Minutes

of

Meeting

BOARD OF STUDIES

May 28, 2024

DEPARTMENT OF ELECTRICAL ENGINEERING

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(Deemed to be University)

NAAC Accredited with A++ Grade

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Date: 28-05-2024

Minutes of Meeting Board of Studies

The Board of Studies (BoS) meeting of the Electrical Engineering department was held in hybrid mode on May 28th, 2024 at 4:00 PM onwards. The following external members were invited in addition to the faculty members of the department:

1. **Dr. A.K. Sharma**, Principal, JEC Jabalpur **(VC, RGPV Nominee)**
2. **Dr. Manisha Dubey**, Professor, Electrical Engineering Department, MANIT, Bhopal **(Subject Expert)**
3. **Dr. J.N Rai**, Professor, Electrical Engineering Department, DTU Delhi (**Subject Expert**)
4. **Er. Sanjay D. Patil**, Power System Training Institute, Bengaluru **(Industry Expert)**
5. **Mr. Sandeep Gandhi**, Key Account Director Tata Projects Limited, Ghaziabad**(Alumnus)**

Above mentioned External experts and the following Internal members attended the meeting:

1. **Dr. Manjaree Pandit,** Professor & Dean Academics
2. **Dr. A.K. Wadhwani,** Professor
3. **Dr. Sulochana Wadhwani,** Professor& Head
4. **Prof. Ashis Patra,** Associate Professor
5. **Dr. Shishir Dixit,** Professor
6. **Prof. Rakesh Narvey**, Assistant Professor
7. **Dr. Himmat Singh**, Assistant Professor
8. **Dr. Vijay Bhuria**, Assistant Professor
9. **Prof. Kuldeep K. Swarnkar**, Assistant Professor
10. **Prof. Vishal Chaudhary**, Assistant Professor
11. **Dr. Vikram**, Assistant Professor
12. **Dr. Ankit Tiwari,** Assistant Professor
13. **Dr. Nikhil Paliwal**, Assistant Professor
14. **Prof. Manoj Kumar**, Assistant Professor
15. **Prof. Poonam Singh,** Assistant Professor
16. **Prof. Richa Sharma**, Assistant Professor
17. **Prof. Anuj Lodhi**, Assistant Professor

In addition, following student member were also present:

1. **Divyanshu Tiwari**, B Tech III Year, EE
2. **Aditya Singh Tomar**, B Tech II Year, EE

Agenda-wise Report of BoS Meeting

The agenda wise report of the BoS meeting held on 28 May 2024 is as follows:

Item EE 1. To confirm the minutes of the previous BoS meeting held in December 2023

The minutes of the last BoS held on 01st December 2023 were confirmed. The BoS Minutes were presented & approved in Academic Council Meeting held on 14th December 2023

Item EE 2. To review and finalize the scheme structure of B.Tech. VII Semester with the provision of Three (03) Departmental Electives (DEs) and Open Category (OC) Course. (Out of which One (01) Elective and 01 Open category course is to be offered in traditional mode and remaining Two (02) Departmental Electives are to be offered in online mode with credit transfer for the batch admitted in 2021-22.

The scheme structure of B. Tech. VII Semester of EE for the batch admitted in 2021-22 is prepared and is annexed at ANNEXURE-1.

Item EE 3. To propose the list of courses which the students can opt from SWAYAM/NPTEL/MOOC based Platforms, to be offered in online mode for Two (02) Departmental Electives (DE) Course, with credit transfer in the B.Tech. VII Semester under the flexible curriculum (Batch admitted in 2021-22)

The Departmental Elective (DE) Courses in VII Semester for batch admitted in 2021-22 taken from SWAYAM/NPTEL/MOOC with credit transfer are:

Details of Departmental Elective (DE-3): SWAYAM/NPTEL/MOOC

Subject Code	Course Name	Offered By	Duration of the course	Start date	End date	Exam date	Name of the Mentor faculty
130761	DC Microgrid and Control Systems	IIT Roorkee	08 Weeks	July 22, 2024	September 13, 2024	September 21, 2024	Dr. Nikhil Paliwal
130762	Economic Operations and Control of Power Systems	IIT Kanpur	12 Weeks	July 22, 2024	October 11, 2024	November 2, 2024	Dr. Himmat Singh
130763	Sustainable Power Generation Systems	IIT Guwahati	12 Weeks	July 22, 2024	October 11, 2024	November 2, 2024	Dr. Ankit Tiwari

Note:

- In each semester (starting from V to VIII semester), it is required to opt for new subjects towards DE/ OC/ Honours Degree/ Minor Specialization.
- Credit for opting a particular NPTEL course will be given only once throughout the tenure of B.Tech. program

Details of Departmental Elective (DE-4): SWAYAM/NPTEL/MOOC

Code	Course Name	Offered By	Duration of the course	Start date	End date	Exam date	Name of the Mentor faculty
130765	Sensor Technologies: Physics, Fabrication, and Circuits	IIT Madras	08 Weeks	July 22, 2024	September 13, 2024	September 21, 2024	Prof Kuldeep Kumar Swarnkar
130767	Digital Switching - I	IIT Kanpur	08 Weeks	July 22, 2024	September 13, 2024	September 21, 2024	Prof Manoj Kumar
130768	Real-Time Digital Signal Processing	IISc Bangalore	12 Weeks	July 22, 2024	October 11, 2024	November 2, 2024	Dr Vikram

Note:

- In each semester (starting from V to VIII semester), it is required to opt for new subjects towards DE/ OC/ Honours Degree/ Minor Specialization.
- Credit for opting a particular NPTEL course will be given only once throughout the tenure of B.Tech. program

Item EE 4. To prepare and finalize the syllabus of courses to be offered (for batch admitted in 2021-22) under Departmental Elective (DE) Course (in traditional mode) for B. Tech. VII Semester along with their COs

Departmental Electives (DE2): In this session, DE courses are proposed to be offered to the students of 2021-22 admitted batch. The list of DE courses proposed for VII Semester in traditional mode is:

1. Utilization of Electrical Energy:130717
2. Electrical Drives: 130718
3. Electric Vehicles:130719

The syllabi along with the course outcomes are at ANNEXURE-2.

Item EE 5. To prepare and finalize the syllabus of courses to be offered (for batch admitted in 2021-22) under the Open Category (OC) Courses (in traditional mode) for B.Tech. VII semester students of other departments along with their COs

Following is the list of OC courses proposed for the VII Semester (Batch admitted in 2021-22), for students of other branches

Category	Course Name	Course code
Open Category (OC2)	Applications of Electrical Equipment & Motors	910205
	Sensor Technology	910206
	Electric Vehicles	910207

The syllabi along with Course Outcomes (COs) are included in ANNEXURE -3

Item EE 6. To review and finalize the Experiment list/ Lab manual for Departmental Laboratory Course (DLC) to be offered in B.Tech VII semester (for batches admitted in 2021-22)

1. Electrical Drives Lab: 130720
2. Industrial Automation Lab: 130721

The name of the Departmental Laboratory Course DLC along with the list of experiments and course outcomes is annexed at ANNEXURE-4

Item EE 7. To propose the list of "Additional Courses" which can be opted for getting an

(i) Honours (for students of the host department)
(ii) Minor Specialization (for students of other departments)

(i) Following courses are identified & proposed for V Semester (Batch admitted in 2022-23) for the B.Tech. VII semester students (for the batch admitted in 2021-22) for their requirement towards getting Honors

B. Tech. V and VII Semester (Honors)

(For students of the host department: Electrical Engineering)

*** Course run through SWAYAM/NPTEL/ MOOC Learning Based Platform**

Specialization 1: Control & Instrumentation	Specialization 2: Power System & Energy
Course Name:	**Course Name**
Advanced Linear Continuous Control Systems: Applications with MATLAB Programming and Simulink (08 weeks)[IITR] Mentor: Prof Ashis Patra	**Smart Grid: Basics to Advanced Technologies** (12 week) [IITR] Mentor: Dr Himmat Singh
Electronic Systems Design: Hands-on Circuits and PCB Design with CAD Software (12 Week) [IITD] Mentor: Dr Ankit Tiwari	**Design of Photovoltaic Systems** (12 Week) [IISc Bangalore] Mentor: Prof Vishal Chaudhary
Power Electronics with Wide Band Gap Devices (12 Week) [IIT Mandi] Mentor: Prof Manoj Kumar	**Advances in UHV Transmission and Distribution** (8 Week) [IISc Bangalore] Mentor: Prof Vishal Chaudhary
Introduction to Industry 4.0 and Industrial Internet of Things (12 Week) [IIT KGP] Mentor: Dr Vikram	**Introduction to Industry 4.0 and Industrial Internet of Things** (12 Week) Mentor: Dr Vikram

Note:

1. In each semester (starting from V to VIII semester), it is required to opt for new subjects towards Honours Degree/ Minor Specialization.
2. Credit for opting a particular NPTEL course will be given only once throughout the tenure of B.Tech. program

(ii) **Minor Specialization (for students of other departments)**

Following courses are identified & proposed for their requirement towards getting **Minor Speciation in Electrical Engineering:**

Course Name	Offered By	Duration of the course	Start date	End date	Exam date	Name of the Mentor faculty
Basic Electrical Circuits	IITM	12 Weeks	July 22, 2024	October 11, 2024	October 26, 2024	Prof Vishal Chaudhary
Electrical Machines – I	IIT KGP	12 Weeks	July 22, 2024	October 11, 2024	October 26, 2024	Prof Ashis Patra
Electrical Measurement and Electronic Instruments	IIT KGP	12 Weeks	July 22, 2024	October 11, 2024	October 27, 2024	Dr Ankit Tiwari
A Basic Course on Electric and Magnetic Circuits	IIT KGP	12 Weeks	July 22, 2024	October 11, 2024	October 27, 2024	Dr Vijay Bhuria
Control Systems	IIT Madras	12 Weeks	July 22, 2024	October 11, 2024	November 2, 2024	Dr Vikram

Note:

- In each semester (starting from V to VIII semester), it is required to opt for new subjects towards Honours Degree/ Minor Specialization.
- Credit for opting a particular NPTEL course will be given only once throughout the tenure of B.Tech. program

Item EE 8. To review and finalize the scheme structure of B.Tech. V Semester under the flexible curriculum (for the Batch admitted in 2022-23)

The Scheme structure of the B.Tech. V Semester EE of 2022-23 admitted batches under the flexible curriculum is at **ANNEXURE -5.**

Item EE 9. To review and finalize the syllabi for all Departmental Core (DC) Courses of B.Tech. V Semester (for batch admitted in 2022-23) under the flexible curriculum along with their COs.

The Syllabi along with the Course Outcomes of V semester of the B.Tech. EE students of 2022-23 admitted batch under the flexible curriculum is included at **ANNEXURE-6**

Item EE 10. To review and recommend the Experiment list/ Lab manual for all the Laboratory Courses to be offered in B. Tech. V Semester (for batch admitted in 2022-23)

List of experiments and course outcomes is annexed at **ANNEXURE-7.**

Item EE 11. To review and recommend the list of projects which can be assigned under the 'Skill based mini-project' category in various laboratory components based courses to be offered in B.Tech. V Semester (for the batch admitted in 2022-23).

List of projects which can be assigned under the 'Skill based mini-project' category in various laboratory components based courses to be offered in B.Tech. V Semester EE

students of 2022-23 admitted batch under the flexible curriculum is included at **ANNEXURE-8**

Item EE 12. To propose the list of courses from SWAYAM/NPTEL/MOOC Platforms to be offered (for the batch admitted in 2022-23) in online mode under Self-Learning/ Presentation, in the B. Tech. V Semester.

Course Name	Offered By	Duration of the course	Start date	End date
Business And Sustainable Development	IITB	4 Weeks	August 19, 2024	September 13, 2024
Selection of Nanomaterial for Energy Harvesting and Storage Application	IIT Roorkee	4 Weeks	July 22, 2024	August 16, 2024
Electrophysiology of Heart	IIT KGP	4 Weeks	August 19, 2024	September 13, 2024
Fundamentals Of Electronic Device Fabrication	IITM	4 Weeks	July 22, 2024	August 16, 2024
Patent Drafting For Beginners	IITM	4 Weeks	July 22, 2024	August 16, 2024
Sociology And Resource Management	IIT KGP	4 Weeks	August 19, 2024	September 13, 2024
Water, Society And Sustainability	IIT KGP	4 Weeks	August 19, 2024	September 13, 2024
Python for Data Science	IITM	4 Weeks	July 22, 2024	August 16, 2024

Item EE 13. To review and finalize the scheme structure of B.Tech. III Semester under the flexible curriculum (Batch admitted in 2023-24)

The Scheme of the B.Tech III Semester EE of 2023-24 admitted batch under the flexible curriculum is at **ANNEXURE -9.**

Item EE 14. To review and finalize the syllabi for all Departmental Core (DC) Courses of B. Tech. III Semester (for batch admitted in 2023-24) under the flexible curriculum along with their COs.

The Syllabi along with the Course Outcomes of III semester of the B.Tech. EE students of 2023-24 admitted batch under the flexible curriculum is included at **ANNEXURE-10**

Item EE 15. To review and recommend the list of experiments and skill-based mini projects of B.Tech. III semester (for batch admitted in 2023-24)

The Experiment list/ Lab manual and skill based mini projects for various laboratory courses to be offered in along with the Course Outcomes of III semester of the B.Tech. EE students of 2023-24 admitted batch under the flexible curriculum is included at **ANNEXURE-11.**

Item EE 16. To propose the list of courses from SWAYAM/NPTEL/MOOC Platforms to be offered in the B.Tech. III Semester (for batches admitted in 2023-24) in online mode under Self-Learning/ Presentation.

Course Name	Offered By	Duration of the course	Start date	End date
Business And Sustainable Development	IITB	4 Weeks	August 19, 2024	September 13, 2024
Selection of Nanomaterial for Energy Harvesting and Storage Application	IIT Roorkee	4 Weeks	July 22, 2024	August 16, 2024
Fundamentals Of Electronic Device Fabrication	IITM	4 Weeks	July 22, 2024	August 16, 2024
Patent Drafting For Beginners	IITM	4 Weeks	July 22, 2024	August 16, 2024
Sociology And Resource Management	IIT KGP	4 Weeks	August 19, 2024	September 13, 2024
Water, Society And Sustainability	IIT KGP	4 Weeks	August 19, 2024	September 13, 2024
Python for Data Science	IITM	4 Weeks	July 22, 2024	August 16, 2024

Item EE 17. To review and recommend the Scheme structure & Syllabi of PG Programme (M.E./ M.Tech./ MCA/MBA) along with their Course Outcomes (COs)

No change is proposed in the Scheme structure and Syllabus of PG programme offered by the department.

Item EE 18. To review and recommend the Scheme structure and Syllabus of Ph.D. Course Work (specific to Doctoral Research Scholars, if any)

No change is proposed in the Scheme structure and Syllabus of Ph.D. Course Work

Item EE 19. To review the CO attainments, to identify gaps and to suggest corrective measures for the improvement in the CO attainment levels for all the courses taught during July-Dec 2023 session.

The CO attainments for each course was computed by the respective faculty are compiled for all the courses taught during July-Dec 2023 session. The gap in attainment, if any, was identified and the corrective actions to be taken were proposed by the subject faculty is reviewed. The CO attainment level of the subject in the above duration is annexed at **ANNEXURE -12**.

Item EE 20. To review the PO attainments levels and suggest the actions to be taken for improvement in PO attainment

The PO attainment levels are computed for the academic batch 2019-2023 and the analysis is made for action to be taken for improvement in attainment levels. The detail document is annexed at ANNEXURE -13.

Item EE 21. To review curricula feedback from various stakeholders, its analysis, and impact

The Feedback on the curriculum is taken from the Stakeholder (Students, Faculty, Alumni, and Employer) in online mode using Moodle &Google Forms. The analysis is carried out on a scale of 1-5. Few suggestions were received from the alumni & employer. Some of them are already in place. The feedback analysis is annexed at **ANNEXURE -14.**

Dr. M. Pandit	Dr. A.K. Wadhwani	Dr. S. Wadhwani	Prof. Ashish Patra	Dr. Shishir Dixit
Prof. Rakesh Narvey	Dr. Himmat Singh	Dr. Vijay Bhuria	Prof. Kuldeep Swarnkar	Prof. Vishal Chaudhary
Dr. Vikram	Dr. Ankit Tiwari	Dr Nikhil Paliwal	Prof. Manoj Kumar	
Prof Anuj Lodhi	Prof Poonam Singh	Prof Richa Sharma		

Annexure-1 Scheme VII Semester

Scheme of Evaluation B. Tech. VII Semester (Electrical Engineering) (2021-22 Admitted Batch)

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted									Total Marks	Contact Hours /week			Total Credits	Mode of Teaching	$$Mode of Exam.
				Theory Slot				Practical Slot			MOOCs								
				End Term Evaluation		Continuous Evaluation		End Sem. Exam.	Continuous Evaluation		Assign-ment	Exam		L	T	P			
				End Sem. Exam.	$Proficiency in subject	Mid Sem. Exam	Quiz/ Assignment		Lab work & Sessiona	Skill-Based Mini Project									
1.	1307xx	DE	Departmental Elective**(DE-2)	50	10	20	20	-	-	-	-	-	100	3	-	-	3	Blended	PP
2.	1307yy	DE	Departmental Elective* (DE-3) - MOOC	-	-	-	-	-	-	-	25	75	100	3	-	-	3	Blended	MCQ
3.	1307zz	DE	Departmental Elective* (DE-4) - MOOC	-	-	-	-	-	-	-	25	75	100	3	-	-	3	Blended	MCQ
4.	OC-2	OC	Open Category**(OC-2)	50	10	20	20	-	-	-	-	-	100	3	-	-	3	Blended	PP
5.	130720	DLC	Electrical Drives Lab	-	-	-	-	60	40	-	-	-	100	-	-	4	2	Offline	SO
6.	130721	DLC	Industrial Automation Lab	-	-	-	-	25	25	-	-	-	50	-	-	2	1	Offline	SO
7.	130722	DLC	Summer Internship Project-III (04 weeks)(Evaluation)	-	-	-	-	60	-	-	-	-	60	-	-	4	2	Blended	SO
Total				100	20	40	40	145	65	-	50	150	610	12	-	10	17	-	-
8	1000008	MAC	Universal Human Values & Professional Ethics (UHVPE)	50	10	20	20	-	-	-	-	-	100	2	-	-	Grade	Blended	MCQ
Additional Course for Honours or minor Specialization (Permitted to opt for maximum two additional courses for the award of Honors or Minor specialization)																			

$ Proficiency in course/subject-includes the weightage towards ability/skill/competence/knowledge level/ expertise attained etc. in that particular course/subject.

$$MCQ: Multiple Choice Question $$AO: Assignment + Oral $$PP: Pen Paper $$SO: Submission + Oral

* Course run through SWAYAM/NPTEL/ MOOC Learning Based Platform with Credit Transfer ** Course run in Traditional Mode

Compulsory registration for one online course using SWAYAM/NPTEL/MOOC, evaluation through attendance, assignments and presentation

1. In each semester (starting from V to VIII semester), it is required to opt for new subjects towards Honours Degree/ Minor Specialization.
2. Credit for opting a particular NPTEL course will be given only once throughout the tenure of B.Tech. program

*DE-3 (SWAYAM/NPTEL/ MOOC platform)		*DE-4 (SWAYAM/NPTEL/ MOOC platform)		**DE-2 (Traditional Mode)		**Open Category (OC-2) (for other disciplines)	
Code	Course Name	Code	Course Name	Code	Course Name	Code	Course Name
130761	DC Microgrid And Control Systems	130765	Sensor Technologies: Physics, Fabrication, And Circuits	130717	Utilization of Electrical Energy	910205	Applications of Electrical Equipment & Motors
130762	Economic Operations And Control Of Power Systems	130767	Digital Switching-I	130718	Electrical Drives	910206	Sensor Technology
130763	Sustainable Power Generation Systems	130768	Real-Time Discrete Signal Processing	130719	Electric Vehicles	910207	Electric Vehicle

Mode of Teaching						Mode of Examination					Total Credits
Theory			Lab	MOOC	SIP	Theory			Lab	SIP/SLP/NEC	
Offline	Online	Blended	Offline	Online Mentoring	Interactive	PP	AO	MCQ	SO	SO	
-	-	6	3	6	2	6	-	6	3	2	17
-	-	35.3%	17.6%	35.3%	11.8%	37%	-	35.3%	17.6%	11.8%	Credits %

B. Tech. with Honors (Electrical Engineering)

(For students of the host department: Electrical Engineering)

*** Course run through SWAYAM/NPTEL/ MOOC Learning Based Platform**

(In each semester, starting from V to VIII semester, students are required to opt for new subjects)

Specialization 1: Control System & Instrumentation	Specialization 2: Power System & Energy
Course Name:	**Course Name:**
Advanced Linear Continuous Control Systems: Applications with MATLAB Programming and Simulink (08 weeks) Mentor: Prof Ashis Patra	**Smart Grid: Basics to Advanced Technologies** (12 weeks) Mentor: Dr Himmat Singh
Electronic Systems Design: Hands-on Circuits and PCB Design with CAD Software (12 Week) Mentor: Dr Ankit Tiwari	**Design of Photovoltaic Systems** (12 Week) Prof Vishal Chaudhary
Power Electronics with Wide Band Gap Devices (12 Week) Prof Manoj Kumar	**Advances in UHV Transmission and Distribution** (8 Week) Mentor: Prof Vishal Chaudhary
Introduction to Industry 4.0 and Industrial Internet of Things (12 Week) Mentor: Dr Vikram	**Introduction to Industry 4.0 and Industrial Internet of Things (12 Week)** Mentor: Dr Vikram

Note: In each semester (starting from V to VIII semester), it is required to opt for new subjects towards Honours Degree/ Minor Specialization.
Credit for opting a particular NPTEL course will be given only once throughout the tenure of B.Tech. program

B. Tech. with Minor Specialization in Electrical Engineering

(For students of the other department)

*** Course run through SWAYAM/NPTEL/ MOOC Learning Based Platform**

Course Name	Course Name
Basic Electrical Circuits (12 weeks) Mentor: Prof Vishal Chaudhary	**Electrical Machines – I (12 Week)** Mentor Prof Ashis Patra
A Basic Course on Electric and Magnetic Circuits (12 Weeks) Mentor: Dr Vijay Bhuria	**Control Systems** Mentor: Dr Vikram
Electrical Measurement and Electronic Instruments Mentor: Dr Ankit Tiwari	**Smart Grid: Basics to Advanced Technologies** (12 week) Mentor: Dr Himmat Singh

Note: In each semester (starting from V to VIII semester), it is required to opt for new subjects towards Honours Degree/ Minor Specialization.
Credit for opting a particular NPTEL course will be given only once throughout the tenure of B.Tech. program

Annexure-2 DE Courses

Utilization of Electrical Energy: 130717

Course Objective:

- To provides an introduction to the principles of electrical drives and their applications in daily life.
- To deals with the fundamentals of illumination and its classification.
- To provides knowledge on electrical traction systems

Unit-I Electric Drives Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, particular applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization.

Unit-II Electric Heating & Electric Welding Advantages and methods of electric heating, resistance heating, induction heating, and dielectric heating. Electric welding, resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

Unit- III Illumination Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light. Discharge lamps, MV and SV lamps comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting.

Unit-IV Electric Traction I System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, methods of electric braking – plugging, rheostatic braking and regenerative braking. Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves.

Unit -V Electric Traction II Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion. Introduction to EMU and Metro railways

Reference Books:

1. Utilization of Electrical Energy - by E. Opens haw Taylor, University Press.
2. Art & Science of Utilization of Electrical Energy - by Par tab, Dhanpat Ravi & Sons.
3. Utilization of Electrical Power including Electric drives and Electric traction – by N.V. Suryanarayana, New Age International (P) Limited, Publishers, 1996.
4. Generation, Distribution and Utilization of Electrical Energy - by C.L. Wadhwa New Age International (P) Limited, Publishers, 1997

Course Outcomes

CO1. Analyze the operating principles and characteristics of traction motors with respect to speed, temperature, loading condition
CO2. Describe different types of heating and welding techniques
CO3. Explain principles of illumination and its measurement
CO4. Explain basic principle of electric traction including speed–time curves of different traction services
CO5. Describe braking, acceleration and other related parameters of traction system, including demand side management.

Electrical Drives: 130718

Course Objectives:

- To provide an over view of complete electrical drive systems to students, including the mechanical parts, electrical machines, and power converters and control.
- To expose the students to the basic and advanced speed control techniques using power electronic converters that are used in industry.

Unit-I Basic Concepts: Elements of drive system, Requirements of electric drives. Ratings and selection of drives, Group and individual drives, constant power and constant torque drive. Dynamics of Electric drive convention and multi quadrant operation. Transient and steady state stability of Electrical drive. Control of Electrical drive, modes of operation, speed control and drive classification, closed loop control of drive.

Unit-II DC Drives: DC motor drives, DC motor and their performance, starting, braking, transient analysis and control, Ward Leonard drives, Thyristorised controlled DC drives, chopper controlled DC drives.

Unit-III Induction Motor Drives: Three phase induction motors Drives, starting, braking, transient operation, Variable frequency control from voltage and current source, rotor resistance control, static Scherbius and Kramer drives, introduction to vector control.

Unit-IV Synchronous Motor Drives: synchronous motor drives, synchronous motor operation from fixed frequency supply, synchronous variable speed drives, self-controlled synchronous motor drives, brushless DC motor, stepper motor and switched reluctance motor drives.

Unit-V Special Drives: Solar and battery powered drives, solar powered electrical vehicles and boat, Traction Drives nature of traction load, conventional DC and AC Traction drives, Energy conservation in electric drives, Servo drives.

Recommended Books:

1. Fundamentals of Electrical Drives by G.K. Dubey, CRC Press, 2nd Ed.2007
2. A first course in Electric Drives by S.K. Pillai, New Age International, 2nd Ed.2007
3. Power Electronics and AC Drives by B.K. Bose, IEEE Press, Newjersey,2001
4. Electrical Drives Concept & Application by Vedam Subrahmanyam, Tata Mcgraw Hill, 2nd Ed.2011.

Course Outcomes:

After the completion of the course, the student will be able to –

CO 1. Describe various components of a drive system along with modes of operation, control needs and identify stable/unstable regions

CO 2. Explain various drives & loads, their characteristics and control methods under various operating

CO 3. Explain performance analysis & control of ac &dc drives

CO 4. Describe working static converters for speed control of different types of drives

CO 5. Explain the functioning of solar, battery powered and traction drives and explain energy conservation methods

Electric Vehicles: 130719

Course Objectives: To impart knowledge on areas like how to choose a suitable drive scheme in developing electric vehicles depending on resources to develop basic schemes, design proper energy storage systems and usage of various protocols of communication under the umbrella of electrical vehicles.

Unit I: Background of EVs
History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles. Advantages & Disadvantages of EVs, Electric Revolution, Types of EVs (Plug-in EVs, ground vehicles, air borne, sea borne, Hybrid EVs, on-and-off road EVs), and Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics.

Unit II: Electric Drive-Trains& Propulsion
Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, Tractive effort, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives.

Unit III: Energy Storage & Management
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel cell-based energy storage and its efficiency analysis, Battery Management System, Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies. Vehicle to grid (V2G) and Grid to Vehicle (G2V) fundamentals.

Unit IV Vehicle Dynamics &Charging
Electric Vehicle Dynamics: Acceleration, Braking, Suspension &Ride Comfort;
Electric Vehicle charging: Introduction, Slow/ fast chargers, Swapping, Standardization, On board chargers, Public Chargers, Bulk chargers.

Unit V Sizing & Selection
Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications.

Recommended Books:
1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2005.

Course Outcomes:

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

CO 1. **Interpret** the environmental importance of electric vehicles and their role in society.
CO 2. **Discuss** electric drive train topologies and propulsion mechanisms used in EVs
CO 3. **Design** energy storage and management strategies for V2G and G2V concepts.
CO 4. **Analyze** dynamics of EVs for constant and variable tractive efforts and charging.
CO 5. **Select** different components and sizes of EVs.

Annexure-3 OC Courses

Applications of Electrical Equipment & Motors: 910205

Course Objectives: To impart knowledge on electrical appliances and their applications, safety on electrical equipment, electric motors, traction system considering economic and technology up gradation.

Unit-I Safe Working on Electrical Equipment: Authorized Person, procedure for shutdown, testing devices for electricity, special shutdown precautions in substations and Power House, safety measures on LV & HV electrical equipment, Electrical Safety: Standards and Regulations

Unit-II Utility of Electrical Equipment: Electrical motors, transformers, cables, and generators, motor control centers, medium voltage distribution panels, power control centers, Motor used in Electric vehicle, Electrical wiring components and accessories, Modern Appliances: Troubleshooting and Maintenance.

Unit-III Substation Equipment: Bus bar, Temperature rise test, rated short time current test, HV test, Power frequency voltage withstand test, Earthling Equipment, Isolator testing equipment, switch gear equipment: relay, CT,PT

Unit-IV Electric Motors Drives: Introduction, Individual and group drive, Factor affecting selection of motor, Types of loads, Revised study of speed torque characteristics of DC and AC motor, Transient Characteristics, size and rating of motors, continuous & intermittent rating, Temperature rise calculation, Load Equalization, Motor enclosures

Unit-V Electric Traction Equipment: Introduction, requirements of an ideal traction system, supply systems for track-electrification, Comparison and application of different systems, Train Movement: speed time and speed distance curves, average and schedule speed, Mechanics of train movement: energy consumption Tractive effort, Factor affecting specific energy consumption, Coefficient of adhesion, Types of motors used for electric traction, current collection systems

Recommended Books:

1. Art and Science of Utilization of Electrical Energy by H. Pratab, Dhanpat Rai and Company, 2nd Ed., 2007.
2. Electric Power Utilization by N.N. Hanock, Wheeler publishing, 1stEd.,1967.
3. Utilization of Electric energy by E.Open shaw Taylor, Orient Longman,1stEd.,1961.
4. Generation Distribution and Utilization of Electrical Energy by C.L. Wadhwa, New Age publications, 1stEd.,1989.

Course Outcomes:

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

CO 1. Discuss the safety procedures involved with electrical equipment.

CO 2. Describe the **working** principle of substation equipment

CO 3. Explain the basics of lighting and illumination and its parameters and able to design Illumination systems for various applications.

CO 4. Explain various drives & loads, their characteristics and control methods under various operating

CO 5. Apply the electrical energy applications for traction and understand the power electronics technology in efficient utilization of electrical power.

Sensor Technology: 910206

Course Objective: Introduction to various types of sensors and the design of basic circuit building blocks.

Unit-I Sensors Fundamentals and Characteristics: Sensor, actuator and transducer, Signals and Systems; Sensor Classification: passive and active Sensor, absolute and relative Sensor; Units of Measurements; Sensor Characteristics: Transfer Function, Calibration, Nonlinearity, Saturation Repeatability, Dead Band, Resolution.

Unit-II Principle of Sensing & Transduction: Mechanical and Electromechanical sensor, Resistive (potentiometric type), Strain gauge, Inductive sensor: common types- Reluctance change type, LVDT, Capacitive Sensors, Thermal Sensors, Magnetic Sensors, Proximity Sensor, Piezoelectric Effect.

Unit-III Interface Electronic Circuits: Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors.

Unit-IV Smart Sensor Technologies: Architecture of Smart Sensor: Features, Fabrication of Sensor And Smart Sensor, Integration of Micromachining and Microelectronics, Wafer bonding, LIGA process, Standard of Smart Sensor Network, Communication for smart sensors.

Unit V Sensors in Different Application Area: Occupancy and Motion Detectors; Position, Displacement, and Level; Velocity and Acceleration; Force, Strain, and Tactile Sensors; Pressure Sensors Neurosensors, Biosensors, MEMS Sensors**,** Sensors for Mechanical Shock, Machinery Vibration Monitoring Sensors, Humidity Sensors, Electromagnetism in Sensing.

Recommended Books:

1. John S.Wilson “Sensor Technology” 4THedition,Elsevier.2005
2. Jacob Fraden “Sensor Technology Design & Application”4th edition, Springer. 2010
3. Frank “Understanding Smart Sensors”2nd Ed.2002.
4. Ramon P. A. and Webster J. G., “Sensors and Signal Conditioning” 2nd 2001 Ed., John Wiley and Sons.
5. Feng Z. and Leonidas G., “Wireless Sensor Networks”, Elsevier Eastern Limited. 2007.
6. Barney G., “Intelligent Instrumentation”, Prentice-Hall International Editions.
7. Yamasaki H., “Intelligent Sensors”, Elsevier Eastern Limited. 1996.

Course Outcomes:

After completing this course, the student will be able to:

CO 1. Explain fundamentals of sensors & transducers.
CO 2. Describe physical principles of sensing.
CO 3. Compare various sensor materials and technology used in designing sensors.
CO 4. Select appropriate sensor for given application.
CO 5. Recognize the latest trends in the field of sensor.

Electric Vehicles: 910207

Course Objectives: To impart knowledge on areas like how to choose a suitable drive scheme in developing electric vehicles depending on resources to develop basic schemes, design proper energy storage systems and usage of various protocols of communication under the umbrella of electrical vehicles.

Unit I: Background of EVs
History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles. Advantages & Disadvantages of EVs, Electric Revolution, Types of EVs (Plug-in EVs, ground vehicles, air borne, sea borne, Hybrid EVs, on-and-off road EVs), and Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics.

Unit II: Electric Drive-Trains& Propulsion
Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, Tractive effort, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives.

Unit III: Energy Storage& Management
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel cell-based energy storage and its efficiency analysis, Battery Management System, Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies. Vehicle to grid (V2G) and Grid to Vehicle (G2V) fundamentals.

Unit IV: Vehicle Dynamics &charging
Electric Vehicle Dynamics: Acceleration, Braking, Suspension &Ride Comfort;
Electric Vehicle charging: Introduction, Slow/ fast chargers, Swapping, Standardization, On board chargers, Public Chargers, Bulk chargers.

Unit V: Sizing & Selection
Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications.

Recommended Books:
1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2005.

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

CO 1. **Interpret** the environmental importance of electric vehicles and their role in society.
CO 2. **Describe** electric drive train topologies and propulsion mechanisms used in EVs
CO 3. **Design** energy storage and management strategies for V2G and G2V concepts.
CO 4. **Analyze** dynamics of EVs for constant and variable tractive efforts and charging.
CO 5. **Select** different components and sizes of EVs.

Annexure-4 List of Experiments VII Semester EE

Electrical Drives Lab: 130720

List of Experiments

1. To perform speed Control of DC shunt motor using single phase Semi-converter.
2. To perform the operation of single phase full wave controlled rectifier with DC motor load.
3. To perform and analyze the Non-circulating current mode of three phase dual converter.
4. To perform and analyze the Circulating current mode of three phase dual converter.
5. To perform the V/f control of 3 phase Induction Motor using Voltage Source Inverter (VSI).
6. Perform and analyze the Open loop speed control of DC Motor using chopper in all four quadrants.
7. To operate and perform microcontroller (DSP) based VSI for speed control of 3 phase Induction Motor.
8. To perform Speed control of Induction Motor using single phase SCR based regulator.
9. To perform Speed control of three phase motor using Three phase SCR based regulator.
10. Determination of performance and characteristic of single phase SCR full bridge inverter with R load.

Course Outcomes:

After completing the course, the students will be able to:

CO 1. Compare the performance of converters with and without modulation

CO 2. Plot the characteristics of drives with changing parameters.

CO 3. Comment on the advantages & limitations of various converters used in industrial drives.

CO 4. Develop teamwork skills for working effectively in groups.

CO 5. Prepare technical report on experiments conducted in the lab

Industrial Automation Lab: 130721

(CREATIVE PROBLEM SOLVING)

List of Experiments

1. To Realize Logic Gates using PLC ladder programming.
2. To observe the Timer and Counter operation in PLC using toggle switch.
3. To Realize the Doorbell operation using push buttons at door or main gate.
4. To observe the performance of starter control for 3 phase slip ring induction motor.
5. To control the sequential operation of four motors with delay times.
6. To observe the traffic light control in different traffic density.
7. To observe the automatic parking system with sensors control.
8. To understand working model of lift elevator simulator using PLC control.
9. To understand working model of Conveyer belt using PLC control.
10. To understand working model of Rotary Transfer Unit using PLC control.

Course Outcomes:

After completing the course, the students will be able to

CO1.Perform the programming of PLC ladder diagrams

CO2. Select appropriate Logic Gate operations

CO3. Analyze industrial automation system with sequential machines control

CO4. Develop small application using PLC & sensors to the real world

Annexure-5 Scheme V Semester

Scheme of Evaluation B.Tech. V Semester (Electrical Engineering)

For batch admitted in academic session 2022– 2023

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching	^{SS}Mode of Exam.
				Theory Slot				Practical Slot									
				End Term Evaluation		Continuous Evaluation		End Sem. Exam	Continuous Evaluation			L	T	P			
				End Sem. Exam	$^{\$}$Proficiency in subject /course	Mid Sem. Exam	Quiz/ Assignment		Lab Work & Sessional	Skill-Based Mini Project							
1.	2130511	DC	Signals & Systems	50	10	20	20	-	-	-	100	3	-	-	3	Blended	PP
2.	2130512	DC	Control System	50	10	20	20	60	20	20	200	2	1	2	4	Blended	PP
3.	2130513	DC	Power Electronics	50	10	20	20	60	20	20	200	2	1	2	4	Blended	PP
4.	2130514	DC	Switchgear & Protection	50	10	20	20	60	20	20	200	2	1	2	4	Blended	PP
5.	2130515	MC	Data Science	50	10	20	20	60	20	20	200	3	-	2	4	Blended	MCQ
6.	2130516	DLC	Minor Project-I**	-	-	-	-	60	40	-	100	-	-	4	2	Offline	SO
7.	2130517	DLC	**Self-learning/Presentation** (SWAYAM/NPTEL/ MOOC)#	-	-	-	-	-	40	-	40	-	-	2	1	Online+ Mentoring	SO
8.	200xxx	CLC	**Novel Engaging Course** (Informal Learning)	-	-	-	-	50	-	-	50	-	-	2	1	Interactive	SO
9.	2130518	DLC	**Summer Internship Project–II (Institute Level Evaluation)**	-	-	-	-	60	-	-	60	-	-	4	2	Offline	SO
Total				**250**	**50**	**100**	**100**	**410**	**160**	**80**	**1150**	**12**	**3**	**20**	**25**		
10.	1000006	MAC	Disaster Management	50	10	20	20	-	-	-	100	2	-	-	Grade	Blended	MCQ
Additional Course for Honours or Minor Specialization				**Permitted to opt for maximum two additional courses for the award of Honours or Minor Specialization**													

$proficiency in course/subject includes the weightage towards ability/skill/competence/knowledge level/ expertise attained etc. in that particular course/subject.

^{SS}**MCQ:** Multiple Choice Question ^{SS}**AO:** Assignment + Oral ^{SS}**PP:** Pen Paper ^{SS}**SO:** Submission + Oral

** **Minor Project-I may be evaluated by an internal committee for awarding sessional marks.**

Compulsory registration for one online course using SWAYAM/NPTEL/MOOC, evaluation through attendance, assignments and presentation

Mode of Teaching						Mode of Examination					Total Credits
Theory				Lab	NEC	Theory			Lab	SIP/ SLP/ NEC	
Offline	Online	Blended		Offline	Interactive	PP	AO	MCQ	SO	SO	
		Offline	Online								
-	-	10	5	9	1	12	-	3	6	4	25
-	-	40%	20 %	36 %	4.0%	48 %	-	12 %	24 %	16 %	Credits %

Annexure-6 Syllabus V Semester

Signals & Systems: 2130511

Course Objectives:

To develop an understanding of fundamental characteristics of signals and systems in both time, frequency and complex domains and to develop mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

Unit I. Dynamic Representation of Systems: Definition & Classification of signals, Systems Attributes, Causality, linearity, Stability, time invariance. Special Signals, Complex exponentials, Singularity functions (impulse and step functions). Linear Time-Invariant Systems: Differential equation representation convolution Integral. Discrete form of special functions. Discrete convolution and its properties, Realization of LTI system (differential and difference equations).

Unit II. Fourier Analysis of Continuous Time Signals and Systems: Continuous-Time Fourier Series and its properties, Continuous-Time Fourier Transform and properties, Parseval's theorem, Frequency response of LTI systems.

Unit III. Fourier Analysis of Discrete Time Signals & Systems: Discrete-Time Fourier series and its properties, Discrete-Time Fourier Transform (including DFT) and properties, Frequency response of discrete time LTI systems, Fast Fourier Transform (FFT).

Unit IV. Laplace Transform: Laplace Transform and its inverse: Definition and existence conditions, Region of Convergence and properties, Significance of poles & zeros, Application of Laplace transform for the analysis of continuous time LTI system (stability etc.). Z-Transform**:** Z-Transform and its inverse: Definition and existence conditions, Region of convergence and properties, Application of Z-Transform for the analysis of Discrete time LTI Systems, Significance of poles and zeros.

Unit V. Sampling: The sampling theorem, reconstruction of signal from its samples, sampling in the frequency domain, sampling of discrete-time signals.

Recommended Books:

1. Signal and systems by Oppenheim AV, Willisky AS and Nawab SH, Pearson
2. Signals and systems by Hwel. P. Hsu, Schaum's outlines, TME
3. Digital Signal Processing Principles by Proakis JP, Manolaxis, Pearson
4. Fundamentals of Signals & Systems by Michael J Roberts, McGraw Hill

Course Outcomes

After the completion of this course, students will be able to:

- **CO 1.** **Explain** the process of sampling and the effects of under sampling.
- **CO 2.** **Classify** systems based on their properties and determine the response of LTI system using convolution.
- **CO 3.** **Apply** the concepts of linear algebra to signals.
- **CO 4.** **Analyze** the spectral characteristics of continuous-time periodic and a periodic signal using Fourier analysis.
- **CO 5.** **Analyze** system properties based on impulse response and Fourier analysis.
- **CO 6.** **Apply** the Laplace transform and Z- transform for analysis of continuous-time and discrete-time signals and systems.

Control System: 2130512

Course Objective:

- To expose the students to the mathematical modeling of the various physical systems, the concept of time-domain response (transient and steady-state response) and frequency-domain analysis of the systems, stability analysis of the systems, specifications of controller and compensator design and its implementations.

Unit-I Modeling of Physical Systems: Transfer Function of Electrical and Mechanical systems. Feedback characteristics of control systems, Open loop and closed loop systems, effect of feedback sensitivity to parameter variations, Block diagram representation and reduction techniques, Signal flow graphs, Mason's rule. Control systems and its components, error sensing devices: Potentiometers, Tacho generators and Synchros, A.C. & D.C. servomotor.

Unit-II Time Response Analysis: Transient Response Analysis: Transient and steady-state response analysis for first and second order systems and their qualitative analysis; error analysis and error constants., Derivative and Integral error compensation, P, PI, PD, PID Controller.

Unit-III Frequency Response Analysis: Frequency domain specifications of second order system, Polar plot, Bode plots, M Circles, N Circles. Compensator Design: Lead, lag and lag-lead compensation using frequency response methods.

Unit-IV State Variable Analysis: Concept of state, state variables and state models, state equations and state transition matrix, relationship between transfer function and state equations, control system with state variable feedback, controllability & observability.

Unit-V Stability: Stability, Absolute and relative stability, Routh Hurwitz stability criteria, Root Locus Analysis: Development of root loci, effects of pole/zero on loci, Nyquist plot &Nyquist stability criterion

Recommended Books:

1. Control System Engineering by I.J. Nagrath and M. Gopal, New Age International Publication.
2. Control Systems by U. A. Bakkshi, Technical Publication, Pune.
3. Linear Control Systems by B. S. Manke, Khanna Publishers
4. Automatic Control System by S.C. Gupta, New Age International Publication.
5. Control System Engineering by Norman Wiley Publication.
6. Automatic Control System by B.C. Kuo, Oxford University Press & Pearson Education.
7. Modern Control Engineering by K. Ogata, Pearson Education, Asia.

Course Outcomes

After the completion of this course students will be able to:

CO 1. **Determine** the mathematical models of mechanical, electrical and electromechanical systems

CO 2. **Represent** the complex system into standard canonical form by signal flow graph and block diagrams reduction rules

CO 3. **Compute** the time and frequency-domain responses of first and second-order systems to standard inputs.

CO 4. **Formulate** control engineering problems in state-variable form

CO 5. **Evaluate** the stability of a closed-loop control system in time-domain as well as in frequency-domain

Power Electronics: 2130513

Course Objective: To introduce the students the basic theory of power semiconductor devices and passive components, their practical application in power electronics and to familiarize the operation principle of AC-DC, DC-DC, DC-AC conversion circuits and their applications. Also to provide the basis for further study of power electronics circuits and systems with inclusion on soft switching techniques and EMI.

Unit-I Power Semiconductor Devices: Classification of Power electronic switches, Power diodes, Transistors, Power MOSFET, IGBT, Thyristor TRIAC and GTO, Thyristor static and dynamic characteristics, two transistor equivalent model, Turn on and turn-off. Design of Firing circuits and protection, Series and parallel operation.

Unit-II Controlled Rectifiers: Principle of phase-controlled converter operation, Single phase half wave, full wave and semi converters. Three phase half wave, full wave and semi converters and inverters, Power factor improvement, Symmetrical angle control. Pulse width modulation control, Effect of load and source inductance.

Unit-III Chopper: Principles of single quadrant, Two quadrant, four quadrant chopper, Control strategies, Pulse width modulation, Frequency modulation, Thyristor commutation schemes, switched mode power supplies, buck-boost regulators, Soft switching techniques.

Unit-IV AC voltage controller: Principle of Ac phase control, Single and three phase ac voltage controllers, practical cyclo-converter circuits, Single phase to single phase, three phase to single phase, three phase to three phase out put voltage control circuit, Cyclo-converter, Circulating and Non Circulating type, Dual converters.

Unit-V Inverter circuits: Principle of operation of voltage source inverter, Single phase and three phase inverters, Voltage control using PWM technique, Forced commutated thyristors, Current source inverters, Series inverter, Inverter applications. EMI in Power Electronics System.

Recommended Books:

1. Power Electronics by P.S. Bimbhra, Khanna Publishers,5th Ed., 2012
2. Power Electronics: Circuits, Devices & Applications by MH Rashid, Pearson, 5th Ed. 2012
3. Power Electronics by Cyril W. Lander , McGraw-Hill; 2nd Ed.,1987
4. Power Electronics Principles and Applications by Josheph Vidyathil, TMH,2010
5. Bose, B.K., Handbook of Power Electronics, IEEE Publications.

Course Outcomes:
After completing this course, the student will be able to:

CO 1. **Explain** the working principle of power electronics devices and their static/ dynamic characteristics**.**
CO 2. **Analyze** the configuration of AC to DC converter, Dual converter, chopper, cyclo-converter.
CO 3. **Classify** converters and identify their applications**.**
CO 4. **Develop** different model of different converters to calculate their performance parameter
CO 5. **Identify** the problems/limitations of power electronics devices, converters and suggest solutions.

Switchgear & Protection: 2130514

Course Objectives:

- To familiarize the students with the learn standard terms and definitions
- To expose the student to the need for protection and various protective devices, their construction, operating principle, torque equation, characteristics and field of application for different types of equipment to identify reasons for mal operation and their remedies

Unit-I Arc Interruption: Arc properties, Formation and extinction of arc, Restrikingand recovery voltage RRRV, different methods and control devices for arc extinction, Current chopping, Interruption of capacitive currents, Resistance switching. Type and classification of circuit breakers. Oil circuit breaker.

Unit-II Air blast and SF6 circuit breakers: Vacuum circuit breakers, duties and rating Maintenance and testing of OCB 's. Isolators, HRC fuse. Protective Relays: introduction, Definition of terms associated with protective relaying. Construction and characteristics of electromagnetic relays.

Unit-III Elements of static relays: Comparator, induction, distances and differential relays, microprocessor based digital relaying. Modern trends in power system protection, Auto reclosure, under and over frequency relays and their applications. Digital Protection. Numerical protection Introduction, block diagram of numerical relay, numerical over current protection.

Unit-IV Protection schemes: Protection of generators and transformers, percentage differential relay, Buchholz relay, different protections provided for generator and transformer, transmission line protection using over current relays, distance relays and carrier current protection, protection of motors and bus bars.

Unit-V Protection against Over Voltages: Power System transients, over voltage in transmission lines, fault clearance and lightning and switching surges, ground wire, lightning arrestors, basic impulse insulation level(BIL), insulation coordination, grounding of P.S. current limiting reactors, their uses and location protection against traveling waves.

Recommended Books:

1. Switchgear protection and power systems by Sunil S. Rao, Khanna publication, 13th edition, 2008.
2. Power system protection & Switchgear by Badriram, TMH publication, 2nd edition, 2011.
3. Switchgear and protection by Ravindranath and Chander, Newage publication, 2nd edition, 2012
4. Switchgear and protection by Deshpande , TMH Publication, 2004
5. Digital Protection by L.P. Singh New Age Publication, 2nd edition, 1997.

Course Outcomes:

After completing this course, the students will be able to:

CO 1. **Explain** the concepts, theories and features associated with protective relays and circuit breakers
CO 2. **Classify** relays and circuit breakers based on criteria such as construction, type of supply, working principle, actuating quantities
CO 3. **Select** relays and circuit breakers for specific equipments and applications
CO 4. **Design** protection schemes for generators, motors, transformers and transmission lines
CO 5. **Analyze** the behavior and performance of relays under different loading levels and faults
CO 6. **Select** the protective devices and their locations for protecting power systems against over voltages.

Data Science: 2130515

Course Objectives:

- To provide the fundamental knowledge of Data Science.
- To present the basic representation and exploratory data analysis used in Data Science.

Unit-I: Need for data science, benefits and uses, facets of data, data science process, Introduction of basics python tool, Setting working Directory, Creating and saving a script file, File execution, removing variables from environment, clearing environment, Commenting script files, Variable creation, Data types and associated operations, Arithmetic and logical operators.

Unit-II: Control structures, loop, Functions, data structures: Lists, Arrays, Tuples, Dictionary, Sets, NumPy library, Data Collection: Getting to know your data, Types of Data, Data collection strategies, Data Pre-processing, Feature engineering, Exploratory Data Analytics.

Unit-III: Descriptive Statistics, Mean, Standard Deviation, Skewness and Kurtosis, inferential statistics: hypothesis testing, probability: probability theory, conditional probability, Pandas library, data frame and data frame related operations, Reading files.

Unit-IV: Data Cleaning and Preparation, Handling Missing Data, Data Transformations using pandas and sklearn library, Removing Duplicates, Replacing Values, Detecting Outliers. Data visualization on different dataset using matplotlib and seaborn libraries, Scatter plot, Line plot, Bar plot, Histogram, Box plot, Pair plot.

Unit-V: Supervised learning: Regression, classification, Linear regression, logistic regression, Unsupervised learning: Clustering, Reinforcement learning, Data Science in Power Systems; Data Science in Renewable Energy Systems, Data Science in Smart Grids and IoT; Future Trends in Data Science, Real-world examples of data science in electrical engineering

Recommended Books:

1. Mastering Python for Data Science, Samir Madhavan
2. Introduction to Linear Algebra - by Gilbert Strang
3. Applied Statistics and Probability for Engineers – by Douglas Montgomery
4. Pattern Recognition and Machine Learning, Christopher M. Bishop

Course Outcomes:

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

CO1: Describe Data Science techniques and various tools such as file execution, variable creations, etc.

CO2: Use control structures and exploratory data analysis for Data processing.

CO3. Evaluate the nature of data using descriptive statistics.

CO4: Apply Data cleaning techniques for effective interpretation.

CO5: Apply data science techniques to analyze and optimize within the field of electrical engineering, including power systems, smart grids, and renewable energy

Annexure-7: V Semester List of Experiments

Control System Lab: 2130512

List of Experiments

1. To determine the Operational Characteristics of real time Air Temperature Controller.
2. To determine the operational characteristics of nonlinear element relay in a closed loop control system.
3. To find the error voltage generated for input DC voltages using potentiometer error detector.
4. To plot the frequency domain characteristics of the lead lag process.
5. To design and analyze an electronic PID controller for a closed loop control system.
6. To improve the performance of the closed loop control system with PI controller.
7. To observe and analyze the plant dynamic response using process reaction curve method.
8. To plot step response and obtain the time response specifications for given 2nd order system,
9. To plot step response of a given TF and system in state-space. Take different values of damping ratio ζ and natural undamped frequency w_n.
10. To plot ramp response of a given TF and system in state-space.

Course Outcomes

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

CO1. **Explore** the properties of different Controllers.

CO2. **Investigate** the time domain and frequency domain performance of system

CO3. **Develop** teamwork skills for working effectively in groups.

CO4. **Prepare** a technical report on experiments conducted in the lab.

Power Electronics Lab: 2130513

List of Experiments

1. To observe the performance of SCR using
   (i) R-triggering Circuit (Half-wave phase control)
   (ii) RC-triggering Circuit (Half-wave phase control and full wave phase control)
2. TRIAC/ SCR Triggering with series transistor-controlled ramp based on UJT/PUT
3. To determine the dv/dt capacity of SCR and design Snubber Circuits.
4. To observe the performance of Half controlled bridge rectifier (semi converter)
   (i) With Reactive load.
   (ii) With reactive load & freewheeling diode.

A To observe the performance of fully controlled bridge converter operates under rectification & inverter mode.

B To study the operation of AC phase controller using R and RL load

C To observe the performance of MOSFET based Buck Boost converter in open and closed loop

D Study of Force Commutation of SCR
   (i). Class-A or self-commutation by resonating the load.
   (ii). Class-B or self-commutation by LC Circuit.
   (iii). Class-C or Complementary commutation.
   (iv). Class-D or Auxiliary commutation.
   (v). Class-E or External pulse commutation.

E Realization of Half-wave Rectifier and Full-wave Rectifier with RL, RLE, FD Load using MATLAB.

F Realization of Voltage Source Inverter with three phase Load in MATLAB.
   (i). 1800 Conduction Mode
   (ii). 1200 Conduction Mode

Course Outcomes:

After completing the LAB course, the students will be able to

CO1 Demonstrate VI characteristics of Semiconductor Devices and Various Firing scheme of SCR.

CO2 Demonstrate the performance of various converters AC to DC and DC to AC converter

CO3 Compare the performance of single and three phases VSI Inverter.

CO4 Demonstrate the performance of converters in its different modes of operation.

CO5 Prepare an organized written report.

CO6 Develop the ability to work is team and learns professional ethics.

Switchgear & Protection Lab: 2130514
List of Experiments

1. To plot the characteristics & analyze the performance of under voltage relay
2. To plot the characteristics & analyze the performance of microprocessor based over voltage relay
3. To plot the characteristics & analyze the performance of electromechanical over current relay
4. To plot the characteristics of percentage biased differential relay (Static) at different biasing
5. To plot the characteristics of percentage biased differential relay (Electro-mechanical) at different biasing
6. To test the over current relay using the relay test bench
7. To operate Motor protection simulation panel
8. To operate Feeder protection simulation panel
9. To simulate distance relay and plot the characteristic by using MATLAB
10. To simulate IDMT relay and plot the characteristic using MATLAB

Course Outcomes:

After completing the lab course the students will be able to: -

CO 1. **Validate** the characteristics & performance of various Relays
CO 2. **Prepare** an organized written report.
CO 3. **Develop** the ability to work in a team
CO 4. **Learn** professional ethics.

Data Science: 2130515
List of Experiments

1. To program using arithmetic operators & logical operators each.
2. Write a function using recursion to print a factorial of number.
3. To write a program in python for demonstrating various functions (creating, appending, extending, etc.) of a list and dictionary.
4. To write a program to create one array using two existing NumPy arrays.
5. To write a program for the creation and manipulation of NumPy arrays- Indexing, Slicing, Reshaping, Joining and Splitting.
6. To write a program to create a 10 x 10 array with random values and find the minimum and maximum values.
7. To write a program to create the following data frame and fill in the missing values with last three digits of your enrolment number. Also, perform various operations (like describe, replacing values, removing null values, etc.)

Name	Institute	Height	Weight
AAA	MITS	6	75
BBB	JEC	NaN	80
CCC	SATI	6.5	NaN
DDD	RGPV	5.9	NaN

8. To write a program to Import Sample Dataset files (.csv,.xls) to Pandas Data Frame and perform the File Handling operations:
    i. Visualize the first and last 10 records
    ii. Get the shape, index and column details
    iii. Select/Delete the records (rows)/columns based on conditions.
    iv. Perform ranking and sorting operations.
    v. Rename single/multiple columns.
8. To write a program to visualize the following data using Line Plots, Bar Plots, Histograms, Density Plots and Scatter Plots, pie charts etc.
9. To write a linear regression program for the following data set.
10. To write a program to perform different image processing operations on a given image.

Annexure-8: V Semester Skill Based Mini Projects

Skill Based Mini Project
Control System Lab: 2130512

1. Design an intelligent traffic light & density control
2. Design an automatic sliding door with light control system
3. Design an object detection system using vibration damping control
4. Comparative study on Position Sensing Techniques for an Unmanned Aerial Vehicle
5. Design ofl Sensor System for Measuring Wheel Loads of Vehicles on Highways
6. Design and develop a line follower robot
7. Design and develop a race car which is controlled using different wireless protocols
8. Design and develop a smart safety helmet for driver health monitoring
9. Design and develop an early accident detection system for the vehicles
10. Design and develop smart safety gadgets for physically/mentally disabled persons.
11. Design and develop smart pet feeder system

Skill based Mini project
Power Electronics Lab: 2130513

1. Design circuit using Power Diode and analysis reverse recovery.
2. Develop circuit for synchronize pulse generation
3. Analysis switching circuit using GTO
4. Design the diode circuit with RL load.
5. Design the diode circuit with LC load.
6. Design the bidirectional power supply
7. Design firing circuit for SCR.
8. Design Half controlled bridge rectifier
9. Design Full controlled bridge rectifier.
10. Analyze AC phase controller using DSO for different load
11. Design variable DC Supply.
12. Design circuit for Amplitude modulation for Chopper
13. Design circuit for Frequency modulation for Chopper
14. Analyze the THD for rippled AC voltage using DSO
15. Analysis of PWM techniques for VSI Inverters

Skill based Mini project
Switchgear & Protection Lab: 2130514

1. Modeling and simulation of Differential Protection Relay Based on MATLAB Simulation
2. Modeling and Simulation of Inverse Time Overcurrent Relay using MATLAB/Simulink
3. Heat protection of a circuit using relay
4. Home safety system using relay and LDR
5. Current regulated short circuit protection using relay
6. Overcurrent protection relay circuit
7. Auto Blinking LED using Relay
8. Smart dustbin using aurdino
9. Electronic circuit breaker
10. Solid state circuit breaker using matlab
11. Dual Active Bridge Control model using simulink
12. Security system using laser light
13. Design of Automatic DC and AC phase changer circuit
14. Small motor protection
15. Over current protection using relay circuit matlab
16. Liquid level control using Relay
17. Speed Adjustable flasher circuit
18. Security Alarm using Laser light
19. Design a Overvoltage Relay using MATLAB Simulink
20. Flickering light using relay
21. Automatic Lighting System using IR Sensor
22. Reverse polarity protection with relay
23. Water level management using relays
24. Mobile phone detector using OP-AMP
25. Under voltage and over voltage protection
26. PWM Circuit Using 555 Timer - MATLAB and Simulink
27. Overcurrent relay modelling by using matlab software
28. Fire alarm with relay
29. Automatic street light Control using Relay
30. Relay based Liquid level Control
31. Adjustable flasher circuit with relay
32. 3 phase voltage source converting using Matlab and Simulink
33. Design a implementation of a simple overcurrent protection circuit
34. Design and Simulation of Overcurrent Protection System for Low Voltage Switchgear
35. DC short circuit protection using relay
36. Fault Detection and Diagnosis in High Voltage Switchgear using Intelligent Techniques
37. Generator Protection: A case study
38. Current Chopping in a circuit Breaker
39. Three phase appliance protector
40. Soft circuit protection relay
41. Analysis and optimization of a distribution network with switchgear using MATLAB optimization tools.

Skill based Mini project
Data Science: 2130515

1. 3D Graph using Python
2. Draw fractal tree using Python
3. Random Password Generator
4. Airport cab analysis
5. Draw Indian Flag using python
6. Automated mailing
7. Drawing on screen using motion sensing road lane line detection
8. Barcode generator using python
9. Ecommerce purchase analysis
10. Salary Prediction Using Linear Regression
11. Binary search using python
12. Email sender screen time analysis
13. Build a countdown calculator
14. Email slicer using python
15. Screen Time Analysis using python
16. Building a chatbot using python
17. Exploratory Data Analysis
18. Sign Language Recognition Using Python
19. Cab pickups Analysis
20. Facial Recognition attendance system using python-opencv
21. Calendar using python
22. Fake logo detection system
23. Speech emotion recognition
24. Calculator using python
25. GUI based Calculator
26. Speech emotion recognition using python
27. Camera Motion Sensing Using Open CV in Python
28. Speech to Text converter
29. Clock using python
30. Library management system
31. Strong automatic password generator
32. Collect college database using python
33. Linear regression
34. Converting image to sketch
35. OTP(one time password) generator using python
36. Text - Encoder Decoder
37. Create Chess board

38. Password authentication using python
39. Text to speech convertor
40. Credit card Fraud Detection using python
41. Ticket Booking System In Python
42. QR code generator using python
43. Traffic Signs Recognition Python Project
44. Designing in python using turtle library
45. Random Dice Roller
46. Virtual Assistant by Python

Annexure-9 Scheme III semester

Scheme of Evaluation B.Tech. III Semester (Electrical Engineering)

(for batch admitted in academic session 2023-24)

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching	Mode of Exam
				Theory Slot				Practical Slot									
				End Term Evaluation		Continuous Evaluation		End Sem. Exam	Continuous Evaluation			L	T	P			
				End Sem Exam	$Proficiency in subject	Mid Sem. Exam.	Quiz/ Assignment		Lab Work & Sessional	Skill Based Mini Project							
1.	3100025	BSC	Engineering Mathematics –II	50	10	20	20	-	-	-	100	2	1	-	3	Offline	PP
2.	3130301	DC	Electromagnetic Field Theory	50	10	20	20	-	-	-	100	2	1	-	3	Blended	PP
3.	3130302	DC	Electrical Machines-I	50	10	20	20	40	30	30	200	2	1	2	4	Blended	PP
4.	3130303	DC	Power System -I	50	10	20	20	40	30	30	200	2	1	2	4	Blended	PP
5.	3130304	DC	Analog & Digital Electronics	50	10	20	20	40	30	30	200	2	1	2	4	Blended	PP
6.	3130305	DLC	Self-learning/ Presentation (SWAYAM/NPTEL/MOOC)#	-	-	-	-	-	40	-	40	-	-	2	1	Online +Mentoring	SO
7.	200xxx	CLC	Novel Engaging Course (Informal Learning)	-	-	-		50	-	-	50	-	-	2	1	Interactive	SO
8.	3130306	DLC	Skill Internship Project (Institute Level Evaluation)	-	-	-	-	60	-	-	60	-	-	4	2	Offline	SO
Total				**250**	**50**	**100**	**100**	**230**	**130**	**90**	**950**	**10**	**5**	**14**	**22**	**-**	**-**
9.	3000002	Natural Sciences & Skills	Engineering Chemistry	50	10	20	20	30	10	10	150	1	-	2	GRADE	Blended	MCQ
10	1000001	MAC	Indian Constitution & Traditional Knowledge	50	10	20	20	-	-	-	-	-	-	-	GRADE	Blended	MCQ

Skill Internship Project (Institute Level) (Qualifier): Minimum two-week duration: Evaluation in III Semester.

$Proficiency in course/subject – includes the weightage towards ability/ skill/ competency /knowledge level /expertise attained etc. in that particular course/subject.

Natural Sciences& Skills: Engineering Physics / Engineering Chemistry / Environmental Science/ Language.

Credits of Natural Sciences & Skills will be added in the VI Semester.

MCQ: Multiple Choice Question **AO:** Assignment + Oral **OB:** Open Book **PP:** Pen Paper **SO:** Submission + Oral

 # Compulsory registration for one online course using SWAYAM/NPTEL/MOOC, evaluation through attendance, assignments and presentation

Mode of Teaching					Mode of Examination					Total Credits
Theory			Lab	NEC/SIP	Theory			Lab	SIP/ SLP/ NEC	
Offline	Online	Blended	Offline	Interactive	PP	AO	MCQ	SO	SO	
3	-	12	5	2	15	-	-	3	4	22
13.6%	-	54.5%	21.7%	8.7%	68.2%	-	-	13.6 %	18.2 %	Credits %

Annexure-10 III Semester Syllabus

Electromagnetic Field Theory: 3130301

Course Objectives:

1. To provide the knowledge of electromagnetic fields and its use in understanding the working principles of various power apparatus and machines.
2. To lay the foundations of electromagnetism and its practice in modern communications such as wireless, guided wave principles etc.
3. To provide the basic concepts of vectors and fields, electrostatics, electric current flow, magnetic fields, Maxwell's equations, and electromagnetic wave propagation.

Unit I: Electrostatics – I

Sources and effects of electromagnetic fields – Coordinate Systems –Vector fields –Gradient, Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity –Field due to discrete and continuous charges – Gauss 's law and applications.

Unit II: Electrostatics – II

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization- Dielectric strength- Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

Unit III: Magnetostatics

Lorentz force, magnetic field intensity (H) – Biot Savart's Law -Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media – Boundary conditions, scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications.'

Unit IV: Electrodynamic Fields

Magnetic Circuits - Faraday's law – Transformer and motional EMF –Displacement current Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications.

Unit V: Electromagnetic Waves

Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth – Pointing vector – Plane wave reflection and refraction – Standing Wave –Applications.

Recommended Books:

1. Electromagnetic Fields by P.V. Gupta, Dhanpat Rai.
2. Element of Engineering Electromagnetic by N.N. Rao, PHI.
3. Engineering Electromagnetic by William H. Hayt; TMH.
4. Electromagnetic by John D. Kraus, TMH.
5. Electromagnetic wave & Radiating System by Jordan Balmian, PHI.
6. Fields and Wave Electromagnetic by David K. Cheng, Addison Wesley.
7. Electromagnetic Field by S.P. Seth, Dhanpat Rai & Sons

Course Outcomes

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

CO1: **Apply** vector calculus to understand the behavior of static electric fields in engineering configurations

CO2: **Describe** Maxwell's equations in differential and integral forms and apply them to diverse engineering problems

CO3: **Formulate** engineering problems of Electromagnetic, Electrostatic and Magnetic to Static circuits using Basic relations.

CO4: **Explain** the nature of Electromagnetic wave propagation and wave polarization.

CO5: **Solve** engineering problems of Electromagnetic.

Electrical Machines-I: 3130302

Course Objectives:

- To develop basic concepts of AC and DC machines, their constructional details and working principles and
- To familiarize the students with the practical applications and operational issues of transformer, induction motor and DC machines.

Unit- I Single Phase Transformer: Phasor diagram, Efficiency and voltage regulation, All day efficiency. Testing of Transformers-O.C. and S.C. tests, Sumpner's test, and Polarity test. Auto Transformer- Single phase and three phase auto transformers, Volt-amp relation, Efficiency, Merits &demerits and applications.

Unit- II D.C. Machines I: Construction of DC Machines, Armature winding, EMF and torque equations, Armature reaction, Commutation, Interpoles and compensating windings, Performance characteristics of DC generators.

Unit- III D.C. Machines II: Performance characteristics of DC motors, Starting of DC motors; 3point and 4 point starters, Speed control of DC motors; Field control, Armature control and Voltage control (Ward Lenonard method); Efficiency and Testing of D.C. machines (Hopkinson's and Swinburn's Test).

Unit- IV Three Phase Induction Motor: Review of constructional details. Principle of operation, Slip. Production of torque, Steady state analysis. Phasor diagram, equivalent circuit. Power flow diagram and Torque speed characteristics. Starting methods.

Unit-V: Induction Motor II: Circle diagram and its experimental determination, cogging and Crawling Losses, Efficiency and Testing I.M, Double cage induction motor, Operation on unbalanced voltages, Speed control, Rotor resistance control, pole changing method, Frequency control, Induction generator, Introduction to Single phase Induction motor.

Recommended Books:

1. Electric Machines by D.P. Kothari &I.J. Nagrath, Tata McGraw Hill
2. Electric Machines by Ashfaq Hussain, Dhanpat Rai & Company
3. Electric Machinery by A.E Fitzerald, Kingsley and S.D. Umans, McGraw Hill.
4. Electrical Machinery by P.S. Bimbhra, Khanna Publisher
5. Generalized Theory of Electrical Machines by P.S. Bimbhra, Khanna Publishers
6. Alternating Current Machines by M.G.Say, Pitman & Sons

Course Outcome (CO)

CO 1. **Explain** the principles and construction of single phase transformer, dc machine and 3-phase induction motor.

CO 2. **Analyze** the fundamental control practices such as starting, reversing, braking, plugging etc. associated with DC machines and three phase induction motor.

CO 3. **Evaluate** the performance of single phase transformer, DC machines and three phase induction motor using equivalent circuits, losses etc.

CO 4. **Describe** various tests conducted for evaluating the performance of AC and DC machines.

Power System –I: 3130303

Course Objectives

- To expose the students with Transmission and distribution system, line parameters, performance of transmission lines, power plant economics and different types of tariffs.

Unit-I: Energy Resources and Electrical Power Generation: Introduction to Conventional and non-conventional energy resources; National and International energy trends; Global warming and greenhouse effects. Generation of electrical power, overview of conventional power generation: Hydro, Thermal, Nuclear and Gas Power; Renewable energy generation.

Unit-II: Transmission and Distribution Systems: Introduction, electrical supply system, comparison of AC and DC systems : conductor volume etc., overhead versus underground systems, choice of working voltages for transmission and distribution, transmission and distribution systems, Overhead line insulators, types of insulators pin, suspension and strain insulators, insulator materials, insulator string; Calculation of voltage distribution and string efficiency, methods of equalizing voltages, use of guard rings. Corona.

Unit-III: Line Parameters: Types of conductor, Inductance of a conductor due to internal flux, Inductance of a single phase & three phase transmission line, Self & mutual G.M.D., Inductance of three phase symmetrical and unsymmetrical spaced lines, transposed lines. Bundle conductors, skin effect, capacitance of single & three phase transmission line, effect of earth and charging current, transmission line communication and line interference.

Unit-IV: Performance of Overhead Transmission Line: Single line diagram of power system, ABCD constant and equivalent circuits of short, medium and long transmission line, regulation and efficiency of short, medium, transmission line, Ferranti effect, surge impedance loading. Long transmission line, Generalized circuit equation relation between generalized circuit constant for simple network

Unit-V Power plants Economics and Tariff: Size and number of generating units. Effect of load factor on cost of generation, Load curves, Maximum demand, Load factor, diversity factor, Plant capacity and plant use factor, type of tariffs and economics of power factor improvements.

Recommended Books:

1. Electric Power Generation, Transmission and Distribution by S.N. Singh, Prentice Hall of India, 2nd Edition.
2. Power system Analysis by A. Husain A, CBS Pub & Distributor.
3. Power System Analysis by B.R. Gupta B.R, S Chand & Co.
4. Electrical Power by S.L. Uppal, Khanna Publishers Limited, New Delhi.
5. Electrical Power Systems by C.L.Wadhwa, New Age International Publishers Ltd., New Delhi

Course Outcomes

After the completion of this course, students will be able to:

CO 1. **Describe** the general structure and supply systems used in power systems
CO 2. **Develop** the knowledge of generation of electricity based on conventional and nonconventional energy sources
CO 3. **Evaluate** the string efficiency, corona losses etc.
CO 4. **Determine** the transmission line parameters
CO 5. **Analyze** the performance of overhead transmission line
CO 6. **Describe** the concept of power plant economics, types of tariffs and power factor economics

Analog & Digital Electronics: 3130304

Course Objectives:

- The course intends to provide an understanding of the principles, operation and application of the analog building blocks like diodes, BJT, FET etc. for performing various functions. Furthermore, the course is likely to impart knowledge of various techniques of digital electronics like K-map for simplified analysis, understanding of combinational & sequential circuits.

Unit- I: Diodes and Transistors Diodes, their characteristics & applications, clipper, clamper circuits, BJT, transistor biasing, CE, CB, CC configurations, input output characteristics, DC load line, small signal analysis.

Unit-II: Amplifiers& FETs BJT usage as switch & amplifier, Darlington pair, differential amplifier using BJT, Operational Amplifiers their types & applications, JFET, V-I characteristics, MOSFET& its types, ADC & DAC converters, Multivibrators, 555 timer.

Unit-III: Digital Circuits Digital (binary) operations of a system, OR gate, AND gate, NOT, EXCLUSIVE OR gate, De Morgan Laws, NAND and NOR DTL gates, Comparison of logic families, properties of Boolean Algebra

Unit-IV: Combinational Logic Circuits K-Map: Sum-of-Products Method, Truth Table to Karnaugh Map, Pairs Quads, and Octets, Karnaugh Simplifications, Don't-care Conditions, Product-of-sums Method, Product-of-sums simplifications. Multiplexers, three state buffers, decoders and encoders, Programmable Logic devices

Unit-V: Sequential Logic Circuits Sequential Circuits, Storage Elements: Latches and flip flops, FLIP-FLOP Timing, SR, JK Master-slave, Analysis of Clocked Sequential Circuits, State Reduction and Assignment, Shift Registers, Asynchronous, Ripple& Ring Counters, Synchronous Counters, Random-Access Memory, Read-Only Memory.

Recommended Books:

1. Microelectronics Circuits by A.S. Sedra & K.C. Smith, Oxford University Press (1997)
2. Electronic Principles by A.P. Malvino, Tata Mcgraw Hill Publications
3. Electronic Devices & Circuit Theory by Robert L. Boylestad & Louis Nashelsky,
4. Digital Electronics by William Kleitz, Prentice Hall International Inc.
5. Introduction to Electronic Devices Michael Shur by John Wiley & Sons Inc., 2000.
6. Op-Amps and Linear Integrated Circuits by Ramakant Gayakwad, Pearson
7. Digital Logic and Computer Design by Morris Mano, Pearson

Course Outcomes:

After the completion of this course students will be able to:

CO1. **Explain** working principles of electronic devices e.g. Diode, Transistor, Amplifier, and Op-Amp.
CO2. **Categorize** the different types of diode, Amplifier, Op-Amp, Flip-flop, logic gates and counters.
CO3. **Describe** the various mathematical models of transistors
CO4. **Apply** the various principles of digital electronics to design different types of Digital Electronics circuits for various applications.
CO5. **Explain** working of various digital electronics circuits like multiplexer, coder circuits, shift registers & counters

Annexure-11 III Semester: List of Experiments& Skilled Based Mini Project

Electrical Machines-I Lab: 3130302

LIST OF EXPERIMENTS

1. To Perform direct load test on single phase transformer
2. To perform parallel operation on two single phase transformers
3. To obtain magnetization characteristics of DC shunt generator
4. To obtain internal and external characteristics of DC shunt generator
5. To control the speed of DC shunt motor(Armature and Field Control)
6. To perform load test on DC shunt motor (Mechanically loaded)
7. To perform load test on DC compound motor (Electrically loaded)
8. To perform various three phase transformer connections
9. To perform load test on induction motor
10. To conduct No Load & Blocked Rotor Test on 3-Ph Slip Ring Induction Motor and plot performance curve.
11. To obtain speed torque characteristics of 3 phase induction motor.
12. A virtual lab simulation of conventional electrical machines.

Course outcomes

CO 1. Draw characteristics of electric machine for a specific purpose, requirement.
CO 2. Determine the efficiency of any transformer, regulation of any transformer.
CO 3. Conduct Load sharing by two or more machines
CO 4. Develop the ability to work in team and learns professional ethics

Skill Based Mini Project

Electrical Machines-I

1. Draw the LAP connected winding arrangement of DC Machines
2. Draw the WAVE connected winding arrangement of DC Machines
3. Draw the construction of DC Machines and also explain its parts
4. Draw the construction of Induction Machines and also explain its parts
5. Draw the phasor diagram of single-phase transformers in lagging, leading and unity power factor load
6. Draw the phasor diagram of 3-phase Induction motor in lagging, leading and unity power factor load
7. Draw the MMF diagram of DC Machines and also explain the effect of Armature reaction
8. How are torque are produced in DC and AC Machines.
9. Discuss with suitable diagrams compare AC and DC Machines
10. Write applications of DC and AC machines in various domestic and Industrial applications

Power System-I Lab: 3130303
List of Experiments:

1. To study EHV AC Transmission Line Simulation Panel.
2. To measure resistance, inductance and capacitance of EHV AC Transmission Line Simulation Panel.
3. To study cables, insulators and line supports used in transmission and distribution system
4. To calculate generalized circuit constants for short, medium and long transmission line of EHV AC Transmission Line Simulation Panel.
5. To simulate L-G, L-L, L-L-G, L-L-L, L-L-L-G faults using MATLAB
6. To write MATLAB code to determine the maximum power without loss of synchronism using equal area criterion
7. To write MATLAB code for determination of the critical clearing angle and critical clearing time.
8. To determine the system stability from the swing curve.
9. To determine stability of the system using MATLAB.
10. A visit and study of 33kV Substation.

Course Outcomes:

At the end of the Laboratory work the students will be able to

CO1 **Determine** transmission line parameters.

CO2 **Simulate** the different types of faults in transmission lines using MATLAB.

CO3 **Identify** the different components of substation & their applications

CO4 **Familiar** with construction & application of various insulators, cables & line support.

CO5 **Prepare a report** for presentation.

Analog & Digital Electronics: 3130304

List of Experiments

1. To measure and plot the forward and reverse V-I characteristics of diode.
2. To measure and plot the forward and reverse V-I characteristics of the SCR.
3. To test and plot input and output common emitter transistor characteristics.
4. To verify the operation of Darlington pair and determine the gain, input and output Impedances.
5. To design and test differential and two stage RC coupled Amplifier using Transistor.
6. Verification of truth tables of (a)OR, AND NOT gates (By using 7400-series) (b) NAND & NOR gates (c)EX-NOR & EX-OR gates.
7. Verification of De-Morgan's Theorem using ICs.
8. Implementations of Multiplexer & Demultiplexer using logic gates (ICs) and verify truth table.
9. Implementations of Half Adder & Full Adder &Half Subtractor & Full Subtractor using logic gates (ICs) and verify truth table.
10. Operation and verifying truth tables of flip- flops- RS, D, and JK using ICs.

Course Outcomes

CO1. Develop skill to build and troubleshoot analog and digital circuits.

CO2. Examine the input-output characteristics of analog circuits SCR, Transistor and Amplifier.

CO3. Apply Boolean algebra techniques to verify and implement the digital circuits

CO4. Develop teamwork skills for working effectively in groups

CO5. Prepare technical report on experiments conducted in the lab.

Skill Based Mini Project

1. Construct a 6x6x6 or a 7x7x7 LED cube that will be operated through multiplexing.
2. Implement a four-way intersection with an intelligent traffic regulation method using logic gates.
3. Construct a calculator to do addition and subtraction of binary numbers.
4. Design a parking counter, having a main entrance and the entire area should be split into at least 3 sections.
5. Design a vending machine with full display for cash as well as items dispensed.
6. Design a generator circuit that generates pulses of varying duty cycle depending on user selection.
7. Design a parking counter, having a main entrance and a main exit.
8. Construct a 16-bit Pseudo Random Number Generator.
9. Street Light Circuit using analog circuit methodology.
10. Air Flow Detector Circuit using analog circuit methodology.

Annexure 12 CO Attainment for July-Dec 2023

Subject Name & Code	CO	Direct Attainment	Indirect Attainment	Total Attainment	Target Level	Gap	Status
Basic Electrical & Electronics Engineering 3100011	CO1	2.4	2.5	2.4	2.3	-0.1	Achieved
	CO2	2.6	2.3	2.5	2.3	-0.2	Achieved
	CO3	2.3	2.3	2.3	2.3	0.0	Achieved
	CO4	2.4	2.3	2.4	2.3	-0.1	Achieved
	CO5	2.5	2.4	2.5	2.3	-0.2	Achieved
Engineering Materials: 3130102	CO1	2.3	2.3	2.3	2.3	0.0	Achieved
	CO2	2.3	2.2	2.3	2.3	0.0	Achieved
	CO3	2.3	2.3	2.3	2.3	0.0	Achieved
	CO4	2.4	2.5	2.4	2.3	-0.1	Achieved
	CO5	2.3	2.3	2.3	2.3	0.0	Achieved
Electromagnetic Field Theory: 2130311	CO1	2.9	2.5	2.8	2.3	-0.5	Achieved
	CO2	2.4	2.3	2.4	2.3	-0.1	Achieved
	CO3	3.0	2.4	2.9	2.3	-0.6	Achieved
	CO4	3.0	2.4	2.9	2.3	-0.6	Achieved
	CO5	2.4	2.6	2.4	2.3	-0.1	Achieved
Electrical Machine-I: 2130312	CO1	2.4	2.4	2.4	2.3	-0.1	Achieved
	CO2	2.2	2.3	2.2	2.3	0.1	Not Achieved
	CO3	2.3	2.4	2.3	2.3	0.0	Achieved
	CO4	2.5	2.3	2.5	2.3	-0.2	Achieved
	CO5	2.3	2.4	2.3	2.3	0.0	Achieved
Power System-I: 2130313	CO1	2.4	2.2	2.4	2.3	-0.1	Achieved
	CO2	2.3	2.3	2.3	2.3	0.0	Achieved
	CO3	2.3	2.5	2.3	2.3	0.0	Achieved
	CO4	2.4	2.3	2.4	2.3	-0.1	Achieved
	CO5	2.3	2.4	2.3	2.3	0.0	Achieved
	CO6	2.2	2.3	2.2	2.3	0.1	Not Achieved
Analog & Digital Electronics: 2130314	CO1	2.1	2.3	2.1	2.3	0.2	Not Achieved
	CO2	2.4	2.4	2.4	2.3	-0.1	Achieved
	CO3	2.3	2.4	2.3	2.3	0.0	Achieved
	CO4	2.1	2.2	2.1	2.3	0.2	Not Achieved
	CO5	2.3	2.3	2.3	2.3	0.0	Achieved
Signals & Systems: 130511	CO1	2.4	2.4	2.4	2.3	-0.1	Achieved
	CO2	2.3	2.3	2.3	2.3	0.0	Achieved
	CO3	2.3	2.3	2.3	2.3	0.0	Achieved
	CO4	2.4	2.3	2.4	2.3	-0.1	Achieved
	CO5	2.1	2.4	2.2	2.3	0.1	Not Achieved
	CO6	2.3	2.3	2.3	2.3	0.0	Achieved
Power System-II: 130512	CO1	2.3	2.3	2.3	2.3	0.0	Achieved
	CO2	2.4	2.4	2.4	2.3	-0.1	Achieved
	CO3	2.2	2.3	2.2	2.3	0.1	Not Achieved
	CO4	2.3	2.4	2.3	2.3	0.0	Achieved
	CO5	2.2	2.3	2.2	2.3	0.1	Not Achieved
	CO6	2.3	2.4	2.3	2.3	0.0	Achieved
Electrical Machines-II: 130513	CO1	2.4	2.2	2.4	2.3	-0.1	Achieved
	CO2	2.3	2.3	2.3	2.3	0.0	Achieved
	CO3	2.3	2.2	2.3	2.3	0.0	Achieved
	CO4	2.1	2.3	2.1	2.3	0.2	Not Achieved
	CO5	2.3	2.4	2.3	2.3	0.0	Achieved
	CO6	2.4	2.3	2.4	2.3	-0.1	Achieved
Power Electronics: 130514	CO1	3.0	2.3	2.9	2.3	-0.6	Achieved
	CO2	2.5	2.4	2.5	2.3	-0.2	Achieved

	CO3	2.0	2.2	2.0	2.3	0.3	Not Achieved
	CO4	3.0	2.3	2.9	2.3	-0.6	Achieved
	CO5	1.7	2.1	1.8	2.3	0.5	Not Achieved
Data Science: 130515	CO1	1.9	2.3	2.0	2.3	0.3	Not Achieved
	CO2	2.4	2.4	2.4	2.3	-0.1	Achieved
	CO3	2.2	2.3	2.2	2.3	0.1	Not Achieved
	CO4	2.3	2.3	2.3	2.3	0.0	Achieved
	CO5	2.1	2.4	2.2	2.3	0.1	Not Achieved
	CO6	2.3	2.1	2.3	2.3	0.0	Achieved
Electrical Vehicles: 130719	CO1	2.4	2.2	2.4	2.3	-0.1	Achieved
	CO2	2.3	2.1	2.3	2.3	0.0	Achieved
	CO3	2.3	2.4	2.3	2.3	0.0	Achieved
	CO4	2.4	2.3	2.4	2.3	-0.1	Achieved
	CO5	2.3	2.5	2.3	2.3	0.0	Achieved
	CO6	2.2	2.3	2.2	2.3	0.1	Achieved
Utilization of Electrical Energy: 130717	CO1	2.3	2.4	2.3	2.3	0.0	Not Achieved
	CO2	2.4	2.3	2.4	2.3	-0.1	Achieved
	CO3	2.3	2.3	2.3	2.3	0.0	Achieved
	CO4	2.4	2.4	2.4	2.3	-0.1	Achieved
	CO5	2.3	2.5	2.3	2.3	0.0	Achieved
Electric Drives: 130718	CO1	3.0	2.4	2.9	2.3	-0.6	Achieved
	CO2	2.5	2.3	2.5	2.3	-0.2	Achieved
	CO3	2.3	2.4	2.3	2.3	0.0	Achieved
	CO4	3.0	2.2	2.8	2.3	-0.5	Achieved
	CO5	2.8	2.3	2.7	2.3	-0.4	Achieved
Applications of Electrical Equipment & Motor: 900205	CO1	2.4	2.2	2.4	2.3	-0.1	Achieved
	CO2	2.3	2.3	2.3	2.3	0.0	Achieved
	CO3	2.4	2.4	2.4	2.3	-0.1	Achieved
	CO4	2.4	2.3	2.4	2.3	-0.1	Achieved
	CO5	2.3	2.3	2.3	2.3	0.0	Achieved
	CO6	2.3	2.5	2.3	2.3	0.0	Achieved
Sensor Technology: 910206	CO1	3.0	2.4	2.9	2.3	-0.6	Achieved
	CO2	3.0	2.5	2.9	2.3	-0.6	Achieved
	CO3	2.7	2.4	2.6	2.3	-0.3	Achieved
	CO4	3.0	2.6	2.9	2.3	-0.6	Achieved
	CO5	2.8	2.4	2.7	2.3	-0.4	Achieved
Electric Vehicle: 900207	CO1	2.3	2.3	2.3	2.3	0.0	Achieved
	CO2	2.4	2.3	2.4	2.3	-0.1	Achieved
	CO3	2.3	2.3	2.3	2.3	0.0	Achieved
	CO4	2.3	2.4	2.3	2.3	0.0	Achieved
	CO5	2.3	2.5	2.3	2.3	0.0	Achieved

Total No of courses	Total No of COs	No of COs not attained	Percentage of COs not attained
17	92	14	15.21 %

Action to be Taken by the faculty for improvement in CO attainments

- Identification of slow learners
- More assignment & tutorial classes
- Additional regular classes.
- Practical exposer through industrial visit, and expert talk for problem solving.
- More interaction with the students.
- Extra time will be given on important topics.
- Additional classes to be conducted
- Extra Assignment and Quizzes

Annexure 13 PO Attainment of 2019-2023 Batch (B. Tech Electrical Engineering)

Direct PO Attainment (Batch 2019-2023 Batch)

S. No.	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
1	100001: Engineering Mathematics II	2.05	2.05	2.05	2.05	2.05		2.08					2.09	2.05	2.05
2	130301: Electro Magnetic Field Theory	2.21	2.21	2.21						2.23				2.21	
3	130302: Measurement & Instrumentation	2.23	2.23	2.23	2.23	2.23	2.24		2.23	2.21	2.23	2.23	2.24	2.25	2.24
4	130302: Measurement & Instrumentation (LAB)	2.28	2.28	2.28	2.28		2.28	2.28	2.28	2.28	2.28				2.28
5	130303: Network Analysis	2.27	2.27	2.26	2.27	2.27	2.28	2.27	2.27	2.27	2.27		2.27	2.27	2.27
6	130303: Network Analysis (LAB)	2.06	2.20	2.20	2.33		2.26	2.26	2.26	2.26	2.26				2.26
7	130304: Analog Electronics	2.19	2.19	2.19	2.19		2.19			2.20				2.19	
8	130304: Analog Electronics (LAB)		2.11					2.12	2.11	2.13	2.11	2.12	2.11		2.11
9	130305: Software Lab-I	2.15			2.15	2.15				2.13	2.13	2.15		2.15	2.15
10	130309 : Summer Internship	2.15	2.15	2.15						2.15	2.15	2.15		2.15	
11	130402: Electrical Machines-I	2.14	2.14	2.14	2.14	2.21	2.13	2.25	2.17	2.12	2.17	2.13	2.17	2.13	2.11
12	130402: Electrical Machines-I (LAB)				2.13			2.14	2.15	2.14	2.14	2.13		2.17	
13	130401: Digital Electronics & Microprocessor	2.17	2.18	2.18										2.16	
14	130401: Digital Electronics & Microprocessor (LAB)						2.20	2.20	2.20					2.20	
15	130403 : Control Systems	2.30	2.30	2.30	2.30	2.30	2.34	2.30	2.30	2.30	2.30		2.32	2.32	2.33
16	130404: Power System-I	2.30	2.30	2.30	2.31	2.30	2.24	2.17	2.31	2.17	2.32	2.33	2.23	2.30	2.26
17	100004: Cyber Security	2.12	2.08	2.06	2.13	2.12	2.07	2.13	2.09	2.13	1.92		2.10	2.18	2.22
18	130405: Simulation Lab-II:	2.35			2.35	2.35								2.35	
19	100005: Ethics, Economics, Entrepreneurship& Management				2.20	2.10	2.14	1.99	2.08	2.08	2.08		2.08		
20	130501: Signals & Systems	2.26	2.26	2.26	2.26	2.26									
21	130502: Power System II	1.98	1.98	1.98	1.98	1.98	1.98	1.98		1.98	1.98	1.98	1.98	1.98	1.98
22	130502: Power System II (Lab)	2.15	2.16	2.16	2.16	2.16	2.16	2.16		2.16	2.13	2.21	2.16		2.16
23	130503: Electrical Machine-II	2.29	2.30	2.30	2.28			2.29	2.30			2.29		2.30	
24	130503:Electrical Machine-II (Lab)				1.91		2.15		1.95	2.01	1.36	1.89		1.77	1.91
25	130504 : Power Electronics	2.23	2.23	2.23		2.23	2.23				2.23				
26	130504: Power Electronics (Lab)	2.37	2.36	2.38		2.38	2.38				2.38				
27	130505: Minor Project-I	2.27	2.27	2.27					2.21	2.21	2.21	2.21		2.21	2.21
28	130506: Summer Internship Project-II	2.43	2.43	2.43					2.43	2.43	2.43	2.43			
29	130507:Seminar/Self Study	2.21	2.21	2.21					2.18	2.18	2.18	2.18		2.18	2.18
30	130601:Switchgear & Protection	2.26	2.21	2.22		2.26	2.27					2.21		2.18	

31	130601:Switchgear & Protection Lab								2.34	2.34	2.34	2.34	2.25		2.34
32	130602: Electrical Engineering Materials	2.28	2.28	2.28	2.28	2.28	2.28	2.28		2.28	2.28	2.28	2.28	2.26	2.28
33	130611 : Computer Aided Power System Analysis (DE-1)	2.44	2.45	2.46		2.46	2.46				2.46				
34	130612:Industrial Automation (DE1)					2.34	2.32	2.34		2.35	2.35	2.35	2.35	2.54	2.34
35	130651: Non Conventional Energy Resources DE2(SWAYAM/ NPTEL)	1.74	1.39	2.22		0.63	0.89	2.22		0.89	1.59	2.22	0.63		
36	130603: Minor Project-II	2.18	2.18	2.18					2.12	2.12	2.12	2.12		2.12	2.12
37	100007:Disaster Management	1.68	2.23			1.33	2.23			2.23	2.23			2.23	2.23
38	130711: Electrical Drives (DE3)	2.24	2.27	2.22	2.19	2.23	2.30	2.23		2.25	2.24	2.22	2.23		
39	130712: Renewable Energy System (DE3)	2.32	2.36		2.28	2.32	2.36	2.39		2.35	2.31		2.32	2.32	2.32
40	130713: IoT in MicroGrid (DE3)	2.18	2.24		2.25	2.26	2.24	2.18		2.27	2.19		2.26	2.20	2.20
41	130714: Intelligent Sensors and Instrumentation (DE3)	2.24	2.23	2.23	2.27	2.28	2.24		2.24	2.24	2.24	2.24	2.27	2.24	2.24
42	130751: Introduction to Smart Grid(DE4)	2.09	2.09		2.09	2.09	2.09			2.09	2.09		2.09	2.09	2.09
43	900201:Applications of Electrical Motor & Equipment	2.03	2.03	2.07	1.96	2.17	1.88				2.04		1.96	2.03	2.03
44	130701:Control System Lab	2.29	2.22	2.05	2.29	2.20	2.20	2.22		2.22	2.22	2.22	2.22	2.20	2.22
45	130702: Summer Internship Project	2.31	2.31	2.31	2.31				2.31	2.31	2.31	2.31	2.31	2.31	2.31
46	130703: Creative Problem Solving	2.14	2.14	2.14	2.14	2.14				2.14	2.14	2.14	2.14	2.14	2.14
47	100008:Intellectual Property Rights(IPR)	2.29	2.29	2.33	2.31	2.31	2.36	2.45	2.33	2.33	2.29	2.54	2.32	2.32	2.33
48	130801 : Internship/ Project	2.34	2.35	2.35	2.35				2.35	2.35	2.35	2.35		2.35	2.35
49	130802 : Professional Development						2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
Direct PO Attainment		**2.20**	**2.21**	**2.23**	**2.21**	**2.15**	**2.18**	**2.22**	**2.23**	**2.18**	**2.18**	**2.22**	**2.14**	**2.20**	**2.20**

Indirect PO Attainment

INDIRECT PO ATTAINMENT	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
(Exit Survey)	2.38	2.41	2.24	2.19	2.10	2.15	2.27	2.39	2.29	2.46	2.32	2.31	2.21	2.29
(Alumni Survey)	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26
(Employer Survey)	2.33	2.56	2.21	2.19	1.99	2.47	2.27	2.47	2.07	2.24	2.16	2.30	2.30	2.41
Indirect PO Attainment	2.32	2.41	2.24	2.21	2.12	2.29	2.27	2.37	2.21	2.32	2.25	2.29	2.25	2.32

PO Attainment: Analysis & Action Taken

Program Outcome	Direct Attainment	Indirect Attainment	Total attainment (in Levels)	Target attainment level	Gap	Action taken
PO1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems	2.20	2.32	2.23	2.2	-0.03	Students are encouraged to learn complex analytical/ mathematical concepts and apply them in real-life problem-solving.
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.	2.21	2.41	2.25	2.2	-0.05	Industrial visits, skill-based mini projects, and weekly quizzes & assignments are used to help students to further gain knowledge on complex engineering problems.
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.	2.23	2.24	2.23	2.2	-0.03	Students are motivated to include all standard parameters and constraints according to National & International safety norms and to address environmental concerns while focusing on innovative designs for their projects.
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.	2.21	2.21	2.21	2.2	-0.01	Students are motivated to further gain deep knowledge about research in multidisciplinary areas. Also, research internships are introduced at the level of III Year.
PO5 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.	2.15	2.12	2.14	2.2	0.06	Students are also encouraged to develop software-based projects.
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.	2.18	2.29	2.21	2.2	-0.01	Humanities-based courses are added in the curriculum.
PO7 Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental	2.22	2.27	2.23	2.2	-0.03	Students are encouraged to indulge in projects, in which global and environmental issues are improved, with respect to effective

contexts, and demonstrate the knowledge of, and need for sustainable development.						electronics circuit designing and miniaturization of circuits.
PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	2.23	2.37	2.26	2.2	-0.06	Career readiness program, corporate lectures and motivational talks are arranged for the students.
PO9 Individual and Team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings**.**	2.18	2.21	2.18	2.2	0.02	Extracurricular activities such as debates, technical and cultural events will be organized by various students clubs.
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.	2.18	2.32	2.21	2.2	-0.01	Soft skills training is imparted to students to enhance various aspects of communication/technical talks by group discussions, presentations and new learning outcomes.
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.	2.22	2.25	2.23	2.2	-0.03	Awareness is created among the student regarding the management principles.
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.	2.14	2.29	2.17	2.2	0.03	Students are encouraged to learn some advanced-level courses as department electives on SWAYAM/NPTEL platforms that have relevance throughout their careers and have long-term benefits.
PSO1: Power System Operation & Control: Graduates will be able to demonstrate proficiency in the planning, operation & control of Electrical Power System	2.20	2.25	2.21	2.2	-0.01	Courses fundamental of smart grid, emerging technologies in renewable energy sources, and simulation of microgrid are being introduced. More hardware-based projects are being undertaken.
PSO2: AI Based Computations: Graduates will be able to apply various artificial intelligent techniques like neural network, fuzzy logic & various nature inspired evolutionary computational methods for the solution of complex engineering problems using MATLAB environment	2.20	2.32	2.23	2.2	-0.03	Students are motivated to take up real-life problems so that they can design, analyze and find a solution that gives exposure to latest technologies in the fild of AI.

Annexure 14 Action Taken Report on Curriculum Feedback by Stakeholders

Table 1: Faculty feedback on curriculum and action taken

Based on the student's feedback, appropriate changes were made as is notified in the following table.

FEEDBACK	ACTION TAKEN
• Unit V of Data Science is to be reviewed to include the applications related to Electrical Engineering.	• The syllabus is reviewed by the course committee and the revised syllabus is proposed in the BoS meeting.

Table 2: Students feedback on curriculum and action taken report

The feedback response from faculty and action taken is illustrated in the following table.

FEEDBACK	ACTION TAKEN
• The Summer Internship Program-I and Summer Internship Program-II should be conducted in Winter.	• The suggestion is forwarded to the Academic Council for consideration.

Table 3: Alumni feed-back action taken report

The feedback response from alumni and action taken is illustrated in the following table.

FEEDBACK	ACTION TAKEN
• Advanced courses on Electric Vehicle, Smartgrid Technology, AI and ML need to be introduced.	• The courses are part of the schemes since 2018.

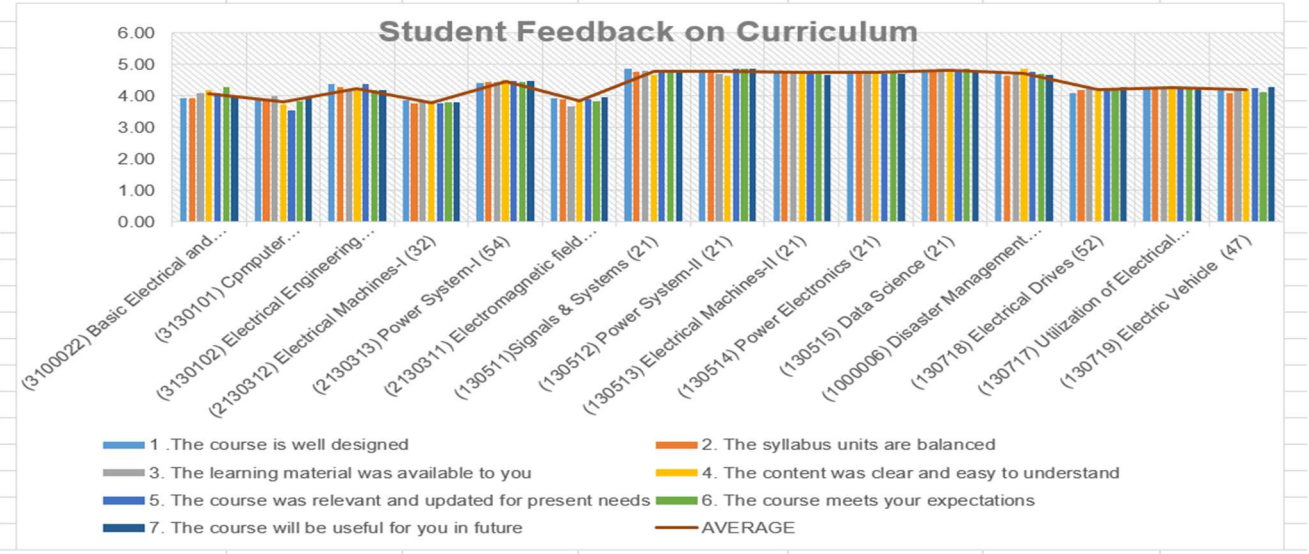
Table 4: Employer feed-back and action taken report

The feedback response from employer and action taken is illustrated in the following table.

FEEDBACK	ACTION TAKEN
• Students need to be aware of industry exposure. • Mini-Project models will help them to face real life presentations • Institute should introduce subject like Python Programming, Data Science, Artificial Intelligence in the core branches also.	All the valuable suggestions are already implemented and are included in II Semester, V Semester and VI semester scheme for the batch admitted in 2021 onwards.

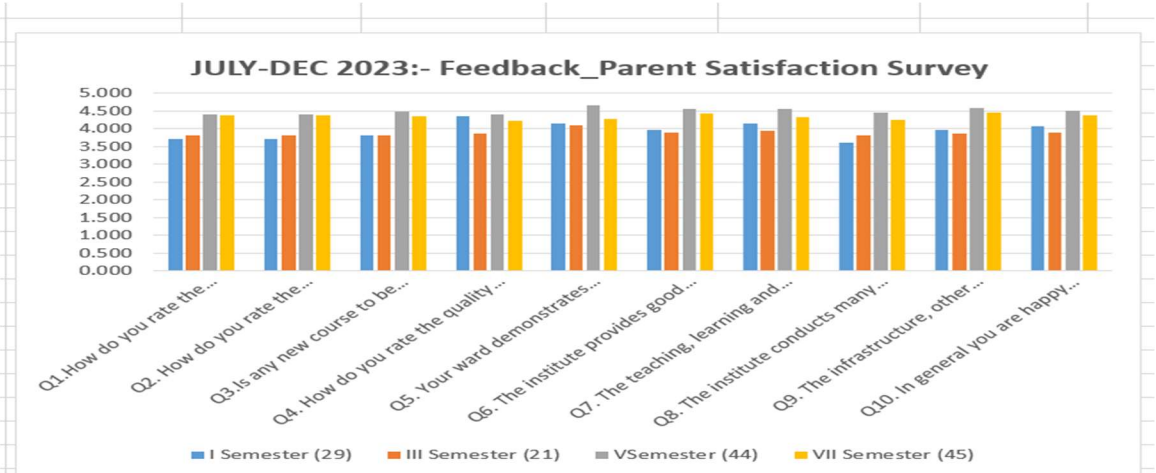
Table 1 Students feedback on curriculum

	course is well-designed	syllabus units are balanced	Availability of earning material	contents clear and easy to understand	course was relevant and updated for present needs	course meets expectations	course will be useful for future	Average
(3100022) Basic Electrical & Electronics Engineering (11)	3.91	3.91	4.09	4.18	4.09	4.27	4.00	4.06
(3130101) Computer Programming (11)	3.91	3.82	4.00	3.73	3.55	3.82	3.91	3.82
(3130102) Electrical Engineering Material (11)	4.36	4.27	4.18	4.18	4.36	4.18	4.18	4.25
(2130312) Electrical Machines-I (32)	3.88	3.75	3.81	3.78	3.75	3.78	3.78	3.79
(2130313) Power System-I (54)	4.41	4.44	4.43	4.50	4.46	4.43	4.46	4.45
(2130311) Electromagnetic field theory (27)	3.93	3.89	3.67	3.81	3.89	3.81	3.96	3.85
(130511)Signals & Systems (21)	4.86	4.76	4.81	4.67	4.76	4.76	4.76	4.77
(130512) Power System-II (21)	4.76	4.76	4.71	4.62	4.86	4.86	4.86	4.78
(130513) Electrical Machines-II (21)	4.81	4.81	4.76	4.81	4.71	4.71	4.67	4.76
(130514) Power Electronics (21)	4.76	4.81	4.71	4.71	4.71	4.76	4.71	4.74
(130515) Data Science (21)	4.81	4.76	4.86	4.76	4.76	4.86	4.81	4.80
(1000006) Disaster Management (21)	4.71	4.62	4.76	4.86	4.76	4.71	4.67	4.73
(130718) Electrical Drives (52)	4.08	4.17	4.25	4.15	4.25	4.23	4.27	4.20
(130717) Utilization of Electrical Energy (51)	4.25	4.27	4.24	4.24	4.22	4.25	4.29	4.25
(130719) Electric Vehicle (47)	4.21	4.09	4.17	4.21	4.23	4.13	4.28	4.19



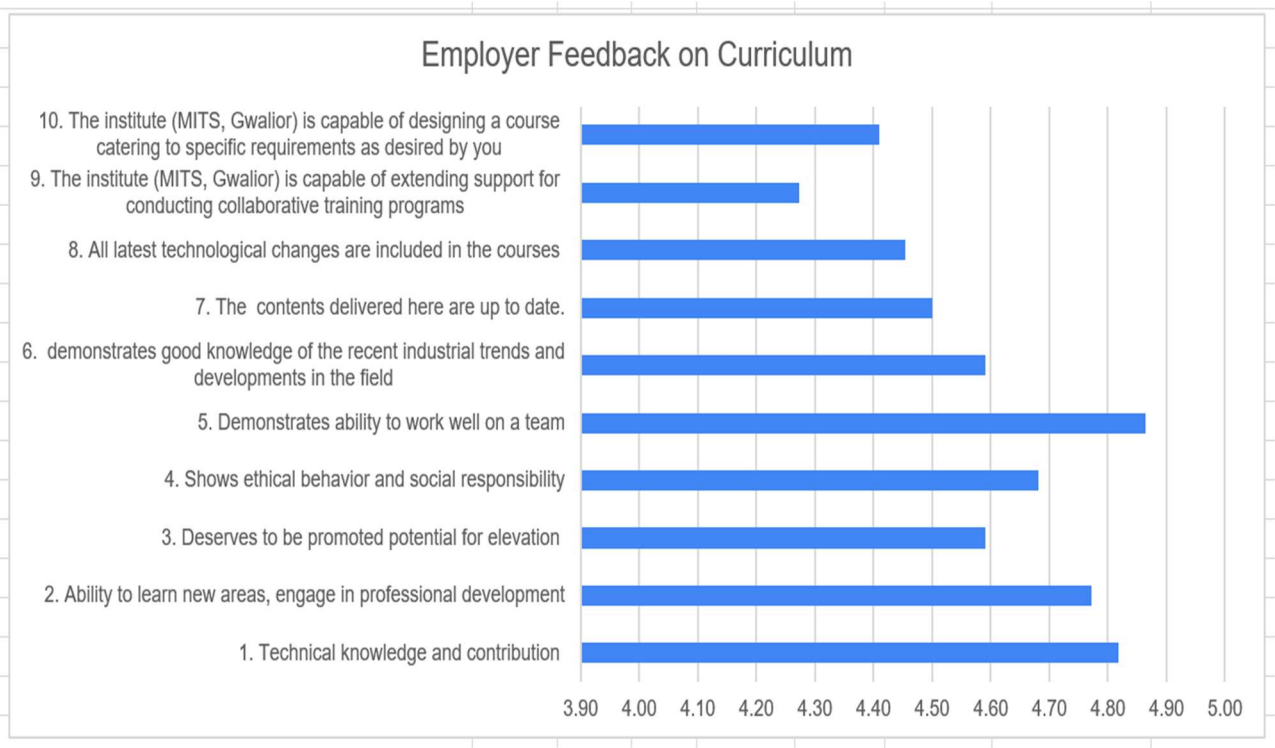
JULY-DEC 2023:- FEEDBACK_PARENT SATISFACTION SURVEY EE I SEM. (ON MOODLE)

Parameter (Average Grading) No.of parents	Q1.How do you rate the programme in terms of the load of the courses in different semesters? / आप अलग-अलग सेमेस्टर में पाठ्यक्रमों के भार के संदर्भ में कार्यक्रम को कैसे रेट करते हैं?	Q2. How do you rate the availability of books & E-learning material in the institute library / website? / आप संस्थान के पुस्तकालय / वेबसाइट में पुस्तकों और ई-शिक्षण सामग्री की उपलब्धता को कैसे दर	Q3.Is any new course to be introduced- to meet current needs & technological changes? / वर्तमान जरूरतों और तकनीकी परिवर्तनों को पूरा करने के लिए क्या कोई नया पाठ्यक्रम किया गया है?	Q4. How do you rate the quality and relevance of the courses included in the programme of study. / आप अध्ययन के कार्यक्रम में शामिल पाठ्यक्रमों की गुणवत्ता और प्रासंगिकता को कैसे दर करते हैं।	Q5. Your ward demonstrates knowledge of the recent trends and developments in the field. / आपका छात्र क्षेत्र में हाल के रुझानों और विकास के ज्ञान को प्रदर्शित करता है।	Q6. The institute provides good support for improving overall personality of your ward. / संस्थान आपके छात्र के समग्र व्यक्तित्व में सुधार के लिए अच्छा समर्थन प्रदान करता है।	Q7. The teaching, learning and evaluation system in the institute is good. /संस्थान में शिक्षण, शिक्षण और मूल्यांकन प्रणाली अच्छी है।	Q8. The institute conducts many activities that help your ward in getting job opportunities and campus placement. / संस्थान कई गतिविधियों का संचालन करता है जो आपके वार्ड को नौकरी के अवसर और कैंपस प्लेसमेंट दिलाने में मदद करते हैं।	Q9. The infrastructure, other facilities and ambience of the institute is good. / संस्थान की आधारभूत संरचना, अन्य सुविधाएं और माहौल अच्छा है।	Q10. In general you are happy and satisfied with the institute. / सामान्य तौर पर आप संस्थान से खुश और संतुष्ट हैं।
I Semester (29)	3.724	3.724	3.828	4.345	4.138	3.966	4.138	3.621	3.966	4.069
III Semester (21)	3.810	3.810	3.810	3.857	4.095	3.905	3.952	3.810	3.857	3.905
VSemester (44)	4.4	4.4	4.475	4.4	4.65	4.55	4.55	4.45	4.575	4.5
VII Semester (45)	4.378	4.378	4.356	4.222	4.267	4.422	4.333	4.244	4.444	4.378



Employer Feedback on Curriculum

Feedback Parameters	Strongly Agree	Agree	Neutral	Disagree	Highly disagree	Feedback Index
1. Technical knowledge and contribution is at a Good level.	18	4	0	0	0	4.82
2. Ability to learn new areas, engage in professional development, and adapt to technological changes	18	3	1	0	0	4.77
3. Deserves to be promoted/has potential for elevation to higher level	15	5	2	0	0	4.59
4. Shows ethical behavior and social responsibility	16	5	1	0	0	4.68
5. Demonstrates ability to work well on a team	20	1	1	0	0	4.86
6. Your employee (our alumnus) demonstrates good knowledge of the recent industrial trends and developments in the field.(If no, please give comments below about areas/fields where our alumni might be lacking)	12	8	3	0	0	4.59
7. The courses being offered at MITS and the contents delivered here are up to date.(If no, please give comments below and please suggest course / contents which need to be updated for making our graduates industry	13	7	2	0	0	4.50
8. All latest technological changes are included in the courses and syllabi are sufficient to meet the requirements of my organization.(If there is need of any new course to be introduced to meet current needs &	13	6	3	0	0	4.45
9. The institute (MITS, Gwalior) is capable of extending support for conducting collaborative training programs for your employees in areas desired by you.(If yes, then please mention areas where above activity can be conducted in future as per mutually agreeable terms)	10	8	4	0	0	4.27
10. The institute (MITS, Gwalior) is capable of designing a course catering to specific requirements as desired by you and also in running it successfully with partial technical support from you.(If yes, please suggest an area/name catering to your specific requirement)	13	5	4	0	0	4.41


Employer Feedback on Curriculum
10. The institute (MITS, Gwalior) is capable of designing a course catering to specific requirements as desired by you
9. The institute (MITS, Gwalior) is capable of extending support for conducting collaborative training programs
8. All latest technological changes are included in the courses
7. The contents delivered here are up to date.
6. demonstrates good knowledge of the recent industrial trends and developments in the field
5. Demonstrates ability to work well on a team
4. Shows ethical behavior and social responsibility
3. Deserves to be promoted potential for elevation
2. Ability to learn new areas, engage in professional development
1. Technical knowledge and contribution
3.90 4.00 4.10 4.20 4.30 4.40 4.50 4.60 4.70 4.80 4.90 5.00