R-18

CURRICULUM ESSENTIALS

Handbook on Outcome Based Education

ELECTRICAL ENGINEERING

NARULA INSTITUTE OF TECHNOLOGY

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Institute Vision

To make the Institute excellent in technological education and research by imparting equitable, inclusive, ethical, flexible and multidisciplinary knowledge to budding technologists to serve the society.

Institute Mission

- To establish continuously improving academic ambience in the Institute in order to prepare the students with beyond curriculum knowledge, creativity, innovation, problem solving abilities, teamwork, communication skills etc. for their holistic development.
- To collaborate with Institutes of higher education, Professional Societies, R&D and Industrial organisations for continuous improvement of academic, research environment in the Institute and to build a strong Industry-Institute interface.
- To promote and nurture entrepreneurial and innovative quality of the students providing proper education, training and supportive facilities so that future entrepreneurs emerge with flying colors.
- To strengthen quality and knowledge-base of faculty through faculty development programmes for continuous upgradation to remain in tune with dynamically changing technology.
- To become a responsible contributor in the socio-economic development of the society through excellence in education and research.

Institute Quality Policy

- Adoption of appropriate standards and practices for good governance, to bring in transparency of all operations and thereby improve credibility at all levels.
- Industry-ready professionals to be developed through interactive teaching learning process involving state of the art class rooms, laboratories, libraries, corporate exposure and innovative project work.
- Higher studies/research for faculty & staff to be encouraged for up gradation of knowledge through participation in Quality Improvement Programs, Seminars, Workshops, Webinars etc.
- Laboratory facilities would be upgraded in emerging areas to promote R&D activities including participation in Govt. and Industry funded projects.
- Industrial consultancy to be carried out in an effective manner for developing sense of accomplishment.
- Interaction with Professional Societies would be encouraged for the professional growth and development of the students, faculties and staff for mutual benefit.
- NBA Accreditation for all AICTE approved programs to be obtained at the earliest and maintained on a long-term basis.
- The innovative and entrepreneurial skills of the students to be nurtured through Innovation & Incubation center, finally culminating in start-ups.

Department Vision

To disseminate quality education in Electrical Technology and prepare capable engineers with ethical and multidisciplinary knowledge for the service of the society.

Department Mission

DM1: To impart comprehensive and quality education through intensive and continuous improvement and to develop innovative entrepreneur and ethical professionals, suitable for a sustainable environment.

DM2: To develop a reservoir of knowledge and experience and to intensify the faculty development program through interaction with the stake holders in education for mutual enrichment.

DM3: To promote, product oriented and dedicated research for establishing a self-sustaining and wealth-creating centre to serve, the social needs.

DM4: To prepare the students for new challenges in the field of electrical engineering.

DM5: To create and sustain an environment for critical thinking and problem solving.

DM6: To maintain intensive interaction with Industry and leading Research Centres, where students can be engaged in Projects, Training and Internships and to contribute vigorously in research and industrial development.

DM7: To undertake collaborative projects which offer opportunities for long-term interaction with academia and industry.

DM8: 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 Objects (PEOs)

B.Tech. in Electrical Engineering

PEO1. Graduates will be able topursue knowledge and skills in the emerging areas of Electrical Engineering.

PEO2. Graduates will be able to test, verify and analyze the characteristics of various electrical apparatus.

PEO3. Graduates will be able to solve real world problem through intensive practice on industry-oriented projects and extending value addition to the society.

PEO4. Graduates will be able to become successful professionals and can pursue their career in the Government/Private sector, higher education, research and successful entrepreneurs.

PEO5. Graduates will be able to develop teamwork and leadership skills in different cultural and interdisciplinary backgrounds.

Program Specific Outcomes (PSOs)

B.Tech. in Electrical Engineering

PSO1. Use engineering knowledge to model and analyse the components of electrical power systems.

PSO2. Apply the knowledge of science and engineering to develop sustainable electrical systems for social and industrial need.

Program outcomes (POs)

Engineering Graduates will be able to:

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

2. **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.

3. **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.

4. **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.

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

6. **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.

7. **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.

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

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

10. ***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.

11. **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.

12. **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

Curriculum Structure

DEPARTMENT OF ELCTRICAL ENGINEERING

B.Tech First Semester Curriculum

1st Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
A.THEORY								
1	BS	M101	Mathematics-I	3	1	0	4	4
2	BS	CH101/ PH101	Chemistry (Gr.A)/ Physics-I (Gr.B)	3	0	0	3	3
3	ES	EE101/ EC101	Basic Electrical Engineering (Gr.A)/ Basic Electronics Engineering (Gr.B)	3	0	0	3	3
4	HS	HU101	English	2	0	0	2	2
Total of Theory							**12**	**12**
B.PRACTICAL								
5	BS	CH191/ PH191	Chemistry Laboratory (Gr.A)/ Physics-I Laboratory (Gr.B)	0	0	3	3	1.5
6	ES	EE191/ EC191	Basic Electrical Engineering Laboratory (Gr.A)/ Basic Electronics Engineering Laboratory (Gr.B)	0	0	3	3	1.5
7	ES	ME191/ ME192	Engineering Graphics & Design(Gr.A)/ Workshop/Manufacturing Practices (Gr.B)	0	0	3	3	1.5
8	PROJ	PR191	Project–IA	0	0	1	1	0.5
9	PROJ	PR192	Project–IB	0	0	1	1	0.5
C.MANDATORYACTIVITIES/COURSES								
10	MC	MC181	Induction Program	0	0	0	0	0
Total of Theory, Practical & Mandatory Activities/Courses							**23**	**17.5**

CO STATEMENTS

Course Name: Chemistry
Course Code: CH 101

CO1	Describethefundamentalpropertiesofatoms&molecules,atomicstructureandtheperiodicityofelements in the periodic table
CO2	Apply fundamental concepts of thermodynamics in different engineering applications.
CO3	Apply the knowledge of water quality parameters, corrosion control &polymers to different industries.
CO4	Determine the structure of organic molecules using different spectroscopic techniques.
CO5	Evaluate the or etical 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 Name: Mathematics –I
Course Code: M 101

CO1	Understand and recall the properties and formula related to matrix algebra, differential calculus, integral calculus and vector calculus.
CO2	Determinethesolutionsoftheproblemsrelatedtomatrixalgebra,differentialcalculus,multivariable calculus, vector calculus and infinite series.
CO3	Applytheappropriatemathematicaltoolsofmatrixalgebra,differentialcalculus,Integral Calculus, multi variable calculus, vector calculus and infinite series forthe solutions of there lated problems.
CO4	Analyzedifferentengineeringproblemslinkedwithmatrixalgebra,differentialcalculus, Integral Calculus, multivariable calculus, vector calculus,
CO5	Applydifferentengineeringproblemslinkedwithmatrixalgebra,differentialcalculus,Integral Calculus, multivariable calculus, vector calculus.

Paper Name: English

Paper Code: HU101

CO1	Understand and communicate in English in a globalized workplace scenario.
CO2	Understand and apply the basic grammatical skills of the English language and develop reading and comprehension skills.
CO3	Acquire a working knowledge of writing strategies, formats and templates of professional writing.
CO4	Understand and know about and employ formal communication modes in meetings and reports.
CO5	Understand and know about and use objective and culturally neutral language in interpersonal and business communication.

Course Name: Basic Electrical Engineering
Course Code: EE 101

CO1	Understand Basic Electrical circuits, Power distribution and Safety measures.
CO2	Analyze and 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 network problems
CO5	Understand basic principles of Transformers and Rotating Machines.

Course Name: Basic Electrical Engineering Lab
Course Code: EE 191

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

Course Name: Chemistry Lab
Course Code: CH 191

CO1	Able to operate different types of instruments for estimation of small quantities chemical suspending industries and scientific and technical fields.
CO2	Able to analyze and determine the composition of liquid and solid samples working as an individual and also as an team member.
CO3	Able to analyse different parameters of water considering environmental issues
CO4	Able to synthesize drug and polymer materials
CO5	Capable to design innovative experiments applying the fundamentals of chemistry

Course Name: Engineering Graphics &Design
Course Code: ME 191

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 technique store present line, surface or solid models in different Engineering view points.
CO4	Produce part models carry out assembly operation and show working procedure of a designed project two rousing animation.

Course Name: Theme based Project I
Course Code: PR191

CO1	Understand the problems and their implications.
CO2	Develop skills for designing the plan of work.
CO3	Justify the societal impact of the said problems.
CO4	Facilitate problem solving skills.
CO5	Implement the technical skills in global interface and inculcate the practices of life long learning.

Course Name: Skill Development –I – Soft Skills
Course Code: PR 192

CO1	Able to develop communication skills, enhance confidence building procedure and learn sense of time management aiming towards personality grooming.
CO2	Able to apply listening, speaking, analytical and critical skills in societal and professional life.
CO3	Able to demonstrate the skills necessary to be a competent Interpersonal communicator and team worker.
CO4	Able to foster leadership skills, decision making abilities, conflict and stress management capacity to develop a holistic approach towards life.
CO5	Able to analyze different situations and professional challenges by adapting negotiation skills.

CO-PO/PSO mapping

Course Name: English
Course Code: HU 101

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	2	-	3	3	-	3	2	2
CO2	-	-	-	-	-	-	2	-	3	3	-	3	2	2
CO3	-	-	-	-	-	-	2	-	3	3	-	3	2	2
CO4	-	-	-	-	-	-	2	-	3	3	-	3	2	2
CO5	-	-	-	-	-	-	2	-	3	3	-	3	2	2

Course Name: Mathematics-I
Course Code: M 101

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2		-	-	-	-	-	-	-	2	2	2
CO2	3	3	3	3	-	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	-	-	-	-	-	-	-	2	2	2
CO5	3	3	3	3	-	-	-	-	-	-	-	2	2	2

Course Name: Chemistry
Course Code: CH 101

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	2	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-	2	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	2	-	-
CO4	3	2	3	2	-	-	-	-	-	-	-	2	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	2	-	-

Course Name: Basic Electrical Engineering
Course Code: EE 101

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	2	-	-	-	2	2	1	2	2
CO2	2	3	-	-	-	-	-	-	-		1	1	3	1
CO3	2	3	1				-	-	-	-	1	1	2	3
CO4	1	2	3	1			-	-	-	-	-	1	2	3
CO5	3	-	-	-	-	-	-	-	-	-	-	1	1	2

Course Name: Basic Electrical Engineering Lab
Course Code: EE 191

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		-	-	-	2	-	-	-	-		1	3	
CO2	2	3	-	-	-		-	-	-	-	1	1	2	3
CO3	3		-	-	-		-	-	-	-		1	3	

Course Name: Chemistry Lab
Course Code: CH 191

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	2	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-	2	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	2	-	-
CO4	3	2	3	2	-	-	-	-	-	-	-	2	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	2	-	-

Course Name: Theme based Project I
Course Code: PR191

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	-	-	2	3	-	-	-	-	-	-	-
CO2	-	-	3	-	-		3	-	-	-	3	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	2	-	-	-
CO5		-	-	-		3		-	-	-	-	3	-	-

Course Name: Skill Development –I – Soft Skills
Course Code: PR 192

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	-	1	3	3	-	3	-	-
CO2	-	3		-	-	3	-	1	2	3	-	3	-	-
CO3	-	3		-	-	2	-	3	3	3	-	3	-	-
CO4	-	3	3	-	-	3	-	2	3	3	-	3	-	-
CO5	-	-	-	-	-	3	-	1	3	3	-	3	-	-

Course Name: Engineering Graphics & Design
Course Code: ME 191

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	-	-

B.Tech Second Semester Curriculum

2nd Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
A.THEORY								
1	BS	M201	Mathematics-II	3	1	0	4	4
2	BS	CH201/ PH201	Chemistry (Gr.B)/ Physics-I (Gr.A)	3	0	0	3	3
3	ES	EE201/ EC201	Basic Electrical Engineering (Gr.B)/ Basic Electronics Engineering (Gr.A)	3	0	0	3	3
4	ES	CS201	Programming for Problem Solving	3	0	0	3	3
5	ES	ME201	Engineering Mechanics	3	0	0	3	3
Total of Theory							**16**	**16**
B.PRACTICAL								
6	ES	CS291	Programming for Problem Solving Laboratory	0	0	3	3	1.5
7	BS	CH291/ PH291	Chemistry Laboratory (Gr.B)/ Physics-I Laboratory(Gr.A)	0	0	3	3	1.5
8	ES	EE291/ EC291	Basic Electrical Engineering Laboratory (Gr.B)/ Basic Electronics Engineering Laboratory (Gr.A)	0	0	3	3	1.5
9	ES	ME291/ ME292	Engineering Graphics & Design (Gr.B)/ Workshop/Manufacturing Practices (Gr.A)	0	0	3	3	1.5
10	HS	HU291	Language Laboratory	0	0	2	2	1
11	PROJ	PR291	Project–II	0	0	1	1	0.5
12	PROJ	PR292	Innovative Activities–I	0	0	0	0	0.5
C. MANDATORY ACTIVITIES/COURSES								
13	MC	MC281	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/entrepreneurshipcelloftheinstitute;participationinconferences/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.

Course Name: Physics –I
Course Code: PH 201

CO1	Describe different types of mechanical resonance and its electrical equivalence
CO2	Explain basic principles of Laser,Optical fiberand Semiconductor Physics.
CO3	Apply superposition principle to explain the phenomena of interference and diffraction
CO4	Analyzedifferentcrystallographicstructuresaccordingtotheirco-ordinationnumberandpackingfactors
CO5	Determine and justify the need of a quantum mechanics as remedy to over come limitations imposed by classical physics

Course Name: Physics –I
Course Code:PH291

CO1	Demonstrate experiments allied to their theoretical concepts
CO2	Conduct experiments using LASER, Optical fiber, Torsional pendulum.
CO3	Participateasanindividualandasamemberorleaderingroupsinlaboratorysessionsactively.
CO4	Analyze experimental data and graphical representations to communicate effectively in laboratory reports including innovative experiments.
CO5	Develop critical thinking skills to solve real life challenges.

Course Name: Basic Electronics Engineering
Course Code:EC201

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 analyzed, 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 analyze and design simple circuits containing non-linear elements such as transistors using the concepts of load lines, operating points and incremental analysis.

Course Name: Programming for Problem Solving

Course Code: CS 201

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 Name: Engineering Mechanics

CourseCode:ME 201

CO1	To understand representation of force, moments for drawing free-body diagram s 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 system s under vibration.

Course Name: Programming for Problem Solving Lab

Course Code: CS291

CO1	Learn the concept of DOS system command s 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 error s 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,UnionandFiles.

Course Name: Basic Electronics Engineering Lab
CourseCode:EC291

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	AnalyzethecharacteristicsofJunctionDiode,ZenerDiode,BJT&FETanddifferenttypes of Rectifier Circuits
CO3	Determination of input-offset voltage,input bias current and Slewrate,Common-mode Rejection ratio,Bandwidth and Off-set null of OPAMPs.
CO4	Able to know the application of Diode ,BJT & OPAMP.

Course Name: Workshop/Manufacturing Practices
CourseCode:ME292

CO1	Gain basic knowledge of Workshop Practice and Safety useful for our daily living.
CO2	Understand the use of Instruments of a pattern shop like Hand Saw, Jack Plain, Chisels etc.
CO3	Apply and performing operations like such as Marking, Cutting etc used in manufacturing processes.
CO4	Analyze the various operations in the Fitting Shop using Hack Saw, various files, Scriber, etc to understand the concept of tolerances applicable in all kind of manufacturing.
CO5	Get hands on practice of in Welding and apply various machining processes which give a lot of confidence to manufacture physical prototypes in project works.

Course Name: Language Lab
Course Code: HU291

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 behaviors
CO5	Able to adapt to multifarious socio-economical and professional are with the help of effective communication and interpersonal skills.

CO-PO/PSO mapping

Course Name: Mathematics - II

Course Code: M 201

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	1	-	-
CO5	1	3	-	-	-	-	-	-	-	-	-	1	-	-

Course Name: Workshop/Manufacturing Practices
CourseCode:ME292

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	2	-	3	3	-	2	2	2
CO2	-	-	-	-	-	-	2	-	3	3	-	2	2	2
CO3	-	-	-	-	-	-	2	-	3	3	-	2	2	2
CO4	-	-	-	-	-	-	2	-	3	3	-	2	2	2
CO5	-	-	-	-	-	-	2	-	3	3	-	2	2	2

Course Name: Basic Electronics Engineering
CourseCode:EC201

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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
CourseCode: CS291

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	-	-

Paper Name: Physics – I Laboratory
Paper Code: PH 291

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	3	-	-	-	-	-	-	-	-	-
CO2	2	3	2	3	3	-	-	-	-	-	-	-	-	-
CO3	2	3	2	3	3	-	-	-	-	-	-	-	-	-
CO4	2	3	2	3	3	-	-	-	-	-	-	-	-	-
CO5	2	3	2	3	2	-	-	-	-	-	-	-	-	-

B.Tech Third Semester Curriculum

3rd Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
A.THEORY								
1	ES	EE301	Electrical Circuit Analysis	3	1	0	4	4
2	PC	EE302	Measurement and Instrumentation	3	0	0	3	3
3	PC	EE303	Analog Electronics	3	0	0	3	3
4	BS	M(EE)301	Mathematics–III	3	1	0	4	4
Total of Theory							**14**	**14**
B.PRACTICAL								
5	ES	EE391	Electrical Circuit Analysis Laboratory	0	0	3	3	1.5
6	PC	EE392	Measurement and Instrumentation Laboratory	0	0	3	3	1.5
7	PC	EE393	Analog Electronics Laboratory	0	0	2	2	1
8	PROJ	PR391	Project–III	0	0	2	2	1
9	PROJ *	PR392	Innovative Activities–II	0	0	0	0	0.5
C.MANDATORYACTIVITIES/COURSES								
10	MC	MC301	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 Expos etc. 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.

Course Name: Electrical Circuit Analysis

Course Code:EE301

COs	Statements
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 Name Measurement and Instrumentation

CourseCode:EE302

COs	Statements
CO1	Understand theoperating principles ofelectrical andelectronic measuringinstruments.
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 Name: Analog Electronics

Course Code: EE 303

COs	Statements
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 Name: Mathematics – III

Course Code : M(EE)301

COs	Statements
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 andBessel's).
CO5	Interpret complex statistical findings using the understanding of inferential statistics

Course Name: Electrical Circuit Analysis Laboratory

CourseCode:EE 391

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

Course Name: Measurement and Instrumentation Laboratory

Course Code: EE 392

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

Course Name: Analog Electronics Laboratory

Course Code: EE393

COs	Statements
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 concept s 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 ,analyze the analog circuits pertaining to applications like amplifier, oscillators and timer
CO6	Able to know how to interface digital circuits with ADC&DAC

Course Name: Environmental Science Course
Code:MC301

COs	Statements
CO1	Student will be able ➢ To understand the natural environment and it s relationships with human activities. ➢ To apply the fundamental knowledge of science and engineering to assess environmental and heal thrisk. ➢ 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

CO-PO/PSO mapping

Course Name: Electrical Circuit Analysis
Course Code:EE301

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	-	-	1	3	2	2
CO2	3	3	3	2	2	-	-	-	-	-	1	3	2	2
CO3	3	3	3	2	2	-	-	-	-	-	2	3	2	2
CO4	3	3	3	2	2	-	-	-	-	-	2	3	2	2

Course Name Measurement and Instrumentation

CourseCode:EE302

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	-	3	-	-	1	-	-	-	-	-	-	-	2	2
CO4	-	3	2	-	2	-	-	-	-	-	-	-	2	2

Course Name: Analog Electronics Course

Code: EE 303

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	-	2	-	3	-	-	3	-	2
CO2	3	3	3	3	2	-	2	-	3	-	-	3	-	2
CO3	3	3	3	3	2	-	2	-	3	-	-	3	-	2
CO4	3	3	3	3	2	-	2	-	3	-	-	3	-	2
CO5	3	3	3	3	2	-	2	-	3	-	-	3	-	2
CO6	3	3	3	3	2	-	2	-	3	-	-	3	-	2

Course Name: Environmental Science

Course Code:MC301

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	-	-	2	3	3	-	-	1	2	2	2

Course Name: Mathematics – III

Course Code: M(EE)301

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	1	2	2
CO2	3	2	1	-	-	-	-	-	-	-	-	1	2	2
CO3	3	2	2	-	-	-	-	-	-	-	-	1	2	2
CO4	3	2	2	-	-	-	-	-	-	-	-	1	2	2
CO5	3	3	2	3	-	-	-	-	-	-	-	1	2	2

Course Name: Electrical Circuit Analysis Laboratory

Course Code: EE 391

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	1	3	-	-	-	1	1	-	-	3	3
CO2	2	-	2	1	3	-	-	-	1	1	-	-	3	3

Course Name: Measurement and Instrumentation Laboratory

Course Code: EE 392

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2			3					3	2		1	2	2

Course Name: Analog Electronics Laboratory Course

Code: EE393

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	-	-

B.Tech Fourth Semester Curriculum

4th Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
A.THEORY								
1	BS	PH401	Physics–II	3	0	0	3	3
2	PC	EE401	Electrical Machines–I	3	0	0	3	3
3	PC	EE402	Power Electronics	3	0	0	3	3
4	PC	EE403	Digital Electronics	3	0	0	3	3
5	PC	EE404	Electromagnetic Fields	2	0	0	2	2
6	HS	HU401	Values and Ethics in Profession	2	0	0	2	2
Total of Theory							**16**	**16**
B.PRACTICAL								
7	BS	PH491	Physics–II Laboratory	0	0	3	3	1.5
8	PC	EE491	Electrical Machines–I Laboratory	0	0	3	3	1.5
9	PC	EE492	Power Electronics Laboratory	0	0	3	3	1.5
10	PC	EE493	Digital Electronics Laboratory	0	0	2	2	1
11	PROJ	PR491	Project–IV	0	0	2	2	1
12	PROJ	PR492	Innovative Activities–III	0	0	0	0	0.5
C.MANDATORYACTIVITIES/COURSES								
13	MC	MC481	Behavioral & 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

Course Name: Physics – II

Course Code: PH 401

COs	Statements
CO1	Explain electron transport in metal-insulators and semiconductors using energy Band theory
CO2	Apply Schrödinger equation in variety of a to midscale problems including nano materials.
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 Name: Electrical Machines - I

CourseCode:EE 401

COs	Statements
CO1	Understand the operation of Transformers, D.C. Machines, Three-Phase InductionMotor.
CO2	AnalyzetheequivalentcircuitofTransformers,D.C.Machines,Three-PhaseInductionMotor
CO3	Conduct different tests on Transformers, D.C. Machines, Three-Phase InductionMotor

Course Name: Power Electronics

Course Code: EE 402

COs	Statements
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 Name: Digital Electronics

Course Code: EE 403

COs	Statements
CO1	Acquired knowledge about solving problems related to number systems conversions and Boolean algebra and design logic circuits using logicgates 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&ADCtechnique and corresponding circuits
CO5	Analyze logic family interfaces, switching circuits & memory storage devices to Plan and execute projects.

Course Name: Electromagnetic Fields
Course Code: EE 404

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

CourseName: Values and Ethics in Profession

CourseCode:HU401

COs	Statements
CO1	Understand the core values that shape the ethical behavior of an engineer and Exposed a wareness 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 Name: Physics–II Laboratory

Course Code: PH 491

COs	Statements
CO1	Demonstrate experiments allied to their theoretical concepts.
CO2	Conduct experiment s 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 the min laboratory reports including innovative experiments.

Course Name: Electrical Machines –I Laboratory

Course Code:EE491

COs	Statements
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.

Course Name: Power Electronics Laboratory

Course Code:EE492

COs	Statements
CO1	The skill to analyze the response of any power electronics devices.
CO2	The ability to trouble shoot 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.

Course Name: Digital Electronics Laboratory

Course Code: EE 493

COs	Statements
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, through put/latency, gatecount and area, energy dissipation and power
CO4	Able to understand different digital circuit s using Programmable Logic Devices
CO5	Able to know how to interface digital circuits with ADC &DAC

Course Name: Behavioral & Interpersonal Skills

CourseCode:MC 481

COs	Statements
CO1	It will equip the student to handle work place 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 work place 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

CO-PO/PSO MAPPING

Course Name: Physics – II
Course Code: PH 401

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	1	-	-
CO4	1	2	2	3	-	-	-	-	-	-	-	1	-	-

Course Name: Electrical Machines - ICourse
Code: EE 401

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	2	-	-	2	3	3	3	3
CO2	3	3	3	3	3		-	-	2	-	3	3	3	3
CO3	3	1	2	-	-	3	-	1	2	-	3	3	3	3

Course Name: Power ElectronicsCourse
Code: EE 402

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	2	2	1	-	-	-	-	-	-	-	-	-

Course Name: Digital Electronics
Course Code: EE 403

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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 FieldsCourse Code: EE 404

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	-	-	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	-	2	2
CO3	3	3	3	2	2	-	-	-	-	-	-	-	2	2
CO4	3	3	3	3	2	-	-	-	-	-	-	-	2	2

Course Name: Values and Ethics in Profession

Course Code: HU401

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	1		
CO2	2	1	-	3	-	-	-	-	-	-	-	-		
CO3	-	-	2	-	-	-	-	-	-	-	-	1		
CO4	-	-	-	-	-	-	-	-	3	-	-	-		
CO5	-	-	-	-	-	-	-	-	-	1	-	-		

Course Name: Power Electronics Laboratory

Course Code: EE 492

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	1	-	-	-	-	-	-	-	-	2	2
CO2	-	1	-	2	-	-	-	-	-	-	-	-	2	2
CO3	2	1	-	2	-	-	-	-	1	-	-	-	2	2
CO4	2	-	-	2	-	-	-	-	1	-	-	-	2	2
CO5	2	1	-	2	-	-	-	-	-	-	-	-	2	2

Course Name: Digital Electronics LaboratoryCourse Code: EE 493

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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: Behavioural & Interpersonal Skills
Course Code: MC 481

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	2	3	-	-	-	-	-	-
CO2	-	-	-	-	-	2	2	3	-	-	-	-	-	-
CO3	-	-	-	-	-	2	2	3	1	-	-	-	-	-
CO4	-	-	-	-	-	2	2	3	1	-	-	-	-	-
CO5	-	-	-	-	-	2	2	3	-	-	-	-	-	-

B.Tech Fifth Semester Curriculum

5thSemester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
A.THEORY								
1	PC	EE501	Electrical Machines–II	3	0	0	3	3
2	PC	EE502	Power System–I	3	0	0	3	3
3	PC	EE503	Control System–I	3	0	0	3	3
4	OE	EE504	A. Data Structure B. Computer Network C. Internet of Things	3	0	0	3	3
5	PE	EE505	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	PC	EE591	Electrical Machines–II Laboratory	0	0	3	3	1.5
7	PC	EE592	Power System–I Laboratory	0	0	3	3	1.5
8	PC	EE593	Control System–I Laboratory	0	0	3	3	1.5
9	OE	EE594	A. Data Structure Laboratory B. Computer Network Laboratory C. Internet of Things Laboratory	0	0	3	3	1.5
10	PROJ	PR591	Project–V	0	0	2	2	1
11	PROJ *	PR592	Innovative Activities–IV	0	0	0	0	0.5
C.MANDATORYACTIVITIES/COURSES								
12	MC	MC501	Constitution of India	3	0	0	3	0
Total of Theory, Practical & Mandatory Activities/Courses							**32**	**22.5**

StudentsmaychooseeithertoworkonparticipationinHackathonsetc.Developmentofnewproduct/BusinessPlan/registrationof 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. (Duration4-6weeks) 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.

Course Name: Electrical Machines - II

Course Code: EE 501

COs	Statements
CO1	Demonstrate the applications of synchronous machine and fractional kW motorsbased 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 performancemachines

Course Name: Power System - I

Course Code: EE 502

COs	Statements
CO1	Understand the concept of power system, know various power system componentsand define associated terms
CO2	Know different type of power generation
CO3	Understand basic performances of power system

Course Name: Control System - I

Course Code: EE 503

COs	Statements
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 infrequency domain

Course Name: Data Structure

Course Code: EE 504A

COs	Statements
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 Name: Computer Network

Course Code: EE 504B

COs	Statements
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 Name: Internet of Things

Course Code: EE 504C

COs	Statements
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 theirperformance
CO4	To implement basic IoT applications on embedded platform

Course Name: Electrical Energy Conservation and Auditing

Course Code: EE 505A

COs	Statements
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 techniqueadopted

Course Name: Electromagnetic Waves

Course Code: EE 505B

COs	Statements
CO1	Understand the propagation of EM waves associated with different ElectricalNetworks
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 whichare used in microwave applications
CO4	Apply concepts of Antenna Engineering and its applications

Course Name: Illumination Engineering

Course Code: EE 505C

COs	Statements
CO1	Analyse the fundamentals of illumination and its measurements with differentapparatus
CO2	Explain the characteristics of various types of lamp with their accessories and theircontrol circuits
CO3	Demonstrate the interior and exterior lighting

Course Name: Power Plant Engineering

Course Code: EE 505D

COs	Statements
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 Name: Electrical Machines – II Laboratory

Course Code: EE 591

COs	Statements
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

Course Name: Power System – I LaboratoryCourse
Code: EE 592

COs	Statements
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 andDistribution Line

Course Name: Control System – I LaboratoryCourse
Code: EE 593

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

Course Name: Data Structure LaboratoryCourse
Code: EE 594A

COs	Statements
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

Course Name: Computer Network Laboratory

Course Code: EE 594B

COs	Statements
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

Course Name: Internet of Things Laboratory

Course Code: EE 594C

COs	Statements
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 theirperformance
CO4	To implement basic IoT applications on embedded platform

Course Name: Constitution of IndiaCourse Code: MC 501

COs	Statements
CO1	Develop human values, create awareness about law ratification and significance of Constitution
CO2	Comprehend the Fundamental Rights and Fundamental Duties of the Indian Citizento 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 Economyof the country

C0-PO-/PSO MAPPING

Course Name: Electrical Machines - II
Course Code: EE 501

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-	-	-	-	-	-	-	2	3	2
CO2	3	2	3	2	-	-	-	-	-	-	-	3	2	3
CO3	3	2	2	2	-	-	-	-	-	-	-	3	3	2

Course Name: Power System - I
Course Code: EE 502

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	-	-	-	-	-	-	2	3	3
CO2	3	3	3	3	2	-	-	-	-	-	-	3	3	3
CO3	3	3	2	3	2	-	-	-	-	-	-	3	3	3

Course Name: Control System - I
Course Code: EE 503

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO2	3	3	3	3	2	-	-	-	-	-	-	1	2	2
CO3	3	3	2	3	2	-	-	-	-	-	-	2	2	2

Course Name: Data Structure
Course Code: EE 504A

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	-	-
CO5	3	3	2	2	2	1	1	-	-	-	-	2	-	-

Course Name: Electrical Energy Conservation and Auditing
Course Code: EE 505A

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	-	-	-	-	2	2
CO2	3	3	2	2	2	-	-	-	-	-	-	-	2	2
CO3	3	2	3	2	2	-	-	-	-	-	-	-	2	2
CO4	3	2	3	1	1	-	-	-	-	-	-	-	2	2

Course Name: Illumination Engineering
Course Code: EE 505C

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	3	3	3
CO2	3	-	3	-	-	-	-	-	-	-	2	-	3	3
CO3	2	-	3	-	-	-	2	-	-	-	2	-	3	3

Course Name: Electrical Machines – II Laboratory
Course Code: EE 591

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	3	-	-	-	-	3	2	-	-	3	3
CO2	2	-	-	3	-	-	-	-	3	2	-	-	3	3

Course Name: Power System – I Laboratory
Course Code: EE 592

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	3	-	-	-	-	3	2	-	-	3	3
CO2	2	-	-	3	-	-	-	-	3	2	-	-	3	3
CO3	2	-	-	3	-	-	-	-	3	2	-	-	3	3
CO4	2	-	-	3	-	-	-	-	3	2	-	-	3	3

Course Name: Control System – I Laboratory
Course Code: EE 593

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	3	-	-	-	-	3	2	-	-	3	3
CO2	2	-	-	3	-	-	-	-	3	2	-	-	3	3

Course Name: Data Structure Laboratory
Course Code: EE 594A

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	2	3	-	-	-	2	-	-
CO2	-	-	-	-	-	3	2	3	-	-	-	2	-	-
CO3	-	-	-	-	-	3	2	3	-	1	-	2	-	-
CO4	-	-	-	-	-	3	2	3	-	1	-	2	-	-

B.Tech Sixth Semester Curriculum

6thSemester								
Sl. No.	Category	Paper Code	Subject	ContactHours/Week				Credit Points
				L	T	P	Total	
A.THEORY								
1	PC	EE601	Microprocessor and Microcontroller	3	0	0	3	3
2	PC	EE602	Power System–II	3	0	0	3	3
3	PC	EE603	Control System–II	3	0	0	3	3
4	OE	EE604	A. Data Base Management System B. Embedded Systems C. Software Engineering	3	0	0	3	3
5	PE	EE605	A. Digital Signal Processing B. High Voltage Engineering C. Computer Architecture	3	0	0	3	3
Total of Theory							**15**	**15**
B.PRACTICAL								
6	PC	EE691	Microprocessor and Microcontroller Laboratory	0	0	2	2	1
7	PC	EE692	Power System–II Laboratory	0	0	3	3	1.5
8	PC	EE693	Control System–II Laboratory	0	0	3	3	1.5
9	OE	EE694	A. Data Base Management System Lab B. Embedded Systems Lab C. Software Engineering Lab	0	0	3	3	1.5
10	PROJ	PR691	Project–VI	0	0	2	2	1
11	PROJ *	PR692	Innovative Activities–V	0	0	0	0	0.5
C.MANDATORYACTIVITIES/COURSES								
12	MC	MC681	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 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 viva voce and submission of necessary certificates as evidence of activities.

CO STATEMENT

Course Name: Microprocessor and Microcontroller

Course Code: EE 601

COs	Statements
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 Name: Power System – II

Course Code: EE 602

COs	Statements
CO1	Learn about advance structure of Power System
CO2	Get depth knowledge of different types of power system protection, fault, stabilityanalysis and load flow method
CO3	Design and analysis of different types of substation and implement these ideas inindustry or real life problem solve

Course Name: Control System – II

Course Code: EE 603

COs	Statements
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 ztransform
CO3	Students will be able to examine the stability of nonlinear systems using appropriatemethods

Course Name: Data Base Management System

Course Code: EE 604A

COs	Statements
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 Name: Embedded Systems

Course Code: EE 604B

COs	Statements
CO1	To familiarize with concepts related to the fundamental principles embedded systemsdesign, 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 usingIntegrated Development Environments and using debugging technique

Course Name: Software Engineering
Course Code: EE 604C

COs	Statements
CO1	Understand the structure and behaviour a software system the UML class diagramsand 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 releasemanagement
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, anddelivery)

Course Name: Digital Signal Processing
Course Code: EE 605A

COs	Statements
CO1	Able to define discrete systems in the Frequency domain using Fourier analysis toolslike DFT, FFT
CO2	Able to interpret the properties of discrete time signals in time domain and frequencydomain
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 Name: High Voltage Engineering
Course Code: EE 605B

COs	Statements
CO1	Understand the basic physics associated with various breakdown processes in differentinsulating materials
CO2	Knowledge of generation and measurement of A. C., D.C. Impulse voltages andcurrents
CO3	Knowledge of tests on H.V. equipment and on insulating materials, as per thestandards
CO4	Knowledge of the causes of Over voltages in power system and InsulationCoordination in a substation

Course Name: Computer Architecture
Course Code: EE 605C

COs	Statements
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 Name: Microprocessor and Microcontroller Laboratory
Course Code: EE 691

COs	Statements
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

Course Name: Power System – II Laboratory
Course Code: EE 692

COs	Statements
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.

Course Name: Control System – II Laboratory
Course Code: EE 693

COs	Statements
CO1	Conduct experiments on Position Control with proper tuning of P, PI and PIDcontroller
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

Course Name: Embedded Systems Laboratory
Course Code: EE 694B

COs	Statements
CO1	Familiarization with PIC Microcontroller, ARM Microcontroller, FPGA and theirinterfacing
CO2	Design of different types real time projects with digital controllers

Course Name: Data Base Management System Laboratory
Course Code: EE 694A

COs	Statements
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

Course Name: Software Engineering LaboratoryCourse Code: EE 694C

COs	Statements
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 likerational rose
CO4	To perform unit testing and integration testing
CO5	To apply various white box and black box testing techniques

CO-PO/PSO MAPPING

Course Name: Microprocessor and Microcontroller
Course Code: EE 601

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	-	-	-	-	-	-	2	3	3
CO2	3	3	2	3	2	-	-	-	-	-	-	2	3	3
CO3	3	3	2	2	-	2	-	-	-	-	-	3	3	3

Course Name: Control System – II
Course Code: EE 603

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	1	-	-	-	-	-	2	2	2
CO2	3	2	-	-	-	-	-	-	-	-	-	1	2	2
CO3	3	2	2	-	-	-	-	-	-	-	-	1		

Course Name: Data Base Management System
Course Code: EE 604A

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	-	-	-	-	2	3	3	3
CO2	3	3	1	-	-	-	-	-	-	-	2	3	3	3
CO3	3	2	2	-	-	-	-	-	-	-	2	3	3	3
CO4	3	3	2	-	-	-	-	-	-	-	2	3	3	3

Course Name: Computer Architecture
Course Code: EE 605C

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	1	-	-	-	-	-	-	-	-	-	-
CO2	3	-	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	2	-	-	-	-	-	-	-	-	-	-	-

Course Name: Microprocessor and Microcontroller Laboratory
Course Code: EE 691

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	-	-	-	1	-	-	-	-	-	-	3	3
CO2	-	3	3	-	-	1	-	-	-	-	-	-	3	3
CO3	-	-	-	2	-	-	-	-	-	-	-	-	3	3
CO4	3	-	3	2	-	-	-	-	-	-	-	-	3	3

Course Name: Control System – II Laboratory
Course Code: EE 693

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	-	-

B.Tech Seventh Semester Curriculum

7th Semester								
Sl. No.	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
				L	T	P	Total	
A.THEORY								
1	PC	EE701	Electrical Drives	3	0	0	3	3
2	OE	EE702	A. Object Oriented Programming using JAVA B. Big Data Analysis C. Digital Image Processing	3	0	0	3	3
3	PE	EE703	A. Power System–III B. Restructured Electrical Power System C. Computer Applications in Power System	3	0	0	3	3
4	PE	EE704	A. Power System Dynamic sand Control B. Power Quality and FACTS C. HVDC Transmission Systems	3	0	0	3	3
5	HS	HU703	Industrial and Financial Management	2	0	0	2	2
Total of Theory							**14**	**14**
B.PRACTICAL								
6	PC	EE791	Electrical Drives Laboratory	0	0	3	3	1.5
7	OE	EE792	A. Object Oriented Programming Laboratory B. Big Data Analysis Laboratory C. Digital Image Processing Laboratory	0	0	3	3	1.5
8	PROJ	PR791	Project–VII	0	0	0	6	3
9	PROJ *	PR792	Innovative Activities–VI	0	0	0	0	0.5
C.MANDATORYACTIVITIES/COURSES								
10	MC	MC781	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 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.(Duration4-6weeks) 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.

CO STATEMENT

Course Name: Electrical Drives
Course Code: EE 701

COs	Statements
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 Name: Object Oriented Programming using JAVA
Course Code: EE 702A

COs	Statements
CO1	Design the process of interaction between Objects, classes & methods w.r.t. ObjectOriented Programming
CO2	Acquire a basic knowledge of Object Orientation with different properties as well asdifferent features of Java
CO3	Analyze various activities of different string handling functions with various I/Ooperations
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 Name: Big Data Analysis
Course Code: EE 702B

COs	Statements
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 Hardtop Ecosystem
CO4	Identify the difference between Pig and Hive

Course Name: Digital Image Processing
Course Code: EE 702C

COs	Statements
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 Name: Power System – III Course
Code: EE 703A

COs	Statements
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 Name: Restructured Electrical Power System
Course Code: EE 703B

COs	Statements
CO1	Understand the need for restructuring of Power Systems, discuss different marketmodels, 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 systemswith numerical examples
CO5	Define ancillary services and understand reactive power as ancillary service and management through synchronous generator

Course Name: Computer Applications in Power System
Course Code: EE 703C

COs	Statements
CO1	Develop proper mathematical models for analysis of a selected problem like loadflow 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 circuitstudies
CO4	Develop power system software for static power system studies

Course Name: Power System Dynamics and Control
Course Code: EE 704A

COs	Statements
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 Name: Power Quality and FACTS
Course Code: EE 704B

COs	Statements
CO1	Describe the characteristics of ac transmission and the effect of shunt and seriesreactive compensation
CO2	Demonstrate the working principles of FACTS devices and their operatingcharacteristics
CO3	Illustrate the basic concepts of power quality
CO4	Categorize the working principles of devices to improve power quality

CO-PO/PSO MAPPING

Paper Name: Electrical Drives
Paper Code: EE 701

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	2	-	-	-	-	-	-	2	2
CO2	3	3	2	-	1	2	-	-	1	-	-	1	2	2
CO3	3	3	2	-	1	2	-	-	1	-	-	1	2	2

Paper Name: Object Oriented Programming using JAVA
Paper Code: EE 702A

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	3	1	-	-	1	1	1	1	2	2
CO2	2	2	2	2	3	1	-	-	1	1	1	1	2	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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	2	-	-	1	1	-	1	3	3	3
CO2	3	2	3	2	-	-	-	-	2	-	-	3	3	3
CO3	3	2	3	3	-	-	-	-	2	-	1	3	3	3

Paper Name: Restructured Electrical Power System
Paper Code: EE 703B

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	-	-	-	-	-	-	-	-	3	3
CO2	3	2	3	3	-	-	-	-	-	-	-	2	3	3
CO3	3	3	3	3	1	2	-	-	-	-	-	3	3	3
CO4	3	3	2	3	1	-	-	-	-	-	-	3	3	3
CO5	3	3	2	3	-	-	-	-	-	-	-	3	3	3

Paper Name: Computer Applications in Power System
Paper Code: EE 703C

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-	2	-	-	-	-	-	2	3	3
CO2	3	3	3	3	-	1	-	-	-	-	-	3	3	3
CO3	3	3	3	3	-	1	-	-	-	-	-	3	3	3
CO4	3	3	3	2	3	2	-	-	-			2	3	3

Paper Name: Power System Dynamics and Control
Paper Code: EE 704A

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-	2	-	-	-	-	-	2	3	3
CO2	3	3	3	3	-	1	-	-	-	-	-	3	3	3
CO3	3	3	3	3	-	1	-	-	-	-	-	3	3	3

Paper Name: Power Quality and FACTS
Paper Code: EE 704B

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	-	-	-	-	2	3	2	2
CO2	3	2	3	-	3	-	-	-	-	-	-	3	2	2
CO3	3	2	3	-	-	-	-	-	-	-	-	3	1	2
CO4	3	3	3	3	3	3	-	-	-	-	2	3	1	2

B.Tech Eighth Semester Curriculum

8thSemester								
Sl No	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
A.THEORY								
1	PE	EE801	A. Wind and Solar Energy Systems B. Utilization of Electric Power C. Line Commutated and Active Rectifiers	2	0	0	2	2
2	PE	EE802	A. Advanced Electric Drives B. Control Systems Design C. Industrial Electrical System	3	0	0	3	3
3	HS	HU801	Principles of Management	2	0	0	2	2
Total of Theory							**7**	**7**
B.PRACTICAL								
4	PROJ	PR891	Project–VIII	0	0	8	8	4
D. MANDATORY ACTIVITIES/COURSES								
5	MC	MC804	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.

Course Name: Wind and Solar Energy Systems

Course Code: EE 801A

COs	Statements
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 Name: Utilization of Electric Power Course Code: EE 801B

COs	Statements
CO1	Demonstrate the working of traction motor and their control under different workingconditions
CO2	Anlyze illumination level for a given application and select the suitable specificationfor installation
CO3	Illustrate the working of Electric Heating, welding processes
CO4	Explain the process of electrolysis

Course Name: Line Commutated and Active Rectifiers Course Code: EE 801C

COs	Statements
CO1	Analyse controlled rectifier circuits
CO2	Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulseconfigurations
CO3	Understand the operation of PWM rectifiers – operation in rectification and regeneration modes and lagging, leading and unity power factor model

Course Name: Advanced Electric DrivesCourse Code: EE 802A

COs	Statements
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 Name: Control Systems Design
Course Code: EE 802B

COs	Statements
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 Name: Industrial Electrical SystemCourse Code: EE 802C

COs	Statements
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 Name: Principles of Management Course Code: HU 801

COs	Statements
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 problemsin an organisation
CO4	Apply principles of management in order to execute the role as a manager in an organisation

Course Name: Essence of Indian Knowledge Tradition Course
Code: MC 804

COs	Statements
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

Paper Name: Wind and Solar Energy Systems
Paper Code: EE 801A

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	3	3	3	3	3	3	3	-	-	-	2	2	2	2
CO 2	3	3	3	3	3	3	3	-	-	-	2	2	2	1
CO 3	3	3	3	3	3	3	3	-	-	-	2	2	2	1

Paper Name: Utilization of Electric Power

Paper Code: EE 801B

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	-	3	3	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	2	3	-	-	-	-	-	-	-	-	-	-

Paper Name: Line Commutated and Active Rectifiers
Paper Code: EE 801C

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	3	2	3	2	-	-	-	-	-	-	-	3	2	2

CO 2	3	2	1	2	2	-	-	-	-	-	-	3	2	2
CO 3	3	2	2	3	-	-	-	-	-	-	-	3	2	2

Paper Name: Advanced Electric Drives
Paper Code: EE 802A

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1	1	-	-	-	-	-	-	-	-	-	-	-	2	2
CO 2	1	3	2	-	1	-	-	-	1	-	-	1	2	2
CO 3	1	3	2	-	1	-	-	-	1	-	-	1	2	2

Paper Name: Control Systems Design
Paper Code: EE 802B

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1	2	1	3	3	2	-	-	-	-	-	-	2	2	3
CO 2	2	2	2	3	2	-	-	-	-	-	-	2	2	2
CO 3	2	3	2	2	-	-	-	-	-	-	-	2	2	2

Paper Name: Industrial Electrical System
Paper Code: EE 802C

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1	3	2	2	3	2	1	-	-	-	-	-	3	2	2
CO 2	3	2	1	3	2	1	-	-	-	-	-	1	2	2
CO 3	3	2	3	3	2	1	-	-	-	-	-	2	2	2

Paper Name: Principles of Management
Paper Code: HU 801

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	-	-	-	-	-	-	-	-	3	-	3	-	-	-
CO 2	-	-	-	-	-	2	-	3	3	-	3	3	-	-
CO 3	-	-	-	-	-	-	-	-	2	-	3	3	-	-
CO 4	-	-	-	-	-	2	-	-	3	-	3	-	-	-

Paper Name: Essence of Indian Knowledge Tradition

Paper Code: MC 804

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	-	-	-	-	-	1	-	-	2	1	2	1	-	-
CO 2	-	-	-	-	-	-	-	3	2	1	2	2	-	-
CO 3	-	-	-	-	-	-	-	-	2	2	-	1	-	-
CO 4	-	-	-	-	-	-	-	-	1	2	-	1	-	-

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81, Nilgunj Rd, Agarpara, Kolkata, West Bengal 700109
www.nit.ac.in | 033 2563 8888