligence and Machine Learning	VI/VII
131	Robotics: Dynamics and Control	VI/VII
132	Robotics: Locomotion Engineering	VI/VII
133	Model-based Systems Engineering: Foundations	VI/VII
134	Model-based Systems Engineering: Advanced Approaches with OPM	VI/VII
135	Electrical Drives	VII/VIII
136	Drones for Agriculture: Prepare and Design Your Drone (UAV) Mission	VII/VIII
137	Object Oriented Programming	VII/VIII
138	Programming for the Web with Java Script	VII/VIII
139	Big Data Analysis	VII/VIII
140	Visualizing Data with Python	VII/VIII
141	Python Basics for Data Science	VII/VIII
142	Analyzing Data with Python	VII/VIII
143	Analyzing Data with Python	VII/VIII
144	4G Network Essentials	VII/VIII
145	Digital Image Processing	VII/VIII
146	Cyber Security Basics: A Hands-on Approach	VII/VIII
147	Advanced Electrical Power System	VII/VIII
148	Restructured Electrical Power System	VII/VIII
149	Computer Applications in Power System	VII/VIII
150	Transmission Lines and Electromagnetic Waves	VII/VIII
151	Power System Dynamics and Control	VII/VIII
152	Power Quality and FACTS	VII/VIII
153	HVDC Transmission Systems	VII/VIII
154	DC Power Transmission Systems	VII/VIII
155	Renewable and Non-Conventional Energy	VII/VIII
156	Solar Energy	VII/VIII
157	Solar Energy: Photovoltaic (PV) Systems	VII/VIII
158	Solar Energy: Photovoltaic (PV) Energy Conversion	VII/VIII
159	Solar Energy: Photovoltaic (PV) Technologies	VII/VIII
160	Solar Energy: Integration of Photovoltaic Systems in Microgrids	VII/VIII
161	Sustainable Energy: Design a Renewable Future	VII/VIII
162	Why Move Towards Cleaner Power	VII/VIII
163	Creating a Pro-Renewables Environment	VII/VIII
164	Incorporating Renewable Energy in Electricity Grids	VII/VIII
165	Using Photovoltaic (PV) Technology in Desert Climates	VII/VIII
166	Solar Resource Assessment in Desert Climates	VII/VIII
167	Solar Energy Engineering: Comprehensive Exams	VII/VIII
168	Nuclear Energy: Science, Systems and Society	VII/VIII
169	Utilization of Electric Power	VII/VIII
170	Line Commutated and Active Rectifiers	VII/VIII
171	Advanced Power Electronics	VII/VIII
172	Power Management Integrated Circuits	VII/VIII

173	High Power Multilevel Converters – Analysis, Design and Operational Issues	VII/VIII
174	Advanced Electric Drives	VII/VIII
175	Mapping Signal Processing Algorithms to Architectures	VII/VIII
176	Neural Networks for Signal Processing – I	VII/VIII
177	Control Systems Design	VII/VIII
178	Advance Power Electronics and Control	VII/VIII
179	Principles and Techniques of Modern Radar Systems	VII/VIII
180	Industrial Electrical System	VII/VIII
181	Manufacturing Process Control II	VII/VIII
182	Sensors and Actuators	VII/VIII
183	Electronic Systems for Sensor Applications	VII/VIII
184	Fabrication Techniques for MEMs based Sensors: Clinical Perspective	VII/VIII
185	Micro and Nanofabrication (MEMS)	VII/VIII
186	Industrial Process Control	VII/VIII
187	PLC and SCADA	VII/VIII
188	Optimization Techniques	VII/VIII
189	Sensing Planet Earth – From Core to Outer Space	VII/VIII
190	Sensing Planet Earth – Water and Ice	VII/VIII
191	Research Methods: An Engineering Approach	VII/VIII
192	Smart Grid / Micro Grid	VII/VIII
193	Power Quality Improvement Technique	VII/VIII
194	Big Data Analytics for Smart Grid	VII/VIII
195	Electric Vehicles	VII/VIII
196	Electric and Conventional Vehicles	VII/VIII
197	Electric Cars: Introduction	VII/VIII
198	Electric Cars: Technology	VII/VIII
199	Electric Cars: Business	VII/VIII
200	Electric Cars: Policy	VII/VIII

Appendix – B

Mandatory Additional Requirement (MAR):

Activity Heads and Sub-Activity Heads along with their capping of the Activity Points that to be earned by the students during the entire B.Tech duration.

Sl. No.	Name of the Activity	Points	Maximum Points Allowed
1.	MOOCS (SWAYAM/NPTEL/Spoken Tutorial) (per course)	20	40
2.	Tech Fest/Teachers Day/Freshers Welcome		
	Organizer	5	10
	Participants	3	6
5.	Rural Reporting	5	10
6.	Tree Plantation (per tree)	1	10
7.	Participation in Relief Camps	20	40
8.	Participation in Debate/Group Discussion/ Tech quiz	10	20
9.	Publication of Wall magazine in institutional level (magazine/article/internet)	10	20
10.	Publication in News Paper, Magazine & Blogs	10	20
11.	Research Publication (per publication)	15	30
12.	Innovative Projects (other than course curriculum)	30	60
13.	Blood donation	8	16
	Blood donation camp Organization	10	20
15.	Participation in Sports/Games		
	College level	5	10
	University Level	10	20
	District Level	12	24
	State Level	15	30
	National/International Level	20	20
21.	Cultural Programme (Dance, Drama, Elocution, Music etc.)	10	20
22.	Member of Professional Society	10	20
23.	Student Chapter	10	20
24.	Relevant Industry Visit & Report	10	20
25.	Photography activities in different Club(Photography club, Cine Club, Gitisansad)	5	10
26.	Participation in Yoga Camp (Certificate to be submitted)	5	10
27.	Self-Entrepreneurship Programme	20	20
28.	Adventure Sports with Certification	10	20
29.	Training to under privileged/Physically challenged	15	30
30.	Community Service & Allied Activities	10	20

Department: Electrical Engineering

LIST OF MOOCS COURSES FOR MAR

MOOCs Equivalent (Theory)	Minimum Duration	Suggested MAR Point
Ethics in Engineering Practice	8weeks	16
Environmental Studies: A Global Perspective	6weeks	12
Introduction To Biology: The Secret of Life	12weeks	20
Engineering Econometrics	12weeks	20
Management in Engineering	8weeks	16
Human Resource Development	12 weeks	20
Organizational Behavior	7 weeks	16
Project Management for Managers	12weeks	20
International Cyber Conflicts	5weeks	10
Fundamentalsof Digital Marketing, Social Media, and E-Commerce	6weeks	12
Developing Soft Skills and Personality	8 weeks	16
History of English Language and Literature	12 weeks	20
Interpersonal Skills	8 weeks	16
Soft skills	12 weeks	20
Technical English for engineers	8 weeks	16
Better Spoken English	12 weeks	20
Business English Communication	4 weeks	8
Calculus of One Real Variable	8 weeks	16
Educational leadership	8 weeks	16
Economics of IPR	4 weeks	8
Enhancing Soft Skills and Personality	8 weeks	16
Human Resource Development	12 weeks	20
Indian Philosophy	12 weeks	20
Intellectual Property	12 weeks	20
Introduction on Intellectual Property to Engineers and Technologists	8 weeks	16
Literature, Culture and Media	12 weeks	20
Science, Technology and Society	12 weeks	20
Soft Skill Development	8 weeks	16
Speaking Effectively	8 weeks	16
Strategic Performance Management	8 weeks	16
Water, Society and Sustainability	4 weeks	8
Calculus of Several Real Variables	8 weeks	16
Higher Engineering Mathematics	12 weeks	20
Introduction to Abstract and Linear Algebra	8 weeks	16
Enhancing Soft Skills and Personality	8 weeks	16

Record of Activities for Mandatory Additional Requirement

College Name (College Code):							Department:					
Student Name:		University Roll No:					Registration No:					
Sl No	Activity	Points	Max. Points Allowed	Points Earned								
				Sem1	Sem2	Sem3	Sem4	Sem5	Sem6	Sem7	Sem8	Total
1	*MOOCS (SWAYAM/NPTEL/Spoken Tutorial) per course*											
	For 12 weeks duration	**20**	**40**									
	For 8 weeks duration	**16**										
2	*Tech Fest/Teachers Day/Freshers Welcome*											
	Organizer	**5**	**10**									
	Participants	**3**	**6**									
3	Rural Reporting	**5**	**10**									
4	Tree Plantation and up keeping (per tree)	**1**	**10**									
5	Participation in Relief Camps	**20**	**40**									
6	Participation in Debate/Group Discussion/ Tech quiz	**10**	**20**									
7	*Publication of Wall magazine in institutional level (magazine/article/internet)*											
	Editor	**10**	**20**									
	Writer	**6**	**12**									
8	Publication in News Paper, Magazine & Blogs	**10**	**20**									
9	Research Publication (per publication)	**15**	**30**									
10	Innovative Projects (other than course curriculum)	**30**	**60**									
11	Blood donation	**8**	**16**									
	Blood donation camp Organization	**10**	**20**									

Record of Activities for Mandatory Additional Requirement (Contd.)

Sl No	Activity	Points	Max. Points Allowed	Points Earned								
				Sem1	Sem2	Sem3	Sem4	Sem5	Sem6	Sem7	Sem8	Total
12	*Participation in Sports/Games*											
	College level	**5**	**10**									
	University Level	**10**	**20**									
	District Level	**12**	**24**									
	State Level	**15**	**30**									
	National/International Level	**20**	**20**									
13	Cultural Programme (Dance, Drama, Elocution, Music etc.)	**10**	**20**									
14	Member of Professional Society	**10**	**20**									
15	Student Chapter	**10**	**20**									
16	Relevant Industry Visit & Report	**10**	**20**									
17	Photography activities in different Club(Photography club, Cine Club, Gitisansad)	**5**	**10**									
18	Participation in Yoga Camp (Certificate to be submitted)	**5**	**10**									
19	Self-Entrepreneurship Programme	**20**	**20**									
20	Adventure Sports with Certification	**10**	**20**									
21	Training to under privileged / Differently abled	**15**	**30**									
22	Community Service & Allied Activities	**10**	**20**									
Total Points												
Signature of Mentor												
Signature of HoD												

SYLLABUS

OF

B.TECH FIRST SEMESTER COURSES

Course Name: Mathematics-I
Course Code: M 101
Contact: 3:1:0
Total contact Hours: 48
Credit: 4

Prerequisite: The students to whom this course will be offered must have the concept of (10+2) standard matrix algebra and calculus.

Course Outcome:

- **CO1.** Recall the distinctive characteristics of matrix algebra and calculus.
- **CO2.** Understand the theoretical working of matrix algebra and calculus.
- **CO3.** Apply the principles of matrix algebra and calculus to address problems in their disciplines.
- **CO4.** Examine the nature of system using the concept of matrix algebra and calculus.

Course Content

Module I: Matrix Algebra (11)
Echelon form and Normal (Canonical) form of a matrix; Inverse and rank of a matrix; Consistency and inconsistency of system of linear equations, Solution of system of linear equations; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton theorem.

Module II: Differential Calculus and Infinite Series (10)
Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Concept of sequence and series, Tests for convergence of infinite series: Comparison test, D'Alembert's ratio test, Raabe's test, Cauchy's root test, Power series; Taylor's series, Series for exponential, trigonometric and logarithm functions.

Module III: Multivariable Calculus (Differentiation) - I (9)
Function of several variables, Concept of limit, continuity and differentiability; Partial derivatives, Total derivative and its application; Chain rules, Derivatives of implicit functions Euler's theorem on homogeneous function, Jacobian.

Module IV: Multivariable Calculus (Differentiation) - II (7)
Maxima and minima of functions of two variables, Method of Lagrange multipliers; Directional derivatives, Gradient, Divergence, Curl.

Module V: Integral Calculus (11)
Evolutes and involutes; Evaluation of definite integrals and its applications to evaluate surface areas and volumes of revolutions; Improper integrals; Beta and Gamma functions and their properties.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
3. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.
4. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
5. Bronson, R., Schaum's Outline of Matrix Operations. 1988.
6. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	2	3	1	-	-	-	-	-	-	-	-	1

Course Name: Chemistry
Course Code: CH 101
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: A basic knowledge in 10+2 science with chemistry.

Course Outcome:

CO1. Able to describe the fundamental properties of atoms & molecules, atomic structure and the periodicity of elements in the periodic table.

CO2. Able to apply fundamental concepts of thermodynamics in different engineering applications.

CO3. Able to apply the knowledge of water quality parameters, corrosion control & polymers to different industries.

CO4. Able to determine the structure of organic molecules using different spectroscopic techniques.

CO5. Capable to evaluate theoretical and practical aspects relating to the transfer of the production of chemical products from laboratories to the industrial scale, in accordance with environmental considerations.

Course Content

Module-I: Inorganic Chemistry **9**

Atomic structure **(5 Lectures)**
Bohr's theory to hydrogen-like atoms and ions; spectrum of hydrogen atom. Quantum numbers, Introduction to the concept of atomic orbitals, diagrams of s, p and d orbitals, Pauli's exclusion principle, Hund's rule, exchange energy, Aufbau principle and its limitation, introduction to Schrodinger equation.

Periodic properties **(4 Lectures)**
Modern Periodic table, group trends and periodic trends in physical properties: electron affinity, electronegativity, polarizability, oxidation states, effective nuclear charges, penetration of orbitals, variations of s, p and d orbital energies of atoms.

Module-II: Physical Chemistry **8**

Use of free energy in chemical equilibria **(6 Lectures)**
Thermodynamic functions: internal energy, enthalpy, entropy and free energy. 2nd Law of Thermodynamics, Estimations of entropy and free energies, Free energy and emf, Cell potentials, the Nernst equation and applications.

Real Gases **(2 Lectures)**
Reason for deviation of real gases from ideal behaviour, Equations of state of real gases, Vander Waals' equation, pressure & volume correction, validity, critical state of gas.

Module III: Organic Chemistry **8**

Stereochemistry **(4 Lectures)**
Representations of 3 dimensional structures, Chirality, optical activity, isomerism, structural isomerism, stereoisomers, enantiomers, diastereomers, configurations (D,L & cis trans), racemisation.

Organic reactions **(4 Lectures)**

Concepts of inductive effect, resonance, hyperconjugation, introduction to reactions involving substitution, addition, elimination, oxidation (Baeyer villiger oxidation), reduction (Clemmensen reduction, Wolff-Kishner reduction)

Module IV: Industrial Chemistry **8**

Water **(2 Lectures)**

Hardness, alkalinity, numerical

Corrosion **(2 Lectures)**

Types of corrosion: wet & dry, preventive measures

Polymers **(3 Lectures)**

Classification of polymers, conducting polymers, biodegradable polymers

Synthesis of a commonly used drug molecule **(1 Lecture)**

Paracetamol, Aspirin

Module V: Spectroscopic techniques in Chemistry **3**

Electromagnetic radiation, Principles of spectroscopy, spectrophotometer, infrared spectroscopy, fingerprint region, functional group region, UV-VIS spectroscopy, 1H Nuclear magnetic resonance spectroscopy, chemical shift.

Text Books

1. A Text Book of Organic Chemistry, Arun Bahl & Arun Bahl
2. General & Inorganic Chemistry, P.K. Dutt
3. General & Inorganic Chemistry, Vol I, R.P. Sarkar
4. Physical Chemistry, P.C. Rakshit

Reference Books

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane (iii)Fundamentals of Molecular Spectroscopy, by C. N. Banwell
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
3. Physical Chemistry, by P. W. Atkins
4. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition
5. http://bcs.whfreeman.com/vollhardtschore5e/default.asp

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	2	2	2	-	-	-	-	1	2	2
CO2	3	3	3	2	1	-	2	1	-	1	-	3
CO3	3	3	3	3	3	1	1	1	-	1	-	2
CO4	2	3	3	3	3	-	-	-	-	1	1	2
CO5	3	3	3	3	1	1	1	-	1	-	2	3

Course Name: Basic Electrical Engineering
Course Code: EE 101
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre-requisite: Basic 12th standard Physics and Mathematics, Concept of components of electric circuit.

Course Outcome: After completion of the course students able to

- **CO1.** Understand Basic Electrical circuits, Power distribution and Safety measures.
- **CO2.** Analyze an apply DC network theorems.
- **CO3.** Analyze and apply concept of AC circuits of single-phase and three-phase.
- **CO4.** Analyze and apply concepts of AC fundamentals in solving AC networkproblems.
- **CO5.** Understand basic principles of Transformers and Rotating Machines.

Course Content

Module I: DC Circuits (9L)

Definition of electric circuit, linear circuit, non-linear circuit, bilateral circuit, unilateral circuit, Dependent source, node, branch, active and passive elements, Kirchhoff's laws, Source equivalence and conversion, Network Theorems - Superposition Theorem, Thevenin's Theorem, Norton Theorem, Maximum Power Transfer Theorem, Star-Delta Conversions.

Module II: AC Fundamentals (9L)

Sinusoidal quantities, Average and RMS values, peak factor, Form factor, Phase and Phase difference, concept of phasor diagram, V-I Relationship in R, L, C circuit, Combination R-L-C in series and parallel circuits with phasor diagrams, impedance and admittance, impedance triangle and power triangle, Power factor, concept of resonance, Power in AC circuit, simple problems (series and parallel circuit only), Three-phase balanced circuits, Concept of three-phase power measurement.

Module III: Single-Phase Transformer (5L)

Brief idea on constructional parts, classifications, working principle. Problems on EMF equation. Phasor diagram, Equivalent circuit.

Module IV: Electrical Rotating Machines (8L)

a) DC Machines (4L)

Brief idea on constructional features, classifications, working principle of both motor and generator. Simple problems on Voltage equation.

b) Three-Phase Induction Motor (4L)

Basic concept of three phase circuit and production of rotating magnetic field. Working principle of three-phase induction motor and torque-speed characteristics (concept only). No numerical problem.

Module V: General Structure of Electrical Power System (1L)

Power generation to distribution through overhead lines and underground cables with single line diagram.

Module VI: Electrical Installations (4L)

Earthing of Electrical Equipment, ideas of basic components- MCB, MCCB, ELCB, SFU, Megger.

Text books:

1. D. P. Kothari & I. J. Nagrath, Basic Electrical Engineering, TMH.
2. V. Mittle & Arvind Mittal, Basic Electrical Engineering, TMH.
3. Ashfaq Hussain, Basic Electrical Engineering, S. Chand Publication.
4. Chakrabarti,Nath & Chanda, Basic Electrical Engineering, TMH.
5. C.L. Wadhwa, Basic Electrical Engineering, Pearson Education.

Reference books:

1. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
2. V. D. Toro, "Electrical Engineering Fundamentals", Printice Hall India, 1989.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	2	-	-	-	2	2	1
CO2	2	3	-	-	-	-	-	-	-	-	1	1
CO3	2	3	1	-	-	-	-	-	-	-	1	1
CO4	1	2	3	1	-	-	-	-	-	-	-	1
CO5	3	-	-	-	-	-	-	-	-	-	-	1

Course Name: English
Course Code: HU 101
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

Prerequisite: The course presupposes a high school level knowledge of English grammar, punctuation, and elementary to intermediate reading and writing skills.

Course Outcome:

CO1. Able to comprehend the basic knowledge of communication skills in English through exposure to communication theory and practice.
CO2. Apply the basic grammatical skills of the English language through intensive practice.
CO3. Able to develop listening and writing skills.
CO4. Able to write Official Letters , Technical report, memo, notice, minutes, agenda, resume, curriculum vitae.
CO5. Able to apply /illustrate all sets of English Language and Communication skills in creative and effective ways in the professional sphere of their life.

Course Content

Module 1: Communication in a Globalized World **4L**

1.1 Definition, Process, Types of Communication
1.2 Verbal and Non-Verbal Communication
1.3 Barriers to Communication
1.4 Workplace Communication

Module 2: Functional Grammar **4L**

2.1. Articles, Prepositions and Verbs
2.2. Verb-Subject Agreement
2.3. Voice, Modality and Modifiers
2.4. Direct and Indirect Speech
2.5. Common Errors in English

Module 3: Vocabulary and Reading **6L**

Word Roots, Prefixes and Suffixes
Antonyms, Synonyms and one word Substitution
Reading—Purposes and Skills (Skimming, Scanning & Intensive Reading)
Reading Comprehension (Fictional and Non-fictional prose)

Module 4: Professional Writing **10L**

Writing Functions: Describing, Defining, ClassifyingStructuring—
coherence and clarity
Business Writing—Letters (Enquiry, Order, Sales, Complaint, Adjustment, Job Application letters), Memos, Notices, Circulars, Agendas and Minutes of Meetings).
E-mails—types, conventions, jargons and modalities.
Reports and Proposals
Précis writing
Essay writing
Punctuation and its importance in writing
Writing for an Audience

Text Books:

1. Ruskin Bond: The Night Train at Deoli
2. Khushwant Singh: The Portrait of a Lady
3. Roald Dahl: Lamb to the Slaughter
4. Somerset Maugham: The Man with the Scar
5. Anne Frank: The Diary of a Young Girl (Letters of 3rd February 1944, 12th February 1944 and 13th February 1944)
6. Jawaharlal Nehru: "How Britain Ruled India" (Glimpses of World History, Chap 112)

Reference Books:

1. Raymond Murphy. *English Grammar in Use*. 3rd Edn. CUP, 2001.
2. A. J Thomson and A. V. Martinet. *A Practical English Grammar* Oxford: OUP, 1980.
3. Michael Swan. *Practical English Usage*. Oxford: OUP, 1980.
4. Simeon Potter. *Our Language*. Oxford: OUP, 1950.
5. Pickett, Laster and Staples. *Technical English: Writing, Reading & Speaking*. 8th ed. London: Longman, 2001.
6. Ben Heasley and Liz Hamp-Lyons. *Study Writing*. Cambridge: CUP, 2006.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	1	-	-	1	-	1	3	3	3	3
CO2	-	-	-	-	-	2	-	-	2	3	3	3
CO3	-	3	2	2	-	3	2	2	3	3	3	3
CO4	-	-	-	2	-	2	-	-	3	3	2	3
CO5	-	2	1	-	-	2	2	1	3	3	2	3

Course Name: Chemistry Lab
Course Code: CH 191
Contact: 0:0:3
Total Contact Hours: 24
Credits: 1.5

Prerequisite: 10+2 science with chemistry

Course Outcome:

- **CO1.** Able to operate different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.
- **CO2.** Able to work as an individual also as a team member.
- **CO3.** Able to analyse different parameters of water considering environmental issues.
- **CO4.** Able to synthesize nano and polymer materials.
- **CO5.** Capable to design innovative experiments applying the fundamentals of chemistry.

List of Experiments: **9**

1. To determine the alkalinity in given water sample.
2. Redox titration (estimation of iron using permanganometry)
3. To determine calcium and magnesium hardness of a given water sample separately.
4. Preparation of phenol-formaldehyde resin (Bakelite).
5. Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).
6. Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.
7. pH- metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
8. Determination of dissolved oxygen present in a given water sample.
9. To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution).
10. Innovative experiment: Preparation of silver nano-particles.

Text Books:

1. A Text Book of Organic Chemistry, Arun Bahl & Arun Bahl
2. General & Inorganic Chemistry, P.K. Dutt
3. General & Inorganic Chemistry, Vol I, R.P. Sarkar
4. Physical Chemistry, P.C. Rakshit

Reference Books:

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane (iii)Fundamentals of Molecular Spectroscopy, by C. N. Banwell
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
3. Physical Chemistry, by P. W. Atkins
4. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition
5. http://bcs.whfreeman.com/vollhardtschore5e/default.asp

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	2	2	2	-	-	-	-	1	2	2
CO2	3	3	3	2	1	-	2	1	-	1	-	3
CO3	3	3	3	3	3	1	1	1	-	1	-	2
CO4	2	3	3	3	3	-	-	-	-	1	1	2
CO5	3	3	3	3	1	1	1	-	1	-	2	3

Course Name: Basic Electrical Engineering Lab
Course Code: EE 191
Contact: 0:0:3
Credits: 1.5

Prerequisite: Basic Physics and applied physics, Basic Mathematics, Basic concept of Electric Circuit.

Course Outcome:

CO1. Identify and use common electrical components.
CO2. To develop electrical networks by physical connection of various components and analyze the circuit behaviour.
CO3. Apply and analyze the basic characteristics of transformers and electrical machines.

List of Experiments:

1. Basic safety precautions – earthing, introduction to measuring instruments – Voltmeter, Ammeter, Multimeter, Wattmeter, Real life Resistor, Capacitor, Inductor.
2. Verification of Thevenin's and Norton's Theorem.
3. Verification of Superposition and Maximum Power Transfer Theorem.
4. Characteristics of Fluorescent, Tungsten and Carbon filament lamps.
5. Study of R-L-C series circuit.
6. Three-phase Power measurement with two wattmeter method.
7. Demonstration of cut-out sections of machines: DC Machine (commutator-brush arrangement), Induction Machine (squirrel cage rotor).
8. Measurement of primary and secondary voltage and current of single-phase transformer – Open Circuit and Short Circuit Test.
9. Starting, Reversing and speed control of DC shunt motor.
10. Torque-Speed characteristics of DC Machine.
11. Torque-Speed characteristics of Three-phase Induction Motor.
12. Test on single-phase Energy Meter.
13. Innovative experiments

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	2	-	-	-	-	-	1
CO2	2	3	-	-	-	-	-	-	-	-	1	1
CO3	3	-	-	-	-	-	-	-	-	-	-	1

Course Name: Engineering Graphics & Design
Course Code: ME 191
Contact: 0:0:3
Credits: 1.5

Prerequisite: Basic knowledge of geometry

Course Outcome:

- **CO1.** Get introduced with Engineering Graphics and visual aspects of design.
- **CO2.** Know and use common drafting tools with the knowledge of drafting standards.
- **CO3.** Apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints.
- **CO4.** Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.

List of Drawing:

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.

Module 1: Introduction to Engineering Drawing
Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module 2: Orthographic & Isometric Projections
Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes- Auxiliary Views; Isometric Scale, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

Module 3: Sections and Sectional Views of Right Angular Solids
Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape of the sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic views of objects from industry and dwellings (foundation to slab only)

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 Modeling; Solid Modeling.

Module 4: Overview of Computer Graphics
Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Zooming methods, Select and erase objects].

Module 5: CAD Drawing, Customization, Annotations, layering
Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerancing; Using various methods to draw straight lines, circles, applying dimensions and

annotations to drawings; Setting up and use of Layers, Changing line lengths (extend/lengthen); Printing documents; Drawing sectional views of solids and project the true shape of the sectioned surface; Drawing annotation, CAD modeling of parts and assemblies with animation, Parametric and non parametric solid, surface and wireframe modeling, Part editing and two dimensional documentation of models.

Module 6: Demonstration of a simple team design project

Illustrating 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, Use of solid-modeling software for creating associative models at the component and assembly levels.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. (Corresponding set of) CAD Software Theory and User Manuals

Reference Books:

1. K. Venugopal**,** Engineering Drawing + AutoCAD, New Age International publishers
2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	-	1	1	-	1	2	1	-	-
CO2	2	1	2	-	1	1	-	2	1	2	1	1
CO3	2	1	3	2	3	-	-	2	2	2	1	1

SYLLABUS

OF

B.TECH SECOND SEMESTER COURSES

Course Name: Mathematics - II
Course Code: M 201
Contact: 3:1:0
Total Contact Hours: 48
Credits: 4

Prerequisite: The students to whom this course will be offered must have the concept of (10+2) standard calculus.

Course Outcome: On successful completion of the learning sessions of the course, the learner will be able to:

- **CO1.** Use mathematical tools to evaluate multiple integrals and vector integrals.
- **CO2.** Apply effective mathematical tools for the solutions of ordinary differential equations that model physical processes.
- **CO3.** Recall the properties of Laplace Transform to evaluate multiple integrals and their usage.
- **CO4.** Understand the concept of Laplace transform to solve ordinary differential equations.

Course Content

Module I: Multivariable Calculus (Integration): ***(12 Lectures)***
Double integration, Change of order of integration in double integrals, Triple integrals, vector line integrals, scalar surface integrals, vector surface integrals, Green's theorem, Gauss divergence theorem and Stokes' theorem.

Module II: First Order Ordinary Differential Equations (ODE): ***(10 Lectures)***
Solution of first order and first degree ODE: Exact ODE, Rules for finding Integrating factors, Linear ODE, Bernoulli's equation, Solution of first order and higher degree ODE: solvable for p, solvable for y solvable for x and Clairaut's equation.

Module III: Second Order Ordinary Differential Equations (ODE): ***(12 Lectures)***
Solution of second order ODE with constant coefficients: C.F. & P.I., Method of variation of parameters, Cauchy-Euler equations, Reduction of 2^{nd} order ODE to a pair of first order ODEs, Solution of simultaneous linear ODEs.

Module IV: Laplace Transform (LT): ***(14 Lectures)***
Definition and existence of LT, LT of elementary functions, First and second shifting properties, Change of scale property, LT of $t\,f\,(t)$, LT of $\frac{f\,(t)}{t}$, LT of derivatives of f (t), LT of $\int f(t)dt$, Evaluation of improper integrals using LT, LT of periodic and step functions, Inverse LT: Definition and its properties, Convolution theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODE with constant coefficients (initial value problem) using LT.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Boyce, W. E. and DiPrima, R. C., Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
3. Ross, S. L., Differential Equations, 3rd Ed., Wiley India, 1984.
4. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969.
5. Coddington, E. A., An Introduction to Ordinary Differential Equations, Prentice Hall, India, 1995.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	-	-	-	1
CO2	3	2	2	-	-	-	-	-	-	-	-	1
CO3	2	2	-	-	-	-	-	-	-	-	-	1
CO4	3	3	2	-	-	-	-	-	-	-	-	1

Course Name: Physics –I
Course Code: PH 201
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre requisite: Knowledge of Physics up to 12th standard.

Course Outcome: At the end of the course students should be able to

- **CO1.** Describe various types mechanical resonance and its electrical equivalence.
- **CO2.** Explain basic principles of Laser, Optical fibers and various types of semiconductors.
- **CO3.** Apply superposition to explain interference and diffraction as well as apply wave mechanics to attainment of Heisenberg's uncertainty principle.
- **CO4.** Analyze importance of light as a carrier of information and examine different crystallographic structures according to their co-ordination number and packing factors.
- **CO5.** Justify the need of a quantum mechanics as remedy to overcome limitations imposed by classical physics.

Course Content

Module 1: Waves & Oscillations (6L)

Simple Harmonic Motion (only preliminary idea), damped harmonic motion-over damped, critically damped and under damped motion, energy decay, logarithmic decrement, force vibration and resonance (amplitude, velocity resonance), sharpness of resonance, quality factor, related numerical problems. 6L

Module 2: Classical Optics (8L)

Interference of light: Huygens's principle, superposition of waves, conditions of sustained interference, Newton's ring (qualitative descriptions of working principles and procedures-no deduction required). Engineering applications, Numerical Problems. 3L

Diffraction of light: Fresnel and Fraunhofer class, Fraunhoffer diffraction of a single slit, multiple slits, intensity distributions, missing order, Rayleigh criterion (no deduction) and resolving power of grating and microscope (no deduction), related numerical problems. 5L

Module 3: Quantum Mechanics-I (8L)

Quantum Theory: Inadequacy of classical physics and its modifications by Planck's quantum hypothesis-qualitative (no deductions), particle concept of electromagnetic wave (example: photoelectric and Compton Effect; no derivation required, origin of modified and unmodified lines), wave particle duality; phase velocity and group velocity; de Broglie hypothesis; Davisson and Germer experiment. 4L

Quantum Mechanics 1: Concept of wave function, physical significance of wave function, probability interpretation; normalization of wave functions; uncertainty principle, relevant numerical problems. 4L

Module 4: Solid State Physics-I (7L)

Crystal Structure: Structure of solids, amorphous and crystalline solids (definition and examples), lattice, basis, unit cell, Fundamental types of lattices –Bravais lattice, simple cubic, fcc and bcc lattices, Miller indices and miller planes, co-ordination number and atomic packing factor, Bragg's equation, applications, numerical problems. 4L

Semiconductor: Physics of semiconductors, electrons and holes, metal, insulator and semiconductor, intrinsic and extrinsic semiconductor, p-n junction. 3L

Module 5: Modern Optics-I (7L)

Laser: Concepts of various emission and absorption process, Einstein A and B coefficients and equations, working principle of laser, metastable state, population inversion, condition necessary for active laser action, optical resonator, illustrations of Ruby laser, He-Ne laser, Semiconductor laser, applications of laser. 5L

Fibre optics: Principle and propagation of light in optical fibres- Numerical aperture and Acceptance angle, Numerical problems. 2L

Text Books:

Waves & Oscillations:

1. Sound-N. K. Bajaj (TMH)
2. Advanced Acoustics-D. P. Roy Chowdhury (Chayan Publisher)
3. Principles of Acoustics-B.Ghosh (Sridhar Publisher)
4. A text book of sound-M. Ghosh (S. Chand publishers)
5. A text book of Light- K.G. Mazumder & B.Ghoshs, (Book & Allied Publisher)
6. Physics of Oscillations and Waves- R.P. Singh
7. College Physics Vol. II - A.B. Gupta
8. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit

Classical & Modern Optics:

1. A text book of Light- K.G. Mazumder & B.Ghoshs (Book & Allied Publisher)
2. A text book of Light-Brijlal & Subhramanium, (S. Chand publishers)
3. Modern Optics-A. B. Gupta (Book & Allied Publisher)
4. Optics-Ajay Ghatak (TMH)
5. Optics-Hecht
6. Optics-R. Kar, Books Applied Publishers
7. Physical Optics Möler
8. Optics -F.A. Jenkins and H.E White

Quantum Mechanics-I

1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
2. Quantum Mechanics-Bagde and Singh (S. Chand Publishers)
3. Perspective of Quantum Mechanics-S. P. Kuilla (New Central Book Agency)
4. Quantum Mechanics-Binayak Datta Roy (S. Chand Publishers)
5. Quantum Mechanics-Bransden (Pearson Education Ltd.)
6. Perspective of Modern Physics-A. Beiser (TMH)
7. Quantum mechanics -A.K. Ghatak and S Lokenathan
8. Modern Physics -E.E. Anderson
9. Physics Volume 2 -Haliday, Resnick & Krane Published by Wiley India

Solid State Physics-I:

1. Solid state physics-Puri & Babbar (S. Chand publishers)

2. Materials Science & Engineering-Kakani Kakani
3. Solid state physics- S. O. Pillai
4. Introduction to solid state physics-Kittel (TMH)
5. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)
6. Problem in Solid state physics -S.O. Pillai (a. b.)

Reference Books:

1. Refresher courses in physics (Vol. 1, Vol. 2 & Vol. 3)-C. L. Arora (S. Chand Publishers)
2. Basic Engineering Physics-Amal Chakraborty (Chaya Prakashani Pvt. Ltd.)
3. Perspective & Concept of Modern Physics -Arthur Baiser
4. Principles of engineering physics – Md. N Khan and S Panigrahi.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	1
CO4	2	3	-	-	-	-	-	-	-	-	-	1
CO5	1	3	-	-	-	-	-	-	-	-	-	1

Course Name: Basic Electronics Engineering
Course Code: EC 201
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: A basic course in Electronics and Communication Engineering Progresses from the fundamentals of electricity, direct current (DC) devices and circuits, series and parallel circuits to the study of active and passive components, Ohm's Law, Kirchhoff's Law i.e. KVL, KCL, Ampere's Law etc.

Course Outcome:

CO1. Study PN junction diode, ideal diode, diode models and its circuit analysis, application of diodes and special diodes.

CO2. Learn how operational amplifiers are modelled and analysed, and to design Op-Amp circuits to perform operations such as integration differentiation on electronic signals.

CO3. Study the concepts of both positive and negative feedback in electronic circuits.

CO4. Develop the capability to analyse and design simple circuits containing non-linear elements such as transistors using the concepts of load lines, operating points and incremental analysis.

Course Content

Module-I: Basics of semiconductor **5**

Conductors, Insulators, and Semiconductors- crystal structure, Fermi Dirac function, Fermi level, E-k and Energy band diagrams, valence band, conduction band, and band gap; intrinsic, and extrinsic (p-type and n-type) semiconductors, position of Fermi level in intrinsic and extrinsic semiconductor, drift and diffusion current – expression only (no derivation) , mass action law , charge neutrality in semiconductor, Einstein relationship in semiconductor , Numerical problems on- Fermi level, conductivity, mass action law, drift and diffusion current .

Module-II: P-N Junction Diode and its applications **7**

P-N junction formation and depletion region , energy band diagram of p-n junction at equilibrium and barrier energy , built in potential at p-n junction , energy band diagram and current through p-n junction at forward and reverse bias, V-I characteristics and current expression of diode , temperature dependencies of V-I characteristics of diode , p-n junction breakdown – conditions , avalanche and Zener breakdown , Concept of Junction capacitance, Zener diode and characteristics. Diode half wave and full wave rectifiers circuits and operation (I_{DC} , I_{rms} , V_{DC} , V_{rms}, ripple factor without filter, efficiency ,PIV,TUF; Reduction of ac ripples using filter circuit (Qualitative analysis); Design of diode clipper and clamper circuit - explanation with example, application of Zener diode in regulator circuit. Numerical problems

Module III: Bipolar Junction Transistor **8**

Formation of PNP/NPN Transistors, energy band diagram, current conduction mechanism, CE, CB, CC configurations, transistor static characteristics in CE, CB and CC mode, junction biasing condition for active, saturation and cut-off modes, current gain α, β and γ, early effect.
Biasing and bias stability; biasing circuits - fixed bias; voltage divider bias; collector to base bias, D.C. load line and Quiescent point, calculation of stability factors for different biasing circuits.
BJT as an amplifier and as a switch – Graphical analysis; Numerical Problems.

Module IV: Field Effect Transistors **6**

Concept of field effect, channel width modulation Classification of FETs-JFET, MOSFET, operating principle of JFET. drain and transfer characteristics of JFET (n-channel and p-channel),

CS,CG,CD configurations, Relation between JFET parameters. FET as an amplifier and as a switch– graphical analysis. E-MOSFET (n-channel and p-channel), D-MOSFET (n-channel and p-channel), Numerical Problems

Module V: Feedback and Operational Amplifier 8

Concept of feedback with block diagram, positive and negative feedback, gain with feedback. Feedback topologies, effect of feedback on input and output impedance, distortion, concept of oscillation and Barkhausen criterion.

Operational amplifier – electrical equivalent circuit ,ideal characteristics , Non ideal characteristics of op- amp – offset voltages ;bias current ;offset current; Slew rate ; CMRR and bandwidth, Configuration of inverting and non-inverting amplifier using Op-amp, closed loop voltage gain of inverting and non- inverting amplifier , Concept of virtual ground, Applications op-amp – summing amplifier; differential amplifier; voltage follower ; basic differentiator and integrator .

Problems on Characteristics of Op-amp, CMRR, slew rate, amplifier and application of Op-amp to be discussed. Any other relevant problems related to topic may be discussed or assigned.

Module-VI: Cathode Ray Oscilloscope (CRO) 2

Operating principle of CRO with block diagram, measurement of voltage, frequency and phase.

Text Books:

1. D. Chattopadhyay, P. C. Rakshit, Electronics Fundamentals and Applications, New Age International
2. Millman & Halkias, Integrated Electronics, Tata McGraw Hill.
3. Sedra & Smith, Microelectronics Engineering

Reference Books:

1. John D. Ryder, Electronic Fundamentals and Applications, PHI
2. J.B.Gupta, Basic Electronics, S.K. Kataria.
3. Malvino: Electronic Principle.
4. Boyelstad & Nashelsky: Electronic Devices & Circuit Theory, McGraw Hill, 1976.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	-	-	-	-	-	-	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2
CO3	3	3	3	2	1	-	-	-	-	-	-	3
CO4	3	3	2	3	2	-	-	-	-	-	-	3

Course Name: Programming for Problem Solving
Course Code: CS 201
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Number system, Boolean Algebra

Course Outcome: On completion of the course students will be able t**o**

- **CO1.** Understand and differentiate among different programming languages for problem solving.
- **CO2.** Describe the way of execution and debug programs in C language.
- **CO3.** Define, select, and compare data types, loops, functions to solve mathematical and scientific problem.
- **CO4.** Understand the dynamic behavior of memory by the use of pointers.
- **CO5.** Design and develop modular programs using control structure, selection structure and file.

Course Content

Module I: Fundamentals of Computer: (8L)

History of Computer, Generation of Computer, Classification of Computers, Basic structure of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. 3L

Binary and Allied number systems representation of signed & unsigned numbers, BCD, ASCII, Binary number Arithmetic – Addition and Subtraction (using 1's complement and 2's complement). 2L

Overview of Procedural vs Structural language, compiler and assembler (basic concepts). 1L

Problem solving-Algorithm & flow chart. 2L

Module II: C Fundamentals: (28L)

Variable and Data Types: The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements. 2L

C Operators & Expressions: Arithmetic operators, relational operators, logical operators, increment and decrement operators, bitwise operators, assignment operators, conditional operators, special operators - type conversion, C expressions, precedence and associativity. 3L

Input and Output: Standard input and output, formatted output - printf, formatted input scanf, bit fields. 1L

Branching and Loop Statements: Statement and blocks, if - else, switch, goto and labels, Loops - while, for, do while, break and continue. 4L

Fundamentals and Program Structures: auto, external, static and register variables Functions, function types, function prototypes, functions returning values, functions not returning values, scope rules, recursion, C preprocessor and macro. 5L

Arrays, Strings and Pointers: One dimensional arrays, Two-dimensional arrays, Multidimensional arrays. Passing an array to a function Character array and string, array of strings, Passing a string to a function, String related functions, Pointers, Pointer and Array, Pointer and String, Pointer and functions, Dynamic memory allocation. 7L

Structures and Unions: Basic of structures, arrays of structures, structures and pointers, structures and functions. 3L

Files handling with C: Formatted and unformatted files, Command line arguments, fopen, fclose, fgetc, fputc, fprintf, fscanf function. 3L

Text books:

1. Kerninghan B.W. & Ritchie D.M. - The C Programming Language ,PHI, 2nd Edition
2. Kanetkar Y. - Let us C, BPB Publication, 15th Edition

Reference Books:

1. E Balagurusamy – Programming in ANSI C, TMH, 3rd Edition
2. K R Venugopal & S R Prasad – MASTERING C, TMH, 2nd Edition
3. Reema Thareja – INTRODUCTION TO C PROGRAMMING, OXFORD UNIVERSITY PRESS, 2nd Edition

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	1	-	3	3	1	1
CO2	2	2	3	3	2	2	-	-	3	3	3	3
CO3	2	2	2	2	2	1	-	-	3	3	1	3
CO4	3	2	2	2	2	3	-	-	3	3	2	3
CO5	3	3	3	3	2	3	-	-	3	3	3	3

Course Name: Engineering Mechanics
Course Code: ME 201
Contacts: 3:0:0
Total Contact Hours: 36
Credits: 3
Prerequisite: Basic Concept of Physics

Course Outcome:

- **CO1.** To understand representation of force, moments for drawing free-body diagrams and analyze friction based systems in static condition.
- **CO2.** To locate the centroid of an area and calculate the moment of inertia of a section.
- **CO3.** Apply of conservation of momentum & energy principle for particle dynamics and rigid body kinetics.
- **CO4.** Understand and apply the concept of virtual work, rigid body dynamics and systems under vibration.

Course Content

Module 1: Introduction to Engineering Mechanics: Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy. 6L

Module 2: Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack. 2L

Module 3: Basic Structural Analysis: Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines. 3L

Module 4: Centroid and Centre of Gravity: Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia-Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook. 5L

Module 5: Virtual Work and Energy Method: Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium. 5L

Module 6: Review of particle dynamics: Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique). 5L

Module 7: Introduction to Kinetics of Rigid Bodies: Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.

5L

Module8: Mechanical Vibrations: Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums. 5L

Text books:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R.C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education

Reference books:

1. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
2. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
3. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
4. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	1	-	-	-
CO2	3	3	2	2	-	-	-	-	1	-	-	1
CO3	3	2	3	2	1	-	-	-	1	-	-	1
CO4	3	3	3	3	-	-	-	-	1	-	1	-

Course Name: Programming for Problem Solving Lab
Course Code: CS 291
Contact: 0:0:3
Credits: 1.5

Prerequisites: Number system, Boolean Algebra

Course Outcomes: On completion of the course students will be able to

- **CO1.** Learn the concept of DOS system commands and editor.
- **CO2.** To formulate the algorithms for simple problems and to translate given algorithms to a working and correct program.
- **CO3.** To be able to identify and correct syntax errors / logical errors as reported during compilation time and run time.
- **CO4.** To be able to write iterative as well as recursive programs.
- **CO5.** Learn the concept of programs with Arrays, Pointers, Structures, Union and Files.

List of Experiments:

1. Some basic commands of DOS, Windows and Linux Operating System, File handling and Directory structures, file permissions, creating and editing simple C program, compilation and execution of C program.
2. Writing C Programs on variable, expression, operator and type-casting.
3. Writing C Programs using different structures of if-else statement and switch-case statement.
4. Writing C Programs demonstrating use of loop (for loop, while loop and do-while loop) concept and use of break and continue statement.
5. Writing C Programs demonstrating concept of Single & Multidimensional arrays.
6. Writing C Programs demonstrating concept of Function and Recursion.
7. Writing C Programs demonstrating concept of Pointers, address of operator, declaring pointers and operations on pointers.
8. Writing C Programs demonstrating concept of structures, union and pointer to structure.
9. Writing C Programs demonstrating concept of String and command line arguments.
10. Writing C Programs demonstrating concept of dynamic memory allocation.
11. Writing C Programs demonstrating concept of File Programming.
12. Innovative Experiment

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	2	2	-	1	-	1	2	3
CO2	3	3	3	-	-	-	-	-	-	-	-	2
CO3	2	2	2	2	2	-	-	-	-	-	-	3
CO4	1	2	2	2	2	-	-	-	-	-	-	2
CO5	2	3	3	3	2	2	3	1	3	3	3	3

Course Name: Physics-I Lab
Course Code: PH 291
Contact: 0:0:3
Credits: 1.5

Prerequisite: Basic knowledge of 10+2
Course Outcome: Student will able to:

- **CO1.** Demonstrate experiments allied to their theoretical concepts.
- **CO2.** Conduct experiments using LASER, Optical fiber, Torsional pendulum, Spctrometer.
- **CO3.** Participate as an individual, and as a member or leader in groups in laboratory sessions actively.
- **CO4.** Analyze experimental data from graphical representations, and to communicate effectively them in Laboratory reports including innovative experiments.

List of Experiment:

General idea about Measurements and Errors (One Mandatory):
i) Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.
ii) Proportional error calculation using Carrey Foster Bridge.

Any 7 to be performed from the following experiments

Experiments on Oscillations& Elasticity:

1. Study of Torsional oscillation of Torsional pendulum & determination of time period using various load of the oscillator.
2. Experiments on Lissajous figure (using CRO).
3. Experiments on LCR circuit.
4. Determination of elastic modulii of different materials (Young's modulus and Rigidity modulus)

Experiments on Optics:

5. Determination of wavelength of light by Newton's ring method.
6. Determination of wavelength of light by Laser diffraction method.
7. Determination of numerical aperture and the energy losses related to optical fiber experiment
8. Measurement of specific rotation of an optically active solution by polarimeter.

Experiments on Quantum Physics:

9. Determination of Planck's constant using photoelectric cell.
10. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.

In addition it is **recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment.

Innovative experiments:

1. Determination of wavelength of light by Fresnel's bi-prism method (beyond the syllabus).
2. Study of half-wave, quarter-wave plate (beyond the syllabus)
3. Study of dispersive power of material of a prism.
4. Study of viscosity using Poyseullie's caplillary flow method/using Stoke's law.
5. Measurement of nodal and antinodal points along transmission wire and measurement of wave length.
6. Any other experiment related to the theory.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	2	2	-	1	-	1	2	3
CO2	3	3	3	-	-	-	-	-	-	-	-	2
CO3	2	2	2	2	2	-	-	-	-	-	-	3
CO4	1	2	2	2	2	-	-	-	-	-	-	2

Course Name: Basic Electronics Engineering Lab
Course Code: EC 291
Contact: 0:0:3
Credits: 1.5

Prerequisite: A basic course in electronics and Communication engineering Progresses from the fundamentals of electricity, active and passive components, basic electronics laws like Ohm's law, Ampere's law.

Course Outcome:

CO1. Knowledge of Electronic components such as Resistors, Capacitors, Diodes, Transistors measuring equipment like DC power supply, Multimeter, CRO, Signal generator, DC power supply.

CO2. Analyse the characteristics of Junction Diode, Zener Diode, BJT & FET and different types of Rectifier Circuits.

CO3. Determination of input-offset voltage, input bias current and Slew rate, Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.

CO4. Able to know the application of Diode, BJT & OPAMP.

List of Experiment:

1. Familiarization with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, millimeters etc.
2. Familiarization with measuring and testing equipment like CRO, Signal generators etc.
3. Study of I-V characteristics of Junction diodes.
4. Study of I-V characteristics of Zener diodes.
5. Study of Half and Full wave rectifiers with Regulation and Ripple factors.
6. Study of I-V characteristics of BJTs.
7. Study of I-V characteristics of Field Effect Transistors.
8. Determination of input-offset voltage, input bias current and Slew rate of OPAMPs.
9. Determination of Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
10. Study of OPAMP circuits: Inverting and Non-inverting amplifiers, Adders, Integrators and Differentiators.
11. Study of Logic Gates and realization of Boolean functions using Logic Gates.
12. Study of Characteristic curves for CB, CE and CC mode transistors.
13. Innovative Experiments

Text Books:

1. D. Chattopadhyay, P. C. Rakshit, Electronics Fundamentals and Applications, New Age International
2. Millman & Halkias, Integrated Electronics, Tata McGraw Hill.
3. Sedra & Smith, Microelectronics Engineering

Reference Books:

1. John D. Ryder, Electronic Fundamentals and Applications, PHI
2. J.B. Gupta, Basic Electronics, S.K. Kataria.
3. Malvino: Electronic Principle.
4. Boyelstad & Nashelsky: Electronic Devices & Circuit Theory, McGraw Hill, 1976.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	-	-	-	-	-	-	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2
CO3	3	3	3	2	1	-	-	-	-	-	-	3
CO4	3	3	2	3	2	-	-	-	-	-	-	3

Course Name: Workshop/Manufacturing Practices
Course Code: ME 292
Contact: 0:0:3
Credits: 1.5

Prerequisite: Higher Secondary with Mathematics, Physics and Chemistry

Course Outcome: Upon completion of this laboratory course, students will be able to

- **CO1.** Fabricate components with their own hands.
- **CO2.** Get practical knowledge of the dimensional accuracies and tolerances applicable for different manufacturing processes.
- **CO3.** Produce small devices of their interest for project or research purpose.

Course Content:

(i) Theoretical discussion & videos: (6P)

Detailed contents:

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Carpentry
4. Welding (arc welding & gas welding), brazing
5. Electrical & Electronics
6. Metal casting
7. CNC machining, Additive manufacturing
8. Plastic moulding& Glass Cutting.

(ii) Workshop Practice:

Module 1 - Machine shop (6P)

Typical jobs that may be made in this practice module:

i. To make a pin from a mild steel rod in a lathe.
ii. To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.

Module 2 - Fitting shop (6P)

Typical jobs that may be made in this practice module:

i. To make a Gauge from MS plate.

Module 3 - Carpentry (6P)

Typical jobs that may be made in this practice module:

i. To make wooden joints and/or a pattern or like.

Module 4 - Welding shop (Arc welding 3P + gas welding 3P) (6P)

Typical jobs that may be made in this practice module:

i. ARC WELDING (3P): To join two thick (approx 5mm) MS plates by manual metal arcwelding.
ii. GAS WELDING (3P): To join two thin mild steel plates or sheets by gas welding.

Module 5 - Electrical & Electronics (3P)

House wiring, soft Soldering

Module 6 - Smithy (3P)

Typical jobs that may be made in this practice module:

i. A simple job of making a square rod from a round bar or like.

Innovative Experiments:

Module 7 - Casting

Typical jobs that may be made in this practice module:

i. One/ two green sand moulds to prepare, and a casting be demonstrated.

Module 8 - Plastic moulding & Glass Cutting

Typical jobs that may be made in this practice module:

i. For plastic moulding, making at least one simple plastic component should be made.
ii. At least one sample shape on glass should be made using laser cutting machine.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

Reference Books:

1. Gowri P., Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
3. Kalpakjian S. and Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
4. Manufacturing Science by A.Ghosh and A.K.Mallick, Wiley Eastern.
5. Principles of Metal Cutting/Principles of Machine Tools by G.C.Sen and A.Bhattacharya, New Central Book Agency, Kolkata.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	1	-	-	-	2	1	-	2
CO2	3	3	2	2	1	-	-	-	2	1	-	2
CO3	3	2	2	2	1	1	-	1	2	2	3	2

Course Name: Language Lab
Course Code: HU 291
Contact: 0:0:2
Credit: 1

Pre requisite: Basic knowledge of LSRW skills

Course Outcome:

- **CO1.** Able to understand advanced skills of Technical Communication in English through Language Laboratory.
- **CO2.** Able to apply listening, speaking, reading and writing skills in societal and professional life.
- **CO3.** Able to demonstrate the skills necessary to be a competent Interpersonal communicator.
- **CO4.** Able to analyze communication behaviours.
- **CO5.** Able to adapt to multifarious socio-economical and professional arenas with the help of effective communication and interpersonal skills.

Course Content:

Module 1: Introduction to the Language Lab

a. The Need for a Language Laboratory
b. Tasks in the Lab
c. Writing a Laboratory Note Book

Module 2: Active Listening

a. What is Active Listening?
b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking
c. Academic Listening vs Business Listening
d. Listening in Business Telephony
e. Study of Contextualized Examples based on Lab Recordings

Module 3: Speaking

a. Speaking—Accuracy and Fluency Parameters
b. Pronunciation Guide—Basics of Sound Scripting, Stress and Intonation
c. Fluency-focussed activities—JAM, Conversational Role Plays, Speaking using Picture/Audio Visual inputs
d. Accuracy-focussed activities—Identifying Minimal Pairs, Sound Mazes, Open and Closed Pair Drilling, Student Recordings (using software)
e. Group Discussion: Principles and Practice

Module 4: Lab Project Work

a. Making a brief Animation film with voice over (5 minutes) OR
b. Making a brief Documentary film (10 minutes)

References:

1. 1.IIT Mumbai**, Preparatory Course in English** syllabus
2. IIT Mumbai, **Introduction to Linguistics** syllabus
3. Sasikumar et al*. A Course in Listening and Speaking*. New Delhi: Foundation Books, 2005.
4. Tony Lynch, *Study Listening*. Cambridge: Cambridge UP, 2004.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	3	-	3	2	2	3	3	-	3
CO2	2	3	3	3	-	3	3	3	2	3	-	3
CO3	1	3	3	3	-	2	2	2	2	3	-	2
CO4	1	2	3	3	-	2	1	1	2	3	-	2
CO5	3	3	2	3	-	2	3	2	2	3	-	2

SYLLABUS

OF

B.TECH THIRD SEMESTER COURSES

Course Name: Electrical Circuit Analysis
Course Code: EE 301
Contact: 3L:1T:0P
Total Contact Hrs: 40
Credit:4

Prerequisites: The students to whom this course will be offered must have the concept of Basic electrical engineering, Laplace transform, First order ordinary differential equation and Second order ordinary differential equation.

Course Outcome: On successful completion of the learning sessions of the course, the learner will be able to

- **CO1.** Understand the basic concepts of electric, magnetic and filter circuits.
- **CO2.** Synthesize different electrical circuits with network theorems.
- **CO3.** Analyze the transient condition of electrical circuits.
- **CO4.** Analyze two port circuit behaviors.

Course Content

MODULE I: Introduction (3)
Continuous & Discrete, Fixed & Time varying, Linear and Nonlinear, Lumped and Distributed, Passive and Active networks , Independent & Dependent sources, Step, Ramp, Impulse, Sinusoidal, Square, Saw tooth signals, Source transformation, KVL & KCL.

MODULE II: Coupled Circuits (5)
Magnetic coupling, Polarity of coils, Polarity of induced voltage, Concept of Self and Mutual inductance, Coefficient of coupling, Modelling of coupled circuits, Ideal Transformer, Solution of problems.

MODULE III: Laplace Transform in Circuit Analysis (8)
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.

MODULE IV: Network Theorems (8)
Loop variable analysis, Node variable analysis, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Millman's Theorem Solution of Problems with DC & AC sources.

MODULE V: Graph Theory (4)
Concept of Tree, Branch, Tree link, Incidence Matrix, Cut Set Matrix, Tie Set Matrix, Formation of incidence, tie set, cut set matrices of electric circuits.

MODULE VI: Two Port Network (8)
Open circuit Impedance & Short circuit Admittance parameter, Transmission parameter, Hybrid Parameter, Conditions Of Reciprocity And Symmetry, Interrelation between different parameters, Driving point impedance & Admittance. Interconnection Of Two Port Networks. Solution of problems.

MODULE VII: Filter (6)

Analysis and synthesis of Low pass, High pass, Band pass, Band reject, All pass filters (first and second order only) using operational amplifier.

MODULE VIII: Fourier Series Analysis (6)

Introduction, Periodic functions: Properties, Even & Odd functions: Properties, Special wave forms: Square wave, Half wave Rectifier, Full wave Rectifier, Saw-toothed wave, Triangular wave. Euler's Formulae for Fourier Series, Fourier Series for functions of period 2π, Dirichlet's conditions, Sum of Fourier series. Theorem for the convergence of Fourier Series (statement only). Fourier Series of a function with its Periodic extension. Half Range Fourier Series: Construction of Half range Sine Series, Construction of Half range Cosine Series. Parseval's identity (statement only).

Text Books:

1. Sudhakar:Circuits & Networks:Analysis & Synthesis 2/e TMH
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
5. D.Chattopadhyay and P.C.Rakshit: Electrical Circuits

Reference Books:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.
3. Sivanandam: Electric Circuits Analysis
4. V.K. Chandna, A Text Book of Network Theory & Circuit Analysis, Cyber Tech References.
5. Kuo F. F., "Network Analysis & Synthesis", John Wiley & Sons.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	-	-	-	-	-	1	3
CO2	3	3	3	2	2	-	-	-	-	-	1	3
CO3	3	3	3	2	2	-	-	-	-	-	2	3
CO4	3	3	3	2	2	-	-	-	-	-	2	3

Course Name Measurement and Instrumentation
Course Code: EE 302
Contact: 3L:0T:0P
Total Contact Hrs: 36
Credit: 3

Prerequisites: Concepts of Basic Electrical Engineering.

Course Outcome:

- **CO1.** Understand the operating principles of electrical and electronic measuring instruments.
- **CO2.** Identify and measure various physical parameters using appropriate measuring instruments.
- **CO3.** Measure various electrical parameters.
- **CO4.** Understand statistical data analysis and computerized data acquisition.

Course Content

Module –I:

Measurements: (4)
Classification of instruments, Definition of accuracy, Precision, Resolution, Speed of response, Errors in measurement. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, Cp, Cpk.

Analog meters: (6)
General features, Construction, Principle of operation and torque equation of Moving coil and Moving iron, Electrodynamometer, Induction instruments, Electrostatic, Thermoelectric, Rectifier type instruments, Extension of instrument ranges and multipliers. Disadvantage of shunt and multipliers

Galvanometer: (2)
Basic concept: Principle of operation, Advantage, Disadvantage, Error and Application.

Module – II:

Instrument transformer: (2)
Advantage of Instrument transformers, Principle of operation of Current &Potential transformer, errors.

Measurement of Power: (3)
Principle of operation of Electrodynamic & Induction type wattmeter. Wattmeter errors.

Measurement of Energy: (2)
Construction, theory and application of AC energy meter. Testing of energy meters.

Module – III:

Measurement of resistance: (3)
Measurement of medium, low and high resistances, Megger. Basic concept of Crompton's DC

potentiometer Polar and Co-ordinate type AC potentiometer. Application.

AC Bridges: (4)
Measurement of Inductance, Capacitance frequency

Module – IV:

Cathode ray oscilloscope (CRO): (3)
Basic concept of Measurement of voltage, current, frequency & phase by oscilloscope. Frequency limitation of CRO. Sampling and storage oscilloscope, Double beam CRO. Digital Storage Oscilloscope

Electronic Instruments: (3)
Basic concept of Digital voltmeter (Electronic), Resolution and sensitivity of digital meters, Digital Multi meter Digital frequency meter, True RMS meters, Clamp-on meters

Sensors & Transducers: (4)
Introduction to sensors & Transducers, Strain gauge, LVDT, Temperature transducers, Flow measurement using magnetic flow measurement.

Text Books:

1. A course in Electrical & Electronic Measurements & Instrumentation, A.K. Sawhney, Dhanpat Rai & sons.
2. Electrical Measurement & Measuring Instruments, E.W. Golding & F.C. Wides, Wheeler Publishing.
3. Electronic Instruments, H.S. Kalsi, Tata Mc-Graw hill, 2nd Edition.

Reference Books:

1. Sensors & Transducers, D. Patranabis, PHI, 2nd edition.
2. Digital Instrumentation, A.J. Bouwens, Tata Mc-Graw hill.
3. Modern Electronic instrumentation & Measuring instruments, A.D. Heltric & W.C. Copper, Wheeler Publication.
4. Instrument transducers, H.K.P. Neubert, Oxford University press

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	1	-	-	-	-	-	-	-
CO4	-	3	2	-	2	-	-	-	-	-	-	-

Course Name : Analog Electronics
Course Code: EE 303
Contact: 3L:0T:0P
Total Contact Hrs: 34
Credit:3

Prerequisites: Basic knowledge about electronic components(R,L,C). Network Theorems (Kirchoffs law, Thevenin's theorem, Norton's theorem, Miller theorem etc.). Basic knowledge about the operation of semiconductor devices (Diode, Transistor, JFET, MOSFET, etc.),Basic idea of integrated circuit, Voltage current equations. Basic knowledge of Differentiation, Integration, Differential equation, matrix etc.

Course Outcome:

- **CO1.** Students will be able to design D.C power supplies.
- **CO2.** Students will be able to analyze transistor amplifier circuit.
- **CO3.** Students will be able to understand effects of different feedback mechanism in amplifier circuit.
- **CO4.** Students will be able to analyze signal generator Circuit.
- **CO5.** Student will be able to design power amplifier circuit.
- **CO6.** Students will be able to understand linear and nonlinear applications of OPAMP (I.C-741).

Course Content

Module – 1: Filters and Regulators [4L]
Capacitor filter, π-section filter, ripple factor, series and shunt voltage regulator, line and load regulation, 78xx and 79xx series, concept of SMPS.

Module – 2: Transistor Biasing and Stability [4L]
Biasing technique, Q-point & its Stability, Self Bias-CE configuration, Bias Compensation techniques, h-parameter model of transistors, Expression for voltage gain, current gain, input and output impedance, power gain, Emitter follower circuit.

Module – 3: Transistor Amplifier [5L]
Different coupling techniques, RC coupled amplifier, functions of all components, derivation of voltage gain, current gain, input impedance and output impedance, High frequency model of transistors (hybrid-π model), frequency response characteristics, Expression for lower and upper half frequencies, bandwidth, and concept of wide band amplifier.

Module – 4: Feedback Amplifiers & Oscillators [5L]
Feedback concept, negative & positive feedback, Voltage/Current & Series/Shunt Feedback Barkhausen criterion, RC Oscillators-Phase shift and Wein bridge oscillators, LC Oscillator-Colpitts, Hartley's and crystal oscillators.

Module – 5: Operational Amplifier [4L]
Ideal OPAMP, Differential amplifier, Constant current source (Current mirror etc), Level shifter, CMRR, Open & closed loop circuits, importance of feedback loop (positive & negative), inverting & non-inverting amplifiers, Voltage follower/Buffer circuits.

Module – 6: Application of Operational amplifiers [5L]

Adder & subtractor circuit, practical integrator & differentiator circuit, Instrumentation Amplifier, Log & Anti-log amplifiers, multipliers, Precision Rectifier, Comparator & Schmitt Trigger, Voltage to current & Current to voltage converter.

Module – 7: Power amplifiers **[3L]**

Class A, B, AB, C, Conversion efficiency, Tuned amplifier.

Module – 8: Multivibrators **[2L]**

Astable, Monostable, Bistable multivibrators; Astable and Monostable operation using 555 timer.

Module – 9: Special Function Circuits **[2L]**

VCO, PLL.

Text Books:

1. Boylested & Nashelsky- Electronic Devices and Circuit Theory- Pearson/PHI.
2. Gayakwad R.A -OpAmps and Linear IC's, PHI.
3. Sedra & Smith-Microelectronic Circuits- Oxford UP.
4. D. Roy Choudhury & B. Jain-Linear Integrated circuits, New Age Science Limited.
5. Franco-Design with Operational Amplifiers & Analog Integrated Circuits, 3/e, McGraw Hill.
6. J.B.Gupta- Electronic Devices and circuits, S.K. KATARIA & SONS.

Reference Books:

1. Millman & Halkias- Integrated El;ectronics, McGraw Hill.
2. Rashid-Microelectronic Circuits-Analysisand Design- Thomson (Cenage Learning)
3. Schilling &Belove-Electronic Circuit:Discrete& Integrated , 3/e , McGraw Hill
4. Razavi- Fundamentals of Microelectronic s- Wiley
5. Malvino-Electronic Principles , 6/e , McGraw Hill
6. Horowitz & Hill- The Art of Electronics;Cambridge University Press.
7. Bell- Operational Amplifiers and Linear ICs- Oxford UP
8. Tobey &Grame-Operational Amplifier: Design and Applications, Mc GrawHill.
9. Coughlin and Driscol-Operational Amplifier and Linear Integrated Circuits – Pearson Education

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	2	-	3	-	-	3
CO2	3	3	3	3	2	-	2	-	3	-	-	3
CO3	3	3	3	3	2	-	2	-	3	-	-	3
CO4	3	3	3	3	2	-	2	-	3	-	-	3
CO5	3	3	3	3	2	-	2	-	3	-	-	3
CO6	3	3	3	3	2	-	2	-	3	-		3

Course Name: Mathematics – III
Course Code: M(EE) 301
Contact: 3L:1T:0P
Total Contact Hours: 48
Credit:4

Prerequisites: The students to whom this course will be offered must have the concept of (10+2) standard calculus, basic probability and differential equations.

Course Outcome: On successful completion of the learning sessions of the course, the learner will be able to:

CO1. Recall the underlying principle and properties numerical analysis, Statistics, partial differential equation and ordinary differential equation.

CO2. Exemplify the variables, functions and differential equations and find their distinctive measures using the underlying concept partial differential equation and ordinary differential equation, numerical methods and statistics.

CO3. Apply numerical methods used to obtain approximate solutions to intractable mathematical problems.

CO4. Solve partial differential equation using method of separation of variables and ordinary differential equation using techniques of series solution and special function (Legendre's and Bessel's).

CO5. Interpret complex statistical findings using the understanding of inferential statistics.

Course Content

MODULE I: Interpolation (8 Lectures)

Difference Operators (Only Definition): Forward and Backward, Shift Operator, Newton forward interpolation, Newton backward interpolation, Lagrange's Interpolation.

MODULE II: Numerical Solution of Linear and Non-linear Equations (6 Lectures)

Numerical Solution of a System of Linear Equations: Gauss elimination method, LU Factorization method, Gauss-Seidel iterative method.

Solution of Polynomial and Transcendental Equations: Bisection method, Regula-Falsi, Newton-Raphson method.

MODULE III: Numerical Integration and Numerical Solution of Differential Equation (10 Lectures)

Numerical Integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms.

Numerical Solution of Ordinary Differential Equation: Taylor series method, Euler's method, Euler's modified method, fourth order Runge-Kutta method and Milne's Predictor-Corrector methods.

Numerical solution of partial differential equation: Finite Difference method, Crank–Nicolson method.

MODULE IV: Statistics (12 Lectures)

Basic Statistics: Basic statistics, measure of central tendency, mean, median, mode, dispersion, correlation coefficient and regression.

Sampling theory: Random sampling. Statistic and its Sampling distribution.Sampling distribution of sample mean and variance in random sampling from a normal distribution (statement only) and related problems.

Estimation of parameters: Unbiased and consistent estimators. Interval estimation. Maximum likelihood estimation of parameters (Binomial, Poisson).Confidence intervals and related problems

MODULE V: Partial Differential Equation (PDE) and Series Solution of Ordinary Differential Equation (ODE) (12 Lectures)

Solution of PDE: Method of Separation of Variables.

Solution of Initial Value & Boundary Value Problem: One Dimensional Wave Equation, One Dimensional Heat Equation, Two Dimensional Laplace Equation.

Series solution of ODE: General method to solve $P_0\, y'' + P_1 y' + P_2 y = 0$ and related problems to Power series method**,** Bessel's Function, Legendre Polynomial.

Text Books:

1. Jain, M. K., Iyengar, S. R. K. and Jain, R. K. *Numerical Methods (Problems and Solution)*. New age International Publisher.
2. Das, N.G. *Probability and Statistics*; The McGraw Hill Companies.
3. Gupta, S. C. and Kapoor, V. K. *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons.
4. Raisinghania, M .D. *Advanced Ordinary & Partial Differential. Equation*; S. Chand Publication.
5. Ross, S. L. *Differential Equations*, John Willey & Sons.
6. Grewal, B. S. *Higher Engineering Mathematics*, Khanna Pub.
7. Kreyszig, E. *Advanced Engineering Mathematics*, John Wiley & Sons, 2006.

Reference Books:

1. Lipschutz & Lipson, *Schaum's Outline in Probability (2ndEd)*, McGraw Hill Education.
2. Shastri, S. S. *Numerical Analysis*, PHI.
3. Mollah, S. A. *Numerical Analysis*, New Central Book Agency Spiegel,
4. M. R. *Theory and Problems of Probability and Statistics (Schaum's Outline Series)*, McGraw Hill Book Co.
5. Goon, A.M., Gupta M .K. and Dasgupta, B. *Fundamental of Statistics*, The World Press Pvt. Ltd.
6. Soong, T. T. *Fundamentals of Probability and Statistics for Engineers*, John Wiley & Sons Inc, 2004.
7. Delampady, M. *Probability & Statistics*, Universities Press.
8. Sneddon, I. N. *Elements of Partial Differential Equations*, McGraw Hill Book Co.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	3	2	2	-	-	-	-	-	-	-	-	1
CO5	3	3	2	3	-	-	-	-	-	-	-	1

Course Name: Electrical Circuit Analysis Laboratory
Course Code: EE 391
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites: Concepts of Basic Electrical Engineering

Course Outcome: On successful completion of the learning sessions of the course, the learner will be able to:

- **CO1.** Demonstrate transient analysis of electric circuits frequency response characteristics of Filter circuits.
- **CO2.** Analyze electric circuits, signals and algorithms using mathematical tools

List of Experiment:

1. Familiarization with various MATLAB commands used in Electrical Engineering
2. Transient response of R-L and R-C network: simulation with PSPICE / MATLAB / Hardware
3. Transient response of R-L-C series and parallel circuit: Simulation with PSPICE / MATLAB / Hardware
4. Study the effect of inductance on step response of series RL circuit in MATLAB / HARDWARE.
5. Determination of Impedance (Z) and Admittance (Y) parameter of two port network: Simulation / Hardware.
6. Frequency response of LP and HP filters: Simulation / Hardware.
7. Frequency response of BP and BR filters: Simulation / Hardware.
8. Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using MATLAB in both discrete and analog form.
9. Amplitude and Phase spectrum analysis of different signals using MATLAB.
10. Verification of Network theorems using hardware components.
11. Innovative Experiments.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	1	3	-	-	-	1	1	-	-
CO2	2	-	2	1	3	--	-	-	1	1	-	-

Course Name: Measurement and Instrumentation Laboratory
Course Code: EE 392
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites: Concepts of different measuring system.

Course Outcome: On successful completion of the learning sessions of the course, the learner will be able to:

CO1. Conduct experiment to measure of Resistance, Inductance, Capacitance, Power and Energy.

List of Experiment:

1. Measurement of power in polyphase circuit.
2. Measurement of power using instrument transformer.
3. Measurement of capacitance using Schering Bridge technique as well as LCR meter.
4. Calibration of Digital Energy Meter.
5. Testing of energy Meter
6. Measurement of capacitance using Anderson Bridge technique as well as LCR meter.
7. Measurement of low resistance using Kelvin Double bridge.
8. Measurement of high resistance and insulation resistance using Megger.
9. Usage of DSO to capture transient like step change in R-L-C circuit.
10. Current measurement using shunt, CT and Hall Sensor
11. Measurement of capacitance by De sauty bridge
12. Measurement of frequency by Wien Bridge.
13. Innovative Experiments.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	3	-	-	-	-	3	2	-	1

Course Name: Analog Electronics Laboratory
Course Code: EE 393
Contact: 0L:0T:2P
Credit: 1

Prerequisites: Knowledge in electrical circuits and electronic devices.

Course Outcome:

- **CO1.** Able to understand, analyse the analog circuits pertaining to applications like amplifier, oscillators and timer.
- **CO2.** Able to know how to interface digital circuits with ADC & DAC.
- **CO3.** Able to understand the fundamental concepts and techniques used in digital electronics.
- **CO4.** Able to understand and examine the structure of various number systems, De-Morgan's law, Boolean algebra and its application in digital design.
- **CO5.** Able to understand, analyse the analog circuits pertaining to applications like amplifier, oscillators and timer.
- **CO6.** Able to know how to interface digital circuits with ADC & DAC.

List of Experiment:

Any 8 Experiments has to be done

1. Design of voltage regulator circuit using zener diode.
2. Study of Switched Mode Power Supply & construction of a linear voltage regulator using regulator IC chip.
3. Design of RC coupled amplifier & study of it's gain & Bandwidth using BJT.
4. Design of RC Phase shift oscillator using BJT.
5. Design of wien bridge oscillator using BJT.
6. Study of class A & class B power amplifiers.
7. Design of Integrator using OPAMP IC 741
8. Design of Differentiator using OPAMP IC 741
9. Study of V to I and I-V converter using OPAMP IC 741
10. Design of Instrumentation Amplifier using OPAMP IC 741
11. Study of timer circuit using NE555 & configuration for monostable & astable multivibrator.
12. Study of voltage controlled oscillator.
13. Innovative Experiments.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	2	-	3	-	-	3
CO2	3	3	3	3	2	-	2	-	3	-	-	3
CO3	3	3	3	3	2	-	2	-	3	-	-	3
CO4	3	3	3	3	2	-	2	-	3	-	-	3
CO5	3	3	3	3	2	-	2	-	3	-	-	3
CO6	3	3	3	3	2	-	2	-	3	-	-	3

Course Name: Environmental Science
Course Code: MC 301
Total Contact Hours: 20
Credit: 2

Pre requisites: Basic knowledge of Chemistry

Course Outcome:

CO1. Student will be able

- To understand the natural environment and its relationships with human activities.
- To apply the fundamental knowledge of science and engineering to assess environmental and health risk.
- To develop guidelines and procedures for health and safety issues obeying the environmental laws and regulations.
- Acquire skills for scientific problem-solving related to air, water, noise & land pollution.

Course Contents

1. General **6L**

Natural Resources: Forest Resource, water resource, mineral resource, energy resources: alternative source of energy

Population Growth: Exponential Growth, logistic growth, Maximum sustainable yield, demography

Disaster Management: Types of disasters (Natural & Man-made), Floods, Earthquake, Tsunamis, Cyclones, landslides (cause, effect & control)

Ecology & Ecosystem: Elements of ecology, definition of ecosystem- components types and function,Food chain & Food web, Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems

Environmental Management: Environmental impact assessment, Environmental laws and protection act of India(The Environment protection Act, Air pollution Act, Water Act, Wildlife Protection Act) , Hazardous waste(management and Handling) Rules.

2. Air pollution and control **6L**

Sources of Pollutants: point sources, nonpoint sources and manmade sources primary & secondary pollutant

Types of air pollutants: primary & secondary pollutant ; Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN, Smog (Photochemical smog and London smog),

Effects on human health & climate: Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion

Air pollution and meteorology: Ambient Lapse Rate, Adiabatic Lapse Rate, Atmospheric stability & Temperature inversion

control of air pollution (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury)

3. Water Pollution **6L**

Classification of water (Ground & surface water)

Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients,

Salts, heavy metals, pesticides, volatile organic compounds.

Surface water quality parameters: pH, DO, 5 day BOD test, BOD reaction rate constants, COD. Numerical related to BOD

Lake: Eutrophication [Definition, source and effect].

Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only),ground water pollution (Arsenic & Fluoride; sources, effects, control)

Quality of Boiler fed water: DO, hardness, alkalinity, TDS and Chloride

Layout of waste water treatment plant (scheme only).

4. Land Pollution **2L**

Types of Solid Waste: Municipal, industrial, commercial, agricultural, domestic, hazardous solid wastes (bio-medical), E-waste

Solid waste disposal method: Open dumping, Land filling, incineration, composting, recycling (Advantages and disadvantages).

Waste management: waste classification, waste segregation, treatment & disposal

5. Noise Pollution **2L**

Definition of noise, effect of noise pollution on human health,

Average Noise level of some common noise sources

Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, $L10$ (18 hr Index) .

Noise pollution control.

References Books:

1. A Textbook of Environmental Studies, Shashi Chawla. Tata McGraw Hill Education Private Limited
2. Environmental Studies, Dr. J P Sharma, University Science Press
3. Environmental Engineering, J K Das Mohapatra, Vikas Publication

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	-	-	2	3	3	-	-	1	2

SYLLABUS

OF

B.TECH FOURTH SEMESTER COURSES

Course Name: Physics – II
Course Code: PH 401
Contact: 3L:0T:0P
Total Contact Hours: 40
Credit: 3

Prerequisites: Knowledge of Physics up B.Tech 1st year Physics-I course

Course Outcome: After completion of this course student will be able to

- **CO1.** Explain electron transport in metal-insulators and semiconductors using energy Band theory.
- **CO2.** Apply Schrödinger equation in variety of atomic scale problems including nanomaterials.
- **CO3.** Analyze the physics of various kinds of electric and magnetic materials
- **CO4.** Justify the importance of Fermi energy level in turning electronic properties of various.

Course Content

Module 1: Electric and Magnetic properties of materials (10L)

Module 1.01: Insulating materials
Dielectric Material: Concept of Polarization, the relation between **D, E** and **P**, Polarizability, Electronic (derivation of polarizability), Ionic, Orientation & Space charge polarization (no derivation), behavior of Dielectric under alternating field (qualitative discussion only), Dielectric losses, Local electric field at an atom: Lorentz field, Lorentz relation; Dielectric constant and polarizability – Clausius-Mossotti equation (with derivation); ferroelctric and piezoelectrics (Qualitative study). 5L

Module 1.02: Magnetic materials and storage devices
Magnetic Field & Magnetization M, relation between **B, H, M**. Bohr magneton, susceptibility, Diamagnetism- & Paramagnetism - Curie law (qualitative discussion), Ferromagnetism– Curie Temperature, Weiss molecular field theory (qualitative) & Curie-Weiss law, concept of θ_p, Hysteresis, Hard ferromagnets, Comparison and applications of permanent magnets (storage devices) and Soft ferromagnets (Permalloys, Ferrites etc.) 5L

Module 2: Quantum Mechanics – II (8L)
Formulation of quantum mechanics and Basic postulates- superposition principle, orthogonality of wave function, expectation value; operator correspondence, Commutator. Measurements in Quantum Mechanics-Eigen value, Eigen function, Schrödinger's equation as energy eigen value equation. 4L
Application of Schrödinger equation – Particle in an infinite square well potential (1-D and 3-D potential well; Discussion on degenerate levels), 1D finite barrier problem and concept of quantum tunnelling (solve only $E<V_0$). 4L

Module 3: Statistical Mechanics (4L)
Concept of energy levels and energy states, phasespace, microstates, macrostates and thermodynamic probability, MB, BE, FD, statistics (Qualitative discussions)- physical significance, conception of bosons, fermions, classical limits of quantum statistics, Fermi distribution at zero & non-zero temperature, Concept of Fermi level. 4L

Module 4: Elements of solid state physics (6L)

Module 4.01: Free electron theory (qualitative) – Electronic conduction in solids
Drude's theory, B Wiedemann Frantz Law, Idea of quantization of energy-Sommerfeld theory. 3L

Module 4.02: Band theory of solids
Bloch Theorem-statement only, Kronig-Penny model (qualitative treatment)- Energy-band (E-k) diagram, allowed and forbidden energy bands. 3L

Module 5: Physics of Nanomaterials (4L)
Reduction of dimensionality, properties of nanomaterials, Quantum wells (two dimensional), Quantum wires (one dimensional), Quantum dots (zero dimensional); Quantum size effect and Quantum confinement. Carbon allotropes. Application of nanomaterials (CNT, grapheme, electronic, environment, medical). 4L

Module 6: Nuclear energy as future energy (4L)
Nuclear Binding Energy, Liquid drop model, Concept of Nuclear Fission, Nuclear Fusion & Energy output , Nuclear Reactor. 4L

Books:

1. Insulating Materials: Principles, Materials, Applications, Margit Pfundstein , Roland Gellert , Martin Spitzner & Alexander Rudolphi: Birkhauser Verlag AG; 1
2. High Voltage and Electrical Insulation Engineering, Ravindra Arora, Wolfgang Mosch: Online ISBN: 9780470947906 DOI: 10.1002/9780470947906 Series Editor(s): Mohamed E. El-Hawary
3. Physics-II, Sujay Kumar Bhattacharya and Soumen Pal, McGraw Hill Education Private Limited
4. Advanced Engineering Physics, S. P. Kuila, New Central Book Agency (P) Ltd.
5. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
6. Quantum Mechanics- Bagde Singh (S. Chand Publishers)
7. Principles of Engineering Physics Vol 1 and Vol 2; by Md. N. Khan and S. Panigrahi, Pub: Cambridge Univ. press
8. Advanced Quantum Mechanics-J. J. Sakurai (TMH)
9. Quantum Computation and Quantum Information(10th Anniversary Edition)- Nielsen & Chuang (Cambridge University Press)
10. Fundamental of Statistical Mechanics: B Laud
11. Introduction to statistical mechanics : .Pathria
12. Fundamental of Statistical and Thermal Physics: F. Reif Advanced Engineering Physics-S. P. Kuila New Central Book Agency (P)Ltd.
13. Electricity and Magnetism (In Si Units): Berkeley Physics Course - Vol.2, Edward M Purcell
14. Introduction to Electrodynamics-Griffiths David J.
15. The Feynman Lectures on Physics. 2 (2nd ed.)., Feynman, Richard P Addison-Wesley. ISBN 978-0-8053-9065-0
16. Solid State Physics, A. J. Dekker, McMillan
17. Nanostructure and Nanomaterials, B.K. Parthasarathy
18. Introduction to Nanotechnology, B.K. Parthasarathy
19. Essentials of Nanotechnology, Rishabh Anand
20. Nanomaterials Handbook (Advanced Materials and Technologies)-YuryGogotsi (Editor) 1. Nuclear Physics, Irvin Keplan
21. Nuclear Physics, J. Pearson, University of Manchester, 2008
22. Nuclear and Particle Physics, Jenny Thomas - University College London , 2000.

23. Solid State Physics, S.O. Pillai.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	2
CO3	2	3	-	-	-	-	-	-	-	-	-	1
CO4	1	2	2	3	-	-	-	-	-	-	-	1

Course Name: Electrical Machines - I
Course Code: EE 401
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Knowledge of Physics up to B. Tech. 1st year Physics-I course.

Course Outcome:

- **CO1.** Understand the operation of Transformers, D.C. Machines, Three-Phase Induction Motor.
- **CO2.** Analyze the equivalent circuit of Transformers, D.C. Machines, Three-Phase Induction Motor.
- **CO3.** Conduct different tests on Transformers, D.C. Machines, Three-Phase Induction Motor.

Course Content

MODULE – I: General Introduction to Electrical Machines (3L)
Faraday's laws of electromagnetic induction, Fleming's rule and Lenz's Law. 1L
Concept of Electrical and Mechanical degree. 2L

MODULE – II: D.C. Machine (9L)
EMF generation in armature, Characteristics of D.C. Machines. 1L
Methods of building up of e.m.f., Significance of Critical resistance and Critical speed. 1L
Armature reaction and its effect, Function of Interpole and Compensating winding. 2L
Commutation method, Concept of reactance voltage. 1L
Power flow diagram, Losses and efficiency, Solution of problems. 1L
Testing of D.C. machines – Hopkinson's, Swinburne's test, Brake test (Tests specified as per standards). 1L
Starting and Speed Control of D.C. Motors. 2L

MODULE – III: Single-Phase Transformers (5L)
Core construction and different parts of transformer and their function, Materials used for core, winding and insulation, Transformer oil, Different types of cooling methods (in brief), Name plate rating. 1L
Equivalent circuit and per unit representation and its importance, Regulation, Efficiency and All day efficiency, Solution of problems. 2L
Single-phase Auto transformer – Comparison of weight, copper loss with 2-winding transformer. 1L
Sumpner Test, Applications of 2-winding transformer and Auto transformer. 1L

MODULE – IV: Three-Phase Transformers (9L)
Types of three-phase transformer. Construction and Different types of windings. 1L
Polarity of transformer, Vector groups for various connections. 1L
Parallel operation and load sharing, Solution of problems. 2L
Effect of unbalanced loading and neutral shifting, Tertiary windings. 1L
Scott-connected transformer and open-delta connection – working principle, connection diagram, practical application. 1L
Tap-changing methods, Tap changers – Off load and On-load type. 1L
Special Transformer: Pulse transformer, Grounding transformer. 1L
Testing of Three-phase Transformers. 1L

MODULE – V: Three-Phase Induction Motor (10L)

Induction motor as a transformer, Concept of rotating magnetic field, Power stages in 3-phase induction motor and their relation, power-slip characteristics. 3L

Determination of equivalent circuit parameters, Separation of losses, Efficiency, Solution of problems. 2L

Concept of Deep bar and Double cage rotor. 1L

Starting and speed control of three phase induction motor. 1L

Space harmonics: Crawling and Cogging, Brief idea of braking of induction motor. 2L

Testing and Industrial applications of 3-phase induction motor. 1L

Text Books:

1. Electrical Machinery, P.S. Bhimra, 6th Edition, Khanna Publishers.
2. Electric machines, D.P. Kothari & I.J Nagrath, 3rd Edition, Tata Mc Graw-Hill Publishing Company Limited.
3. Electrical Machines, P.K. Mukherjee & S. Chakrabarty, Dhanpat Rai Publication.

Reference Books:

1. Electric Machinery & Transformers, Bhag S. Guru and H.R. Hiziroglu, 3rd Edition, Oxford University press.
2. Electrical Machines, R.K. Srivastava, Cengage Learning
3. Theory of Alternating Current Machinery, Alexander S Langsdorf, Tata Mc Graw Hill Edition.
4. The performance and Design of Alternating Current Machines, M. G. Say, CBS Publishers & Distributors.
5. Electric Machinery & transformer, Irving L Koskow, 2nd Edition, Prentice Hall India.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	2	-	-	2	3	3
CO2	3	3	3	3	3		-	-	2	-	3	3
CO3	3	1	2	-	-	3	-	1	2	-	3	3

Course Name: Power Electronics
Course Code: EE 402
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Concept of Basic Electronics, Electrical Circuit Analysis, Analog Electronics.

Course Outcome: On successful completion of the learning sessions of the course, student will be able to:

- **CO1.** Demonstrate the characteristics of different power electronic switches along with their turn-on, turn-off, triggering and protection circuits.
- **CO2.** Analyse various power converter circuits.
- **CO3.** Understand the use of power converters in commercial and industrial applications.

Course Content

MODULE I: Power Electronic Switching Devices 8L

Advances in Power Electronics Power Semiconductor Switches: Rectifier diodes, fast recovery diodes, Schottky barrier diode, BJT, Power MOSFET, SCR, TRIAC, IGBT, IGCT and GTO. Ratings, Static and Dynamic Characteristics, triggering and switching characteristics and cooling. SCR turn–on and turn-off methods, Triggering circuits, SCR Commutation circuits, SCR Series and Parallel operation, Snubber Circuit.

MODULE II: Uncontrolled and Controlled Rectifiers 6L

Single-Phase and Three-Phase Uncontrolled rectifiers.
Phase controlled Rectifiers: Principle of operation of single phase and three phase semi-controlled, full controlled converters with R, R-L and RLE loads. Effects of source inductance on the performance of converters. Performance parameters of converters, Dual converters, Solution of problems.

MODULE III: DC-DC Converters 5L

Principle of operation, control strategies, Step up and Step down choppers, Buck, Boost, Buck - Boost and Cuk Converters, Concept of Resonant Switching.

MODULE IV: Inverters 10L

Inverters: Principle of operation of single phase inverter, 120º and 180° conduction mode of operation of three phase inverter, performance parameters of inverters, PWM techniques, Sinusoidal PWM, modified Sinusoidal PWM - multiple PWM Voltage and harmonic Control, introduction to Space vector modulation method, Series resonant inverter-Current Sources Inverter.

MODULE V: Cycloconverters and AC Voltage Regulators 5L

AC Voltage Controllers, Single phase and three phase Cycloconveters, Concept of Matrix Converter.

MODULE VI: Applications 2L

UPS (Online and Offline), SMPS, Battery Chargers.

Text Books:

1. L. Umanand, Power Electronics: Essentials and Applications.
2. M. H. Rashid, Power Electronics, PHI/ Pearson Education.

3. P. S. Bhimra, Power Electronics, Khanna Publications.
4. K. Hari Babu: Power Electronics

Reference Books:

1. C.W. Lander, Power Electronics, McGraw Hill.
2. B. K. Bose, Modern Power Electronics, JAICO.
3. Mohan, N Undeland, TM & Robbins, WP- Power Electronics, John Wiley & Sons.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	-
CO3	2	-	2	2	1	-	-	-	-	-	-	-

Course Name: Digital Electronics
Course Code: EE 403
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Knowledge of Basic Electronics and Mathematics.

Course Outcome: The students will be able to:

CO1. Acquired knowledge about solving problems related to number systems conversions and Boolean algebra and design logic circuits using logic gates to their simplest forms using De Morgan's Theorems; Karnaugh Maps.
CO2. Design of combinational circuits
CO3. Design of various synchronous and asynchronous sequential circuits using State Diagrams & Tables.
CO4. Understand DAC & ADC technique and corresponding circuits
CO5. Analyze logic family interfaces, switching circuits & memory storage devices to Plan and execute projects.

Course Content

Module 1: **11L**

Binary, Octal and Hexadecimal number system representation and their conversions; BCD, Gray codes and their conversions. Signed binary number representation with 1's, 2's, 9's and 10's complement methods, Binary arithmetic.
Boolean algebra; Various Logic gates- their truth tables and circuits; Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K-map method.

Module 2: **10L**

Combinational circuits- Half Adder, Full Adder, Serial & Parallel Adder, BCD Adder, Half Subtractor, Full Subtractor circuits, Adder-Subtractor Circuit. Encoder, Decoder, Multiplexer, De Multiplexer, Adder & Subtractor Design using decoder & multiplexer, Comparator and Parity Generator-Checker.

Module 3: **10L**

Sequential Circuits- latch & Flip Flops-S-R, J-K, D and T, Conversion of Flip Flops, Various types of Shift Registers-SISO, SIPO, PISO, PIPO, Bidirectional & Universal Shift. Counters-Synchronous, Asynchronous, Ring & Johnson Counter.

Module 4: **5L**

Parameters of D/A & A/D Converters. Different types of A/D -Flash Type, Successive Approximation and Dual Slope and D/A -R-2R Ladder. Logic families- TTL, ECL, MOS and CMOS, their operation and specifications. TTL Equivalent Circuit.

Textbooks:

1. A. Anand Kumar, Fundamentals of Digital Circuits-PHI
2. Morries Mano- Digital Logic Design- PHI
3. S. Salivahanan & S.Arivazhagan, Digital Circuit & Design- Bikas Publishing
4. A. K. Maini- Digital Electronics- Wiley-India

Reference Books:

1. Floyed & Jain- Digital Fundamentals-Pearson.
2. R.P.Jain—Modern Digital Electronics, 2/e , Mc Graw Hill
3. H.Taub & D.Shilling, Digital Integrated Electronics- Mc Graw Hill.
4. D.Ray Chaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publishers
5. Kharate- Digital Electronics- Oxford
6. Tocci, Widmer, Moss- Digital Systems, 9/e- Pearson

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	3	1	1	1	1	1	1	3
CO2	3	3	3	1	3	1	1	1	1	1	1	3
CO3	3	3	3	3	3	2	2	1	1	1	2	3
CO4	3	3	3	3	3	2	2	1	1	2	1	3
CO5	3	3	3	3	3	1	2	1	2	2	2	3

Course Name: Electromagnetic Fields
Course Code: EE 404
Contact: 2L:0T:0P
Total Contact Hours: 24
Credit: 2

Prerequisites: Concept of mathematics, physics and basic electrical engineering.

Course Outcome:

- **CO1.** Know the orthogonal co-ordinates and their transformation to solve & analyze problems on vector calculus.
- **CO2.** Know the basic laws of electrostatics and electromagnetism and define associated terms.
- **CO3.** Understand Maxwell's equation in different forms.
- **CO4.** Understand the propagation of EM waves associated with different Electrical Networks.

Course Content

Module 1: Co-ordinate systems **3L**
Cartesian coordinates, Circular cylindrical coordinates, Spherical coordinates and their transformation. Differential length, area and volume in different coordinate systems. Solution of problems.

Module 2: Introduction to Vector calculus **3L**
DEL operator, Gradient of a scalar, Divergence of a vector and Divergence theorem, Curl of a Vector and Strokes theorem, Solution of problems.

Module 3: Electrostatic field **5L**
Coulomb's law, field intensity, Gauss's law, Electric potential and potential gradient, Relation between E and V, Concept of Electric dipole, flux lines and Energy density in electrostatic field. Boundary conditions: Dielectric-dielectric, Conductor–dielectric, Conductor-free space. Poisson's and Laplace's equation, Solution of problems.

Module 4: Magneto static fields **5L**
Biot-savart's law, Ampere's circuit law, Magnetic flux density, Magnetic static and Vector potential, Forces due to magnetic field, Magnetic torque and moments, Magnetization in material, Magnetic boundary condition, Concept of Magnetic energy, Magnetostriction, Solution of problems.

Module 5: Electromagnetic fields **3L**
Faraday's law, Transformer and motional emf, Displacement current, Maxwell's equations, Solution of problems.

Module 6: Electromagnetic wave propagation **5L**
Wave equation, Wave equation in conducting medium, Wave propagation in lossy dielectric, Plane waves in loss less dielectric, Plane wave in free space, Plane wave in good and dielectric conductor, Skin effect, Skin depth, Power and Poynting vector. Solution of problems.

Text Books:

1. Quantum Field Theory, Lewis H. Ryder, 2nd Edition, Cambridge University Press.

2. Elements of Electromagnetic, Mathew N.O. Sadiku, 4th edition, Oxford University press.
3. Engineering Electromagnetic, W.H. Hyat & J.A. Buck, 7th Edition, TMH
4. Theory and problems of Electromagnetic, Edminister, 2nd Edition, TMH
5. Electromagnetic field theory fundamentals, Guru & Hizroglu, 2nd edition, Cambridge University Press.
6. Elements of Electromagnetic Fields, S.P. Seth, Dhanpat Rai & Sons.

Reference Books:

1. Electromagnetic with application, Krause, 5th Edition, TMH.
2. Elements of Engineering Electromagnetic, N.N. Rao, 6th Edition, Pearson Education.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-

Course Name: Values and Ethics in Profession
Course Code: HU401
Contact: 2L:0T:0P
Total Contact Hours: 24
Credit: 2

Prerequisites: Basic knowledge of management, knowledge about environment science.

Course Outcome: On Completion of this course student will be able to:

- **CO1.** Understand the core values that shape the ethical behaviour of an engineer and Exposed awareness on professional ethics and human values.
- **CO2.** Understand the basic perception of profession, professional ethics, various moral issues & uses of ethical theories.
- **CO3.** Understand various social issues, industrial standards, code of ethics and role of professional ethics in engineering field.
- **CO4.** Aware of responsibilities of an engineer for safety and risk benefit analysis, professional rights and responsibilities of an engineer.
- **CO5.** Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives.

Course Content

Module 1: Introduction **4L**
Definition of Ethics; Approaches to Ethics: Psychological, Philosophical, Social.

Module 2: Psycho-social theories of moral development **4L**
View of Kohlberg; Morality and Ideology, Culture and Morality, Morality in everyday Context.

Module 3: Ethical Concerns **4L**
Work Ethics and Work Values, Business Ethics, Human values in organizations: Values Crisis in contemporary society.
Nature of values: Value Spectrum of a good life, Steven Covey's Pursuit of Excellence.

Module 4: Ethics of Profession **4L**
Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals.
Social and ethical responsibilities of Technologists. Codes of professional ethics. Whistle blowing and beyond, Case studies.

Module 5: Self Development **4L**
Character strengths and virtues, Emotional Intelligence, Social intelligence, Positive cognitive states and processes (Self-efficacy, Empathy, Gratitude, Compassion, and Forgiveness).
Maslow's Pyramid and Theory of Motivation.

Module 6: Effects of Technological Growth **4L**
Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development Energy Crisis: Renewable Energy Resources, Environmental degradation and pollution. Eco-friendly Technologies. Environmental Regulations, Environmental Ethics.
Appropriate Technology, Movement of Schumacher; Problems of man, machine, interaction.

Text / Reference Books:

1. Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994 (2nd Ed).
2. Deborah Johnson, Ethical Issues in Engineering, Prentice Hall, Englewood Cliffs, New Jersey 1991.
3. A N Tripathi, Human values in the Engineering Profession, Monograph published by IIM, Calcutta 1996.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-		-	-	-	1	1	1	1	2	-	-
CO2	-	-	-	-	-	1	1	3	1	2	-	-
CO3	-	-	-	-	-	3	2	3	-	1	-	-
CO4	-	-	-	-	-	3	2	1	-	-	-	-
CO5	-	-	-	-	-	3	2	2	-	1	3	-

Course Name: Physics – II Laboratory
Course Code: PH 491
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites: Knowledge of Physics up B. Tech. 1st year Physics-I course.

Course Outcome: At the end of the course students' will be able to

- **CO1.** Demonstrate experiments allied to their theoretical concepts
- **CO2.** Conduct experiments using semiconductors , dielectric and ferroelectrics
- **CO3.** Classify various types of magnetic materials.
- **CO4.** Participate as an individual, and as a member or leader in groups in laboratory sessions actively.
- **CO5.** Analyze experimental data from graphical representations, and to communicate effectively them in laboratory reports including innovative experiments.

List of Experiment:

Experiments on Module 1: Electric and Magnetic properties of materials (8L)

1. Study of dipolar magnetic field behavior using deflection magnetometer.
2. Study of hysteresis curve of a ferromagnetic material using CRO.
3. Use of paramagnetic resonance and determination of Lande-g factor using ESR setup.
4. Measurement of Curie temperature of the given sample.
5. Determination of dielectric constant of given sample (frequency dependent) / Measurement of losses in a dielectric using LCR circuits.

Experiments on Module 2: Quantum Mechanics-II (6L)

6. Determination of Stefan's radiation constant.
7. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells & measurement of maximum workable power.
8. Measurement of specific charge of electron using CRT.

Experiments on Module 4: Solid state physics (9L)

9. Determination of band gap of a semiconductor using four probe method.
10. Determination of Hall co-efficient of a semiconductor and measurement of magnetoresistance of a given semiconductor
11. Study of I-V characteristics of a LED.
12. Study of Intensity-Resistance characteristics of a LDR.

In addition to regular 7 experiments it is **recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment.

Probable experiments beyond the syllabus:

1. Determination of thermal conductivity of a bad conductor by Lees and Chorlton's method.
2. Determination of thermal conductivity of a good conductor by Searle's mothod.
3. Study of transducer property: Determination of the thermo-electric power at a certain temperature of the given thermocouple.
4. Innovative Experiments.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	1
CO2	2	1	-	3	-	-	-	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-	1
CO4	-	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	-	-	-	-	1	-	-

Course Name: Electrical Machines – I Laboratory
Course Code: EE 491
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites: Concept of Basic Electrical Engineering Laboratory, Electrical Measurement Laboratory.

Course Outcomes: After successful completion of this course, student will be able to

CO1. Conduct different tests on Transformers, D.C. Machines, Three-Phase Induction Motor.

CO2. Analyze the characteristics of Transformers, D.C. Machines, Three-Phase Induction Motor.

List of Experiment (At least *ten* experiments to be performed):

1. Heat-run test of a single-phase transformer.
2. Regulation and Efficiency of single-phase transformer by direct loading method.
3. Parallel operation of two single-phase transformer and find out the load sharing between them.
4. Efficiency of a single-phase transformer by Back-to-Back test.
5. Polarity test and vector grouping of a three-phase transformer.
6. Swinburne test of a D.C. shunt motor.
7. Brake test of D.C. series motor.
8. Voltage build-up of a D.C. shunt generator and find out critical resistance and critical speed.
9. Circle diagram of a three-phase Induction Motor.
10. Speed control of three-phase Induction Motor by V/f constant.
11. Separation of losses in three-phase Induction Motor.
12. Load test of a three-phase wound rotor Induction Motor.
13. Innovative Experiments.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	3	-	-	-	-	3	2	-	1
CO2	2	-	-	3	-	-	-	-	3	2	-	1

Course Name: Power Electronics Laboratory
Course Code: EE 492
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites: Concept of Basic Electronics, Electrical Circuit Analysis, Analog Electronics.

Course Outcomes: After successful completion of this course, student will be able to

- **CO1.** The skill to analyze the response of any power electronics devices.
- **CO2.** The ability to troubleshoot the operation of a power electronics circuit.
- **CO3.** The ability to select suitable power electronic devices for a given application.
- **CO4.** The ability to know how to control and convert output signal as per requirements.
- **CO5.** The ability to construct any power electronics circuits as needed in operation.

List of Experiment (At least *ten* experiments to be performed):

1. Study of the characteristics of an SCR.
2. Study of the characteristics of a TRIAC
3. Study of different triggering circuits of an SCR.
4. Study of the operation of a single phase full controlled bridge converter with R and R-L load.
5. Study of performance of single phase half controlled symmetrical and asymmetrical bridge converters.
6. Study the performance of step down chopper.
7. Study the performance of step up chopper.
8. Study the performance of single-phase inverter with 180° conduction mode of operation.
9. Study the performance of SPWM controlled single-phase inverter.
10. Study of performance of single phase controlled converter with and without source inductance (Simulation).
11. Study of performance of step up and step down chopper with MOSFET, IGBT and GTO as switch (simulation).
12. Study of performance of single phase half controlled symmetrical and asymmetrical bridge converter (Simulation).
13. Study of performance of three phase controlled converter with R & R-L load (simulation).
14. Innovative Experiments.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	1	-	-	-	-	-	-	-	-
CO2	-	1	-	2	-	-	-	-	-	-	-	-
CO3	2	1	-	2	-	-	-	-	1	-	-	-
CO4	2	-	-	2	-	-	-	-	1	-	-	-
CO5	2	1	-	2	-	-	-	-	-	-	-	-

Course Name: Digital Electronics Laboratory
Course Code: EE 493
Contact: 0L:0T:2P
Credit: 1

Prerequisites: Knowledge of Basic Electronics and Mathematics.

Course Outcomes:

CO1. Able to understand the fundamental concepts and techniques used in digital electronics.

CO2. Able to understand and examine the structure of various number systems, De-Morgan's law, Boolean algebra and its application in digital design.

CO3. Able to understand, analyse the timing properties (input setup and hold times, minimum clock period, output propagation delays) and design various combinational and sequential circuits using various metrics: switching speed, throughput/latency, gate count and area, energy dissipation and power.

CO4. Able to understand different digital circuits using Programmable Logic Devices.

CO5. Able to know how to interface digital circuits with ADC & DAC.

List of Experiment:

1. Realization of basic gates using Universal logic gates.
2. Realization of logic gates using TTL.
3. Design the circuit of Grey to Binary and vice versa.
4. Design a circuit for BCD to 7-segment display.
5. Four-bit parity generator and comparator circuits.
6. Construction of simple Encoder & Decoder circuits using logic gates.
7. Construction of simple Multiplexer & De Multiplexer circuits using logic gates.
8. Design of Half Adder & Full Adder Circuit using Logic Gates.
9. Design Half Subtractor & Full Subtractor Circuit using Logic Gates.
10. Realization of RS, D, JK and T flip-flops using logic gates.
11. Realization of Register using flip-flops and logic gates.
12. Realization of Up/Down counters.
13. One Innovative design of Digital Circuits.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	3	1	1	1	-	-	1	3
CO2	3	3	3	1	3	1	1	-	1	1	1	3
CO3	3	3	3	3	3	2	2	1	-	1	2	3
CO4	3	3	3	3	3	2	2	1	-	2	1	3
CO5	3	3	3	3	3	1	2	1	2	2	2	3

Course Name: Behavioral & Interpersonal Skills
Course Code: MC 481
Contact: 0:0:3

Course Outcome:

- **CO1.** It will equip the student to handle workplace interpersonal communication in an effective manner.
- **CO2.** To enable students with strong oral and written interpersonal communication skills.
- **CO3.** To prepare students to critically analyze workplace situations and take appropriate decisions.
- **CO4.** To make students campus ready through proper behavioral and interpersonal grooming.
- **CO5.** Integration of enhanced skill set to design and frame team based Project Report and Presentation.

MODULE I – INTERPERSONAL COMMUNICATON

1. The skills of Interpersonal Communication.
2. Gender/Culture Neutrality.
3. Rate of Speech, Pausing, Pitch Variation and Tone.
4. Corporate Communication.
5. Branding and Identity.

MODULE II- INTERPERSONAL COMMUNICATION BASED ON WORKPLACE COMMUNICATION

6. Workplace Communication.
7. Modes of Communication (Telephone, Conference Call, Team Huddle, Public Relation etc.)
8. Communication with Clients, Customers, Suppliers etc.
9. Organizing/Participating in Business Meeting.
10. Note Taking.
11. Agenda.
12. Minutes.

MODULE III – BUSINESS ETIQUETTE AND CORPORATE LIFE

13. Presenting oneself in the Business Environment.
14. Corporate Dressing and Mannerism.
15. Table Etiquette (Corporate Acculturation, Office parties, Client/Customer invitations etc.)
16. E-mail Etiquette.
17. Activity based Case Study.

MODULE IV – MOVIE MAKING: CORPORATE BUSINESS MEETING

18. Team based Brainstorming.
19. Process Planning and Developing Plot.
20. People management.
21. Documentation and Scripting.
22. Shooting the Movie: Location and Camera.
23. Post Production and Editing.
24. Movie Review: Feedback and Analysis

List of Reference:

1. Interpersonal Communication, Peter Hartley, Routledge, 1993.
2. Workplace Vagabonds: Career and Community in Changing Worlds of Work, Christina Garsten, Palgrave Macmillan, 2008.
3. Transnational Business Cultures Life and Work in a Multinational Corporation, Fiona Moore, Ashgate, 2005.
4. Global Business Etiquette: A Guide to International Communication and Customs, Jeanette S. Martin and Lillian H. Chaney, Praeger Publishers, 2006.
5. Making Teams Work: 24 Lessons for Working Together Successfully, Michael Maginn, McGraw-Hill, 2004.
6. Corporate Communications: Convention, Complexity, and Critique, Lars Thøger Christensen, Mette Morsing and George Cheney, SAGE Publications Ltd., 2008.
7. The Business Meetings Sourcebook: A Practical Guide to Better Meetings and Shared Decision Making, Eli Mina, AMACOM, 2002.
8. Moving Images: Making Movies, Understanding Media, Carl Casinghino, Delmar, 2011.

SYLLABUS

OF

B.TECH FIFTH SEMESTER COURSES

Course Name: Electrical Machines - II
Course Code: EE 501
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Knowledge of Physics up to B. Tech. 1st year Physics-I course and Electrical Machines – I.

Course Outcome: On completion of the course students will be able to

- **CO1.** Demonstrate the applications of synchronous machine and fractional kW motors based on different types of requirement.
- **CO2.** Understand the principle of operation and know performance of synchronous machine and fractional kW motors.
- **CO3.** Illustrate different tests on electrical machine and determine the performance machines.

Course Content

MODULE – I: Synchronous Machines (21L)

Construction of 3-phase Synchronous Machines, Description of salient & non-salient rotor, Advantages of Stationary armature and Rotating field system, Name plate rating. 1L
Methods of excitation systems: Static excitation, Brushless excitation, DC generator. 1L
Armature reaction at various p.f, concept of Synchronous reactance. 2L
Phasor diagrams of alternator at lagging, leading and unity p.f. loads. 1L
Voltage regulation of alternator by synchronous impedance method, Solution of problems. 2L
Open circuit characteristics, Short circuit characteristics of alternator and determination of synchronous reactance. 1L
Theory for salient pole machine, Two reaction theory, phasor diagram at different loads. 2L
Power angle characteristics of Synchronous machines, Solution of problems. 1L
Short circuit ratio (SCR) – concept and significance. 1L
Method of control of Active & Reactive Power of an alternator. 1L
Reasons and advantages of Parallel operation. 1L
Synchronization of two or more alternators: Three lamps method, Synchroscope. 1L
Parallel operation of (i) an alternator and infinite bus and (ii) Between two alternators and Load sharing between them. Solution of problems. 2L
Methods of starting of Three-Phase Synchronous Motor: by auxiliary motor and Damper winding. 1L
Effect of variation of excitation at infinite bus (over and under excitation) – V curves and inverted Vcurves. 1L
Hunting and its prevention. 1L
Applications of synchronous motor, Synchronous condenser. 1L

MODULE – II: Single-Phase Induction Motor (11L)

Construction, Concept of Pulsating Torque, Double-revolving field theory. 2L
Development of equivalent circuit, Determination of equivalent circuit parameters, Solution of problems. 2L
Methods of starting using auxiliary winding, Selection of capacitor value during starting and running, Solution of problems. 2L
Speed-Torque characteristics, Phasor diagram, Condition of Maximum torque. 2L
Constructional features and performance characteristics of Universal Series Motors, Compensated

and uncompensated motors. 2L
Testing of Single phase motors and Applications. 1L

MODULE – III: Special Machines (4L)

Principle and construction of switched Reluctance motor, Permanent magnet machines, Brushless DC machines, Hysteresis motor, Stepper Motor. 2L
Construction and Operational characteristics of Induction generator and Linear Induction motor. 2L

Text Books:

1. Electrical Machines, Nagrath & Kothary, TMH
2. The performance and design of Alternating Current machines, M. G. Say, C.B.S Publishers & Distributors
3. Electrical Machinery, P.S. Bhimra, Khanna Publishers.
4. Electrical Machines, Ashfaq Husain, Dhanpat Rai & Co.
5. Electrical Machines, S.K.Bhattacharya, T.M.H Publishing Co. Ltd.

Reference Books:

1. Electrical Machines, Theory & Applications, M.N. Bandyopadhyay, PHI
2. Electrical Technology, H.Cotton, C.B.S. Publisher New Delhi
3. Electric Machinery & Transformes, Irving L. Kosow, PHI
4. Electric Machinery, A.E.Fitzgerald, Charles Kingsley, Jr. & Stephen D. Umans, 6th Edition, Tata McGraw Hill Edition.
5. Problems in Electrical Engineering, Parker smith, 9th Edition, CBS publishers & distributors.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	3	-	-	2	-	-	-	-	-	-	-	-

Course Name: Power System - I
Course Code: EE 502
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Concepts of basic electrical engineering, circuit theory and electrical machine.

Course Outcome: On completion of the course students will be able to

- **CO1.** Understand the concept of power system, know various power system components and define associated terms.
- **CO2.** Know different type of power generation.
- **CO3.** Understand basic performances of power system.

Course Content

Module 1: Basic Concept of Electrical Supply System 1L
Structure of Power system, basic idea of transmission, distribution, tie lines, Grid networks etc.

Module 2: Generation of Electric Power 3L
General layout of a typical coal fired power station, Hydroelectric power station, and Nuclear power station, their components and working principles, comparison of different methods of power generation, Introduction to Solar and Wind energy system.

Module 3: Mechanical Design of Overhead Transmission Line 6L
Design of Conductors, Line supports: Towers, Poles, Insulators: Types, Voltage distribution across a suspension insulator string, String efficiency, Arching shield and rings, Methods of improving voltage distribution across Insulator strings, Electrical tests on line Insulators Sag, Tension and Clearance, Effect of Wind and Ice on Sag, Stringing Chart Dampers.

Module 4: Electrical Design of Overhead Transmission Line 8L
Choice of frequency, Choice of voltage, Types of conductors, Inductance and Capacitance of a single phase and three phases‟ symmetrical and unsymmetrical configurations. Bundle conductors. Transposition. Concept of GMD and GMR. Influence of Earth on conductor capacitance.

Module 5: Corona 3L
Principle of Corona formation, Critical disruptive voltage, Visual critical corona discharge potential, Corona loss, advantages & disadvantages of Corona. Methods of reduction of Corona.

Module 6: Cables 5L
Types of cables, cable components, capacitance of single core and 3 core cables, dielectric stress, optimum cable thickness, grading, dielectric loss and loss angle.

Module 7: Performance of Lines 8L
Short, medium (nominal π, T) and long lines and their representation. ABCD constants, Voltage regulation, Ferranti effect, Power equations and line compensation, Power Circle diagrams.

Module 8: Tariff 2L
Introduction of Economics of power. Guiding principle of Tariff, different types of tariff. Indian Electricity Rule-1956 and 2003: General Introduction.

Text Books:

1. Electrical Power System, Subir Roy, Prentice Hall
2. Power System Engineering, Nagrath & Kothery, TMH
3. Elements of Power System Analysis, C.L. Wadhwa, New Age International.
4. Electrical Power System, Ashfaq Hussain, CBS Publishers & Distributors
5. Principles of Power System, V.K.Mehta and Rohit Mehta, S.Chand.

Reference Books:

1. Electric Power Transmission & Distribution, S.Sivanagaraju, S.Satyanarayana, Pearson Education.
2. A Text book on Power system Engineering, Soni, Gupta, Bhatnagar & Chakrabarti, Dhanpat Rai & Co.
3. Power System Protection and Switchgear, Badri Ram, TMH
4. Electric Power Distribution System Engineering, 2nd Edition, T. Gonen, CRC Press.
5. www.powermin.nic.in/acts_notification/pdf/ier1956.pdf

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	1
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-

Course Name: Control System - I
Course Code: EE 503
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Concept of Basic Electrical Engineering, Circuit Theory and Engineering Mathematics.

Course Outcome: On completion of the course students will be able to

- **CO1.** Get knowledge of basic structure of control systems, define basic terminologies, components.
- **CO2.** Modelling physical systems using transfer function to analyse system dynamic and steady state behaviour.
- **CO3.** Understand the concept of feedback system and controllers, design compensators in frequency domain.

Course Content

Module 1: Introduction to Control System **2L**
Concept of feedback and Automatic control, Types and examples of feedback control systems, Definition of transfer function .Poles and Zeroes of a transfer function.

Module 2: Mathematical Modelling of Dynamic Systems **6L**
Writing differential equations and determining transfer function of model of various physical systems including - Translational & Rotational mechanical systems, Basic Electrical systems and transfer function, Liquid level systems, Electrical analogy of Spring – Mass Dashpot system. Block diagram representation of control systems. Block diagram algebra. Signal flow graph. Mason‟s gain formula.

Module 3: Control System Components **2L**
Potentiometer, Synchros, Resolvers, Position encoders. DC and AC tachogenerators, Actuators.

Module 4: Time Domain Analysis **8L**
Time domain analysis of a standard second order closed loop system. Determination of time-domain specifications of systems. Step and Impulse response of first and second order systems. Stability by pole location. Routh-Hurwitz criteria and applications. Control Actions: Basic concepts of PI, PD and PID control, Steady-state error and error constants.

Module 5: Stability Analysis by Root Locus Method **4L**
Root locus techniques, construction of Root Loci for simple systems. Effects of gain on the movement of Pole and Zeros.

Module 6: Frequency Domain Analysis of Linear System **8L**
Bode plots, Polar plots, Nichols chart, Concept of resonance frequency of peak magnification. Nyquist criteria and Nyquist plots, measure of relative stability, phase and gain margin. Determination of margins in Bode plot.

Module 7: Control System Performance **4L**
Improvement of system performance through compensation, Lead, Lag and Lead-Lag compensation.

Module 8: Case-studies **4L**

Block diagram level description of feedback control systems for position control, speed control of DC motors, temperature control, liquid level control, voltage control of an Alternator.

Numerical problems to be solved in the tutorial classes.

Text Books:

1. Modern Control Engineering, K. Ogata, 4th Edition, Pearson Education.
2. Control System Engineering, I. J. Nagrath & M. Gopal. New Age International Publication.
3. Control System Engineering, D. Roy Choudhury, PHI
4. Automatic Control Systems, B.C. Kuo & F. Golnaraghi, 8th Edition, PHI

Reference Books:

1. Control Engineering Theory & Practice, Bandyopadhyaya, PHI
2. Control systems, K.R. Varmah, Mc Graw Hill
3. Control System Engineering, Norman Nise, 5th Edition, John Wiley & Sons
4. Modern Control System, R.C. Dorf & R.H. Bishop, 11th Edition, Pearson Education.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1

Course Name: Data Structure
Course Code: EE 504A
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites:
1. Familiarity with the fundamentals of C or other programming language.
2. A solid background in mathematics, including probability, set theory.

Course Outcome: On completion of the course students will be able to
- **CO1.** Differentiate how the choices of data structure and algorithm methods impact the performance of program.
- **CO2.** Solve problems based upon different data structure and also write programs.
- **CO3.** Identify appropriate data structure and algorithmic methods in solving problem.
- **CO4.** Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing.
- **CO5.** Compare and contrast the benefits of dynamic and static data structures implementations.

Course Content

Module I: Linear Data Structure **10L**

Introduction: ***2L***

Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type.
Algorithms and programs, basic idea of pseudo-code. 1L
Algorithm efficiency and analysis, time and space analysis of algorithms – order notations. 1L

Array: ***2L***

Different representations – row major, column major. 1L
Sparse matrix - its implementation and usage, Array representation of polynomials. 1L

Linked List: ***6L***

Singly linked list – operations, Doubly linked list – operations. 4L
Circular linked list – operations, Linked list representation of polynomial and applications. 2L

Module II: Linear Data Structure **6L**

Stack and Queue: ***4L***

Stack and its implementations (using array and linked list) 1L
Applications (infix to Postfix, Postfix Evaluation) 1L
Queue, circular queue, de-queue 1L
Implementation of queue- linear and circular (using array and linked list) 1L

Recursion: ***2L***

Principles of recursion - use of stack, tail recursion. 1L
Applications - The Tower of Hanoi 1L

Module III: Nonlinear Data structures **12L**

Trees: ***8L***

Basic terminologies, forest, tree representation (using array and linked list) 1L
Binary trees - binary tree traversal (pre-, in-, post- order) 1L
Threaded binary tree 1L
Binary search tree- operations (creation, insertion, deletion, searching) 1L
Concept of Max-Heap and Min-Heap (creation, deletion) 1L
Height balanced binary tree – AVL tree (insertion with examples only) 1L

Height balanced binary tree – AVL tree (deletion with examples only) 1L
m –Way Search Tree, B Tree – operations (insertion, deletion with examples only) 1L
Graphs: ***4L***
Graph theory review 1L
Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) - concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, and forward-edge) 2L
Minimal spanning tree – Prim‟s algorithm, Kruskal‟s algorithm (basic idea of greedy methods) 1L

Module IV: Searching, Sorting **8L**
Sorting Algorithms: ***4L***
Bubble sort, Insertion sort, Selection sort – with notion of complexity 1L
Quick sort, Merge sort – with complexity 2L
Radix sort – with complexity 1L
Searching: ***2L***
Sequential search – with complexity 1L
Binary search, Interpolation Search– with complexity 1L
Hashing: ***2L***
Introduction to Hashing and Hashing functions 1L
Collision resolution techniques 1L

Text Books:

1. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPB Publications.
2. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2nd Edition, Universities Press.

Reference Books:

1. Data Structures, Algorithms, and Software Principles in C by Thomas A. Standish, 1st Edition, Pearson.
2. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited.
3. Data Structures and Program Design In C by Robert L. Kruse, Bruce P. Leung 2nd Edition, Pearson.
4. Data Structures in C by Aaron M. Tenenbaum, 1st Edition, Pearson.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2	2	3	3	3	2	3
CO2	3	2	2	2	2	2	3	2	2	3	3	2
CO3	3	3	3	2	3	3	3	2	2	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3

Course Name: Computer Network
Course Code: EE 504B
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites:

1. Familiarity and knowledge of Operating Systems and Computer Architecture
2. Also require little bit programming languages concepts like C, Java

Course Outcome: On completion of the course students will be able to

CO1. Understand OSI and TCP/IP models.
CO2. Analyze MAC layer protocols and LAN technologies.
CO3. Design applications using internet protocols.
CO4. Implement routing and congestion control algorithms.
CO5. Develop application layer protocols and understand socket programming.

Course Content

Module I: Introduction **6L**

Introduction: Computer Network, data communication, topology, OSI and TCP/IP Reference Models, layers and characteristics, Wireless Network, comparison to wired and wireless network. 3L

Physical Layer: Overview of data (analog and digital), signal (analog and digital), transmission (analog and digital) and transmission media (guided and unguided); Circuit switching: time division and space division switch, TDM bus; Telephone Network. 3L

Module II: Data Link Layer **10L**

Framing, Error Control, Error Detection and Correction, Flow Control, Data Link Protocols, Simple Stop-and-Wait Protocol, ARQ mechanism, Sliding Window Protocols, One-Bit Sliding Window Protocol, Go-Back-N and Selective Repeat, HDLC, PPP Medium Access Control Sub-layer, The Channel Allocation. 5L

Multiple Access Protocols **:** ALOHA, Carrier Sense Multiple Access Protocols, IEEE 802.x Ethernet, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet, Wireless LANs - IEEE 802.xx , Bluetooth, RFID, Bridges, Virtual LANs, Switching. 5L

Module III: Network Layer **10L**

IP Addressing, IPv_4 and IPv_6. Difference IPv_4 and $IPv_{6,\ Conversion}$ of IPv_4 and IPv_6 , Subnetting, Supernetting, Design Issues, Store-and-Forward Packet Switching, Virtual-Circuit and Datagram Networks, ARP, IP, ICMP, IPV6, BOOTP and DHCP–Delivery protocols Other Protocols such as mobile IP in wireless Network. 5L

Routing: Shortest Path Algorithms, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Anycast Routing, : RIP, OSPF, BGP; Routing for Mobile Hosts. 5L

Module IV: Transport layer **6L**

Process to Process delivery; UDP; TCP, SCTP, TCP RENO, TCP/IP in Wireless environment, Congestion control in TCP :Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm. 5L

Advanced topic such as Remote Procedure Call, Delay Tolerant Networks. 1L

Module V: Application Layer **3L**

Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW: Cryptography (Public, Private Key based), Digital Signature, Firewalls

Module VI: Socket Programming **1L**

Introduction to Socket Programming, UDP socket and TCP Socket

Text Books:

1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH
2. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
3. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP

Recommended Books:

1. Kurose and Rose – " Computer Networking -A top down approach featuring the internet" – Pearson Education
2. Leon, Garica, Widjaja – "Communication Networks" – TMH
3. Walrand – "Communication Networks" – TMH.
4. Comer – "Internetworking with TCP/IP, vol. 1, 2, 3 (4th Ed.)" – Pearson Education/PHI

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	2	-	-	-	-	2	-	-	-
CO2	-	2	-	-	-	-	-	-	2	-	-	-
CO3	2	2	-	-	2	-	-	-	2	-	-	-
CO4	2	2	-	-	2	2	-	-	2	-	-	-
CO5	3	3	-	-	3	-	-	-	2	-	-	-

Course Name: Internet of Things
Course Code: EE 504C
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Fundamental knowledge in computer networking and wireless sensor network.

Course Outcome: On completion of the course students will be able

- **CO1.** To understand the concepts of Internet of Things.
- **CO2.** To analyze basic protocols in wireless sensor network.
- **CO3.** To design IoT applications in different domain and be able to analyze their performance.
- **CO4.** To implement basic IoT applications on embedded platform.

Course Content

Module I: Fundamental of IoT **7L**

The Internet of Things , Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Design challenges, Development challenges, Security challenges, Other challenges.

Module II: IoT and M2M **7L**

A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module III: Wireless Sensor Network **6L**

Network and Communication aspects, Wireless medium access issues, MAC protocol , routing protocols, Sensor deployment and Node discovery, Data aggregation and dissemination.

Module IV: IoT Architecture **7L**

Introduction, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Module V: IoT Applications for Value Creations **5L**

Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, Real-time monitoring and control of processes - Deploying smart machines, smart sensors, and smart controllers with proprietary communication and internet technologies, Maximize safety, security and reliability through high precision automation and control, Advanced Metering Infrastructure (AMI), Smart Inverters, Remote control operation of energy consuming devices.

Module VI: Internet of Things Privacy, Security and Governance 4L

Introduction, Overview of Governance, Privacy and Security Issues, Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in smart cities, Security.

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

Reference Books:

1. Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493-9357-1
2. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice".

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	1	-	-	-	-	2
CO2	3	3	2	2	2	1	1	-	-	-	-	2
CO3	3	2	3	2	3	3	3	-	1	2	2	2
CO4	3	2	3	1	3	3	3	-	1	2	2	2

Course Name: Electrical Energy Conservation and Auditing
Course Code: EE 505A
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Electrical Machines and Power Systems.

Course Outcome:

- **CO1.** Identify the demand supply gap of energy in Indian scenario.
- **CO2.** Carry out energy audit of an industry/Organization.
- **CO3.** Draw the energy flow diagram of an industry and identify the energy wasted or a waste stream.
- **CO4.** Select appropriate energy conservation method to reduce the wastage of energy.
- **CO5.** Evaluate the techno economic feasibility of the energy conservation technique adopted.

Course Content

Module 1: **5L**

Energy Conservation and Environment: Electricity Act 2003, Integrated Energy Policy. Energy and environment, Air pollution, Climate change, United Nations Framework Convention on climate change (UNFCCC), Montreal Protocol, Kyoto Protocol, Clean Development Mechanism (CDM), CDM methodology and Procedures, Sustainable development.

Module 2: **9L**

Electrical Systems: Supply and Demand Side, Economic operation, Input-Output curves, Load profiling, Electricity tariff types;
Energy auditing: Necessity of Energy audit, Types of energy audit, Energy audit instruments and intervals of EA regulation. Energy Conservation Act-2001 and its features, Notification Under the act, Designated agencies, Schemes of Bureau of Energy Efficiency (BEE);
Energy Economics: Economic assessment and Economic methods for specific energy analysis.

Module 3: **6L**

Electric motors: Energy efficient controls and starting efficiency-Motor Efficiency and Load Analysis- Energy efficient /high efficient Motors-Case study; Load Matching and selection of motors.
Variable speed drives; Pumps and Fans-Efficient Control strategies- Optimal selection and sizing – Optimal operation and Storage; Case study

Module 4: **7L**

Electrical Demand Side: Transformer Loading/Efficiency analysis, Feeder/cable loss evaluation, case study. Reactive Power management-Capacitor Sizing-Degree of Compensation, Peak Demand controls-Methodologies-Types of Industrial loads-Optimal Load scheduling-case study; Lighting-Energy efficient light sources-Energy conservation in Lighting Schemes- Electronic ballast-Power quality issues-Luminaries, case study;

Module 5: **9L**

Cogeneration: Types and Schemes;
Electric loads and Energy conservation measures: Air conditioning and Refrigeration, Cold storage-Types-Optimal operation-case study; Electric water heating-Geysers-Solar Water Heaters-

Power Consumption in Compressors, Energy conservation measures; Electrolytic Process;
Computer Controls: Hardware, Software-EMS.

Text Books:

1. Leon K. Kirchmayer, "Economic Operation of power system", Wiley India Pvt Ltd, July 2010.
2. Jean-Claude SabonnadiAre, "Low emission power generation technologies and energy management", John Wiley & Sons, August 2010.
3. Ursula Eicker, "Low energy cooling for sustainable buildings", John Wiley & Sons, August 2010
4. Timothy J. E. Miller, "Reactive power control in electric systems", Wiley edition, August 2010
5. Paul C. Crause, Oleg Wasynczuk, Scott D.sudhoff, "Analysis of electric machinery and drive system", Wiley 2nd Edition, August 2010.
6. Albert Thumann, P.W. "Plant Engineers and Managers Guide to Energy Conservation" TWI Press Inc, Terre Haute, 9th edition, 2008
7. Francois, Leveque, "Transport pricing of electricity networks", Springer 2003.
8. Parasiliti F., P. Bertoldi, "Energy Efficiency in motor driven systems", Springer, 2003.

Reference Books:

1. Turner, Wayne C., "Energy Management Handbook", Lilburn, The Fairmont Press, 2001
2. Donald R. W., "Energy Efficiency Manual", Energy Institute Press,2000
3. Giovanni Petrecca, ".Industrial Energy Management: Principles and Applications", The Kluwer international series -207, 1999 Springer 2000.
4. Anthony J. Pansini, Kenneth D. Smalling, "Guide to Electric Load Management", Pennwell Pub,1998
5. Albert Thumann , "Handbook of Energy Audits", Fairmont Pr; 5th edition,1998
6. Howard E. Jordan, "Energy-Efficient Electric Motors and Their Applications", Plenum Pub Corp; 2nd edition 1994
7. Petrecca, Giovanni, "Industrial Energy Management", Springer 1993
8. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities", IEEE Inc, USA.,1985
9. NESCAP-Guide Book on Promotion of Sustainable Energy Consumption.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	-
CO3	-	-	2	-	1	-	-	-	-	-	-	-
CO4	-	-	2	2	-	-	-	-	-	-	-	-
CO5	2	1	2	-	1	-	-	-	-	-	-	-

Course Name: Electromagnetic Waves
Course Code: EE 505B
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Concept of Physics, Mathematics and Basic Electrical Engineering.

Course Outcome:

- **CO1.** Understand the propagation of EM waves associated with different Electrical Networks.
- **CO2.** Apply Maxwell,,s equations to solutions of problems relating to transmission lines and uniform plane wave propagation.
- **CO3.** Analyze the nature of electromagnetic wave propagation in guided medium which are used in microwave applications.
- **CO4.** Apply concepts of Antenna Engineering and its applications.

Course Content

Module 1: Electromagnetic Waves 6L
Maxwell‟s equations, Wave equation, Wave propagation in lossy dielectric, Plane waves in loss less dielectric, Plane wave in free space, Plane wave in good conductor, Skin effect, Skin depth, Power and Poynting vector, Reflection of a plane wave at normal incidence, reflection of a plane wave at oblique incidence, Polarisation. Solution of problems.

Module 2: Transmission Lines 4L
Concept of lumped and distributed parameters, Line parameters, Transmission line equation and solutions, Physical significance of solutions, Propagation constants, Characteristic impedance, Wavelength, Velocity of propagation. Solution of problems

Module 3: Waveguides 3L
Parallel planes waveguides, Rectangular waveguides, Circular waveguides, Power transmission in waveguides, Dielectric slab waveguides, Application of waveguides.

Module 4: Antenna Parameters and Characteristics 5L
Antenna Concepts, Antenna Characteristic; Hertzian dipole (Radiation Fields, Radiation Resistance, Radiation patterns, Directive Gain); Properties and typical applications of Half-wave dipole, Yagi-Uda array, Array Antennas.

Module 5: Radio Wave Propagation 3L
Different modes of propagation, Tilt, Sky wave propagation, MOF maximum Ustable frequency, Skip distance, Critical frequency, Virtual height.

Module 6: Space Wave Propagation 3L
Space wave propagation, Modified refractive index, Diffraction, Anomalous propagation, Duct propagation, Tropospheic propagation.

Text Books:

1. Quantum Field Theory, Lewis H. Ryder, 2nd Edition, Cambridge University Press.
2. Elements of Electromagnetic, Mathew N.O. Sadiku, 4th edition, Oxford University press.
3. Engineering Electromagnetic, W.H. Hyat & J.A. Buck, 7th Edition, TMH
4. Theory and problems of Electromagnetic, Edminister, 2nd Edition, TMH

5. Electromagnetic field theory fundamentals, Guru & Hizroglu, 2nd edition, Cambridge University Press.
6. Elements of Electromagnetic Fields, S.P. Seth, Dhanpat Rai & Sons

Reference Books:

1. Electromagnetic with application, Krause, 5th Edition, TMH.
2. Elements of Engineering Electromagnetic, N.N. Rao, 6th Edition, Pearson Education.
3. Electromagnetic Theory & Applications, A. K. Saxena, Narosa Publishing House Pvt. Ltd.
4. Electromagnetic Waves and Transmission Lines- by G.Prasad, J.Prasad and J.Reddy-Scitech.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-

Course Name: Illumination Engineering
Course Code: EE 505C
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Concept of Physics, Basic Electrical Engineering.

Course Outcome:

- **CO1.** Analyse the fundamentals of illumination and its measurements with different apparatus.
- **CO2.** Explain the characteristics of various types of lamp with their accessories and their control circuits.
- **CO3.** Demonstrate the interior and exterior lighting.

Course Content

Module 1: Fundamentals of Light 5L
Types of illumination, Theory of gas discharge and production of light, Perception of light and colour, Radiation of energy, Electromagnetic radiation and Electromagnetic spectrum, Human eye as an optical system, Spectral sensitivity of human eye, Visual characteristics and Visual performance.

Module 2: Measurement of Light 7L
Definition of luminous flux, Luminous intensity, Lumen, Candle power, Illumination, M.H.C.P, M.S.C.P, M.H.S.C.P, Lamp efficiency, Brightness or luminance, Photometry – Fundamentals of detector, Application of Polar Photometer and Goniophotometer, Calculation of luminance and illumination, Luxmeter, CIE standard source of illuminant, Colorimetry –Source colour and Object colour. Colorimetric instrument, Colour rendering index.

Module 3: Lamp, Accessories and Luminaries 9L
Lamp materials – glass, filament, phosphor coating, ceramics, electrodes, gases, capping cement etc., Theory and basic properties of low and high pressure gas discharge. Theory of operation, Life, Characteristics and Application of - High and Low pressure sodium vapour, High and Low pressure mercury vapour, Metal halide, Fluorescent lamp, LED, LASER, Luminaire – Types of luminaire, Design consideration, Indian standard recommendation.

Module 4: Illumination Control and Control circuits 6L
Purpose of lighting control in view of energy conservation, Operation of Electromagnetic and Electronic ballast and their comparison in light control, Function of Ignitor in lamps, Control circuits and operation of Fluorescent lamp circuit, Low pressure sodium vapour lamp circuit, High pressure sodium vapour lamp circuit.

Module 5: Interior Lighting 6L
National standards of interior lighting calculation, Design considerations for interior lighting of Residential complex, Commercial complex, Industrial premises, Day lighting – Sky luminance pattern, Daylight factor, estimation of average daylight factor, window design considerations for maximum day lighting, Application of daylight in interior lighting, Use of photocell, occupancy sensor in lighting controls, Concept of Isolux contour in lighting design.

Module 6: Exterior Lighting **3L**

Lighting calculations of exterior lighting, Calculation of lighting and design considerations for exterior lighting of Road lighting, Flood lighting, Industrial complex, Commercial complex, Sports complex, National and CIE standards of exterior lighting calculation.

Text Books:

1. Generation, Distribution and Utilization of Electrical Energy, C.L. Wadha, New Age International Ltd.
2. Applied Illumination Engineering, Jack L. Lindsey, The Fairmont Press Inc.
3. Art and Science of Utilization of Electrical Energy, H. Partab, Dhanpat Rai & Sons.
4. Standard Hand Book for Electrical Engineers, Fink & Beaty, McGraw Hill International.

Reference Books:

1. Utilization of Electric Power, C.L. Wadha, New Age International Ltd.
2. Handbook of Applied Photometry, Casimer M Decusatis, Springer.
3. Light Engineering: Applied calculations, R.H. Simons, Robert Bean, Architectural Press.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	2	3	2	-	-	-	3	3
CO2	3	2	1	3	3	3	-	-	-	-	3	3
CO3	3	1	2	-	3	3	-	-	-	-	3	3

Course Name: Power Plant Engineering
Course Code: EE 505D
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Concept of Energy Conversion.

Course Outcome:

- **CO1.** Understand the principles of operation for different power plants.
- **CO2.** Understand the economics of operation for different power plants.
- **CO3.** Analyse the interconnection between different power plants.

Course Content

Module 1: Basics of Power Generation 2L
Importance of electrical power in daily life, Different forms of energy, Comparison of different energy sources, Power crisis in India and Future Trend, Overview of method of electrical power generation.

Module 2: Coal Based Thermal Power Plants 8L
List of thermal power stations in the state with their capacities, basic Rankine cycle and its modifications, Selection of site for thermal power stations, Layout of modern coal power plant, Quality of fuel and its effect on quality of power generation, Operation of different components – Super critical boilers, FBC boilers, Economizer, Air pre heater, Super-heaters and re-heaters, Steam turbines, Condensers, Spray ponds and cooling towers, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems, Merits and demerits of Thermal Power Plants.

Module 3: Nuclear Power Stations 6L
Basics of nuclear energy conversion, Selection of site for Nuclear Power plants, Block diagram and working of Nuclear Power station, Fuels used in Nuclear Power Station, 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, Merits and demerits of Nuclear Power Plants, List of Nuclear power stations in state and county with their capacities.

Module 4: Hydro Power Stations 5L
Selection of site and classification of Hydroelectric Power Plants, Layout and working of Hydro Power Station, Types of Turbines and generators used, Pumped storage Power Plant, Merits and demerits of Hydro Power Station, List of Hydro Power stations with their capacities and number of units in the state.

Module 5: Gas Turbine Power Plants 3L
Selection of site for Gas Turbine Power Station, Fuels for gas turbine, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems, Merits, demerits and application Gas turbine power plants.

Module 6: Diesel Electric Power Stations 3L
Selection of site for Diesel Electric Power Station, Elements of diesel Electric power plants and

their working, Operation, maintenance & trouble shooting, chart of diesel Electric plant, Merits, demerits and applications of diesel electric power stations, Performance and thermal efficiency of Diesel Electric Power Plant.

Module 7: Non-Conventional Energy Sources 3L

Principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

Module 8: Economics of Power Generation 3L

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, firm power, cold reserve, hot reserve, spinning reserve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Module 9: Interconnected Power Systems 3L

Advantages of Interconnection, Base load and peak loads, load allocation among various types of power stations, Load sharing and transfer of load between power stations, Inter connection of power stations at state and national level.

Text Books:

1. P.K. Nag – Power plant Engineering, Tata McGraw – Hill.
2. T. C. Elliot, K. Chen and R. C. Swanekamp, Power Plant Engineering, 2nd ed., McGraw Hill, 1998.
3. M. M. El Wakil, Power Plant Technology, Tata McGraw Hill, 2010.
4. Arora and Domkundwar – A course in Power plant Engineering, Dhanpat Rai & Sons.

Reference Books:

1. Godfrey Boyle, Renewable Energy, Oxford University Press.
2. Soni, Gupta and Bhatnagar, A course in Electrical Power, Dhanpatrai & Sons.
3. Dr. S. L. Uppal, Electrical Power, Khanna Publishers.
4. Umesh Rathore, Energy Management, S.K.Katharia & Sons
5. K.K. Ramalingam, Power Plant Engineering, Scitech Publication (India) Pvt. Ltd.
6. S P Sukhatme, Solar Energy, Tata McGrawhill Publishing co. Ltd.
7. A.K.Raja, M. Dwibedi and A.P.Srivastava, Introduction to Non-conventional Energy sources, Scitech Publication (India) Pvt. Ltd.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	3
CO2	3	-	3	-	-	-	-	-	-	-	2	-
CO3	2	-	3	-	-	-	2	-	-	-	2	-

Course Name: Electrical Machines – II Laboratory
Course Code: EE 591
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites: Concepts of Electrical Machine.

Course Outcomes: After successful completion of this course, student will be able to

CO1. Perform different tests on Three-Phase A.C. Generators, Synchronous Motors and Single-Phase Induction Motor.

CO2. Interpret the observed result using theoretical knowledge and hence calculate unknown parameters.

List of Experiment (At least *ten* experiments to be performed):

1. To observe the effect of excitation and speed on induced e.m.f of a three-phase alternator and plot the O.C.C. of the alternator.
2. Determination of regulation of Synchronous machine by
   a) Potier reactance method.
   b) Synchronous Impedance method.
3. To determine the direct axis resistance [X_d] and quadrature reactance [X_q] of a 3-phase synchronous machine by slip test.
4. Parallel operation of three-phase Synchronous generators.
5. V-curve of Synchronous motor.
6. Determination of equivalent circuit parameters of a single-phase Induction motor.
7. Load test on single-phase Induction motor to obtain the performance characteristics.
8. To study the performance of Three-Phase Induction generator.
9. To study the effect of capacitor on the starting and running condition of a Single-Phase Induction motor and to determine the method of reversing the direction of rotation.
10. Innovative Experiments.

N.B.: Experiment No. 2(a) and 2(b) may be considered as separate experiment.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	3	-	-	-	-	3	2	-	-
CO2	2	-	-	3	-	-	-	-	3	2	-	-

Course Name: Power System – I Laboratory
Course Code: EE 592
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites: Concepts of Power System.

Course Outcomes: After successful completion of this course, student will be able to

- **CO1.** Able to estimate performance of Transmission Line and Distribution line.
- **CO2.** Able to select line support for a particular Transmission Line.
- **CO3.** Able to explain methods of active and reactive power control.
- **CO4.** Able to test the reliability of different components of Transmission Line and Distribution Line.

List of Experiment:

1. Draw the Schematic diagram of structure of power system and power transmission line and Symbol of Electrical Equipment.
2. Simulation of DC distribution by network analyzer.
3. Measurement of earth resistance by earth tester.
4. Dielectric strength test of insulating oil, solid Insulating Material.
5. Different parameter calculation by power circle diagram.
6. Study of different types of insulator.
7. Determination of the generalized constants A, B, C, D of long transmission line.
8. Active and reactive power control of alternator.
9. Study and analysis of an electrical transmission line circuit with the help of software.
10. Dielectric constant, tan delta, resistivity test of transformer oil.
11. Any Innovative experiment according to knowledge of power System – I.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	3	-	-	-	-	3	2	-	-
CO2	2	-	-	3	-	-	-	-	3	2	-	-
CO3	2	-	-	3	-	-	-	-	3	2	-	-
CO4	2	-	-	3	-	-	-	-	3	2	-	-

Course Name: Control System – I Laboratory
Course Code: EE 593
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites: Concept of Simulation Software and Control System.

Course Outcomes: After successful completion of this course, student will be able to

CO1. Simulate, analyze system behaviour using software simulator/hardware.
CO2. Design compensators, controllers to meet desired performance of system.

List of Experiment:

1. Familiarization with MATLAB control system tool box, MATLAB simulink tool box and PSPICE.
2. Determination of Step response for first order and Second order system with unity feedback on CRO and calculation of control system specification like Time constant, % peak overshoot, settling time etc. from the response.
3. Simulation of Step response and Impulse response for Type-0, Type-1 and Type-2 system with unity feedback using MATLAB and PSPICE.
4. Determination of Root locus, Bode plot, Nyquist plot using MATLAB control system tool box for 2^{nd} order system and determination of different control system specification from the plot.
5. Determination of PI, PD and PID controller action of first order simulated process.
6. Determination of approximate transfer functions experimentally from Bode plot.
7. Evaluation of steady state error, setting time, percentage peak overshoot, gain margin, phase margin with addition of Lead.

Reference Books:

1. MATLAB and Simulink for Engineers, Agam Kumar Tyagt, Oxford.
2. Modeling and Simulation Using MATLAB - Similink, Dr. S. Jain, Wiley India.
3. MATLAB and Its Application in Engineering, Raj K Bansal, A.K. Goel and M.K. Sharma, Pearson.
4. MATLAB programming for Engineers, S.J. Chapman, 3^{rd} Edition, Cengage.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	3	-	-	-	-	3	2	-	-
CO2	2	-	-	3	-	-	-	-	3	2	-	-

Course Name: Data Structure Laboratory
Course Code: EE 594A
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites: Computer Fundamentals and Principal of Computer Programming Laboratory.

Course Outcomes: After successful completion of this course, student will be able to

- **CO1.** Choose appropriate data structure as applied to specified problem definition.
- **CO2.** Handle operations like searching, insertion, deletion, traversing mechanism on various data structures.
- **CO3.** Have practical knowledge on the applications of data structures.
- **CO4.** Able to store, manipulate and arrange data in an efficient manner.
- **CO5.** Able to implement queue and stack using arrays and linked list. Implementation of queue, binary tree and binary search tree.

List of Experiment:

1. Write a C program to implement Single Link List.
2. Write a C program to implement Double Link List.
3. Write a C program to implement Single Circular Link List.
4. Write a C program to implement Double Circular Link List.
5. Write a C program to implement Polynomial addition and Polynomial multiplication using Linked List.
6. Write a C program to convert a given infix expression into its postfix Equivalent.
7. Write C programs to implement a queue ADT using i) array and ii) doubly linked list respectively.
8. Write a C program to implement Binary Search Tree (BST).
9. Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order:
   a) Insertion sort
   b) Merge sort
10. Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order:
    a) Quick sort
    b) Selection sort
11. Write C programs for implementing the following searching methods:
    a) Linear Search
    b) Binary Search

    Write a C program to implement all the functions of a dictionary (ADT) using hashing.
12. Write C programs for implementing the following graph traversal algorithms:
    a) Depth first search
    b) Breadth first search

Text Books:

1. Data Structures using C, R. Thareja, 2nd Edition, Oxford University Press.
2. Data Structures Using C E. Balagurusamy, Mcgraw Hill

Reference Books:

1. Data Structures in C by Aaron M. Tenenbaum, 1st Edition, Pearson
2. Data Structures Through „C‟ Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPB Publications

3. Data structures using C, A.K.Sharma, 2nd Edition, Pearson
4. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2nd Edition, Universities Press

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	1	1	-	1	-	-
CO2	3	2	2	-	2	2	1	-	-	1	-	2
CO3	2	1	1	-	-	-	-	1	-	-	-	-
CO4	3	2	-	2	-	1	1	-	1	-	1	-
CO5	1	-	2	1	2	-	-	1	1	-	1	2

Course Name: Computer Network Laboratory
Course Code: EE 594B
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites:

1. Familiarity and knowledge of Computer Network and Computer Architecture
2. Also require strong knowledge of programming languages like C, Java and UNIX or Linux environment.

Course Outcomes: After successful completion of this course, student will be able to

- **CO1.** Demonstrate the socket program using TCP and UDP.
- **CO2.** Develop simple applications using TCP and UDP.
- **CO3.** Develop the code for Data link layer protocol simulation.
- **CO4.** Examine the performances of Routing protocol.
- **CO5.** Experiment with congestion control algorithm using network simulator.

List of Experiment:

1. Familiarization of UNIX or Linux environment, UNIX or Linux general Commands specially Network Commands. Familiarization of Internetworking - Network Cables - Color coding - Crimping. Internetworking Operating Systems - Configurations. 6L
2. Socket Programming using TCP and UDP. 18L
3. Implementing routing protocols such as RIP, OSPF. 2L
4. Familiarization of advanced simulators like Packet Tracer, NS2/NS3, OMNET++, TinyOS. 4L
5. Server Configuration: only web server (If time permit..instructor can do more than that). 6L

Text Books:

1. TCP sockets in C programs-Practical guide for Programmers By Micheal J Donahoo and Kenneth L Calvert.
2. Socket Programming by Rajkumar Buyaa.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	2	1	-	3	2	2	3
CO2	3	3	3	2	3	3	2	3	3	2	2	3
CO3	3	3	3	2	2	1	2	1	3	2	2	3
CO4	3	3	3	1	2	2	1	3	3	2	2	3
CO5	3	3	3	2	2	2	1	2	3	2	2	3

Course Name: Internet of Things Laboratory
Course Code: EE 594C
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites:
1. Fundamental knowledge in computer networking and wireless sensor network.
2. Basic Programming Knowledge.

Course Outcomes: After successful completion of this course, student will be able
- **CO1.** To understand the concepts of Internet of Things.
- **CO2.** To explain the IoT tools like Arduino Uno, Raspberry Pi.
- **CO3.** To design IoT applications in different domain and be able to analyze their performance.
- **CO4.** To implement basic IoT applications on embedded platform.

Major Equipment:
1. Raspberry pi.
2. Arduino.

List of Experiment:
1. Introduction to various sensors and various actuators and its Application. Perform experiment using Arduino Uno using following Ultrasonic Sensor: [9L]
   a) PIR Motion Sensor.
   b) Rain Drop Sensor.
   c) Moisture Sensor.
   d) Temperature Sensor.
   e) Touch Sensor.
   f) Infrared Sensor.
   g) Servo Moto.
   h) RFID Sensor.
   i) Bluetooth Module.
   j) Wi-Fi Module.
2. Getting Started with ESP8266 Wi-Fi SoC and hands on. [6L]
3. Demonstrate NodeMCU and its working principal. [3L]
4. Create a circuit using Arduino and sensors. Perform experiment using Arduino Uno to Learn Working of Servo Motor. [6L]
5. Define and Explain Eclipse IoT Project, List and summarize few Eclipse IoT Projects. [3L]
6. Creating a webpage and display the values available through Arduino. [3L]
7. Demonstration of Setup & Working principal of Raspberry Pi. [6L]
8. Connect Raspberry Pi with your existing system components. [3L]

Text books:
1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

Reference books:
1. Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493-9357-1.

2. Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks: Theory and Practice”.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	1	--	--	--	--	2
CO2	3	3	2	2	2	1	1	--	--	--	--	2
CO3	3	2	3	2	3	3	3	--	1	2	2	2
CO4	3	2	3	1	3	3	3	--	1	2	2	2

Course Name: Constitution of India
Course Code: MC 501
Contact: 3L:0T:0P

Prerequisites:NA.

Course Outcome:

- **CO1.** Develop human values, create awareness about law ratification and significance of Constitution.
- **CO2.** Comprehend the Fundamental Rights and Fundamental Duties of the Indian Citizen to implant morality, social values and their social responsibilities.
- **CO3.** Create understanding of their Surroundings, Society, Social problems and their suitable solutions.
- **CO4.** Familiarize with distribution of powers and functions of Local Self Government.
- **CO5.** Realize the National Emergency, Financial Emergency and their impact on Economy of the country.

Course Content

1. Meaning of the constitution law and constitutionalism 2L
2. Historical perspective of the Constitution of India 2L
3. Salient features and characteristics of the Constitution of India 1L
4. Scheme of the fundamental rights 2L
5. The scheme of the Fundamental Duties and its legal status 2L
6. The Directive Principles of State Policy – Its importance and implementation 2L
7. Federal structure and distribution of legislative and financial powers between the Union and the States 3L
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India 2L
9. Amendment of the Constitutional Powers and Procedure 2L
10. The historical perspectives of the constitutional amendments in India 2L
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency 3L
12. Local Self Government – Constitutional Scheme in India 3L
13. Scheme of the Fundamental Right to Equality 2L
14. Scheme of the Fundamental Right to certain Freedom under Article 19 2L
15. Scope of the Right to Life and Personal Liberty under Article 21. 2L

Text Books:

1. Introduction to Constitution of India, D.D. Basu, Lexis Nexus
2. The Constitution of India, PM Bhakshi, Universal Law

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	2	3	-	-	-	2
CO2	-	-	-	-	-	3	2	3	-	-	-	2
CO3	-	-	-	-	-	3	2	3	-	1	-	2
CO4	-	-	-	-	-	3	2	3	-	1	-	2
CO5	-	-	-	-	-	3	2	3	-	1	-	2

SYLLABUS

OF

B.TECH SIXTH SEMESTER COURSES

Course Name: Microprocessor and Microcontroller
Course Code: EE 601
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Knowledge in Digital Electronics.

Course Outcome:

- **CO1.** Able to correlate the architecture, instructions, timing diagrams, addressing modes, memory interfacing, interrupts, data communication of 8085.
- **CO2.** Able to interpret the 8086 microprocessor-Architecture, Pin details, memory segmentation, addressing modes, basic instructions, interrupts.
- **CO3.** Recognize 8051 micro controller hardware, input/output pins, ports, external memory, counters and timers, instruction set, addressing modes, serial data i/o, interrupts.
- **CO4.** Apply instructions for assembly language programs of 8085, 8086 and 8051.
- **CO5.** Design peripheral interfacing model using IC 8255, 8253, 8251 with IC 8085, 8086 and 8051.

Course Content

Module 1: 8085 Microprocessor [6]
Introduction to Microcomputer based system, Evolution of Microprocessor and microcontrollers and their advantages and disadvantages, Architecture of 8085 Microprocessor, Address / Data Bus multiplexing and demultiplexing, Status and Control signal generation, Instruction set of 8085 Microprocessor, Classification of instructions, addressing modes, timing diagram of the instructions, Memory interfacing , IO interfacing, ADC / DAC interfacing, Stack and Subroutine, Delay Calculation, Interrupts of 8085 processor, classification of interrupts, Serial and parallel data transfer – Basic concept of serial I/O, DMA, Asynchronous and synchronous serial transmission using SID and SOD pins of 8085.

Module 2: Assembly language programming with 8085 [2]
Addition, Subtraction, Multiplication, Block Transfer, ascending order, descending order, Finding largest & smallest number, Look-up table etc. Programming using interrupts (programming using INTR is not required).

Module 3: 8086 Microprocessor [8]
8086 Architecture, Pin details, memory segmentation, addressing modes, Familiarization of basic Instructions, Interrupts & Direct Memory Access, Memory interfacing, ADC / DAC interfacing.

Module 4: Assembly language programming with 8086 [3]
Addition, Subtraction, Multiplication, Block, Transfer, ascending order, descending order, Finding largest & smallest number etc.

Module 5: 8051 Microcontroller [7]
8051 architecture, hardware, input/output pins, ports, internal and external memory, counters and timers, instruction set, addressing modes, serial data i/o, interrupts, Memory interfacing, ADC / DAC interfacing.

Module 6: Assembly language Programming using 8051 [4]

Moving data: External data moves, code memory read only data moves, PUSH and POP opcodes, data exchanges; Logical operations: Byte-level, bit-level, rotate and swap operations; Arithmetic operations: Flags, incrementing and decrementing, addition, subtraction, multiplication and division, decimal arithmetic; Jump and call instructions: Jump and call program range, jumps, calls and subroutines, interrupts and returns.

Module 7: Support IC chips [6]

8255, 8253 and 8251: Block Diagram, Pin Details, Modes of operation, control word(s) format. Interfacing of support IC chips with 8085, 8086 and 8051.

Text Books:

1. Microprocessor architecture, programming and application with 8085 – R. Gaonkar, Penram International
2. The 8051 microcontroller - K. Ayala, Thomson
3. Microprocessors & interfacing – D. V. Hall, Tata McGraw-hill
4. Ray & Bhurchandi, Advanced Microprocessors & Peripherals, TMH
5. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley, Pearson
6. An Introduction to Microprocessor and Applications –Krishna Kant,Macmillan

Reference Books:

1. Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan, Oxford university press
2. 8086 Microprocessor –K Ayala, Cengage learning
3. The 8051 microcontrollers – Uma Rao and Andhe Pallavi, Pearson

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	3	1	1	1	1	1	1	3
CO2	3	3	3	1	3	1	1	1	1	1	1	3
CO3	3	3	3	3	3	2	2	1	1	1	2	3
CO4	3	3	3	3	3	2	2	1	1	2	1	3
CO5	3	3	3	3	3	1	2	1	2	2	2	3

Course Name: Power System – II
Course Code: EE 602
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Basic Electrical Engineering, Circuit Theory, Electrical Machines – II, Power System – I.

Course Outcome: On successful completion of the course, the learner will be able to

- **CO1.** Learn about advance structure of Power System.
- **CO2.** Get depth knowledge of different types of power system protection, fault, stability analysis and load flow method.
- **CO3.** Design and analysis of different types of substation and implement these ideas in industry or real life problem solve.

Course Content

MODULE – I: Representation of Power System Components [4L]
Single-phase representation of balanced three phase networks, the one-line diagram and the Impedance or reactance diagram, per unit (PU) system.
Distribution substation: Types of substations, location of substations, substation equipments and accessories, Earthling (system and equipment), feeder and distributors, radial and loop systems.

MODULE – II: Basic Idea of Real and Reactive Power Control [2L]
Introduction to Real and Reactive Power Control (SMIB)Single machine connected to Infinite Bus.

MODULE – III: Load Flow Studies [7L]
Network model formulation, formation of Ybus, load flow problem, Gauss-Siedel method, Newton-Raphson method, Decoupled load flow studies with flowchart, comparison of load flow methods.

MODULE – IV: Power System Stability [4L]
Steady state stability, transient stability, equal area criteria, swing equation, multi machine Stability concept, Introductory idea of Voltage Stability and Voltage Collapsed.

MODULE – V: Faults in Electrical Systems [7L]
Transient on a transmission line, short circuit of a synchronous machine under no load and Loaded condition. Symmetrical component transformation, sequence impedance and sequence network of power system, synchronous machine, transmission lines and transformers. Symmetrical component analysis of unsymmetrical faults, L-G fault, L-L fault, L-L-G fault.

MODULE – VI: Power System Protection [12L]
i) Operating Principles and Relay Constructions: 6L
Functions of Protective Relaying, different terminologies used in protective relaying, Basic Operation of Relay, Electromagnetic Attraction Relays (Plunger Type, Hinged Armature Type, Balanced Beam Type, Polarized Moving Iron Type), Advantages and Disadvantages, Applications of Electromagnetic Attraction Relays, Electromagnetic Induction Type Relays, Theory of Induction Relay Torque, Induction Type Over Current Relay (Non-Directional), Induction Type Directional Power Relay, Directional Over Current Relay, Distance Relay (Impedance Relays, Reactance Relay, MHO Relay), Differential Relay (Current Differential Relay, Voltage Balance Differential Relay) Translay Relay, Directional Relay (Single Phase Directional Relays), Negative Sequence

Relays, Under Frequency Relays, Over Current Relays, Static Relays (Transductor Relays, Rectifier Bridge Relays, Transistors Relays, Hall Effect Relays, Gauss Effect Relays). Over Current Relays (Static Time Over Current Relays, Directional Static Over Current Relay), Static Differential Relay, Static Distance Relays, Microprocessor Based Relays, Universal Relay Torque Equations, Protection Scheme for Transformer, Generators and Motors, Bus Zone Protection, Protection of Transmission Lines, C.T.s and P.T.s and their applications in the protective schemes. Static Relays and Numerical Protections.

ii) Construction and operating principle of circuit Breaker: 6L

Brief description of Circuit Breakers, Operating principle of Circuit Breaker, Arc Phenomenon, Principles of Arc Extinction, Methods of Arc Extinction, Voltage Breaking Transients, Transient Recovery Voltage, Current Chopping and Resistance Switching, Circuit Breaker Rating, Arc and Arc Extinction, Circuit Breaker Types, Oil Circuit Breaker, Vacuum Circuit Breaker, Air Blast Circuit Breaker, SF_6 Circuit Breaker and Operating Mechanism, Advantages and Disadvantages of Different Types of Circuit Breakers. Testing of Circuit Breakers.

Text Books:

1. Electrical Power System, Subir Roy, Prentice Hall
2. Power System Engineering, Nagrath & Kothary, TMH
3. Elements of power system analysis, C.L. Wodhwa, New Age International.
4. Electrical Power System, Ashfaq Hussain, CBS Publishers & Distributors
5. Principles of Power System, V.K. Mehta and Rohit Mehta, S.Chand.
6. A Course in Power Systems, J.B. Gupta, S.K. Kataria & Sons.

Reference Books:

1. Electric Power transmission & Distribution, S.Sivanagaraju, S.Satyanarayana, Pearson Education.
2. A Text book on Power system Engineering, Soni, Gupta, Bhatnagar & Chakrabarti, Dhanpat Rai & Co.
3. Power System Protection and Switchgear, Badri Ram, TMH
4. Electric Power distribution system Engineering, 2nd Edition, T. Gonen, CRC Press.
5. www.powermin.nic.in/acts_notification/pdf/ier1956.pdf

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	3	-	-	-	-	-	-	-	1
CO2	-	3	2	3	-	-	-	-	-	-	-	1
CO3	3	-	2	-	-	2	-	-	-	-	-	1

Course Name: Control System – II
Course Code: EE 603
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Any introductory course on Matrix Algebra, Calculus, Engineering Mechanics.

Course Outcome:

- **CO1.** Express and Solve system equations in state-variable form (state variable models).
- **CO2.** Students will be able to analyze and design of discrete time control systems using z transform.
- **CO3.** Students will be able to examine the stability of nonlinear systems using appropriate methods.

Course Content

MODULE – I: State Variable Model of Continuous Dynamic Systems [13L]
Converting higher order linear differential equations into state variable form. Obtaining SV model from transfer functions. Obtaining characteristic equation and transfer functions from SV model. Obtaining SV equations directly for R-L-C and spring-mass-dashpot systems. Concept and properties associated with state equations. Linear Transformations on state variables. Canonical forms of SV equations. Companion forms. Solutions of state equations, state transition matrix, properties of state transition matrix. Controllability and observability. Linear State variable feedback controller, the pole allocation problems. Linear system design by state variable feedback.

MODULE – II: Analysis of Discrete Time (Sampled Data) Systems Using Z-Transform [10L]
Difference Equations. Inverse Z transform. Stability and damping in z-domain. Practical sampled data systems and computer control. Practical and theoretical samplers. Sampling as Impulse modulation. Sampled spectra and aliasing. Anti-aliasing filters. Zero order hold. Approximation of discrete (Z domain) controllers with ZOH by Tustin transform and other methods. State variable analysis of sampled data system. Digital compensator design using frequency response.

MODULE – III: Introduction to Non-Linear Systems [13L]
Block diagram and state variable representations. Characteristics of common nonlinearities. Phase plane analysis of linear and non-linear second order systems. Methods of obtaining phase plane trajectories by graphical method – isoclines method. Qualitative analysis of simple control systems by phase plane methods. Describing Function method. Limit cycles in non-linear systems. Prediction of limit cycles using describing function.Stability concepts for nonlinear systems. BIBO vs. State stability. Lyapunov's definition. Asymptotic stability, Global asymptotic stability. The first and second methods of Lyapunov methods to analyze nonlinear systems.

Text Books:

1. Gopal M : Digital Control and State Variable Methods, 2e, – TMH
2. Roy Choudhuri, D., Control System Engineering, PHI
3. Nagrath I J & Gopal M : Control Systems Engg. - New Age International
4. Anand,D.K, Zmood, R.B., Introduction to Control Systems 3e, (Butterworth-Heinemann), Asian Books

Reference Books:

1. Goodwin, Control System Design, Pearson Education
2. Bandyopadhyaya, Control Engg. Theory and Practice, PHI
3. Kuo B.C. : Digital Control System, Oxford University Press.
4. Houpis, C.H, Digital Control Systems, McGraw Hill International.
5. Ogata, K., Discrete Time Control Systems, Prentice Hall, 1995
6. Jury E.I. : Sampled Data Control System- John Wiley & Sons Inc.
7. Umez-Eronini, Eronini., System Dynamics and Control, Thomson
8. Dorf R.C. & Bishop R H. Modern Control System- Pearson Education.
9. Ramakalyan, Control Engineering, Vikas
10. Natarajan A/Reddy, Control Systems Engg., Scitech
11. Lyshevski, Control System Theory with Engineering Applications, Jaico
12. Gibson J E : Nonlinear Control System - McGraw Hill Book Co.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	1	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1

Course Name: Data Base Management System
Course Code: EE 604A
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites:
1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Outcome: On completion of the course students will be able to
- **CO1.** Apply the knowledge of Entity Relationship (E-R) diagram for an application.
- **CO2.** Create a normalized relational database model.
- **CO3.** Analyze real world queries to generate reports from it.
- **CO4.** Determine whether the transaction satisfies the ACID properties.
- **CO5.** Create and maintain the database of an organization.

Course Content

Module 1: Introduction [3L]
Concept and Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.

Module 2: Entity-Relationship and Relational Database Model [11L]
Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features, case study on E-R Model. Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications of the Database.

Module 3: SQL and Integrity Constraints [6L]
Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.

Module 4: Relational Database Design [8L]
Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF , Case Study

Module 5: Internals of RDBMS [9L]
Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols; two phase locking, Dead Lock handling

Module 6: File Organization and Index Structures [6L]
File and Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes

Text Books:
1. Henry F. Korth and Silberschatz Abraham, –Database System Concepts‖, Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, –Fundamentals of Database Systems‖, Benjamin

Cummings Publishing Company.
3. Ramakrishnan: Database Management System , McGraw-Hill
4. Gray Jim and Reuter Address, –Transaction Processing : Concepts and Techniques‖, Moragan Kauffman Publishers.
5. Ullman JD., –Principles of Database Systems‖, Galgottia Publication.

Reference Books:

1. Jain: Advanced Database Management System CyberTech
2. Date C. J., –Introduction to Database Management‖, Vol. I, II, III, Addison Wesley.
3. –Fundamentals of Database Systems‖, Ramez Elmasri, Shamkant B.Navathe, Addison Wesley Publishing Edition
4. –Database Management Systems‖, Arun K.Majumdar, Pritimay Bhattacharya, Tata McGraw Hill

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	2	1	1	2	2	3	3
CO2	2	3	3	3	3	1	1	1	2	2	3	3
CO3	3	3	2	3	3	2	2	2	3	3	3	3
CO4	3	3	2	2	2	1	1	1	1	1	2	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3

Course Name: Embedded Systems
Course Code: EE 604B
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Concept of Digital Electronics, Microprocessor and Microcontrollers.

Course Outcome:

- **CO1.** To familiarize with concepts related to the fundamental principles embedded systems design, explain the process and apply it.
- **CO2.** To understand knowledge of the advanced Embedded technology both for hardware and software.
- **CO3.** To understand Hardware/Software design techniques for microcontroller-based embedded systems and apply techniques in design problems.
- **CO4.** To develop Embedded System programming in C and assembly language using Integrated Development Environments and using debugging technique.

Course Content

Module I: Introduction to Embedded System [12L]
Basics of Embedded computer Systems, Microprocessor and Microcontroller difference, Hardware architecture and software components of embedded system List of various applications [Mobile phones, RFID, WISENET, Robotics, Biomedical Applications, Brain machine interface etc.], Difference between embedded computer systems and general-purpose computer Systems. Characteristics of embedded systems, Classifications of embedded system.

Module II: Hardware Software Co-Design [16L]
Co-Design Types: Microprocessors/Microcontrollers/DSP based Design, FPGA/ASIC/pSOC based Design, Hybrid Design. Methodology: i) System specifications; ii) co-specifications of hardware and software; iii) System Design Languages (capturing the specification in a single Description); iv) System modelling/simulation; v) Partitioning (optimizing hardware/software partition); vi) Co-verification (simulation interaction between custom hardware and processor) f) Co-implementation; vii) Embedded Systems Design development cycle. Programming concepts and embedded programming in C.

Module III: Real Time Operating System (RTOS) [8L]
Introduction, Types, Process Management, Memory Management, Interrupt in RTOS, Task scheduling, Basic design using RTOS; Basic idea of Hardware and Software testing in Embedded Systems

Text Books:

1. Embedded system Design: Peter Marwedel, Springer
2. Embedded Systems - Raj Kamal
3. Embedded Systems - K. Shibu

Reference Books:

1. M. A. Mazidi, J. G. Mazidi and R. D. McKinlay, ―The8051 Microcontroller and Embedded Systems: Using Assembly and C‖, Pearson Education, 2007.
2. R. Kamal, ―Embedded System‖, McGraw Hill Education, 2009.
3. K. J. Ayala, ―8051 Microcontroller‖, Delmar Cengage Learning, 2004.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	1	-	-	-	1	1	-	1
CO2	3	2	2	-	-	-	-	1	2	1	-	1
CO3	3	2	1	2	1	1	-	-	2	1	-	-
CO4	3	2	2	1	1	1	-	1	2	1	-	1

Course Name: Software Engineering
Course Code: EE 604C
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites:
1. An understanding of basic computer software.
2. Object Oriented programming skills.

Course Outcome: On completion of the course students will be able to

CO1. Understand the structure and behaviour a software system the UML class diagrams and state diagrams.

CO2. Understand common lifecycle processes including waterfall (linear), incremental approaches (such as Unified process), and agile approaches.

CO3. Apply software testing and quality assurance techniques at the module level, and understand these techniques at the system and organization level.

CO4. Work collaboratively in a small team environment to develop a moderate-sized software system from conceptualization to completion, including requirements elicitation, system modelling, system design, implementation, unit and system testing, integration, source code management configuration management, and release management.

CO5. Prepare technical documentations and make presentations on various aspects of a software development project, including the technical aspects (architecture, design, quality assurance) as well as the managerial aspects (planning, scheduling, and delivery).

Course Content

Module I: Introduction **3L**

Definition of SE, Software crisis, Evolution of technology- Hype curve, Exploratory style of Software development vs SE, Human cognition mechanism, SE principle- abstraction and decomposition.

Module II: Software life-cycle models **4L**

Water fall model, V Model, Prototyping Model, Spiral Model, RAD Agile Model.

Module III: Software Project Management **10L**

Responsibility of a project manager, Project planning, Metrics for project size estimation, Project estimation techniques, COCOMO model, Halstead's Software Science, Scheduling- CPM, PERT, Gantt chart, Risk management, Software configuration management, Staffing and team leader project and planning.

Module IV: Requirement analysis and specification **4L**

SRS, Requirement gathering and specification, Functional requirement, Traceability, 4GL.

Module V: Software Design **7L**

Characteristics of a good software, Cohesion and coupling, Function oriented design- DFD, Structure chart. Object oriented design- class and relationship, Design phase in life cycle, System Design Definitions, Concept and methodologies, data flow oriented Design, Program Design and the requirements

Module VI: Coding and Testing **10L**

Coding Standard, software documentation, Testing- unit testing, black box testing- equivalence class partitioning, boundary value analysis, white box testing- McCabe's Cyclomatic Complexity, Mutation Testing, Debugging, Program analysis tool, Integration Testing, Grey box testing, System testing- Smoke and performance testing.

Module VII: Software Reliability and Quality Management **5L**

Reliability, Hazard, MTTF, Repair and Availability, Software quality, SEI CMM and ISO-9001. Software reliability and fault-tolerance, Six sigma

Module VIII: Computer-aided software engineering (CASE) **4L**

Environment and benefit, Function point methods (FSM, ISO, OMG) & Metrics. Standards: Capability Maturity Model Integration, ISO 9001.

Text Books:

1. Rajib Mall: Software Engineering, PHI
2. Roger S. Pressman, –Software Engineering – A Practitioner's Approach‖, Seventh Edition, McGraw-Hill International Edition.

Reference Books:

1. Ian Sommerville, –Software Engineering‖, 9th Edition, Pearson Education Asia, 2011.
2. Pankaj Jalote, –Software Engineering, A Precise Approach‖, Wiley India, 2010.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	1	1	-	-	-	-	-	3
CO2	3	3	-	3	-	-	2	-	1	2	2	3
CO3	3	3	2	3	3	2	-	-	-	3	3	3
CO4	3	3	1	2	-	-	-	-	2	-	2	3
CO5	3	3	-	1	2	-	1	-	-	1	3	3

Course Name: Digital Signal Processing
Course Code: EE 605A
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites:

Prerequisites for Digital signal Processing are required a thorough understanding of various signals, systems, and the methods to process a digital signal and also the knowledge of arithmetic of complex numbers and a good grasp of elementary calculus. The questions reflect the kinds of calculations that routinely appear in Signals. The candidates are expected to have a basic understanding of discrete mathematical structures.

The candidates required the concept of Z-transform, Relation between Fourier transform and Z transform, Properties of ROC and properties of Z transform, Initial value theorem and final value theorem, stability considerations for LTI systems using Z-transform, Perseval's relation, Inverse Z-transform by Residue method, power series & partial-fraction expansions.

Course Outcome:

- **CO1.** Able to define discrete systems in the Frequency domain using Fourier analysis tools like DFT, FFT.
- **CO2.** Able to interpret the properties of discrete time signals in time domain and frequency domain.
- **CO3.** Able to describe finite word length effects and digital filters.
- **CO4.** Able to analyse convolution for long sequences of data.
- **CO5.** Able to implement digital filters.

Course Content

MODULE – I: Discrete-time Signals and Systems 6L

i) Discrete-time signals:

Concept of discrete-time signal, basic idea of sampling and reconstruction of signal, sampling theorem, sequences,-periodic, energy, power, unit-sample, unit step, unit ramp and complex exponentials, arithmetic operations on sequences.

ii) LTI systems:

Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical and overlap-add methods to compute convolution supported with examples and exercise, properties of convolution, interconnection of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems.

MODULE – II: Z-Transforms 4L

Definition, mapping between s-plane and Z-plane, unit circle, convergence and ROC, properties of Z-transform, Z-transform on sequences with examples and exercises, characteristic families of signals along with ROC, convolution, correlation and multiplication using Z-transform, initial value theorem, Perseval's relation, inverse Z-transform by contour integration, power series and partial-fraction expansions with examples and exercises.

MODULE – III: Fourier Transforms 10L

i) Discrete Time Fourier Transform (DTFT):

Concept of frequency in discrete and continuous domain and their relationship (radian and radian/sec), freq. response in the discrete domain. Discrete system's response to sinusoidal/complex inputs (DTFT), Representation of LTI systems in complex frequency domain.

ii) Discrete Fourier Transform:

Concept and relations for DFT/IDFT, Relation between DTFT and DFT. Twiddle factors and their properties, computational burden on direct DFT, DFT/DFT as linear transformation, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circulation convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences Overlap-Save and Overlap-Add methods with examples and exercises.

iii) Fast Fourier Transforms:

Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithm, signal flow graph, Butterflies, computations in one place, bit reversal, examples for DIT and DIF FFT, Butterfly computations and exercises.

MODULE – IV: Filter Design 10L

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, Bandstop 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.

MODULE – V: Digital Signal Processor 6L

Elementary idea about the architecture and important instruction sets of TMS320C 5416/6713 processor, writing of small programs in assembly Language to measure A.C. and D.C. voltage, current, power and energy.

Text Books:

1. Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis & D.G.Manolakis, Pearson Ed.
2. Digital Signal Processing, S.Salivahanan, A.Vallabraj & C. Gnanapriya, TMH Publishing Co.
3. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).
4. Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co.

Reference Books:

1. Digital Signal Processing; Spectral Computation and Filter Design Chi-Tsong Chen, Oxford University Press
2. Texas Instruments DSP Processor user manuals and application notes.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	-	2	-	2	2	2	2	3
CO2	3	2	2	1	2	3	-	2	2	1	2	3
CO3	3	3	1	3	2	3	1	2	2	1	2	3
CO4	3	2	1	3	-	3	1	3	1	1	1	3
CO5	3	2	-	1	-	-	1	1	1	2	2	1

Course Name: High Voltage Engineering
Course Code: EE 605B
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Concept of Basic Physics, Measurement and Instrumentation, Fundamentals of Power System, Switchgear, Travelling waves.

Course Outcome: On completion of the course students will be able to

- **CO1.** Understand the basic physics associated with various breakdown processes in different insulating materials.
- **CO2.** Knowledge of generation and measurement of A. C., D.C.,Impulse voltages and currents.
- **CO3.** Knowledge of tests on H.V. equipment and on insulating materials, as per the standards.
- **CO4.** Knowledge of the causes of Overvoltages in power system and Insulation Coordination in a substation.

Course Content

MODULE – I: Breakdown Occurrences 13L

i) Breakdown of Gases:

Ionization processes and de-ionization processes, Types of Discharge, Charge multiplication, Secondary emission, Townsend's Theory, Streamer Mechanism, Paschen's Law, Gases as insulating materials, Determination of Minimum breakdown voltage, Breakdown in uniform and non-uniform gaps, Corona discharge.

ii) Breakdown of Liquid:

Breakdown in pure and commercial liquids, Cavitation Theory, Suspended Particle Theory.

iii) Break Down of Solids:

Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown, Streamer Breakdown.

iv) Partial Discharge:

Definition and development in solid dielectrics and composite dielectrics.

v) Breakdown in Vacuum:

Non-metallic electron emission mechanism, Clump mechanism, Effect of pressure on breakdown voltage.

MODULE – II: Generation of High Voltages and Currents 6L

i) Generation of High Alternating Voltages and Currents:

Testing transformer, Cascaded transformer, Series resonant circuit, single stage and multi stage. Advantages of Series Resonant Circuit in testing of cables.

ii) Generation of High D.C. Voltages and Currents.:

Cockcroft Walton doubler and multistage circuit, Electrostatic generator.

Definition of Impulse Voltage and current as per Indian Standard Specification, Wave front and wave tail time, Generation of Impulse Voltage, Multistage Impulse generator, tripping and control of impulse generators.

MODULE – III: Measurement of High Voltages and Currents 4L

Peak voltage, impulse voltage and high direct current measurement method as per Indian Standard Specifications, cathode ray oscillographs for impulse voltage and current measurement, Sphere gap voltmeter, Resistance and Capacitance Potential dividers, Peak voltmeters for measurement of high

A.C. voltage in conjunction with capacitance dividers. Capacitance Voltage Transformer, Rotating Voltmeter for the measurement of D.C. high voltage, partial discharge measurements, Electrostatic Voltmeter.

MODULE – IV: Lightning and Switching Over-voltages 8L

Lightning Phenomena, Charge formation in the Clouds, Development of Lightning Stroke, lightning induced over voltage, direct stroke, indirect stroke. Protection of Electrical Apparatus against over voltage, Lightning Arrestors, Valve Type, Metal Oxide arresters, Expulsion type. Effect of location of lightning arresters on protection of transformer. Protection of substation, Ground wires, Surge diverters, Surge absorbers, Insulation Coordination, Basic Insulation level. Basic Impulse level, Switching Impulse level. Volt time characteristics of protective devices, Determination of Basic Impulse level of substation equipment.

MODULE – V: High Voltage Testing of Electrical Apparatus and High Voltage Laboratories 5L

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, induced over voltage and impulse test on transformers, Power frequency dry and wet withstand test of insulators, Impulse test on insulators, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H.V. Laboratories.

Text Books:

1. High Voltage Engineering, C.L. Wadhwa, New Age International Publishers.
2. High Voltage Engineering, M.S. Naidu & V. Kamaraju, Tata McGraw Hill publication.
3. Extra High Voltage AC Transmission Engineering, R.D. Bgamudre, New Age Internal Publishers.
4. D. V. Razevig (Translated by Dr. M. P. Chourasia), ‒High Voltage Engineering Fundamentals‖, Khanna Publishers.

Reference Books:

1. High Voltage Engineering, M.A. Salem, H. Anis, A. E. Morahedy, R. Radwan, Marcel Dekker, Inc.
2. E. Kuffel, W. S. Zaengl and J. Kuffel, ‒High Voltage Engineering Fundamentals‖, Newnes Publication.
3. R. Arora and W. Mosch ‒High Voltage and Electrical Insulation Engineering‖, John Wiley & Sons.
4. Various IS standards for HV Laboratory Techniques and Testing.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	-	-	-	-	-	-	-	2	3
CO2	3	3	1	-	-	-	-	-	-	-	2	3
CO3	3	2	2	-	-	-	-	-	-	-	2	3
CO4	3	3	2	-	-	-	-	-	-	-	2	3

Course Name: Computer Architecture
Course Code: EE 605C
Contact: 3L:0T:0P
Total Contact Hours: 36
Credit: 3

Prerequisites: Digital Electronics and Computer Organization.

Course Outcome: On completion of the course students will be able to

- **CO1.** Learn pipelining concepts with a prior knowledge of stored program methods.
- **CO2.** Learn about memory hierarchy and mapping techniques.
- **CO3.** Study of parallel architecture and interconnection network.

Course Content

Module – 1: Introduction [5L]
Introduction to basic computer architecture. 1L
Stored Program Concepts: Von Neumann & Havard Architecture 1L
RISC VS CISC 1L
Amdahl's law. 1L
Performance Measure: MIPS, Benchman Programs (SPECINT,SPECFP). 1L

Module – 2: Pipelining [6L]
Pipelining: Basic concepts, Linear vs. Non Linear, Static vs. Dynamic, Unifunction vs. Multifunction. 2L
Instruction Pipeline. 1L
Arithmetic pipeline. 1L
Hazards: Data hazards, control hazards and structural hazards. 1L
Techniques for handling hazards. 1L

Module – 3: Instruction-level parallelism [4L]
Instruction-Level Parallelism: Basic Concepts 1L
Techniques For Increasing ILP, Superscalar, Super Pipelined 1L
VLIW Processor Architectures 1L
Array and Vector Processors 1L

Module – 4: Memory [5L]
Memory Hierarchy: Internal Memory, Main Memory, Cache Memory, Secondary memory. 2L
Mapping Technique in cache memory: Direct, Full Associative and Set Associative. 2L
Performance Implementation in Cache Memory. 1L

Module – 5: Multiprocessor Architecture [16L]
Introduction to Parallel Architecture-Different Classification scheme, Performance of Parallel Computers, PRAM model (EREW, CREW, CRCW) 6L
Interconnection Network (Omega, Baseline, Butterfly, Crossbar) 6L
Multi-Core Processor with case study (INTEL) 2L
Different Classification scheme: Serial Vs. Parallel, Pipeline vs. Parallel 2L

Text Books:

1. Patterson D.A. and Hennessy , J.L. ‐Computer architecture a quantitative approach‖, 2nd ed., Morgan Kaufman, 1996

2. Stone, H.S., –Advanced Computer‖, Addison Wesley, 1989
3. Siegel, H.J., –Interconnection Network for Large Scale parallel Processing‖, 2nd Ed., McGraw Hill, 1990

Reference Books:

1. Hwang & Briggs—Computer Architecture & Parallel Processing, TMH
2. Hayes J. P., –Computer Architecture & Organisation‖, McGraw Hill
3. Design and Analysis of Prallel Algorithm-Schim G. Akl

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	1	-	-	-	-	-	-	-	-
CO2	3	-	2	-	-	-	-	-	-	-	-	-
CO3	2	-	2	-	-	-	-	-	-	-	-	-

Course Name: Microprocessor and Microcontroller Laboratory
Course Code: EE 691
Contact: 0L:0T:2P
Credit: 1

Prerequisites: Knowledge in Digital Electronics.

Course Outcomes:

CO1. Able to handle arithmetic and Logical operations, using assembly language programming in 8085 & 8086 Trainer Kits.

CO2. Able to Program using arithmetic, logical and bit manipulation instructions of 8051.

CO3. Able to validate the interfacing technique of 8255 Trainer kit with 8085 & 8086 through Subroutine Call and IN/OUT instructions like glowing LEDs accordingly, to control stepper motor rotation, interfacing Seven Segment Display and to display a string etc.

CO4. Able to program and verify Timer/Counter and Interrupt handling in 8051.

List of Experiment:

Demonstration Programs for 8085 Trainer Kit

1. Familiarization with 8085 register level architecture, the basic instruction sets (data transfer, arithmetic, logical, branching) and the trainer kit components including the memory map.
2. Familiarization with the process of storing, executing and viewing the contents of memory as well as registers in the trainer kit 8085 and simulator through small assignments.
3. Programming using 8085 kit and simulator for: Addition, Subtraction, Multiplication by repeated addition method, Square, Complement, look up table, copying a block of memory, Shifting, Packing and unpacking of BCD numbers, Addition of BCD numbers, Binary to ASCII conversion.

Demonstration Programs for 8086 Trainer Kit

4. Addition, Subtraction, Multiplication & division of two 16-bit numbers using 8086 trainer kit
5. Factorial of two 16-bit numbers using 8086 trainer kit
6. Smallest and Largest number from an array of numbers, Ascending order, Descending Order, String Matching, Multiplication using shift and add method using 8086 trainer kit.

Interfacing with 8086

7. Interfacing Stepper motor with 8086 trainer kit using 8255
8. Interfacing Seven Segment Display using 8086 trainer kit and to display a string

Interfacing with 8051

9. Programming using arithmetic, logical and bit manipulation instructions of 8051
10. Program and verify Timer/Counter in 8051
11. Program and verify Interrupt handling in 8051

Additional Programs

12. Read a character from a keyboard and display it on Screen
13. Display a string on screen
14. To check for a Password

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	3	1	1	1	1	1	1	3
CO2	3	3	3	1	3	1	1	1	1	1	1	3
CO3	3	3	3	3	3	2	2	1	1	1	2	3
CO4	3	3	3	3	3	2	2	1	1	2	1	3

Course Name: Power System – II Laboratory
Course Code: EE 692
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites: Circuit Theory, Electrical Machines – I, Power System – I.

Course Outcomes: On completion of the course students will be able to

- **CO1.** Analyse the testing, operation and response of protection of electrical instruments.
- **CO2.** Conduct experimental investigation and gain knowledge of various parts of relays and its operation.
- **CO3.** Able to incorporate the measuring error with actual value and calibrate the instrument transformers.
- **CO4.** Enhance the capability of software analysis by load flow solution in ETAP, MATLAB etc.

List of Experiment:

1. Study on (i) on load Time Delay Relay (ii) off load Time Delay Relay
2. Polarity, Ratio and Magnetization Characteristics Test of CT & PT
3. Testing on (i) Under Voltage Relay and (ii) Earth Fault Relay
4. Study on D C Load Flow
5. Study of A C Load Flow Using Gauss – Seidel Method
6. Study of A C Load Flow Using Newton – Raphson Method
7. Study of IEEE 30, 66 bus Load Flow by Software Simulation (ETAP, MAT Lab or others)
8. Study on Economic Load Dispatch by software
9. Study of Transformer Protection by Simulation
10. Study of Generator Protection by Simulation
11. Study of Motor Protection by Micon Relay
12. Study of Different Characteristics of Over Current Relay.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	3	-	-	-	1	-	-	-	-	-	-
CO2	-	3	3	-	-	1	-	-	-	-	-	-
CO3	-	-	-	2	-	-	-	-	-	-	-	-
CO4	3	-	3	2	-	-	-	-	-	-	-	-

Course Name: Control System – II Laboratory
Course Code: EE 693
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites: Knowledge of MATLAB.

Course Outcomes: On completion of the course students will be able to

- **CO1.** Conduct experiments on Position Control with proper tuning of P, PI and PID controller.
- **CO2.** Demonstrate Lead-Lag Compensators.
- **CO3.** Investigate the response of a Real Time System using State Variable Analysis.
- **CO4.** Analyse Performance of Discrete-Time System an Non-Linear System.

List of Experiment:

1. **Study of a Practical Position Control System:**
   Obtaining closed step responses for gain setting corresponding to over-damped and under-damped responses. Determination of rise time and peak time using individualized components in SIMULINK. Determination of un-damped natural frequency and damping ratio from the experimental data.

2. **Tuning of P, PI and PID Controller for First Order Plant with Dead Time using Z-N Method:**
   Process parameters (time constant and delay/lag) will be provided, the students would compute controller gains by using Z-N method. Steady state and transient performance of the closed loop plant with and without steady disturbances will have to be noted. Theoretical phase and gain margins will have to be manually computed for each gain settings.

3. **Design of Lead and Lag Compensation Using Cacsad Tools**:
   Plant transfer function will be provided. Step response is to be obtained. (PSPICE, MATLAB, SciLab may be used).

4. **State Variable Analysis using Cacsad Command Tool:**
   Familiarization and use of CACSAD command for state variable analysis. Obtaining transfer function from SV model and vice versa. Obtaining step response for a SISO system given in SV form. (PSPICE, MATLAB, SciLab may be used).

5. **State Variable Analysis using Cacsad Block Diagram Tool:**
   Familiarization and use of CACSAD BLOCK DIAGRAM TOOL for state variable analysis. Obtaining step response and initial condition response for a single input, two output system given in SV form. (PSPICE, MATLAB, SciLab may be used).

6. **Performance Analysis of a Discrete Time System using Cacsad Tool:**
   Familiarization and use of CACSAD block diagram tool for Digital Control System. Study of closed response of a continuous system with a digital controller with sample and hold. (PSPICE, MATLAB, SciLab may be used).

7. **Studying The Effects of Nonlinearity in a Feedback Controlled System using Time Response:**

Determination of step response with a limiter nonlinearity introduced into the forward path of 2nd order unity feedback control systems. The open loop plant will have one pole at the origin and the other pole will be in LHP or RHP. To verify that (i) with open loop stable pole, the response is slowed down for larger amplitude input and (ii) for unstable plant, the closed loop system may become oscillatory with large input amplitude. (PSPICE, MATLAB, SciLab may be used).

8. **Studying The Effects of Nonlinearity in a Feedback Controlled System using Phase Plane Plots:**
   Determination of phase plane trajectory and possibility of limit cycle of common nonlinearities. CACSAD block diagram tool will be used (PSPICE, MATLAB, SciLab may be used).

Note: From the list of experiments a minimum of 7 (seven) experiments shall have to be performed by each student.

Reference Books:

1. Herniter, Programming in MATLAB, Vikas
2. Ogata K : Modern Control Engg. 4e, Pearson/PHI

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	-	-	2	1	3	3
CO2	3	3	2	3	2	1	-	-	2	-	1	2
CO3	3	3	3	3	3	2	-	-	2	-	1	2
CO4	3	3	2	3	3	2	-	-	2	2	3	3

Course Name: Data Base Management System Laboratory
Course Code: EE 694A
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites:
1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Outcomes: On completion of the course students will be able to

CO1. Understand the basic concepts regarding database, know about query processing and techniques involved in query optimization and understand the concepts of database transaction and related database facilities including concurrency control, backup and recovery.

CO2. Understand the introductory concepts of some advanced topics in data management like distributed databases, data warehousing, deductive databases and be aware of some advanced databases like partial multimedia and mobile databases.

CO3. Differentiate between DBMS and advanced DBMS and use of advanced database concepts and become proficient in creating database queries.

CO4. Analyse database system concepts and apply normalization to the database.

CO5. Apply and create different transaction processing and concurrency control applications.

List of Experiment:

A. Structured Query Language
   1. Creating Database
      a) Creating a Database
      b) Creating a Table Specifying Relational Data Types
      c) Specifying Constraints Creating Indexes
   2. Table and Record Handling
      a) INSERT statement
      b) Using SELECT and INSERT together
      c) DELETE, UPDATE, TRUNCATE statements
      d) DROP, ALTER statements
   3. Retrieving Data from a Database
      a) The SELECT statement
      b) Using the WHERE clause
      c) Using Logical Operators in the WHERE clause
      d) Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause Using Aggregate Functions
      e) Combining Tables Using JOINS
      f) Sub-queries
   4. Database Management
      a) Creating Views
      b) Creating Column Aliases
      c) Creating Database Users
      d) Using GRANT and REVOKE

B. PL/SQL

C. Database design using E-R model and Normalization

D. Design and implementation of some on line system [Library Management System]

Text Book:

1. SQL, PL/SQL by Ivan Bayross, BPB Publications
2. Oracle PL/SQL Programming, 6th Edition - O'Reilly Media By Steven Feuerstein, Bill Pribyl

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	2	1	1	2	2	3	3
CO2	2	3	3	3	3	1	1	1	2	2	3	3
CO3	3	3	2	3	3	2	2	2	3	3	3	3
CO4	3	3	2	2	2	1	1	1	1	1	2	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3

Course Name: Embedded Systems Laboratory
Course Code: EE 694B
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites: Concept of Digital Electronics Lab, Microprocessor and Microcontroller Lab.

Course Outcomes:

CO1. Familiarization with PIC Microcontroller, ARM Microcontroller, FPGA and their interfacing.

CO2. Design of different types real time projects with digital controllers.

List of Experiment:

1. **PIC based experiment (Any Five)**
   a) Familiarization of PIC kit.
   b) Interface and control a LED, LCD, Keyboard, ADC & DAC using PIC.
   c) Connect two PIC kit and transfer data serially.
   d) Design a Digital watch based on PIC.
   e) Control a stepper motor and display temperature from a temperature sensor on a LCD.
2. **ARM based experiment (Any Four)**
   a) Familiarization with ARM evaluation system
   b) Familiarization with Raspberry Pi
   c) Interfacing with a real time clock using a serial port to display time.
   d) Interface a Keyboard and display the keystrokes on a LCD, LED.
   e) Familiarization of image processing using ARM
3. **FPGA based experiment**
   a) Design a 3 to 8 decoder circuit.
   b) Design an UP/DOWN counter and display the count on a 7-segment display.
   c) Designing an ALU and verify with mathematical operations.
   d) Innovative Project.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	-	-	2	3
CO2	3	3	3	3	3	1	-	-	3	1	3	3

Course Name: Software Engineering Laboratory
Course Code: EE 694C
Contact: 0L:0T:3P
Credit: 1.5

Prerequisites: For Software Engineering Lab, design a project proposal which will be used throughout the lab for performing different experiments using CASE Tools.

Course Outcomes:

- **CO1.** To handle software development models through rational method.
- **CO2.** To prepare SRS document, design document, test cases and software configuration management and risk management related document.
- **CO3.** To Develop function oriented and object oriented software design using tools like rational rose.
- **CO4.** To perform unit testing and integration testing.
- **CO5.** To apply various white box and black box testing techniques.

Assignments to be given from the following:

1. Preparation of requirement document for standard application problems in standard format. (e.g. Library Management System, Railway Reservation system, Hospital management System, University Admission system) .DFD of standard application problems.
2. Project Schedule preparation. Software Requirement Analysis: Describe the individual Phases/ modules of the project, Identify deliverables.
3. Use Case diagram, Class Diagram, Sequence Diagram, Activity Diagram and prepare Software Design Document using tools like Rational Rose.(For standard application problems)
4. Software Development and Debugging. Estimation of project size using Function Point (FP) for calculation.
5. Design Test Script/Test Plan(both Black box and White Box approach)
6. Compute Process and Product Metrics (e.g Defect Density, Defect Age, Productivity, Cost etc.) Cost Estimation models. COCOMO

Recommended Books:

1. Software Engineering: Apractitioner's approach – Pressman (TMH)
2. Software Engineering – Pankaj Jalote (Wiley-India)

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	1	1	-	-	-	-	-	3
CO2	3	3	-	3	-	-	2	-	1	2	2	3
CO3	3	3	2	3	3	2	-	-	-	3	3	3
CO4	3	3	1	2	-	-	-	-	2	-	2	3
CO5	3	3	-	1	2	-	1	-	-	1	3	3

SYLLABUS OF

B.TECH SEVENTH SEMESTER COURSES

Paper Name: Electrical Drives
Paper Code: EE 701
Contact: 3L:0T:0P
Credit: 3

Prerequisites: Concept of Electrical Machines, and Power Electronics.

Course Outcome: After successful completion of the course students will be able to

- **CO1.** Analyse the characteristics of electric motors required for a particular drive.
- **CO2.** Describe different types of braking and speed-control of electric motors for various applications.
- **CO3.** Apply power electronic converters for various kinds of drive operations.

Course Content

Module – I: Fundamental Concept of Electric Drive 3L
Definition of electric drive, type of drives; Speed torque characteristic of driven unit/loads, motors, Concept of Multi-quadrant operation, Classification and components of load torque; Equivalent value of drive parameters for loads with rotational and translational motion.

Module – II: Electric Braking 3L
Electric Braking of DC motor during lowering of loads and stopping, Regenerative braking, AC and DC rheostatic braking.

Module – III: Selection of motor power rating 2L
Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating for continuous, short time and intermittent duty, Load equalization

Module – IV: DC Motor Drives 7L
Ward-Leonard System, Single phase and three phases controlled DC drives, Dual converter control of DC drives. Chopper controlled DC drives, Close loop control of DC drive.

Module – V: Induction Motor Drives 8L
Review of three phase Induction Motor analysis and performance, Stator voltage control, V/f controlled induction motors, Slip power recovery, CSI fed induction motor drives.

Module – VI: Synchronous Motor Drives 10L
Introduction, Sinusoidal SPM machine drives, synchronous reluctance machine drives, wound field synchronous motor drive, Load-commutated Synchronous Motor Drives, Model of PMSM.

Module – VII: Application and Energy conversion Drives 3L
Introduction to Battery Powered Drive for Solar System, Stepper motor Drive, Steel Mills, Paper Mills, Coal Mining, Energy Efficient operation and power factor improvement of drives.

Text Books:

1. G. K. Dubey, ‐Fundamentals of Electrical Drives‖, Narosa, 2001.
2. R. Krishnan, ‐Electric Motor Drives: Modeling, Analysis and Control‖, PHI-India, 2005.
3. N. K. De and P. K. Sen, ‐Electric Drives‖, Prentice Hall of India Private Limited, 2006.
4. S. K. Pillai, ―A First Course on Electrical Drives‖, New Age International.
5. S. B. Dewan, G. R. Slemon and A. Straughen, ‐Power Semiconductor Drives‖, John Wiley and Sons, New York 1984.

Reference Books:

1. G. K. Dubey, –Power Semiconductor Controlled Drives‖, Prentice Hall international, New Jersey, 1989.
2. B. K. Bose, –Modern Power Electronics and AC Drives‖, Pearson Education Asia, 2003.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	3	2	-	1	-	-	-	1	-	-	1
CO3	1	3	2	-	1	-	-	-	1	-	-	1

Paper Name: Object Oriented Programming using JAVA
Paper Code: EE 702A
Contact: 3L:0T:0P
Credit: 3

Prerequisites:
1. Computer Fundamentals.
2. Basic understanding of Computer Programming and related Programming Paradigms.
3. Problem Solving Techniques with proper logic Implementation.

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

CO1. Design the process of interaction between Objects, classes & methods w.r.t. Object Oriented Programming.

CO2. Acquire a basic knowledge of Object Orientation with different properties as well as different features of Java.

CO3. Analyze various activities of different string handling functions with various I/O operations.

CO4. Discuss basic code reusability feature w.r.t. Inheritance, Package and Interface.

CO5. Implement Exception handling, Multithreading and Applet (Web program in java) programming concept in Java.

Course Content

Module 1: Introduction **5L**

Object Oriented Analysis and Design-Concepts of object oriented programming language, Object, Class; Relationships among objects and classes-Generalization, Specialization, Aggregation, Association, Composition, links, Meta-class; Object Oriented Programming concepts - Difference between OOP and other conventional programming – advantages and disadvantages. Class, object, Method; Properties of OOP- message passing, inheritance, encapsulation, polymorphism, Data abstraction; Difference between different OOPs Languages.

Module 2: Java Basics **9L**

Basic concepts of java programming - Advantages of java, Byte-code and JVM, Data types, Different types of Variables; Access specifiers, Operators, Control statements and loops; Array; Creation of class, object, method; Constructor - Definition, Usage of Constructor, Different types of Constructor; finalize method and garbage collection, Method and Constructor overloading; this keyword, use of objects as parameter & methods returning objects; Call by value & call by reference; Static variables & methods. Nested & inner classes.

Module 3: Basic String handling & I/O **4L**

Basic string handling concepts- Concept of mutable and immutable string, Methods of String class- charAt(), compareTo(), equals(), equalsIgnoreCase(), indexOf(), length(), substring(); toCharArray(), toLowerCase(), toString(), toUpperCase() , trim() , valueOf() methods, Methods of String buffer class- append(), capacity(), charAt(), delete(), deleteCharAt(); ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString(); Command line arguments, basics of I/O operations – keyboard input using BufferedReader& Scanner classes.

Module 4: Inheritance and Java Packages **8L**

Inheritance - Definition, Advantages, Different types of inheritance and their implementation; Super and final keywords, super() method; Method overriding, Dynamic method dispatch; Abstract

classes and methods; Interface - Definition, Use of Interface; Multiple inheritance by using Interface; Java Packages - Definition, Creation of packages; Importing packages, member access for packages.

Module 5: Exception handling, Multithreading and Applet Programming 10L

Exception handling - Basics, different types of exception classes. Difference between Checked & Unchecked Exception; Try & catch related case studies; Throw, throws & finally; Creation of user defined exception; Multithreading - Basics, main thread, thread life cycle; Creation of multiple threads-yield(), suspend(), sleep(n), resume(), wait(), notify(), join(), isAlive(); Thread priorities, thread synchronization; Interthread communication, deadlocks for threads; Applet Programming - Basics, applet life cycle, difference between application & applet programming; Parameter passing in applets.

Text Books:

1. Herbert Schildt – "Java: The Complete Reference " – 9th Ed. – TMH
2. E. Balagurusamy – " Programming With Java: A Primer " – 3rd Ed. – TMH.

Reference Books:

1. R. K. Das – " Core Java for Beginners " – VIKAS PUBLISHING.
2. Rambaugh, James Michael, Blaha – " Object Oriented Modelling and Design " – Prentice Hall, India.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	-	-	1	-	-	1
CO2	3	2	2	-	1	-	-	-	1	-	-	2
CO3	2	3	2	3	-	-	-	-	2	-	-	-
CO4	1	-	-	-	-	-	-	-	1	2	-	2
CO5	2	1	1	-	1	-	-	-	2	-	-	2

Paper Name: Big Data Analysis
Paper Code: EE 702B
Contact: 3L:0T:0P
Credit: 3

Prerequisites: Familiarity and knowledge of Database Management Systems.

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

- **CO1.** Identify the difference between structured, semi-structured and unstructured data.
- **CO2.** Summarize the challenges of big data and how to deal with the same.
- **CO3.** Explain Hadoop Ecosystem.
- **CO4.** Identify the difference between Pig and Hive.

Course Content

Module I: Data and Big Data Analytics 8L

Introduction:

Types of digital data: Structured: Sources of structured data and Ease with Structured data Semi-Structured: sources of semi-structured data Unstructured: sources of unstructured data: Issues with terminology, dealing with unstructured data. 2L

Big data analytics-1: Characteristics of data-Definition of big data-Challenges of big data Traditional BI vs. Big data-A typical BI environment-A big data environment-Big data stack. 2L

Big data analytics-2: Classification of analytics-Top challenges facing big data-Data science. 2L

Terminologies used in big data environment: In memory analytics-In database processing. Massively parallel processing-Parallel vs distributed systems-Shared Memory architecture CAP (Consistency, Availability, Partition Tolerance) theorem explained- BASE (Basically Available Soft State Eventual Consistency)-Few top Analytics tools. 2L

Module II: Big Data Technology and Hadoop 9L

The big data technology landscape: NoSQL-Types of NoSQL databases-Why NoSQL - Advantages of NoSQL- What we miss with NoSQL?-NoSQL Vendors SQL Vs. NoSQL. NewSQL - Comparison of SQL,NoSQL and NewSQL. 1L

Hadoop: Features of Hadoop- Key advantages of Hadoop- Versions of Hadoop-Hadoop 1.0 Hadoop2.0- Overview of Hadoop Ecosystems- Hadoop Vs. SQL- Integrated Hadoop systems offered by leadingmarket vendors-Cloud based Hadoop solutions. 2L

Introducing Hadoop: Why not RDBMS-Distributed Computing Challenges. Hadoop Overview:Hadoop Components-High Level Architecture of Hadoop. Hadoop Distributed File System: HDFSArchitecture-Daemons Related to HDFS- Working with HDFS Command-Special Features of Hadoop. 2L

Processing Data With Hadoop: Introduction-How Map Reduce Works-Map Reduce Example. WordCount Example using Java. 2L

Managing Resources and Applications with YARN: Introduction-Limitation of Hadoop 1.0-Hadoop2: HDFS-Hadoop 2: YARN-Business Intelligence on Hadoop. 2L

Module III: Hadoop Hive 10L

Introduction to Hive - The Problem Solution: Hive Use Case- Data Growth- Schema Flexibility andEvolution- Extensibility. What is Hive: History of Hive and Recent Releases of Hive-Hive Features-HiveIntegration and Work Flow- Hive Data Units.Hive Architecture-Hive Primitive Data Types and Collection Types-Hive File Formats-Hive QueryLanguage Statements: DDL-DML. Hive Partitions-Bucketing-Views-Sub Query-Joins Hive User Defined. 4L

Function-Aggregations in Hive-Group by and Having-Serialization and Deserialization-Hive AnalyticFunctions. 6L

Module IV: Hadoop – Pig 9L

Hadoop – Pig: Introducing Pig: History and Anatomy of Pig-Pig on Hadoop-Pig Features-PigPhilosophy-Word count example using Pig-Use Case for Pig-Pig Primitive Data Types, Collection Typesand NULL. 2L

Pig Latin Overview: Pig Latin Grammar - Comments, Keywords, Identifiers-Case sensitivity in Pig-Common Operators in Pig. 1L

Pig Statements: LOAD-STORE-DUMP-Interactive Shell – GRUNT: FILTER- SORTGROUPBY-ORDER BYJOIN-LIMIT. 2L

Pig Latin Script: Local Mode-Map Reduce Mode-Running Pig Script. Working with: Field Tuple-Bag. User Defined Function-Parameters in Pig. 2L

Jasper Report using Jasper soft studio: Introduction to Jasper Report using Jasper Soft Studio Reportingusing MongoDB-Reporting using Cassandra. 2L

Text Books:

1. Mark Dexter, Louis Landry, ‑Joomla Programming‖, 2012 Pearson Education.
2. SeemaAcharya and Subhashini C, ‑Big Data and Analytics‖, Wiley Publication, 2015

Reference Books:

1. Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman, ‑Big data for dummies‖, Wiley Publication, 2013.
2. Tom White, ‑Hadoop: The Definitive Guide‖, O‟Rilly Publication, 2015.
3. Chuck Lam, ―Hadoop in action‖, Dreamtech Press, 2011.
4. Dirk Deroos, Paul C. Zikopoulos, Roman B. Melnyk, Bruce Brown, ‑Hadoop for dummies‖, Wileypublication, 2015.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	1	-	-	1	1	1	1
CO2	2	2	2	2	3	1	-	-	1	1	1	1
CO3	2	2	2	2	3	1	-	-	1	1	1	1
CO4	2	3	2	2	3	1	-	-	1	1	1	1

Paper Name: Digital Image Processing
Paper Code: EE 702C
Contact: 3L:0T:0P
Credit: 3

Prerequisites: Basic concept of vectors and matrices (relation between a column matrix and vector), inner product of two vectors, matrix multiplication, inversion, extracting Eigenvectors and Eigen values of a matrix, covariance matrix. Perception of dimensionality and hyper plane. Distance measures in Euclidean space between two points (e.g. Euclidean distance) and a point with a group of points (Mahalanobis distance). Knowledge about statistical distributions (e.g. Normal/ Gaussian), statistical independence, probability distribution function, condition probability, the law of total probability and Bayes rule.

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

- **CO1.** Explain the structure of human eye, image formation, Brightness, sensing and acquisition, storage, Processing, Communication, Display Image Sampling and quantization, spectrum analysis.
- **CO2.** Illustrate image Enhancement in the Spatial and Frequency Domain, image transformations, Histogram processing, time and Spatial filtering.
- **CO3.** Evaluate Image and video Data Compression, Redundancies.
- **CO4.** Develop Morphological Processed Image using Dilation, Erosion, Opening, closing, Hit -or-miss transformation.
- **CO5.** Evaluate Image Segmentation by detection of discontinuities, Edge linking and Boundary detection, Thresholding, Image Representation schemes, Boundary descriptors, and Regional descriptors.

Course Content

Module 1: Digital Imaging Fundamentals and Its Transform 7L

Digital Imaging Fundamentals:

Basic idea of Digital image, Image formation in human eye, Pixel, Mathematical operation of Digital Image, Sampling, Quantization, application of digital Image Processing. 3L

Transform of Digital Images:

Importance of Digital Image Transform, Fourier Transform of Digital Image (DFT), Inverse Fourier Transform (IDFT), Fast Fourier Transform, Inverse Fast Fourier Transform, Application of Digital Image Transform in different area. 4L

Module 2: Digital Image Enhancement 6L

Importance of Digital Image enhancement, enhancement in spatial and frequency domain, Bit plane slicing, Histogram, Histogram Equalization , Mean and Median filtering in Digital Images, Frequency domain filtering in Digital Images – LPF, HPF and BPF.

Module 3: Digital Image Compression 6L

Importance of Digital Image Compression, Types of Image Compression, example of lossless and lossy compression, Image compression standards, Compression in spatial domain, compression using Huffman coding, DCT and Wavelet based Digital image compression.

Module 4: Digital Image Restoration and Segmentation 8L

Digital Image Restoration:

Application and Importance of Digital Image Restoration, Reason for Image degradation, Inverse filtering. 3L

Segmentation of Digital Images:

Importance and applications of Digital Image Segmentation, Detection of discontinuities, Edge linking and Boundary detection, Thresholding, Segmentation based on Region Growing, Watershed algorithm. 5L

Module 5: Edge Detection and Security 8L

Edge Detection in Digital Image Processing:

Importance of Edge detection in Digital Image Processing, Types of Edge Detection, Mathematical Equation of each operator. 4L

Security in Digital Image Processing:

Importance of Digital Image Security, Watermarking, Image encryption in spatial and frequency domain, Steganography. 4L

Text Books:

1. Rafael C. Gonzales, Richard E. Woods, ‐Digital Image Processing‖, Third Edition, Pearson Education, 2010.
2. S. Annadurai, R. Shanmugalakshmi, ‐Fundamentals of Digital Image Processing‖, Pearson Education, 2006.

Reference Books:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, ‐Digital Image Processing Using MATLAB‖, Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
2. Anil Jain K. ‐Fundamentals of Digital Image Processing‖, PHI Learning Pvt. Ltd., 2011.
3. Willliam K Pratt, ‐Digital Image Processing‖, John Willey, 2002.
4. Malay K. Pakhira, ‐Digital Image Processing and Pattern Recognition‖, First Edition, PHI Learning Pvt. Ltd., 2011.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	2	2	2	2	2	2	2
CO2	3	3	3	3	2	3	2	2	2	2	2	2
CO3	3	3	2	2	3	2	2	2	2	2	1	2
CO4	3	3	2	2	2	3	2	2	1	2	2	2
CO5	3	3	3	3	2	2	2	2	2	2	2	2

Paper Name: Power System – III
Paper Code: EE 703A
Contact: 3L:0T:0P
Credit: 3

Prerequisites: Electrical Machines – II, Power Systems – I, Power Systems – II, Control Systems – I, Control Systems – II.

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

CO1. Demonstrate various power systems components, models and their operation, optimization of cost criteria.

CO2. Apply fundamentals and concepts to analyze, formulate and solve complex problems of electrical power systems and its components and control of frequency and voltages.

CO3. Analyze advanced techniques, skills and modern scientific and engineering tools for professional practice for power system to enhanced power quality, Stability, reliability, security and load ability.

Course Content

Module 1: Objectives of Power System Operation 5L

Power Systems in Restructured Environment; Distributed and Dispersed Generation; Environment Aspects of Electric Power Generation.

Module 2: Economic Operation of Energy Generation Systems 9L

Generation Cost Curves; Economic Operation of Thermal System; Plant Scheduling; Transmission Loss and Penalty Factor; Hydro-Thermal Scheduling; Concept of Reserves and Constraints; Unit Commitment.

Module 3: Automatic Generation Control 7L

Concept of AVR and ALFC Loops, Significance of Double Loop in ALFC; Exciter and VAR Control; Single Area Load Frequency Control; Two Area Load Frequency Control; Frequency Response.

Module 4: Compensation in Power System 8L

Reactive Power Sensitivity and Voltage Control; Load Compensation with Capacitor Banks; Line Compensation with Reactors; Shunt and Series Compensation; Fixed Series Capacitors; Thyristor Controlled Series Capacitors (TCSC); Introduction to SVC and STATCOM, UPFC.

Module 5: Power System Transients 7L

Types of System Transients; Overvoltage in Transmission Lines; Propagation of Surges and Travelling Waves; Protection against Lightning and Surges.

Text Books:

1. Kothari and Nagrath, ‑Power System Engineering‖, McGraw Hill.
2. John J. Granger and William D. Stevension, ‑Power System Analysis‖, McGraw Hill.
3. Allen J. Wood and Bruce F. Woolenberg, ‑Electric Power Generation, Operation and Control‖, Willey.

Reference Books:

1. Prabha Kundur, ‑Power System Stability and Control‖, McGraw Hill.

2. D. P. Kothari and I. J. Nagrath, –Modern Power System Analysis‖, McGraw Hill.
3. T. K. Nagsarkar and M. S. Sukhija, –Power System Analysis‖, Pearson.
4. Abhijit Chakrabarti and Sunita Halder, –Power System Analysis, Operation and Control‖, PHI.
5. Elgerd, Olle Ingemar, –Electric Energy Systems Theory: An Introduction‖, McGraw Hill.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	2	-	-	1	1	-	1	3
CO2	3	2	3	2	-	-	-	-	2	-	-	3
CO3	3	2	3	3	-	-	-	-	2	-	1	3

Paper Name: Restructured Electrical Power System
Paper Code: EE 703B
Contact: 3L:0T:0P
Credit: 3

Prerequisites: Power System – I and Power System – II.

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

- **CO1.** Understand the need for restructuring of Power Systems, discuss different market models, different stakeholders and market power.
- **CO2.** Understand and generalize the functioning and planning activities of Independent System Operator (ISO).
- **CO3.** Understand transmission open access pricing issues and congestion management.
- **CO4.** Define transfer capability and estimate the transfer capability of small power systems with numerical examples.
- **CO5.** Define ancillary services and understand reactive power as ancillary service and management through synchronous generator.

Course Content

Module 1: Introduction to restructuring of power industry 5L
Introduction, Reasons for restructuring / deregulation of power industry, Understanding the restructuring process, Introduction to issues involved in deregulation, Reasons and objectives of deregulation of various power systems across the world.

Module 2: Power System Operation 8L
Introduction, need for operational reliability, value of reliability, cost of reliability, procuring reliability resources, operational issues, balancing resources, effect of generation from stochastic renewable sources, limits on power transfer, voltage control and reactive support, stability services, system restoration, co-optimization of energy and reserve in a centralized electricity market, allocation of transmission capacity between energy and reserve, allocating the costs, who should pay for reserve.

Module 3: Transmission Congestion Management 7L
Introduction, Classification of congestion management methods, Calculation of ATC, Non-market methods, Market based methods, Nodal pricing, Price area congestion management.

Module 4: Pricing of transmission network usage and loss allocation 8L
Introduction to transmission pricing, Principles of transmission pricing, Classification of transmission pricing methods, Rolled-in transmission pricing methods, Marginal transmission pricing paradigm, Composite pricing paradigm, Merits and de-merits of different paradigms, Debated issues in transmission pricing, Introduction to loss allocation, Financial markets associated with electricity markets, Introduction to optimal bidding by a generator company, Optimal bidding methods.

Module 5: Investing in Transmission 8L
Nature of transmission business, cost based transmission expansion, allocating the cost of transmission, optimal transmission capacity, effect of load fluctuation, load duration curve, the transmission demand function, recovery of variable transmission investment cost, sharing reserve, sharing generating capacity margin.

Text Books:

1. Daniel Kirschen and Goran Strbac, Fundamentals of Power System Economics‖, John Wiley & Sons Ltd, 2004.

Reference Books:

1. Sally Hunt, ‒Making competition work in electricity‖, John Wiley & Sons, Inc., 2002.
2. Kankar Bhattacharya, Jaap E. Daadler, Math H. J. Bollen, ‒Operation of Restructured Power Systems‖, Kluwer Academic Pub., 2001.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	-	-	-	-	-	-	-	-
CO2	3	2	3	3	-	-	-	-	-	-	-	2
CO3	3	3	3	3	1	2	-	-	-	-	-	3
CO4	3	3	2	3	1	-	-	-	-	-	-	3
CO5	3	3	2	3	-	-	-	-	-	-	-	3

Paper Name: Computer Applications in Power System
Paper Code: EE 703C
Contact: 3L:0T:0P
Credit: 3

Prerequisites: Numerical Methods, Power System – I and Power System – II.

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

- **CO1.** Develop proper mathematical models for analysis of a selected problem like load flow study or fault analysis.
- **CO2.** Prepare the practical input data required for load flow or fault calculations.
- **CO3.** Select and identify the most appropriate algorithm for load–flow and short circuit studies.
- **CO4.** Develop power system software for static power system studies.

Course Content

Module 1: Network Formulation and Graph Theory 5L
Introduction, Network Equations, Graph Theory, Development of Network Matrices from Graph Theoretic Approach, Augment Cut-set Incidence Matrix Cut-set and Circuit Equations, Building Algorithm for the Bus Impedance Matrix Modification of Z_{BUS} matrix due to changes in the primitive network

Module 2: Load Flow Studies 4L
Introduction, Different techniques such as Gauss Saidal method, Newton Raphson method, De-Coupled method, Fast Decoupled method, Modified Fast Decoupled, Concept of Optimal Power Flow, Solution of Optimal power flow by Gradient method, Solution of Optimal power flow by Newton‘s method Linear Programming Methods, DC load flow, Continuation Power flow

Module 3: Sensitivity Analysis 6L
Sensitivity analysis- General sensitivity relations, generation shift distribution factors, line outage distribution factors, compensated shift factors, sensitivity associated with voltage-VAR, sensitivities relating load bus voltage changes in terms of PV bus voltage changes, sensitivity relating changes in reactive power generation for changes in PV Bus Voltage.

Module 4: Power System Security 7L
Introduction, Factors Affecting Power System Security, Short Circuit Studies of a Large Power System Networks, Symmetrical Fault Analysis Using Bus Impedance Matrix, Algorithm for Formation of Bus Impedance Matrix, Contingency Analysis: Detection of Network Problems, Overview of security analysis, Linear Sensitivity Factors, Contingency Selection, Concentric Relaxation, Bounding

Module 5: Introduction to State Estimation in Power Systems 8L
Introduction, Power system state estimation, Maximum Likelihood Concept, Weighted Least Squares Estimation, Introduction, Matrix Formulation, State Estimation of an AC network, Development of Method, State Estimation by Orthogonal Decomposition, An Introduction to Advanced topics in state estimation, Detection and Identification of Bad measurements, Estimation of quantities not being measured, Network Observability and Pseudo measurements, Application of Power Systems State Estimation

Module 6: Numerical Integration Techniques 6L

Numerical integration techniques: One step methods, Taylor series based methods, Forward - Euler's method, Runge-Kutta methods, Trapezoidal method, backward-Euler's method, Accuracy and error analysis, Numerical stability analysis, Stiff systems, Step-size selection, Differential algebraic systems, triangular factorization, Power system applications: Transient stability analysis.

Text Books:

1. Computer Methods in Power System Analysis, Glenn Stagg and El-abiad, McGraw-Hill.
2. Power System Analysis, Stevenson and Grainger, TATA McgrawHill.
3. Computational Methods for Electric Power Systems, Mariesa Crow, CRC press.
4. Computer-Aided Power Systems Analysis, George Kusic, CRC Press – Indian Edition.

Reference Books:

1. Computer Modelling of Electrical Power System, J. Arrilaga and N. R. Wattson, Wiley 2001.
2. Computational Methods for Large Sparse Power System Analysis – An Object Oriented Approach, S. A. Soman, S. A. Khaparde, Kluwer Academic Publishers.
3. Power System Analysis, Hadi Saadat, Tata Mcgraw Hill, New Delhi.
4. Large Networks by Matrix Methods, H. E. Brown, John Wiley.
5. Power Generation Operation & Control, A. J. Wood and B. F. Wollenberg, John Wiley & Sons, Inc.
6. AC-DC Power System Analysis, Jos Arrillaga and Bruce Smith, IEE London UK.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	2	-	-	-	-	-	2
CO2	3	3	3	3	-	1	-	-	-	-	-	3
CO3	3	3	3	3	-	1	-	-	-	-	-	3
CO4	3	3	3	2	3	2	-	-	-			2

Paper Name: Power System Dynamics and Control
Paper Code: EE 704A
Contact: 3L:0T:0P
Credit: 3

Prerequisites: Numerical Methods, Electrical Machines, Power Systems and Control Systems.

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

- **CO1.** Understand the problem of power system stability and its impact on the system.
- **CO2.** Analyse linear dynamical systems and use of numerical integration methods.
- **CO3.** Understand the methods to improve stability.

Course Content

Module 1: Introduction to Power System Operations 3L
Introduction to power system stability, Stability problems in Power System. Impact on Power System Operations and control.

Module 2: Analysis of Linear Dynamical System and Numerical Methods 5L
Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysis using Numerical Integration Techniques. Issues in Modelling: Slow and Fast Transients, Stiff System.

Module 3: Modelling of Synchronous Machines and Associated Controllers 12L
Modelling 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. Modelling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

Module 4: Stability Analysis 11L
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 5: Enhancing System Stability 5L
Planning Measures. Stabilizing Controllers (Power System Stabilizers). Operational Measures Preventive Control. Emergency Control.

Text Books:

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

Reference Books:

1. A. J. Wood and B. F. Wollenberg, ‑Power Generation Operation & Control‖, John Wiley & Sons, Inc.
2. A. Chakrabarti and S. Halder, ‑Power System Analysis, Operation and Control‖, PHI.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	2	-	-	-	-	-	2
CO2	3	3	3	3	-	1	-	-	-	-	-	3
CO3	3	3	3	3	-	1	-	-	-	-	-	3

Paper Name: Power Quality and FACTS
Paper Code: EE 704B
Contact: 3L:0T:0P
Credit: 3

Prerequisites: Power Electronics, Synchronous Machine, Power Systems and Control Systems.

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

- **CO1.** Describe the characteristics of ac transmission and the effect of shunt and series reactive compensation.
- **CO2.** Demonstrate the working principles of FACTS devices and their operating characteristics.
- **CO3.** Illustrate the basic concepts of power quality.
- **CO4.** Categorize the working principles of devices to improve power quality.

Course Content

Module 1: Transmission Lines and Series/Shunt Reactive Power Compensation 4L
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.

Module 2: Thyristor-based Flexible AC Transmission Controllers (FACTS) 6L
Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Harmonics and control of SVC and TCSC. Fault Current Limiter.

Module 3: Voltage Source Converter based (FACTS) controllers 9L
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.

Module 4: Application of FACTS 4L
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.

Module 5: Power Quality Problems in Distribution Systems 4L
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.

Module 6: DSTATCOM 9L
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.

Text Books:

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 Age International (P) Ltd. 2007.
3. R. C. Dugan, –Electrical Power Systems Quality‖, McGraw Hill Education, 2012.

References Books:

1. T. J. E. Miller, –Reactive Power Control in Electric Systems‖, John Wiley and Sons, New York, 1983.
2. G. T. Heydt, ―Electric Power Quality‖, Stars in a Circle Publications, 1991.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	-	-	-	-	2	3
CO2	3	2	3	-	3	-	-	-	-	-	-	3
CO3	3	2	3	-	-	-	-	-	-	-	-	3
CO4	3	3	3	3	3	3	-	-	-	-	2	3

SYLLABUS OF

B.TECH EIGHTH SEMESTER COURSES

Paper Name: Wind and Solar Energy Systems
Paper Code: EE 801A
Contact: 2L: 0T:0P
Credit: 2

Prerequisites: Concept of Basic Physics, Power Electronics and Electrical Machines.

Course Outcome: After successful completion of the course students will be able to

CO1. Analyze the fundamental principle of wind and solar power generation.
CO2. Categorize different types wind generators and solar power plants.
CO3. Apply power electronic interfaces for wind and solar generation.

Course Content

Module 1: Introduction to Wind Power **3L**

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.

Module 2: Wind Generator Classifications **4L**

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.

Module 3: Solar Radiation **3L**

The sun to earth transaction of solar energy, Study of wavelength Of solar radiation spectra, Solar Spectrum Electromagnetic Radiation, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability

Module 4: Solar Photovoltaic System **5L**

Technologies-Amorphous, monocrystalline, 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.

Module 5: Grid Integration of Wind and Solar Power **7L**

Constant- Voltage, Constant Frequency Generation, Single output system, Double Output System with Current Converter and voltage source inverter, Variable-voltage, Variable frequency generation, Circuit Model of Self Excited Induction Generator, Effect of Wind Generator on a power network.

Solar PV and wind farm behaviour during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Module 6: Solar Thermal Power Generation **1L**

Technologies involved in solar thermal generation, Analysis of Parabolic trough, central receivers, parabolic dish, Concept of solar pond.

Text Books:

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.

Reference Books:

1. H. Siegfried and R. Waddington, –Grid integration of wind energy conversion systems‖ John Wiley and Sons Ltd., 2006.
2. G. N. Tiwari and M. K. Ghosal, –Renewable Energy Applications‖, Narosa Publications, 2004.
3. J. A. Duffie and W. A. Beckman, –Solar Engineering of Thermal Processes‖, John Wiley & Sons, 1991.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	3	-	-	-	2	2
CO2	3	3	3	3	3	3	3	-	-	-	2	2
CO3	3	3	3	3	3	3	3	-	-	-	2	2

Paper Name: Utilization of Electric Power
Paper Code: EE 801B
Contact: 2L:0T:0P
Credit: 2

Prerequisites: Basic Electrical Engineering and Electrical Machines.

Course Outcome: After successful completion of the course students will be able to

- **CO1.** Demonstrate the working of traction motor and their control under different working conditions.
- **CO2.** Anlyze illumination level for a given application and select the suitable specification for installation.
- **CO3.** Illustrate the working of Electric Heating, welding processes.
- **CO4.** Explain the process of electrolysis.

Course Content

Module – 1: Electric Traction **9L**

Requirement of an ideal traction system, Supply system for electric traction, Train movement (speed time curve, simplified speed time curve, average speed and schedule speed), Mechanism of train movement (energy consumption, tractive effort during acceleration, tractive effort on a gradient, tractive effort for resistance, power and energy output for the driving axles, factors affecting specific energy consumption, coefficient of adhesion).

Electric traction motor & their control:

Parallel and series operation of Series and Shunt motor with equal and unequal wheel diameter, effect of sudden change of in supply voltage, Temporary interruption of supply, Tractive effort and horse power. Use of AC series motor and Induction motor for traction.

Traction motor control:

DC series motor control, Multiple unit control, Braking of electric motors, Electrolysis by current through earth, current collection in traction system, Power electronic controllers in traction system.

Module – 2: Illumination **6L**

The nature of radiation, Polar curve, Law of illumination, Photometry (Photovoltaic cell, distribution photometry, integrating sphere, brightness measurement).

Types of Lamps:

Conventional and energy efficient, Basic principle of light control, Different lighting scheme and their design methods, Flood and Street lighting.

Module – 3: Electric Heating and Welding **4L**

Types of heating, Resistance heating, Induction heating, Arc furnace, Dielectric heating, Microwave heating.

Module – 4: Electrolytic Processes **3L**

Basic principles, Faraday‘s law of Electrolysis, Electro deposition, Extraction and refining of Metals, Power supply of Electrolytic processes.

Text Books:

1. T. Starr, ‒Generation, Transmission and Utilization of Electrical Power‖, Pitman.
2. J. B. Gupta, ‒Utilization of Electric Power & Electric Traction‖, S. K. Kataria & Sons.
3. C. L. Wadhawa, ‒Generation Distribution and Utilization of Electrical Energy‖, New Age International Publishers.

Reference Books:

1. H. Partab, –Art and Science of Utilization of Electrical Energy‖, Dhanpat Rai & Sons.
2. E. Openahaw Taylor, Orient Longman, –Utilisation of Electric Energy‖.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-
CO3	-	-	3	3	-	-	-	-	-	-	-	-
CO4	-	-	2	3	-	-	-	-	-	-	-	-

Paper Name: Line Commutated and Active Rectifiers
Paper Code: EE 801C
Contact: 2L:0T:0P
Credit: 2

Prerequisites: Concept of Transformers and Power Electronic Converters.

Course Outcomes: After successful completion of the course students will be able to

- **CO1.** Analyse controlled rectifier circuits.
- **CO2.** Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulse configurations.
- **CO3.** Understand the operation of PWM rectifiers – operation in rectification and regeneration modes and lagging, leading and unity power factor model.

Course Content

Module 1: Diode and Phase-Controlled Rectifiers with passive filtering 7L
single-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current waveshape. single-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape.

Module 2: Multi-Pulse converter 4L
Review of transformer phase shifting, generation of 6-phase AC voltage from 3-phase AC, 6-pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

Module 3: Single-phase AC-DC single-switch boost converter 3L
Review of DC-DC boost converter, power circuit of single-switch AC-DC converter, steady state analysis, unity power factor operation, closed-loop control structure.

Module 4: AC-DC bidirectional boost converter 4L
Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes.

Module 5: Isolated single-phase AC-DC flyback converter 6L
DC-DC flyback converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of AC-DC flyback converter, steady state analysis, unity power factor operation.

Text Books:

1. G. De, ‑Principles of Thyristorised Converters‖, Oxford & IBH Publishing Co, 1988.
2. J. G. Kassakian, M. F. Schlecht and G. C. Verghese, ‑Principles of Power Electronics‖, Addison-Wesley, 1991.
3. L. Umanand, ‑Power Electronics: Essentials and Applications‖, Wiley India, 2009.

Reference Books:

1. N. Mohan and T. M. Undeland, ‑Power Electronics: Converters, Applications and Design‖, John Wiley & Sons, 2007.
2. R. W. Erickson and D. Maksimovic, ‑Fundamentals of Power Electronics‖, Springer Science & Business Media, 2001.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	-	-	-	-	-	-	-	3
CO2	3	2	1	2	2	-	-	-	-	-	-	3
CO3	3	2	2	3	-	-	-	-	-	-	-	3

Paper Name: Advanced Electric Drives
Paper Code: EE 802A
Contact: 3L:0T:0P
Credit: 3

Prerequisites: Concept of Electrical Machines and Power Electronics.

Course Outcome: After successful completion of the course students will be able to

- **CO1.** Analyze the operation of power electronic converters and their control strategies.
- **CO2.** construct the modelling of AC motors in different reference frames.
- **CO3.** Understand the vector control strategies for ac motor drives.

Course Content

Module 1: Power Electronic Converters for AC Drives 10L

Review of Three-Phase Inverter with square-wave switching, Pulse Width Modulation Techniques – Sinusoidal PWM, Selected Harmonic Elimination, Space Vector Modulation, current control of VSI with PWM, three-level inverter and its different topologies, SVM for three-level inverter, H-bridge as a four-quadrant drive.

Module 2: Modelling and Control of DC Machines 5L

Electromechanical modelling, state-space modelling, Block diagram and transfer function, Control of separately excited dc motor drives for Inner current loop and speed control design.

Module 3: Induction Motor Drives 7L

Different transformations and reference frame theory, modelling of induction machines, voltage fed inverter control, open loop Volt/Hz control, vector control, direct torque and flux control, Introduction to three-phase traction drives with parallel machines.

Module 5: Permanent Magnet Motor Drives 4L

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

Module 6: Switched Reluctance Motor Drives 4L

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

Text Books:

1. B. K. Bose, ―Modern Power Electronics and AC Drives‖, Pearson Education, Asia, 2003.
2. R. Krishnan, ―Permanent Magnet Synchronous and Brushless DC motor Drives‖, CRC Press, 2009.

Reference Books:

1. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, ―Analysis of Electric Machinery and Drive Systems‖, John Wiley & Sons, 2013.
2. Bin-Wu, ―High-power Converters and AC Drives‖, IEEE Press, John Wiley & Sons, 2006.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	3	2	-	1	-	-	-	1	-	-	1
CO3	1	3	2	-	1	-	-	-	1	-	-	1

Paper Name: Control Systems Design
Paper Code: EE 802B
Contact: 3L:0T:0P
Credit: 3

Prerequisites: Control System – I, Control Systems – II.

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

- **CO1.** Understand various design philosophy of classical controllers.
- **CO2.** Analysis of conventional and robust controllers satisfying the desired specifications.
- **CO3.** Design of optimal and non-linear controllers.

Course Content

Module 1: Design Specifications 6L
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.

Module 2: Design of Classical Control System 5L
Introduction to compensator, Design of Lag, lead lag-lead compensator, Feedback and Feed forward compensator design, Feedback compensation, Realization of compensators.

Module 3: Design of PID controllers 6L
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.

Module 4: Introduction to Robust Control 9L
Robust control system and system sensitivities to parameter, perturbations, analysis of robustness, systems with uncertain parameters, considerations in design of robust control system, robust PID controller.

Module 5: Lyapunov's stability and optimal control 10L
Positive/negative definite, positive/negative semi-definite functions, Lyapunav stability criteria, introduction to optimal control, Riccatti Equation, Linear Quadratic Regulator, Design Examples.

Text 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.

Reference Books:

1. K. Ogata, ‑Modern Control Engineering‖, Prentice Hall, 2010.
2. B. C. Kuo, ‑Automatic Control system‖, Prentice Hall, 1995.
3. J. J. D‘Azzo and C. H. Houpis, ‑Linear control system analysis and design (conventional and modern)‖, McGraw Hill, 1995.
4. R.T. Stefani and G.H. Hostetter, ‑Design of feedback Control Systems‖, Saunders College Pub, 1994.
5. G. C. Goodwin, S. F. Graebe, M. E. Salgado, ‑Control System Design‖.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	3	2	-	-	-	-	-	-	2
CO2	2	2	2	3	2	-	-	-	-	-	-	2
CO3	2	3	2	2	-	-	-	-	-	-	-	2

Paper Name: Industrial Electrical System
Paper Code: EE 802C
Contact: 3L:0T:0P
Credit: 3

Prerequisites: Concept of Electrical Machines and Power Systems.

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

- **CO1.** Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
- **CO2.** Understand various components of industrial electrical systems.
- **CO3.** Analyze and select the proper size of various electrical system components.

Course Content

Module 1: Electrical System Components 7L

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 12L

General rules and guidelines for installation, 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, 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: Industrial Electrical Systems 9L

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 4: Industrial Electrical System Automation 8L

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 Books:

1. K. B. Raina, ‑Electrical Design, Estimating & Costing‖, New age International, 2007.
2. S. Singh and R. D. Singh, ‑Electrical estimating and costing‖, Dhanpat Rai and Co., 1997.
3. Paul Gill, ‑Electrical Power Equipment, Maintenance and Testing‖, CRC Press.
4. R. G. Jamkar, ‑Industrial Automation using PLC, SCADA & DCS‖, Global Education.

Reference Books:

1. S.L. Uppal and G.C. Garg, ‑Electrical Wiring, Estimating & Costing‖, Khanna publishers, 2008
2. Web site for IS Standards.
3. H. Joshi, ‑Residential Commercial and Industrial Systems‖, McGraw Hill Education, 2008.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	1	-	-	-	-	-	3
CO2	3	2	1	3	2	1	-	-	-	-	-	1
CO3	3	2	3	3	2	1	-	-	-	-	-	2

Paper Name: Principles of Management
Paper Code: HU 801
Contact: 2L:0T:0P
Credit: 2

Prerequisites:NIL.

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

- **CO1.** Recall and identify the relevance of management concepts.
- **CO2.** Apply management techniques for meeting current and future management challenges faced by the organization
- **CO3.** Compare the management theories and models critically to solve real life problems in an organisation.
- **CO4.** Apply principles of management in order to execute the role as a manager in an organisation.

Course Content

Module 1: Management Concepts **4L**

Definition, roles, functions and importance of Management, Evolution of Management thought-contribution made by Taylor, Fayol, Gilbreth, Elton Mayo, McGregor, Maslow.

Module 2: Planning and Control **4L**

Planning: Nature and importance of planning, types of planning, Levels of planning, The Planning Process - MBO, SWOT analysis, McKinsey's 7S Approach.

Organising for decision making: Nature of organizing, span of control, Organisational structure – line and staff authority.

Control: Basic control process: Control as a feedback system, Feed Forward Control, Requirements for effective control.

Module 3: Group dynamics **4L**

Types of groups, characteristics, objectives of Group Dynamics.

Leadership: Definition, styles & functions of leadership, qualities for good leadership, Theories of leadership .

Module 4: Work Study and Work Measurement **4L**

Definition of work study, Method Study Steps, Tools and Techniques used in the Method Study and Work Measurement Time Study: Aim and Objectives,, Use of stopwatch procedure in making Time Study. Performance rating, allowances and its types. Calculation of Standard Time. Work sampling.

Module 5: Marketing Management **2L**

Functions of Marketing, Product Planning and development, Promotional Strategy .

Module 6: Quality Management **6L**

Quality definition, Statistical quality control, acceptance sampling, Control Charts –Mean chart, range chart, c chart, p chart, np chart, Zero Defects, Quality circles, Kaizen and Six Sigma, ISO - 9000 Implementation steps, Total quality management.

Text Books:

1. Essentials of Management, by Harold Kooritz & Heinz Weihrich Tata McGraw Hill.
2. Production and Operations Management, K.Aswathapa, K .Shridhara Bhat, Himalayan Publishing House.

References Books:

1. Organizational Behavior, by Stephen Robbins Pearson Education, New Delhi.
2. New era Management, Daft, 11th Edition, Cengage Learning.
3. Principles of Marketing, Kotlar Philip and Armstrong Gary, Pearson publication.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	-	3	-
CO2	-	-	-	-	-	2	-	3	3	-	3	3
CO3	-	-	-	-	-	-	-	-	2	-	3	3
CO4	-	-	-	-	-	2	-	-	3	-	3	-

Paper Name: Essence of Indian Knowledge Tradition
Paper Code: MC 804
Contact: 3L:0T:0P
Credit: 0

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

- **CO1.** Identify the concept of Traditional knowledge and its importance.
- **CO2.** Explain the connection between Modern Science and Indian Knowledge System.
- **CO3.** Understand the importance of Yoga for health care.
- **CO4.** Interpret the effect of traditional knowledge on environment.

Course Content

Module 1: Basic structure of Indian Knowledge System
Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs western knowledge traditional knowledge.

Module 2: Modern Science and Indian Knowledge System
Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge.

Module 3: Yoga and Holistic Health care
Yoga for positive health, prevention of stress related health problems and rehabilitation, Integral approach of Yoga Therapy to common ailments.

Module 4: Traditional Knowledge and Environment
Traditional knowledge and engineering, Traditional medicine system, Importance of conservation and sustainable development of environment, Management of biodiversity.

Reference Books:

1. V. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014.
2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan.
3. Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan.
4. Fritzof Capra, The Wave of life.
5. VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay Foundation, Velliarnad, Arnakulam.
6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata.
7. RN Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakashan, Delhi 2016 RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakashan,Delhi 2016.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	-	-	2	1	2	1
CO2	-	-	-	-	-	-	-	3	2	1	2	2
CO3	-	-	-	-	-	-	-	-	2	2	-	1
CO4	-	-	-	-	-	-	-	-	1	2	-	1