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XXXV Academic Council (AC) Minutes- Annexure-2.10

Dt: 12-03-2022

Department of Electrical & Electronics Engineering

Minutes of the XXVII BOS Meeting

The Department XXVIII BOS meeting is held on 12th March 2022 from 2.00 PM onwards in online mode.

The following members were present:

1. Dr. J Somlal-Professor & HoD, Department of EEE, KLEF- Chairman
2. Dr. K Siva Kumar, Associate Professor, IIT Hyderabad-External Member
3. Dr. P. Shankar, Assistant Professor, NIT AP-External Member
4. Dr. Praveen Damacharla, Research Scientist & Co-Founder- KineticAI.com External Member
5. Dr. M V V K Srinivasa Prasad, Assistant Professor & Associate Dean Curriculum Aspects TLP- KLEF-Invited Member from DAO
6. Dr. M Venkata Narayana, Professor, ECE Department, KLEF Co-Opted Member
7. Dr. J V Shanmukha Kumar, Professor, Department of Chemistry, KLEF Co-Opted Member
8. Dr. K V Divya, Professor, Department of English, KLEF- Co-Opted Member
9. Dr. N S M P Latha Devi, Associate Professor, Department of Physics, KLEF- Co-Opted Member
10. Mr. T Ratna Prasad, Assistant Professor, ME Department, KLEF -Co-Opted Member
11. Dr. K Subba Rao, Professor, Department of EEE, KLEF -Internal Member
12. Dr. S V N L Lalitha, Professor, Department of EEE, KLEF -Internal Member
13. Dr. K Narasimha Raju, Professor, Department of EEE, KLEF -Internal Member
14. Dr. A Pandian, Professor, Department of EEE, KLEF - Internal Member
15. Dr. B Loveswara Rao, Professor, Department of EEE, KLEF - Internal Member
16. Dr. P Srinivas Varma, Associate Professor, Department of EEE, KLEF- Internal Member
17. Dr. M Kiran Kumar, Associate Professor, Department of EEE, KLEF- Internal Member
18. Dr. B Jyothi, Associate Professor, Department of EEE, KLEF- Internal Member
19. Mrs. K Sarada, Associate Professor, Department of EEE, KLEF- Internal Member
20. Mr. R Bhanu Prakash, Associate Professor, Department of EEE, KLEF- Internal Member
21. Mr. D Seshi Reddy, Associate Professor, Department of EEE, KLEF- Internal Member
22. Dr. G Raja Sekhar, Associate Professor, Department of EEE, KLEF-Internal Member
23. Mr. T Teja Sreenu, Assistant Professor, Department of EEE, KLEF-Internal Member
24. Mr. D Kalyan, Assistant Professor, Department of EEE, KLEF-Internal Member
25. Mr. S Ravi Teja, Assistant Professor, Department of EEE KLEF- Internal Member

Members Absent: NIL

J. somlal 22/3/22

Dr. J. SOMLAL
Professor & HOD EE
Department of EEE
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AGENDA and RESOLUTIONS

AGENDA ITEM-1

Department Achievements for the A. Y.2021-2022	BoS appreciated the efforts of faculty and the university management for their achievements done by the students.

The chairman reported the faculty awards and recognitions, research activities and placement status of the department for the current semester before the BoS members.

Placements & Progression:

Placement statistics for the A.Y:2021-2022 were presented to all the members.

All the fifty-one students registered for placements were successfully placed in various core and software companies.

Fourteen students got multiple job offers, fourteen got more than three job offers.

The average salary package is 5.1Lakhs per annum.

Research & Development

Total no. of publications including Scopus and SCI indexed by the department are 1100 to date.

Seven scholars of the department were awarded with PhD degrees in the A.Y: 2021-2022 till date.

External member Dr. K Siva Kumar, IIIT Hyderabad has appreciated the department faculty and HoD for successfully conducting all the academic activities.

AGENDA ITEM-2

Course Structure of 2020-21 admitted batches for B. Tech EEE program as per the contemporary requirements and approved in DAC	It is resolved to approve the curriculum of the 2020-2021 admitted batch and the same is recommended to the academic council for approval

As per the contemporary requirements Activity-based learning and social work are included as audit courses with L-T-P-S: 2-0-0-0 in A. Y:2020-2021 B. Tech admitted structures were put before the BoS members for review.

The finalized course structure for 2020-21 B. Tech-EEE is provided in Point 1 of Annexure II

AGENDA ITEM-3

Course Structure and Syllabi for 2022-23 admitted batches for the B. Tech EEE program as per the suggestions and feedback received from stakeholders and approved in DAC	It is resolved to approve the curriculum of the 2022-2023 admitted batch and the same is

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	recommended to the academic council for approval

As per the feedback from academic peers, industry experts and alumni to improve practical knowledge and skills among the students few changes in B. Tech structures were put before the BoS members for review. The changes in the B. Tech EEE course structure are the inclusion of lab and tutorial components in relevant professional elective courses in all specializations.

SL	Course Code	Course Title	Course Type	Percentage of Revision	Remarks
1	22SC2103	Object Oriented Programming	ES	10	Topics Added in CO4- multi-threaded programming, java input/output, collection framework and swing package-based event-driven programming.
2	22EE3132	Distributed Energy Resources and Smart Grids	Elective	25	The laboratory component is introduced for gaining practical knowledge.
3	22EE3232	Internet Of Things and Smart Grid Analytics	Elective	25	The laboratory component is introduced for gaining practical knowledge.
4	22EE3123	Energy Management and Green Buildings	Elective	25	The tutorial component is added to gain problem-solving.
5	22EE3221	AI and IoT for Green Energy Integration	Elective	25	The laboratory component is introduced for gaining practical knowledge.
6	22EE3222	Grid Integration of Renewable Energy Sources	Elective	25	The laboratory component is introduced for gaining practical knowledge.
7	22EE3141	Power Train Design for Electric Vehicle	Elective	25	The tutorial component is added to gain problem-solving.
8	22EE3142	Battery State Estimation Algorithms for Electric Vehicle	Elective	25	The laboratory component is introduced for gaining practical knowledge.

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9	22EE3143	Charging Stations for Electric Vehicles	Elective	25	The laboratory component is introduced for gaining practical knowledge.
10	22EE3241	AI and IoT for Electric Vehicles	Elective	25	The laboratory component is introduced for gaining practical knowledge.
11	22EE3242	Communication Protocols & Testing of Electric Vehicle	Elective	25	The laboratory component is introduced for gaining practical knowledge.
12	22EE3112	Introduction To Industrial Internet of Things	Elective	25	The laboratory component is introduced for gaining practical knowledge.
13	22EE3211	Industrial Communicatlon Protocols and Cyber Security	Elective	25	The tutorial component is added to gain problem-solving.
14	22EE3212	Smart Sensors and Sensor Networking	Elective	25	The laboratory component is introduced for gaining practical knowledge.

BoS members reviewed the structure, outcomes and syllabus of courses which are modified. The following recommendations are made for the approval of structures and syllabi. Dr. K. Siva Kumar, Associate Professor, IIT Hyderabad. and Dr. P. Shankar, Assistant Professor, NIT AP-External Member enquired on how pre-requisite concepts for a few advanced topics in professional electives viz. AI tools, Networking etc. are taken care of. The department academic committee in reply justified the pre-requisite concepts completion through skilling courses.

The syllabus for the courses for which lab and tutorial components are included is put before the BoS.

- Pravashik (Id No: 170060031) requested that project-based learning should be a blend of a software tool applied to core course concepts.
- Dandolu Vivek Vardhan (Id No: 2000069001) suggested providing a lab for the course Distributed Energy Resources and Smart Grids L-T-P-S: 2-0-2-0, to gain more practical knowledge, Internet of Things and Smart Grid Analytics L-T-P-S: 2-0-2-0, to gain knowledge for developing projects.
- Pami Setty Venkata Kedarnath (Id No: 190060028) suggested including tutorial hours for the course Energy Management Systems and Green Buildings L-T-P-S:2-1-0-0, and practical component for the course IOT for Green Energy Integration L-T-P-S:2-0-2-0.

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- Kota Chandra Sekhar (Id No: 2000069005) requested to include practical component Grid Integration of Renewable Energy Resources L-T-P-S: 2-0-2-0, BoS members suggested making the syllabus lighter for Grid Integration of Renewable Sources as one theory hour is reduced to include lab component.
- Kanigolla Yaswanth Sai, VISI engineer, Wipro, India Lab, or skilling for AI & IoT courses in specialization subjects provides a better understanding of the course and helps to achieve course outcomes. AI and IoT for Electric Vehicle, L-T-P-S:2-0-2-0,
- Lakshmi Lavanya Mani Deepika (Id No: 190069019) requested to provide lab components for gaining knowledge in electric vehicle technology specialization courses-Communication Protocols &Testing of Electric Vehicle L-T-P-S:2-0-2-0, Charging Stations for Electric Vehicles L-T-P-S:2-0-2-0.
- Dr. Srinivasa Kishore Babu, JNTUK academician suggested including tutorial components to improve real-world problem-solving skills in Power Train Design for Electric vehicle, L-T-P-S: 2-1-0-0
- R Phani Varun (Id No: 2000069027) requested to have lab & Tutorial components Introduction to Industrial Internet of Things L-T-P-S:2-0-2-0, Industrial Communication protocols and Cybersecurity L-T-P-S: 2-1-0-0, Smart Sensor and Sensor Networking L-T-P-S:2-0-2-0
- Sai Krishna Reddy, Traction power engineer -Alstom, India- to incorporate real-time problems and case studies in power electronics and electrical drives.

Dr. Praveen Damacharla and Dr. T. Ratna Prasad suggested having sufficient lab facilities before these changes commence.

BoS members suggested making the syllabus lighter for the courses as theory hour is reduced to include a lab component. Also, suggested to start with 5 to 6 listed experiments and follow open-ended questions thereof for the lab courses in professional electives.

The revisions proposed in the syllabus of revised and newly introduced courses are provided in Point 2 of Annexure II 20% revision is achieved.

Annexure 1.1 DAC MoM and summary of stakeholders' feedback dt. 08/02/2022, Annexure 1.2 DAC-2 MoM dt. 26-02-2022)

AGENDA ITEM-4

List of courses and syllabi for B. Tech EEE (Hons.) degree for 2022-23 admitted batch.	It is resolved to approve the Honor degree of the 2022-2023 admitted batch and the same is recommended for the academic council for approval

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Dr. K Siva Kumar, Associate Professor, IIT Hyderabad has suggested considering custom custom-designed syllabus for one or two Honour courses which help the student to take higher education or research in his interested area.

Dr. P. Shankar, Assistant Professor, NIT AP suggested including power electronic converter applications in the syllabus of the Power Quality subject and reducing fault aspects.

- Dr. P Srinivasa Varma, Associate Professor, EEE, KLEF, faculty recommended for Honour degree programs in EEE.
- Dr. Praveen Damacharla suggested considering self-study and MOOC courses for Honour degree courses. (Annexure-III)

AGENDA ITEM-5

List of courses and syllabi for Minor degrees offered by the Department of EEE for the 2022-23 admitted batch	It is resolved to approve the Minor Degree courses of the 2022-2023 admitted batch and the same is recommended for the academic council for approval

All the external BoS members suggested taking care of pre-requisite concepts as the Minor courses are offered to other department subjects.

Dr. K. Siva Kumar, Associate Professor, IIT Hyderabad suggested restricting the eligible branches as per the suitability.

Viz. A minor in Portable Power Supplies could be restricted to Mechanical and Electronics Branches, a Minor in Smart Electric Grid could be restricted to Computer Science and Engineering, Minor in Electric vehicles is restricted to mechanical, ECM and ECE branches.

Also suggested collaborating with the CSE department to implement a Minor in Cyber physical systems.

All the above recommendations are agreed upon by all the BoS members and corresponding modifications are made for eligible branches to minor degrees.

Dr. P. Shankar, Assistant Professor, NIT AP suggested making the syllabus lighter for the Dynamics of Renewable Sources, Microgrids, and Distributed Energy Resources courses.

Bos members suggested including UPS concepts, energy storage concepts, optimal utilization concepts, and end solution for embedded system concepts for Minor in Portable Power Supplies.

- Jampani Jaya Sai Sree Likhita, a student requested to provide a cyber-physical system minor degree course.
- Dr. Srinivas Bhaskar Karanki, Associate Professor., IIT Bhubaneswar, industry expert - offer green technologies-related courses to other domains as MINOR degree courses.

(Annexure-IV)

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AGENDA ITEM-6

Course Structure and Syllabi for 2022-23 admitted batches for newly applied M. Tech PEPS program	It is resolved to approve the curriculum of M. Tech PEPS program of the 2022-2023 admitted batch and the same is recommended to the academic council for approval

Based on the demands of contemporary requirements of local/ global needs M. Tech- Power Electronics & Power Systems Program is introduced and presented to BOS members. All BOS members expressed their consent to the newly approved programs.

- K Prajwal, AE AP Genco recommended offering power electronics and power system specialization for PG students as per industry needs

M. Tech PEPS: Power electronics and power systems play a crucial role in enhancing the energy efficiency of electrical devices and systems. As energy conservation and sustainability become increasingly important, experts in this field are in high demand to design and optimize systems that consume less energy and minimize wastage. With the growing emphasis on renewable energy sources like solar and wind, power electronics and power systems specialists are needed to develop technologies that efficiently convert and manage energy from these sources, ensuring a smooth integration into the power grid.

Dr. Shankar, Assistant Professor, NIT AP expressed to make the syllabus of PSPE courses content lighter as the courses should cover both PS and PE specialisations. Dr. S.VNL Lalitha, Professor, Department of EEE, KLEF suggested having power system analysis concepts included in semester-1 along with power system stability and protection concepts to be moved to be shifted to semester-2 in Advanced Power system protection and control. Dr. S.VNL Lalitha, Professor, Department of EEE, KLEF has suggested changing the name of the Python program for electrical systems to Applications of Python for electrical systems.

(Point 1 of Annexure-V)

AGENDA ITEM-7

Course Structure and Syllabi for 2022-23 admitted batches for newly applied M. Tech EVT program	It is resolved to approve the curriculum of M. Tech EVT program of the 2022-2023 admitted batch and the same is recommended to the academic council for approval

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Based on the demands of contemporary requirements of local/ global needs M. Tech Programs in Electric Vehicle Technology are introduced and presented to BOS members. All BOS members expressed their consent to the newly approved programs.

- Anmol Agarwal, C.E.O, SKY LAMP INDIA, INDIA, Industry expert suggested offering Electric Vehicle Technology specialization for PG students.

M. Tech EVT: The global shift towards sustainable and environmentally friendly transportation has led to a surge in the demand for electric vehicles. Specializing in EV technology positions individuals and companies to tap into this growing market.

Dr. Shiva Kumar, Associate Professor, IIT Hyderabad suggested modifying the syllabus of Power train design for EV. The concepts of vehicle dynamics are to be shifted to mechanical design for EVs. Dr. K. Narasimha Raju, Professor, Department of EEE, KLEF suggested making the syllabus more suitable for ME, ECE and EEE students. All these branches can be given eligibility to take admission into the program. Dr. Shiva Kumar, Associate Professor, at IIT Hyderabad, suggested including fuel cell concepts in the power train design for EV course. (Ppoint 2 of Annexure-V)

AGENDA ITEM-8

Modifications in the syllabus for courses offered in A.Y: 2022-23 Odd semester	It is resolved to approve the TPT-1 syllabus of the 2022-2023 admitted batch and the same is recommended to the academic council for approval

A minor syllabus modification in the Technical Proficiency-1 course for the Y20 batch is put before the BoS members. The members reviewed and approved for inclusion of machine learning concepts. (Point one of Annexure-VI)

AGENDA ITEM-9

Value-added courses to be offered in AY 2022-23 for B. Tech EEE program	Bos members recommended Value added courses to the academic council for approval

The syllabus of value-added courses is reviewed for mapping to employability entrepreneurship or career progress. The courses are planned to be certified by National Instruments, Decibel Labs Pvt. Ltd, Huawei, NASCOM, Entuple Pvt. Ltd. The reputation of the course-delivering organizations and the usefulness of the certificate were discussed, and courses were approved by the BoS members.

- M. Sri Rama Murthy suggested offering certificate courses on tools and technologies that will help them for core placements.

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- T. LAKSHMI parent requested to provide certification courses on various platforms.

(Annexure-VII)

AGENDA ITEM-10

Courses for Informal learning mapping with SAC activities, Startup, Innovation, Incubation mapping with industry curriculum, International /national challenges/events/competitions (online and offline) mapping with credits	Bos members recommended to the academic council for approval

All the project components in the curriculum will be offered through informal learning, Innovation, and Incubation mapping is done with the Design Thinking and Innovation course and social internship courses. The mapping of credits for International/national challenges/events/competitions (online and offline) will be done as per the decision of respective authorities.

AGENDA ITEM-11

Approval of Program Development Document and academic regulations for 2022-23 admitted B. Tech and M. Tech Programs	Bos members recommended to the academic council for approval

The program development document for 2022-23 B. Tech and M. Tech structures highlighting Local/Regional/National/ Global needs and Mapping to courses is presented to all the BoS members and is reviewed for significance to the introduction or revision of courses. The academic regulations for the 2022-23 admitted batches are approved by the BoS members.

AGENDA ITEM-12

Review of Percentage of courses mapped to employability, entrepreneurship, and skill development for 2022-23 B. Tech and M. Tech Programs	Bos members recommended to the academic council for approval

The finalized courses were reviewed by BoS members for mapping employability, entrepreneurship, and skill development. The weightage of courses mapping for each component is analyzed (point 1 of Annexure-II, point 1 of Annexure-III, point of Annexure-IV)

AGENDA ITEM-13

MOOCs courses, Work in Lieu courses, AICTE-SLA PARAKH assessment courses for 2022-23 admitted batch of B. Tech EEE program	Bos members recommended MOOC courses to academic council approval

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BoS members reviewed the contents of all proposed MOOC courses for relevance to domain knowledge, suggested verifying continuous availability of the same and approved for inclusion.

The preliminary set of industries and equivalent courses identified for Work in lieu are appreciated. However, the suggestion of providing the option to choose a relevant industry to the student and thereof verifying the quality and proposing for equivalence should rest on the department academic committee, to recommend the same for BoS.

(Annexure VIII)

AGENDA ITEM-14

Review of Results obtained last semester and CO-PO attainment	It is resolved to approve CO-PO attainment of the previous semester and the same is recommended to Academic Council

AGENDA ITEM-15

Review of Ambula Gopi Raja Id No:14006006 equivalence courses for awarding B. Tech degree. Other items to discuss	It is resolved to approve Gopi Raja Id No:14006006 for equivalence courses to be done and the same is recommended to the Academic Council

- Because of the National and International level competition achievements of Ambula Gopu Raja, Id No: 14006006 student equivalence for the courses to be done are put forward in front of BoS members for review.

The BOS members reviewed and recommended for consideration the courses to be done to award a B. Tech degree for Ambula Gopi raja. (Annexure IX)

- Bos members discussed the contents of all other items.

22/3/22
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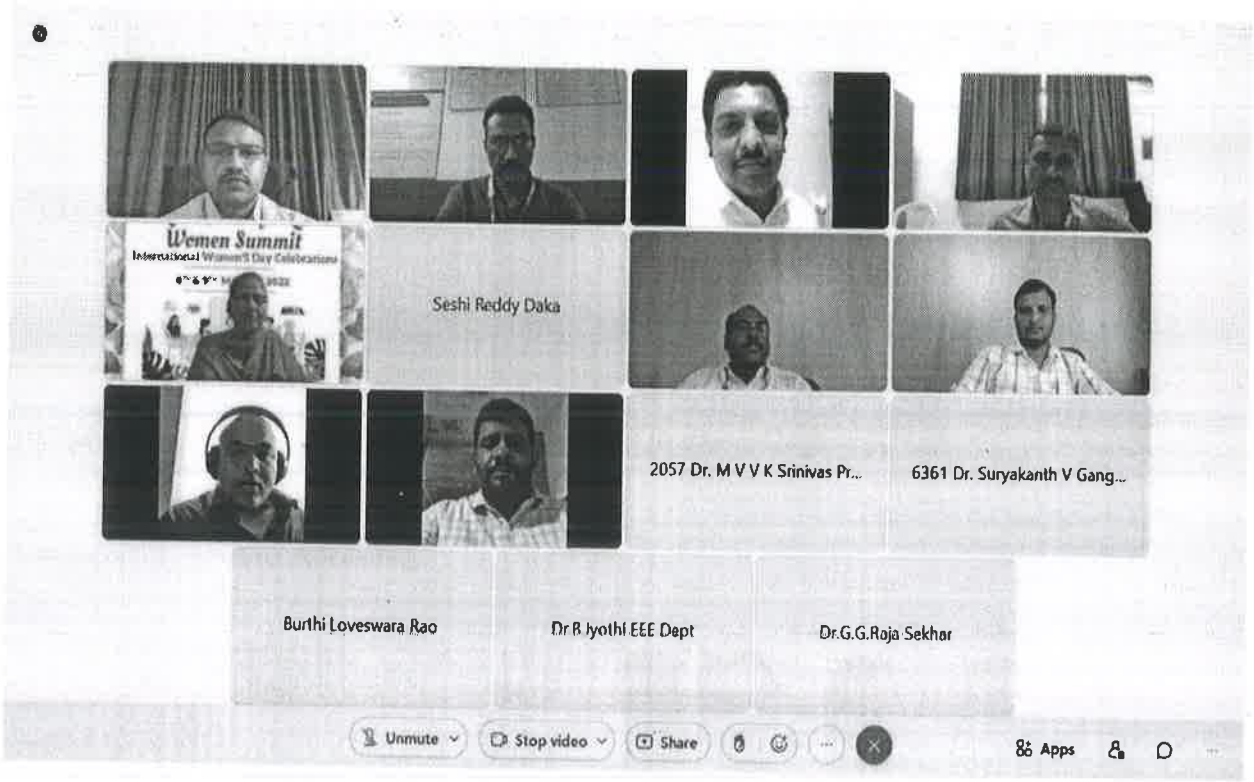
Pictures of BOS meeting proceedings:



J. Somlal
22/3/22

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Minutes of the DAC meeting, Electrical & Electronics Engineering Department held on 08-02-2022 from 10:00 AM to 2:00 PM.

Dr. J Somlal , Head EEE has welcomed all the members attended the meeting he appreciated the efforts for student members for their concern in improving the curriculum as per the local/global/national needs for the benefit of the society

The following Faculty Members were present:

1	Dr. J Somlal	, Professor & HOD
2	Dr. K Narasimha Raju	, Professor, Department of EEE
3	Dr. S V N L Lalitha	, Professor, Department of EEE
4	Dr. P Srinivas Varma	, Associate Professor, Department of EEE
5	Dr. A Pandian	, Professor & PED Research Group Head, EEE
6	Dr. B Loveswara Rao	, Professor, Power Systems Research Group Head, EEE
7	Dr. M Kiran Kumar	, Associate Professor, Department of EEE
8	Dr. B Jyothi	, Associate Professor, RPAC Chairman, EEE
9	Dr. G G Raja Sekhar	, Associate Professor, Department of EEE
10	Mrs. K Sarada	, Associate Professor, Department of EEE
11	Mr. R B R Prakash	, Associate Professor, Department of EEE
12	Mr. D Seshi Reddy	, Associate Professor, Department of EEE
13	Mr. M Naga Chaitanya	, Assistant Professor, Department of EEE
14	Mr. S Ravi Teja	, Assistant Professor, Department of EEE
15	Mr. D. Kalyan	, Assistant Professor, Department of EEE
16	Mr. T. Teja Sreenu	, Assistant Professor, Department of EEE

The following Students Members were present:

1. Chiluvuri Sravya Sri (180060036)
2. Dadi Tirumala Tarun (180060022)
3. Tambura Surya Teja(190060031)
4. Nakka Nagendra Kumar (2000060007)
5. Dandolu Vivek Vardhan (200006001)
6. RVarun (2000069027)
7. K Chandhra Sekhar 2000069005

8/2/2022

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Minutes of the DAC meeting, Electrical & Electronics EngineeringDepartment held on February 8th,2022 from 10:00 AM to 2:00 PM.

AGENDA ITEMS

1. To analyze Stake holders feed-back for AY 2021-22
2. To analyze Course Closure minutes and recommendations to BoS
3. To review course structure for Y22 UG & PG programs
4. To review PDD of Y22 UG & PG programs
5. To map Employability, Entrepreneurship and Skill Development Courses for Y22 UG & PG programs
6. Proposal of Value added courses for Y22 B.Tech EEE program
7. To review and propose software and infrastructure requirements pertaining to Y22 B.Tech EEE program
8. Discussion on modifications in courses offered during AY 2022-23 Odd Semester.

AGENDA and RESOLUTIONS

AGENDA ITEM-1

Stake Holders feed back Analysis	Action plan identified and recommended to BoS

Positive feedback is obtained from the stake holders regarding y21 structures. How ever few important points were made by various stake holders which help for further improvement of courses and program outcomes. The gist of which include introduction of lab component in specializations, inclusion of python programming tool for project-based learning, revision in level of outcomes, inclusion of tutorials for problem solving. Corresponding points are taken for review by the DAC members and few modifications are made in Y22 structures accordingly and the same is recommended for discussion in BoS.

(Annexure 2)

AGENDA ITEM-2

Analysis of Course Closure minutes of AY 2021-22 Odd Sem	Action plan identified and recommended to BoS

Course Coordinators Course closure remarks of AY 2021-22 odd semester were reviewed in detail and identified positive and negative aspects of courses organization. Micro-learning, Higher order thinking, feedback collection, attaining outcomes, attendance percentage, student feedback were effective implemented in the department. Identified a gap pertaining to industry expert lectures and benchmarking. The DAC members reviewed the same and proposed for betterment in organizing courses which include observing tutorial component for electrical circuits course, identification of benchmarking standards and industry experts for course delivery and the same is recommended for discussion in BoS

(Annexure 3)

12/2/22

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AGENDA ITEM-3

course structure for Y22 UG & PG programs	Draft approved for recommendation to BoS

Following the analysis of stake holders' feedback and course coordinators remarks few modifications in Y22 Structures were made by the DAC.

i. Syllabus modifications in BEEE and OOPS courses
ii. Adding lab component for SPVMES and AI& IoT for Green Energy Integration courses of GET specialization
iii. Adding lab component for CSEV, AI& IoT for EV, Communication Protocols and Testing of EV courses of EVT specialization
iv. Adding lab component for DERSG, IOT and Smart Grid Analytics courses of SGT specialization
v. Adding lab component for IIOT and Sensors networking courses of IA specialization

(Annexure 1)

AGENDA ITEM-4

Review PDD of Y22 UG & PG programs	Draft approved for recommendationto BoS

The program development document for 2022-23UG and PG structures highlighting Local/Regional/National/ Global needs and Mapping to courses is presented to all the DAC members which is reviewed for significance to introduction or revision of courses.

(Annexure 6)

AGENDA ITEM-5

Mapping of Employability, Entrepreneurship and Skill Development Courses	Proposal recommended to BoS

The tentative courses were reviewed by DAC members for mapping to employability, entrepreneurship,and skill development.

(Annexure 7, Annexure 8, Annexure 9)

AGENDA ITEM-6

Proposal of Value added courses for Y22 B.Tech EEE program	Approved by DAC for recommendation to BoS

Existing streams were retained and the same is proposed for Y22 B.Tech EEE batch as well.

12/12/22

AGENDA ITEM-7

Software and infrastructure requirements pertaining to Y22 B.Tech EEE program	Approved by DAC for recommendation to BoS

Following the proposed changes in Y22 B.Tech EEE structure software and infrastructure requirements for inclusion of labs and cloud tools for three specializations (Annexure 15)

AGENDA ITEM-8

Modifications in courses structure or syllabus offered during 2022-23 Odd Semester	No Recommendations identified for discussion in BoS

12/12/22

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Deartment of EEE

Stake Holders Feedback for A.Y 2022-2023

SL	Feedback received	Resolution Taken	Program	Dept
	STUDENTS			
1	Pravashik requested that project based learning should be blend of a software tool applied to core courses concepts	Planned to include python programming based simulation applied to core courses in semester	B.TECH	EEE
2	JAMPANI JAYA SAI SREE LIKHITA requested to provide cyber physical system minor degree course	Cyber Physical System is included in the cirriculum and was forwarded to BOS approval	B.TECH	EEE
3	Dandolu Vivek Vardhan suggested to for lab for the courses Distributed Energy Resources and Smart Grids ,Internet of Things and Smart Grid Analytics	Labs for Distributed Energy Resources and Smart Grids ,Internet of Things and Smart Grid Analytics were included and was	B.TECH	EEE
4	Pami Setty Venkata Kedarnathai recommended to include tutorial hour for the course Energy Management Systems and Green Buildings and AI for Green Energy Integration	tutorial hour for the course Energy Management Systems and Green Buildings and AI for Green Energy Integration were recommended and was forwarded to BOS approval	B.TECH	EEE
5	Kota Chandhra Sekhar requested to lab for Grid Integration of Renewable Energy Resources	Labs for Grid Integration of Renewable Energy Resources were recommended and was forwarded to BOS approval	B.TECH	EEE
6	Lakshmi Mani Deepika requested to provide lab for Communication Protocols &Testing of Electric Vehicle, Charging Stations For Electric Vehicles	Labs forCommunication Protocols &Testing of Electric Vehicle, Charging Stations For Electric Vehicles were recommended and was forwarded to BOS approval	B.TECH	EEE
7	R Varun requested to have lab & Tutorial components Jntroduction to Industrial Internet of Things, Industrial Communication protocols and Cyber Security , Smart Sensor and Sensor Networking	lab & Tutorial components Introduction to Industrial Internet of Things, Industrial Communication protocols and Cyber Security , Smart Sensor and Sensor Networking were included and was forwarded to BOS approval	B.TECH	EEE
	PARENTS			
8	M. Sri Rama Murthy, Suggested to offer certificate courses on tools and technologies that will help them for core placements.	Certificate courses on Electric vehicle design with Matlab, Inductrial IOT, IOT and data science for smart grid are proposed and forwarded for BOS	B.TECH	EEE
9	T.LAKSHMI requested to provide certification courses on various platform.	Certification courses were identified and bos members recommended to forward for approval in BOS	B.TECH	EEE
	FACULTY			

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10	Dr. B Jyothi recommended to add research methodology as a subject in PG cirriculum	The department will explore the possibility to introduce course related to research/ research methodology after discussing with the subject experts in coming BOS meetings.	M.TECH	EEE
11	Dr. P Srinivasa Varma recommended for Honour degree programs in EEE	Bos members agreed for Honor in EEE and put forward to BOS approval	B.TECH	EEE
		ALUMNI		
12	Kanigolla Yaswanth Sai , Vlsi engineer , Wipro , India Lab or skilling for AI & IoT courses in specilization subjects provides better understanding of course and help to achieve course outcomes	Identified suitable subjects and drafted structure, tentative experiments to recommend to BOS for approval	B.TECH	EEE
13	Sai Krishna Reddy , Traction power engineer , Alstom, India- to incorporate real time problems and case studies in power electronics and electrical drives	electrical vehicle technology specilization stream courses has case studies	B.TECH	EEE
		ACADENIC PEER		
14	Dr. Srinivas Bhaskar Karanki,Assoc. Prof., IIT Bhubaneswar- offer green technologies related courses to other domain as MINOR degree courses	BOS members recommended to Include Green Technologies in cirriculum and forwarded to BOS	B.TECH	EEE
15	Dr. Srinivasa Kishore Babu, JNTUK - include tutorial components to improve real world problem solving skills in power train design and energy management	identifed Power train design for EV and EMS & Green Building courses as suitable for incuding tutorial components and recommended for consideration by BOS	B.TECH	EEE
		INDUSTRY EXPERT		
16	Anmol Agarwal , C.E.O , SKY LAMP INDIA, INDIA- suggested to offer portable power sources as minor degree for Ece students	BOS members recommended to Include Portable power Supplies in cirriculum and forwarded to BOS	B.TECH	EEE
17	Vinay Are, CEO, BlueCap Home Services LLP, India- Additional courses on the semi-conductor chips because that is next revolutionary in the industry. And practice school should be mandatory for every student so they can learn how the industry runs and what will be there.	proposal was put forward for approval in BOS	B.TECH	EEE

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Phone No. 08645 - 350200; www.klef.ac.in; www.klef.edu.in; www.kluniversity.in
Admin Off: 29-36-38, Museum Road, Governorpet, Vijayawada - 520 002. Ph: +91 - 866 - 3500122, 2577715, 2576129.

Minutes of the DAC meeting, Electrical & Electronics Engineering Department held on 26-02-2022 from 10:00 AM to 2:00 PM.

AGENDA ITEMS

1. To analyze in person feedback received on tentative structure from selected Stake holders.
2. To review course structure and syllabus for Y22 UG & PG programs

The following Faculty Members were present:

1	Dr. J Somlal	, Professor & HOD
2	Dr. K Narasimha Raju	, Professor, Department of EEE
3	Dr. S V N L Lalitha	, Professor, Department of EEE
4	Dr. P Srinivas Varma	, Associate Professor, Department of EEE
5	Dr. A Pandian	, Professor & PED Research Group Head, EEE
6	Dr. B Loveswara Rao	, Professor, Power Systems Research Group Head, EEE
7	Dr. M Kiran Kumar	, Associate Professor, Department of EEE
8	Dr. B Jyothi	, Associate Professor, RPAC Chairman, EEE
9	Dr. G G Raja Sekhar	, Associate Professor, Department of EEE
10	Mrs. K Sarada	, Associate Professor, Department of EEE
11	Mr. R B R Prakash	, Associate Professor, Department of EEE
12	Mr. D Seshi Reddy	, Associate Professor, Department of EEE
13	Mr. M Naga Chaitanya	, Assistant Professor, Department of EEE
14	Mr. S Ravi Teja	, Assistant Professor, Department of EEE
15	Mr. D. Kalyan	, Assistant Professor, Department of EEE
16	Mr. T. Teja Sreenu	, Assistant Professor, Department of EEE

The following Students Members were present:

1. Chiluvuri Sravya Sri (180060036)
2. Dadi Tirumala Tarun (180060022)
3. Tambura Surya Teja(190060031)
4. Nakka Nagendra Kumar (2000060007)
5. Dandolu Vivek Vardhan (200006001)
6. RVarun (2000069027)
7. K Chandhra Sekhar 2000069005

5/3/2022

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Minutes of the DAC meeting, Electrical & Electronics EngineeringDepartment held on Feb 26th , 2022 from 10:00 AM to 2:00 PM.

AGENDA ITEMS

1. To analyzein person feedback received on tentative structure from selected Stake holders
2. To review course structure and syllabus for Y22 UG & PG programs

AGENDA and RESOLUTIONS

AGENDA ITEM-1

Analysis of In-person feedback from selected Stake Holders	Action plan identified and recommended to BoS

Few important points were made by various stake holders which help for further improvement of courses and program outcomes. The gist of which include introduction of lab component in specializations, inclusion of python programming tool for project-based learning, revision in level of outcomes, inclusion of tutorials for problem solving. Corresponding points are taken for review by the DAC members and few modifications are made in Y22 structures accordingly and the same is recommended for discussion in BoS.

AGENDA ITEM-2

Modifications in courses structure or syllabus for Y22 UG & PG programs	Recommendations made for BoS

The suggestions from Mr. D. Ravi Teja, Advanced Business Analyst Novonordisk, Bengaluru to include the concepts of Pneumatic & Hydraulic control, process control and discrete control systems are considered by DAC and included in syllabus.

Noorbasha Rahmatullah, Senior Analyst, Bank of America suggested that Introduction to computer science for core branch engineering streams would be effective through python as compared to C. Also machine learning algorithms could be taught through MATLAB.

Dr. Praveen Damacharla, Research Scientist, Kinetic AI Inc. also suggested to introduce programming through python. Also, reviewed lab components introduced in professional electives and suggested to ensure two courses have lab components for first time.

Dr. Sankar Peddpati, Asst. professor, NIT AP reviewed syllabus of Minor Degree Courses offered by department and Honor degree courses. The following suggestions are made.

1. Make syllabus lighter for Minor degree courses
2. Consider deriving few Honor Courses from core courses either by offering in advanced mode or addiing new courses which could help research orientation and entrepreneurship in students

5/3/22

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Minutes of the DAC meeting, Electrical & Electronics EngineeringDepartment held on Feb 26th , 2022 from 10:00 AM to 2:00 PM.

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2. To review course structure and syllabus for Y22 UG & PG programs

AGENDA and RESOLUTIONS

AGENDA ITEM-1

Analysis of In-person feedback from selected Stake Holders	Action plan identified and recommended to BoS

Few important points were made by various stake holders which help for further improvement of courses and program outcomes. The gist of which include introduction of lab component in specializations, inclusion of python programming tool for project-based learning, revision in level of outcomes, inclusion of tutorials for problem solving. Corresponding points are taken for review by the DAC members and few modifications are made in Y22 structures accordingly and the same is recommended for discussion in BoS.

AGENDA ITEM-2

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ANNEXURE-II

Point 1

KLEF

Department of EEE

B.Tech 2020-21 Admitted Batch Category wise Course Structure

Sl No	Course Code	Course Title	Category	L	T	P	S	Cr	CH	Pre-requisite
1	20UC1101	Integrated Professional English	HSS	0	0	4	0	2	4	Nil
2	20UC1202	English Proficiency	HSS	0	0	4	0	2	4	Nil
3	20UC2103	Professional Communication Skills	HSS	0	0	4	0	2	4	Nil
4	20UC2204	Corporate Communication Skills	HSS	0	0	4	0	2	4	Nil
5	20UC3005	Aptitude Builder	HSS	0	0	4	0	2	4	Nil
6	20UC0007	Indian Heritage and Culture	HSS	2	0	0	0	0	2	Nil
7	20UC0008	Indian Constitution	HSS	2	0	0	0	0	2	Nil
8	20UC0009	Ecology & Environment	HSS	2	0	0	0	0	2	Nil
9	20UC0010	Universal Human Values & Professional Ethics	HSS	2	0	0	0	0	2	Nil
10	UC0014	Activity Based Learning	HSS-Audit	2	0	0	0	0	2	Nil
11	UC0015	Social Work	HSS	2	0	0	0	0	2	Nil
12	20MT1101	Mathematics for Computing	BS	2	2	0	2	4.5	6	Nil
13	19MT2102	Mathematics for Engineers	BS	2	1	0	0	3	3	Nil
14	20EE2104	Mathematical Transforms for Signal Processing	BS	2	1	0	0	3	3	Nil
15	20UC1102	Design Thinking and Innovation-I	BS	1	0	0	4	2	5	Nil
16	20UC1203	Design Thinking and Innovation-II	BS	1	0	0	4	2	5	Nil
17	19BT1001	Biology for Engineers	BS	2	0	0	0	2	2	Nil
18	20EE2101	Electrical Circuits	BS	2	0	0	2	2.5	4	Nil
19	19PH1006	Materials & Measurements (Science Elective-1)	BS	3	0	2	0	4	5	Nil
20	19CY1101	Engineering Chemistry (Science Elective-2)	BS	3	0	2	0	4	5	Nil
21	20SC1101	Computational Thinking for Design	ES	3	0	2	6	5.5	11	Nil
22	20ME1103	Design Tools Workshop - I	ES	0	0	4	0	2	4	20SC1101
23	20CS1202	Data Structures and Algorithms	ES	3	0	2	4	5	9	NIL
24	20SC1203	Object Oriented Programming	ES	2	0	4	0	4	6	Nil
25	19SC1209	Design Tools Workshop - II	ES	0	0	4	0	2	4	Nil
26	20EC1101	Digital Logic & Processors	ES	3	0	2	0	4	5	Nil
27	19EC1202	Computer Organization & Architecture	ES	2	0	0	0	2	2	Nil
28	20EE1201	Basics of Electrical and Electronics Engineering	ES	3	1	2	0	5	6	Nil
	19EE3106	Sensors & Internet of Things	ES	3	0	2	0	4	5	Nil
31	19EC2103	Analog Electronics Circuit Design	PC	3	0	2	2	4.5	7	Nil
32	19EC2106	Embedded Controllers	PC	2	0	3	2	4	7	Nil
33	19EE2102	Electrical Power Engineering	PC	3	1	0	0	4	4	Nil
34	19EE2103	Electrical Machines	PC	3	0	2	0	4	5	Nil

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35	19EE2201	Industrial Applications of Electrical Machines	PC	3	0	2	0	4	5	19EE2103
36	20EE2202	Power Electronics	PC	3	0	2	2	4.5	7	20EE2101
37	19EE2203	Computer Applications in Power Systems	PC	3	0	2	0	4	5	19EE2102
38	20EE2204	Control Systems	PC	3	0	2	2	4.5	7	Nil
39	PE-1	Professional Elective - 1	PE	3	0	0	0	3	3	-
40	PE-2	Professional Elective - 2	PE	3	0	0	0	3	3	-
41	PE-3	Professional Elective - 3	PE	3	0	0	0	3	3	-
42	PE-4	Professional Elective - 4	PE	3	0	0	0	3	3	-
43	PE-5	Professional Elective - 5	PE	3	0	0	0	3	3	-
44	FC-1	Flexi Core -1	FC	3	0	2	0	4	5	-
45	FC-2	Flexi Core -2	FC	3	1	0	0	4	4	Nil
46	OE-1	Open Elective - 1	OE	3	0	0	0	3	3	Nil
47	OE-2	Open Elective - 2	OE	3	0	0	0	3	3	Nil
48	ME-1	Modelling Business Systems	OE	3	0	0	0	3	3	Nil
49	OE-3	Entrepreneurship Essentials	OE	3	0	0	0	3	3	Nil
50	FL	Foreign Language Elective	OE	2	0	0	0	2	2	Nil
51	20TS3101	Technical Proficiency - 1	PR	0	0	0	##	3	12	Nil
52	20TS3202	Technical Proficiency - 2	PR	0	0	0	##	3	12	Nil
53	20TS4103	Technical Proficiency - 3 MODEL BASED DESIGN	PR	0	0	0	##	0	12	Nil
54	20TS4204	Technical Proficiency - 4	PR	0	0	0	##	0	12	Nil
55	20IE2050	Social Internship	PR	0	0	0	8	2	8	Nil
56	20IE3050	Technical Internship	PR	0	0	0	8	2	8	Nil
58	20IE3150	Mid Grad Capstone Project - I	PR	0	0	0	8	2	8	Nil
59	20IE3250	Mid Grad Capstone Project - II	PR	0	0	0	8	2	8	Nil
60	20IE4150	Capstone Project - I	PR	0	0	0	##	6	24	Nil
61	20IE4250/20IE4	Capstone Project - II/ Practice	PR	0	0	0	##	6	24	Nil
tal Credits				**##**	**7**	**##**	**##**	**167**		

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Department of EEE

B.Tech EEE 2022-23 Admitted Batch Category Wise Course Structure

Sl N	Course Co	Course Title	ıtego	L	T	P	S	Cr	CH	Pre-req	E/En/S	R/M/N	Percentage
1		Integrated Professional English	HSS	0	0	4	0	2	4	Nil	Employability	Retained	
2		English Proficiency	HSS	0	0	4	0	2	4	Nil	Employability	Retained	
3		Essential Skills for Employability	HSS	0	0	4	0	2	4	Nil	Employability	Retained	
4		Corporate Readiness Skills	HSS	0	0	4	0	2	4	Nil	Employability	Retained	
5		Universal Human Values & Professional Ethics	HSS	2	0	0	0	2	2	Nil	Employability	Retained	
6		Indian Heritage and Culture	HSS	2	0	0	0	0	2	Nil	Employability	Retained	
7		Indian Constitution	HSS	2	0	0	0	0	2	Nil	Employability	Retained	
8		Ecology & Environment	HSS	2	0	0	0	0	2	Nil	Employability	Retained	
9		Gender Sensitization	HSS	2	0	0	0	2	2	Nil	Employability	Retained	
10		Mathematics for Computing	BS	2	2	0	2	4.5	6	Nil	Employability	Retained	
11		Mathematics for Engineers	BS	2	1	0	0	3	3	Nil	Employability	Retained	
12		Mathematical Transforms for Signal Processing	BS	3	0	0	0	3	3	Nil	Employability	Retained	
13		Design Thinking and Innovation	BS	0	0	4	0	2	4	Nil	Enterpreneurship	Retained	
14		Science Elective - 1	BS	3	1	0	0	4	4	Nil	Employability		
15	21EE2103	Electromagnetic Fields and Engineering Materials (Science	BS	3	1	0	0	4	4	Nil	Employability	Retained	
16		Problem Solving Skills-I	BS	0	0	2	2	1.5	4	Nil	Skill Development	Retained	
17		Problem Solving Skills-II	BS	0	0	2	2	1.5	4	Nil	Skill Development	Retained	
18		Computational Thinking for Structured Design	ES	3	0	2	6	5.5	11	Nil	Employability	Retained	
19		Design Tools Workshop – I	ES	0	0	4	0	2	4	Nil	Skill Development	Retained	
20		Design Tools Workshop – II	ES	0	0	4	0	2	4	Nil	Skill Development	Retained	
21		Design of Data Structures	ES	3	0	2	4	5	9		Employability	Retained	
22		Computer Organization & architecture	ES	2	0	0	0	2	2	Nil	Employability	Retained	
23	22EE1201	Basic Electrical and Electronics Engineering	ES	3	1	2	0	5	6	Nil	Skill Development	Modified	10
24	22SC2103	Object Oriented Programming	ES	2	0	4	0	4	6	Nil	Skill Development	Modified	10
25		Digital Logic & Processors	ES	3	0	2	0	4	5	Nil	Employability	Retained	
26	21EE2203	Elctrical Power Generation, Transmission and Distribution	PC	3	0	0	0	3	3	Nil	Employability	Retained	
27	21EE2101	Electrical Circuits	PC	3	0	2	0	4	5	Nil	Skill Development	Retained	
28	21EE2102	Electrical Machines	PC	3	0	2	0	4	5	Nil	Employability	Retained	
29	21EE2201	Analog Electronics	PC	3	1	2	0	5	6	Nil	Skill Development	Retained	

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30	21EE3103	Power System Analysis	PC	3	0	0	0	3	3	Nil	Employability	Retained	
31	21EE2202	Industrial Applications of Electrical Machines	PC	3	0	2	0	4	5	21EE21	Employability	Retained	
32	21EE2204	Power Electronics	PC	3	0	2	0	4	5	21EE21	Employability	Retained	
33	21EE3101	Control Systems	PC	3	0	2	0	4	5	Nil	Skill Development	Retained	
34	21EE3202	Power System Protection and Control	PC	3	0	2	0	4	5	Nil	Employability	Retained	
35	21EE3102	Measurements and Instrumentation	PC	3	0	2	0	4	5	Nil	Employability	Retained	
36	21EE3104	AI Techniques for Electrical Engineering	PC	3	0	2	0	4	5	Nil	Employability	Retained	
37	21EE3201	Embedded Controllers & Applications	PC	3	0	2	0	4	5	Nil	Employability	Retained	
38	PE-1	Professional Elective – 1	PE					3		-			
39	PE-2	Professional Elective – 2	PE					3		-			
40	PE-3	Professional Elective – 3	PE					3		-			
41	PE-4	Professional Elective – 4	PE					3		-			
42	PE-5	Professional Elective – 5	PE					3		-			
43	OE	Open Elective – 1	OE	3	0	0	0	3	3	Nil			
44	OE	Open Elective – 2	OE	3	0	0	0	3	3	Nil			
45	OE	Open Elective – 3	OE	3	0	0	0	3	3	Nil			
46	OE	Management Elective(OE-4)	OE	3	0	0	0	3	3	Nil	Enterpreneurship	Retained	
47	OE	Foreign Language Elective(OE-5)	OE	2	0	0	0	2	2	Nil	Employability	Retained	
48		Social Internship	PR	0	0	0	4	1	4	Nil	Employability	Retained	
49		Technical Internship	PR	0	0	0	4	1	4	Nil	Employability	Retained	
50		Industry Internship	PR	0	0	0	4	1	4	Nil	Employability	Retained	
51		Project Based Learning -1	PR	0	0	0	6	1.5	6	Nil	Skill Development	Retained	
52		Project based learning -2	PR	0	0	0	6	1.5	6	Nil	Skill Development	Retained	
53		Term paper	PR	0	0	0	4	1	4	Nil	Skill Development	Retained	
54		Mid Grad Capstone Project – I	PR	0	0	0	8	2	8	Nil	Skill Development	Retained	
55		Mid Grad Capstone Project – II	PR	0	0	0	8	2	8	Nil	Skill Development	Retained	
56		Project / Internship -1/Practice School	PR	0	0	0	16	4	16	Nil	Employability	Retained	
57		Project / Internship 2/Practice School	PR	0	0	0	16	4	16	Nil	Employability	Retained	
Total Credits				**89**	**7**	**64**	**92**	**160**	**252**				

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List of Professional Electives for 2022-23 admitted batch of B.Tech EEE													
S No	Course Code	Course Title	Specialization	L	T	P	S	Cr	CH	Pre-requisite	E/En/S	R/M/N	Percentage Revision
1	21EE3131	DISTRIBUTION SYSTEM PRACTICES	Smart Grid Technologies	3	0	0	0	3	3	21EE2203	Employability	Retained	NA
2	22EE3132	DISTRIBUTED ENERGY RESOURCES AND SMART GRIDS		2	0	2	0	3	4	Nil	Employability	Modified	20
3	21EE3133	ENERGY MANAGEMENT SYSTEMS AND SCADA		3	0	0	0	3	3	Nil	Employability	Retained	NA
4	21EE3231	SMART GRID COMMUNICATION AND CYBERSECURITY		3	0	0	0	3	3	Nil	Employability	Retained	NA
5	22EE3232	INTERNET OF THINGS AND SMART GRID ANALYTICS		2	0	2	0	3	4	Nil	Enterpreneurship	Modified	20
6	21EE3121	SOLAR PV AND MICRO ENERGY TECHNOLOGIES	Green Energy Technologies	3	0	0	0	3	3	Nil	Employability	Retained	NA
7	21EE3122	WIND AND ENERGY STORAGE TECHNOLOGIES		3	0	0	0	3	3	Nil	Employability	Retained	NA
8	22EE3123	ENERGY MANAGEMENT AND GREEN BUILDINGS		2	1	0	0	3	3	Nil	Employability	Modified	20
9	22EE3221	AI AND IOT FOR GREEN ENERGY INTEGRATION		2	0	2	0	3	4	Nil	Employability	Modified	20
10	22EE3222	GRID INTEGRATION OF RENEWABLE ENERGY SOURCES		2	0	2	0	3	4	Nil	Employability	Modified	20
11	22EE3141	POWER TRAIN DESIGN FOR ELECTRIC VEHICLE	Electric Vehicle Technology	2	1	0	0	3	3	Nil	Employability	Modified	20
12	21EE3142	BATTERY STATE ESTIMATION ALGORITHMS FOR ELECTRIC VEHICLE		3	0	0	0	3	3	Nil	Employability	Retained	20
13	22EE3143	CHARGING STATIONS FOR ELECTRIC VEHICLES		2	0	2	0	3	4	21EE2204	Enterpreneurship	Modified	20
14	22EE3241	AI AND IOT FOR ELECTRIC VEHICLE		2	0	2	0	3	4	Nil	Employability	Modified	20
15	22EE3242	COMMUNICATION PROTOCOLS & TESTING OF ELECTRIC VEHICLE		2	0	2	0	3	4	Nil	Skill Development	Modified	20
16	21EE3111	INDUSTRIAL AUTOMATION AND ROBOTICS	Industrial Automation	3	0	0	0	3	3	Nil	Employability	Retained	NA
17	22EE3112	INTRODUCTION TO INDUSTRIAL INTERNET OF THINGS		2	0	2	0	3	4	Nil	Employability	Modified	20
18	21EE3113	INDUSTRIAL DRIVES AND CONTROL		3	0	0	0	3	3	Nil	Employability	Retained	NA
19	22EE3211	INDUSTRIAL COMMUNICATION PROTOCOLS AND CYBER SECURITY		2	1	0	0	3	3	Nil	Employability	Modified	20
20	22EE3212	SMART SENSORS AND SENSOR NETWROKING		2	0	2	0	3	4	Nil	Employability	Modified	20

Basics of Electrical and Electronics Engineering

Course Code: 20EE1201 **L-T-P-S: 3-1-2-0**
Pre-Requisite: NIL **Credits: 5**

Mapping of Course Outcomes with PO/PSO:

CO No	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO1	Understand the methods to solve electrical circuit using nodal and mesh analysis and apply various network theorems.	PO1,5/ PSO1	2
CO2	Analyse the various properties of Ac circuits and understand the concept of resonance.	PO1,5/ PSO1	3
CO3	Understand the working of active circuit elements.	PO1,5/ PSO1	2
CO4	Understand the applications of semiconductor devices	PO1,5/ PSO1	2
CO5	Demonstrate various experiments related to basics of electrical and electronics concepts.	PO1,5/ PSO1	4

Syllabus:

Mesh and Nodal Analysis, Theorems: Introduction to network elements, Mesh and Node Analysis. **Network Theorems:** - Superposition, Reciprocity, Thevenin's, Norton's, Maximum power transfer, star/delta transformation and source transformation. - Simple numerical problems. **Fundamentals of AC, Resonance:** RMS and average values and form factor of Sinusoidal wave form, steady state analysis of R, L and C (in series, parallel and series parallel combinations) with sinusoidal excitation, concept of reactance, impedance, susceptance and Admittance, Phase and Phase difference, concept of power factor, Real and Reactive powers, j-notation, complex and polar forms of representations, complex power. Series and parallel resonance, bandwidth, selectivity, Q factor, current locus diagrams. **Basic active Circuits elements:** P & N - type semiconductors, P-N junction, forward bias and reverse bias, V-I characteristics, ideal and practical diodes, approximate model, diode data sheet, types of diodes and variants (Introductory level only), Types of transistors (PNP and NPN). **Applications of active elements:** Clippers, Clampers, Rectifiers - HWR, FWR with and without capacitive filters. Power supply with ripple reduction and regulation, Zener diode as a voltage regulator. **Applications of Transistor:** Transistor as an amplifier, switching transistors, power transistors (low, medium and large power), key parameter from data sheet. **Analog & Digital ICs:** 7805, 7905, IC 741, IC 555, LM 339, LM723.

Text Books:

1. John Bird. Electrical Circuit Theory and Technology, Routledge publishers, 6th edition, 2017.
2. Electronic Devices and Circuit Theory 12th Edition - Robert L. Boylestad

Reference Books:

1. A Sudhakar, Shyam Mohan S Palli, Circuits and Networks: Analysis and Synthesis, TMH, 5e
2. David A. Bell, Electronic Devices and Circuits, 5th Edition.

List of Experiments:

1. Verification of Kirchhoff's laws
2. Verification of Superposition theorem
3. Verification of Thevenin's theorem
4. Verification of Maximum Power Transfer theorem

5. Parameters of Choke coil
6. Resonance of Series / Parallel RLC circuits
7. Characteristics of Diode
8. Characteristics of Zenar Diode
9. Operation of HWR & FWR
10. Characteristics of Transistor
11. Performance of clipper and clamper circuits
12. Voltage regulator using ICs.

Object Oriented Programming

Course code : 20SC2103 **L-T-P-S : 2-0-4-0**
Pre-requisite : NIL **Credits : 4**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand basic Concepts of OOP, fundamentals of java and apply the concepts of classes and objects through Java Language. Apply constructors, Overloading, parameter passing.	PO3, PO5/PSO1	2
CO2	Apply access control, Inheritance, Packages.	PO3, PO5/ PSO2	3
CO3	Apply Interfaces, Exception Handling, multi- threading, I/o.	PO3, PO5/ PSO2	3
CO4	Apply collection framework and event driven programming.	PO3, PO5/ PSO2	3
CO5	Apply object-oriented programming concepts to write programs and Analyses requirements and design to implement lab-based project with SDLC in a group of students.	PO7, PO9, PO10/ PSO1	4

Syllabus:

Introduction: Object-Oriented Programming, OOP Principles, Encapsulation, Inheritance and Polymorphism Java as a OOPs & Internet Enabled language, The Byte code, Data types, Variables, Dynamic initialization, scope and life time of variables, Arrays, Operators, Control statements, Type Conversion and Casting, Compiling and running of simple Java program.

Classes and Objects: Concepts of classes and objects, Declaring objects, Assigning Object Reference Variables, Methods, Constructors, Access Control, Garbage Collection, Usage of static with data and methods, usage of final with data,

Overloading methods and constructors, parameter passing - call by value, recursion, Nested classes.

Inheritance: Inheritance Basics, member access rules, Usage of super key word, forms of inheritance, Method Overriding, Abstract classes, Dynamic method dispatch, Using final with inheritance, String handling functions.

Packages and Interfaces: Packages, Class path, Importing packages, differences between classes and interfaces, Implementing & Applying interface.

Exception Handling: Exception Handling fundamentals, Collections Framework.

Text books:

1. Herbert Schildt, "The Complete Reference Java", 7th edition TMH.
2. Timothy A. Budd, "An Introduction to Object-Oriented Programming", 3/e, Pearson, 2008.

Reference books:

1. Deitel&Deitel, "'Java – How to program", 6th edition, PHI, 2007
2. Cay.S.Horstmann and Gary Cornell "Core Java 2, Vol 1, Fundamentals", Seventh Edition, Pearson Education.

List of Lab Experiments:

1. Every student must complete minimum 12 experiments and one Lab based Project.
2. Java program to implement nested if
3. Java program to generate a multiplication table using for- loop
4. Java program to find out second largest number
5. Java program on array – bubble sort
6. Java program on constructor over loading
7. Java program on method overloading
8. Java program on inheritance and method overriding
9. Java program on access specifiers
10. Java program on packages

11. Java program with two interfaces
12. Java program on exception handling
13. java programs on collection Frame work-1
14. java programs on collection Frame work-2

Introduction to Industrial Internet of Things

Course Code: 21EE3112
Pre Requisite: NIL

L-T-P-S: 3-0-0-0
Credits: 3

Mapping of Course Outcomes to Program outcomes:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the Industry 4.0 Globalization	1/2	2
CO2	Understand the Model and architecture of IIOT	1/2	2
CO3	Understand the IIoT Computing	1/2	2
CO4	Understand the Various Applications of IIoT	1/2	2

Syllabus:

Industry 4.0- Globalization: The Fourth Revolution, LEAN Production Systems , Sensing & actuation, Communication, Networking types.

Cyber Physical Systems and Next Generation Sensors: Collaborative Platform and Product Lifecycle Management.

Basics of Industrial IoT: Industrial Processes Industrial Sensing & Actuation, Industrial IoT: Business Model and Reference Architecture, Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing, IIoT Networking.

Industrial IoT Computing: Big Data Analytics and Software Defined Networks, Data Center Networks, Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT

Industrial IoT Application Domains: Healthcare, Power Systems, Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies.

Text Books:

1. Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress), 2017.
2. "Industrial Internet of Things: Cybermanufacturing Systems"by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer), 2017.

Reference Books:

1. Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Capasso, Packt, 2018.

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Industrial Communication Protocols & Cyber Security

Course Code: 21EE3211 **L-T-P-S: 3-0-0-0**
Pre Requisite: NIL **Credits: 3**

Mapping of Course Outcomes to Program outcomes:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the communication technology protocols & standards	1/2	2
CO2	Understand the information security and measurement technology	1/2	2.
CO3	Understand the introduction to cyber crime	1/2	2
CO4	Understand the hacking and cyber-security models ·	6/2	2

Syllabus

Different types of Communication technologies for the smart grid, Modbus - Modbus Protocol Overview - PROFIBUS-FMS, DP, PA and technology overview - DNP3- IP based Real Time data Transmission, Substation communication network.

PROTOCOL & STANDARDS

Introduction to Industrial Network Technology CAN and CiA (CAN in Automation)- Technical Overview - Application Layers- CAN Kingdom- CAN open -Introduction-Benefits and Challenges Of Interoperability, Model For Smart Grid Network Interoperability, Approach to Smart Grid Interoperability Standards, IEC61850, GOOSE.

INFORMATION SECURITY AND MEASUREMENT TECHNOLOGY

Introduction – Encryption and Decryption Authentication, Digital signature, Message digest, cyber security standards. Communication and Measurement - Monitoring, GIS and Google Mapping Tools-

Introduction to Cyber Crime - Classification of Cyber Crimes- Reasons for Commission Of Cyber Crimes - Malware – Types -Cyber Security Initiatives in India -Counter Cyber Security initiatives in India -Wireless Security - Major Issues With WLAN - Secure WLAN- Wi-Fi at Home.//

HACKING AND CYBER-SECURITY MODELS

Identifying a target-Vulnerability- Attack tools-Attack methods-Cyber security architecture • SGCG reference architecture - ISA-62443: zones and conduits and Smart Grids - Smartphone Security- Smartphone Security Guidelines- Communicating Securely (Through Voice and Messages) with a Smartphone- Secure Voice Communication- Sending Messages Securely

Text books:

1. JanakaEkanayake, N. Jenkins, K. Liyanage, J. Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley.
2. James Momoh "Smart grid: Fundamental of Design and analysis" ,John Wiley & sons Limited IEEE Press (2012).

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Smart Sensors and Sensor Networking

Course Code: 21EE3212 **L-T-P-S: 3-0-0-0**
Pre Requisite: NIL **Credits: 3**

Mapping of Course Outcomes to Program outcomes:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the basics of smart sensors and micromachining	2	2
CO2	Understand the sensor communication:	5	3
CO3	Understand the packaging, testing and reliability of smart sensors:	3	2
CO4	Understand the wireless sensor networks:	2	2

Syllabus:

Basics of smart sensors and micromachining: Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, overview of smart sensing and control systems, integration of micromachining and microelectronics, introduction to micromachining, bulk micromachining, wafer bonding, surface micromachining, other micromachining techniques for Sensor Design.

Sensor Communication and MEMS: Wireless zone sensing, surface acoustical wave devices, intelligent transportation system, RF-ID, Micro optics, micro-grippers, micro-probes, micro- mirrors, FEDs, communications for smart sensors – sources and standards, automotive protocols, industrial networks, office and building automation, home automation, protocols in silicon, other aspects of network communications.

Packaging, Testing and Reliability of Smart Sensors: Introduction, Semiconductor packaging applied to sensors, reliability implications, testing smart sensors.

Unit Standards for Smart Sensors: Introduction, setting the standards for smart sensors and systems, IEEE 1451.1, IEEE 1451.2, IEEE P1451.3, IEEE 1451.4, extending the systems to network.

Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, – energy harvesting wireless sensors, Power sources for WSN – Power generation – conversion

Text Books:

1. Understanding Smart Sensors- Randy Frank, 2nd Edition. Artech House Publications, 2013.

Reference Books:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat, V. K. Aatre, Micro and Smart Systems: Technology and modeling, Willey Publications,2012.

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Energy Management and Green Buildings

Course Code: 21EE3123
Pre Requisite: NIL

L-T-P-S: 3-0-0
Credits: 3

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply energy audit for energy management in buildings	PO2 / PSO1	3
CO2	Interpret energy conservation opportunities in electrical systems	PO7/ PSO2	2
CO3	Identify energy management strategies for energy efficiency	PO7/ PSO1	3
CO4	Identify practices for energy efficiency green buildings	PO2 / PSO1	3

Syllabus

Energy Audit: Need, types, methodology and approach, Instruments for energy audit, Energy Management Approach, Understanding Energy Costs, Bench marking, Energy performance, matching energy usage to requirements, maximizing system efficiency, Return of Investment.

Energy conservation opportunities: Energy conservation in HVAC, Refrigeration and Air Conditioning, Pumping Systems, lighting control, lighting control, Energy Conservation Building Code, Energy Conservation opportunities in Transformers and cables, Transmission lines.

Energy Management: Definition and Objective of Energy Management, General Principles, Energy Management Strategy, Energy Balance sheet and Management Information System (MIS), Energy Modelling and Optimization, Demand Side management (DSM), Peak Demand control- Methodologies.

Green Building Practices: Energy efficiency-life cycle perspective, Environmental product declaration, Building information model, choice of heat insulation materials, high thermal mass materials, phase change materials, Green building certifications.

Text books:

1. Industrial Energy Management: Principles and Applications by Giovanni and Petrecca, The Kluwer international series-207 (1999)
2. Guide to Electric Load Management by Anthony J.Pansini, Kenneth D.Smalling, Pennwell pub (1988)

Reference books:

1. Energy Management Hand book by Turner, Wayne C, Lilburn, The Fairmont press, 2001
2. Handbook of Energy Audits by Albert Thumann, Fairmont Pr; 5th edition (1998).
3. Recommended practice for Energy Conservation and cost effective planning in Industrial facilities by IEEE Bronze book, IEEE Inc, USA.
4. Energy Management Principles: C.B. Smith (Pergamon Press)
5. Bureau of Energy Efficiency Publications-Rating System, Teri Publications – Griha Rating System, Leeds Publications.

Grid Integration of Renewable Energy Sources

Course Code: 21EE3123 **L-T-P-S: 3-0-0-0**
Pre Requisite: NIL **Credits: 3**

Mapping of Course Outcomes with PO/PSO:

CO	Description	PO/PSO	BTL
CO1	Apply the control principles for PV - grid integration control	PO5	3
CO2	Apply the control principles for wind power integration control	PO4	3
CO3	Identify power quality challenges in grid integration of renewable energy	PO4	3
CO4	Identify challenges in grid integration of multiple renewable sources	PO5	3

Syllabus:

PV Integration Technology: Photovoltaic (PV) inverter topologies- configurations and control strategies, Grid codes and technical regulations of Solar PV integration
Wind Power Integration Technology: Wind power and voltage control for synchronous and induction generators-based integration; active and reactive power control, Grid codes and technical regulations of Wind power integration
Power quality management: THD, voltage sag, voltage swell, frequency change and its effects, network voltage management, frequency management, effects on system stability
Challenges: Integrating multiple renewable energy sources; DC link integration; AC link integration; HFAC link integration; islanding and interconnection

Text Books:

1. Renewable Energy Grid Integration, Marco H. Balderas, Nova Science Publishers, New York, 2009

S. Borlase, "Smart Grids, Infrastructure, Technology and Solutions", CRC Press, 1st Edition, 2013

Reference Books:

1. Grid integration of solar photovoltaic systems, Majid Jamil, M. Rizwan, D.P.Kothari, CRC Press (Taylor & Francis group), 2017
2. Wind Power Integration connection and system operational aspects, B. Fox, D. Flynn L. Bryans, N. Jenkins, M. O' Malley, R. Watson and D. Milborrow, IET Power and Energy Series 50 (IET digital library), 2007

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AI and IoT for Green Energy Integration

Course Code: 21EE3125 **L-T-P-S:** 2-0-2-0
Pre Requisite: NIL **Credits:** 3

Mapping of Course Outcomes with PO/PSO:

CO	Description	PO/PSO	BTL
CO1	Utilize AI techniques for PV based Power generation	PO4	3
CO2	Utilize AI techniques for wind and hybrid power generation	PO4	3
CO3	Demonstrate IoT devices and tools for Green energy systems	PO2	2
CO4	Build IoT Systems for Green Energy Integration	PO7	3

Syllabus:

AI for solar PV Power generation: Fuzzy logic based PV MPP techniques, RMSE and MAPE a short term irradiance, solar energy and load forecasting, Machine learning algorithms for short ter irradiation and temperature forecasting, Day ahead power output forecasting for PV systems with machine learning and deep learning techniques, case studies

AI for Wind and Hybrid Power generation: Wind speed forecasting, Frequency control of induc generator using genetic algorithm, stochastic wind generation and congestion management, Intellig Energy Management System of Hybrid Solar/Wind/Battery Power Sources, Islanding detection, ca

IoT Devices and Tools for Green Energy systems: Sensors- temperature, vibration, irradiance, w speed, PIR, proximity, current, voltage Controllers, networking, Cloud computing, Data analytics

IoT Applications for green energy systems: Cloud based Real- time Monitoring systems: PV Pow output, State of Health of Battery Storage, wind turbine vibration, M2M communication case study

Text Books:

1. AI and IoT in Renewable Energy, **Shaw,** R.N., **Mendis, N., Mekhilef, S., Ghosh,** A, Springe
2. Applications of AI and IoT in Renewable Energy, R.N., **Mendis, N., Mekhilef, S., Ghosh,** A Elsevier, 2021

Reference Books:

1. Introduction to AI Techniques for Renewable Energy System, Suman Lata Tripathi, Mithiles Kumar Dubey, Vinay Rishiwal, Sanjeevikumar Padmanaban, CRC Press, Edition 1, 2021

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Distributed Energy Resources and Smart Grids

Course Code: 21EE3132 | **L-T-P-S: 3-0-0-0**
Credits: 3 | **Pre Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand different types of distributed energy resources	PO2 / PSO1	2
CO2	Apply the principles for integrating DERs to grid	PO5 / PSO1	3
CO3	Understand smart grid objectives and its activities in India	PO3 / PSO1	2
CO4	Monitor various applications in smart grid with its smart infrastructure.	PO2 / PSO2	3

Syllabus:

Distributed Energy Resources: Introduction, combined heat and power (CHP) systems, solar photovoltaic (PV) systems, Wind energy conversion systems (WECS), small-scale hydroelectric power generation, batteries, ultra-capacitors, flywheels.

Integration of Distributed Generation to Grid: Introduction, concepts of micro grid, typical micro-grid configurations, AC and DC micro grids, interconnection of micro-grids, protection and control issues in micro-grids, technical and economic advantages of micro-grid, challenges and disadvantages of micro-grid.

Introduction to Smart Grid: Introduction to smart grid, architecture of smart grid, smart grid standards and policies, smart grid components, smart grid technologies, the fundamental components of smart grid designs, and smart-grid activities in India.

Smart Grid Monitoring: Load dispatch centers, wide-area monitoring system (WAMS), PMU; Smart sensors/telemetry, advanced metering infrastructure (AMI);smart metering; demand side management and demand response programs, demand pricing and time of use, real time pricing, peak time pricing, smart grid system monitoring and self-healing.

Text Books:

1. S. Borlase, "Smart Grids, Infrastructure, Technology and Solutions", CRC Press, 1st Edition, 2013.
2. G. Masters, "Renewable and Efficient Electric Power System", Wiley–IEEE Press, 2nd Edition, 2013.

Reference Books:

1. INIEWSKI , Smart Grid Infrastructure and Networking, McGraw-Hill Education India Pvt.Ltd (2012), 1 st Edition.
2. James Momoh, Smart Grid: Fundamentals of Design and Analysis, IEEE Computer Society Press (2012).
3. EkanayakeJ.,Jenkins N., Liyanage K., Wu, J., Yokoyama A., Smart Grid: Technology and applications, Wiley Publications.
4. Momoh J., Smart Grid: Fundamentals of design and analysis, John Wiley & Sons. Flick T., Morehouse J., Securing the smart grid: Next generation power grid security, paperback).

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INTERNET OF THINGS AND SMART GRID ANALYTICS

Course Code: 21EE3232 **L-T-P-S: 2-0-2-0**
Credits: 3 **Pre Requisite: Nil**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand network protocols and standards	PO1 / PSO1	2
CO2	Analyze IoT architecture and data analytics architecture	PO5/ PSO2	3
CO3	Understand various applications of IoT to Smart Grids	PO5/ PSO2	2
CO4	Analyze the Big Data Analytics	PO5/ PSO2	3

Syllabus:

Networking Protocols and Standards for Internet of Things: Introduction, IoT Data Link Protocols, Network Layer Routing Protocols, Network Layer Encapsulation Protocols, Session Layer Protocols, IoT Management Protocols, Security in IoT Protocols, IoT Challenges.

IoT Architecture: Introduction, Architectural Approaches, Business Architecture, Functional Architecture, Application Architecture, Data and Analytics Architecture, Technology Architecture, Security and Governance.

Applications of IOT to Smart Grid: Energy monitoring, energy harvesting, smart parking, smart medium access in mobile IOT.

Introduction to Big Data Analytics: Attributes of Big Data: Volume of data, velocity of data, variety of data; Overview of big data analytics, benefits of big data analytics, big data analytics for smart grids, big data analytics tools.

Smart Grid Data Management and Applications: Smart Meter Data Management: Smart metering architecture, challenges and opportunities, smart meter data management, future trends and issues; PHEVs: Internet of Vehicles: Convergence of PHEVs and internet of vehicles, electric vehicles management, future trends and issues; Smart Buildings: Concept of smart buildings, challenges and opportunities, different approaches for establishing smart buildings, future trends and issues.

Text Books:

1. Al-Turjman, Fadi. *Smart Grid in IoT-enabled Spaces: The Road to Intelligence in Power*. CRC Press, 2020.
2. Misra, Sudip, and Samaresh Bera. *Smart Grid Technology: A Cloud Computing and Data Management Approach*. Cambridge University Press, 2018.

Reference Books:

1. Geng, Hwaiyu, ed. *Internet of things and data analytics handbook*. John Wiley & Sons, 2017.

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ELECTRIC VEHICLE TECHNOLOGIES

POWER TRAIN DESIGN FOR ELECTRIC VEHICLE

Course Code: 21EE3141 **L-T-P-S: 3-0-0-0**
Credits: 3 **Pre-Requisite: 21EE2103**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the History, Economics, Environmental issues and power train of Electric Vehicles	PO10/ PSO1	1
CO2	Analyze the dynamics of EV	PO7/ PSO1	4
CO3	Select and size the power train for 2W	PO6/ PSO1	3
CO4	Select and size the power train for 4W	PO6/ PSO2	3

Syllabus:

HISTORY, ECONOMIC & ENVIRONMENTAL IMPACT OF ELECTRIC VEHICLE

History of EV, Case studies on Economic and Environment aspects of EV, EV markets – Supply and demand, Economical analysis with case study, Environmental impact analysis with case study. Impact of different transportation technologies on environment and energy supply.

Power train components: BEV, HEV, PHEV and FCEV including working of Fuel cell, **Super capacitor, energy management, Hybrid sources.**

INTRODUCTION TO EV DYNAMICS

Motion and dynamic equations of electric vehicles, General description of vehicle movement, Vehicle resistance, Dynamic equation, Tire Ground Adhesion and maximum tractive effort, different drive cycles for, Drive cycles for vehicle emission, fuel consumption and performance testing.

2W POWER TRAIN SIZING

Chassis, differential and transmission selection for different drive trains, Battery, converter and motor drive sizing for different 2W drive trains. Analysis on the effect of sizing of different components for different drive cycles

4W POWER TRAIN SIZING

Chassis, differential and transmission selection for different drive trains, Battery, converter and motor drive sizing for different 4W drive trains. Analysis on the effect of sizing of different components for different drive cycles

Text books:

1. "A History of Electric Vehicles" by Nigel Burton, Edition -1, Crowood Publisher.
2. "Electric Cars: The Ultimate Guide for Understanding the Electric Car And What You Need to Know" by Brad Durant

Reference books:

1. "Electric Vehicle Technology Explained" by James Larminie and John Lowry.

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CHARGING STATION FOR ELECTRIC VEHICLE

Course Code: 21EE3143 **L-T-P-S: 3-0-0-0**
Credits: 3 **Pre-Requisite: Nil**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Interpret Power electronic converters for electric vehicle charging	PO5 / PSO1	2
CO2	Develop control algorithms for various electric vehicle charging modes	PO5 / PSO1	3
CO3	Demonstrate charging station infrastructure	PO5 / PSO1	3
CO4	Demonstrate installation of charging station	PO7/ PSO2	2

Syllabus:

Charger Topologies

Charging time and charging speed, Defining power levels- Normal charging, Semi-fast charging, Overview of power levels ,DC conductive charging, AC conductive charging, Low power Charger, Automotive standard charger, High power topologies, Multi-port Charger.

Power Electronics for EV Battery Charging

Forward/ Flyback Converters, Half-Bridge DC–DC Converter, Full-Bridge DC–DC Converter, Power Factor Correction, Bidirectional Battery Chargers, Dual active bridge dc-dc converter, Solar charging station.

Charging Modes

Constant-current charging, Constant-voltage charging, Pulse Charging, Reflex charging, Float charge, Trickle Charge, Load management at charging station and peak load management

Charging Infrastructure

Charger - Existing National & International Charger Architecture Standards - SAE J1773, VDE-AR-E 2623-2-2, JEVS G105-1993 (CHAdeMO), CCS, Type-1 AC, Type-2 AC, Bharat DC-001, Bharat AC-001.

Cords and Cables, Earthing, Fault Protection, Testing, Charging Safety, Protection against electric shock, Digital Communication between EV and Charging Station.

Installation

Govt. of India guideline on Public Charging Stations, IEC Standards- 60068-2(1, 2, 14, 30), 61683, 60227, 60502, 60947 part I,II, III and 61215.

Site assessment, EVSE Typical Site Plans, Design Guidelines and Site Drawings, Planning Considerations, Station Configuration, Selection and erection of electrical equipment - Isolation, switching and control.

Text books:

1. Power Electronics by Daniel W.Hart.
2. Power Electronics for Renewable Energy Systems, Transportation and industrial Applications by Haitham Abu-Rub, Mariusz Malinwoski, Kamal Al-Haddad.

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COMMUNICATION PROTOCOLS & TESTING OF ELECTRIC VEHICLE

Course Code: 21EE3242 **L-T-P-S: 3-0-0-0**
Credits: 3 **Pre-Requisite: Nil**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the communication protocols used in Electric Vehicles	PO1, PO5	2
CO2	Apply the communication protocols for fault diagnostics of Electric Vehicle	PO1, PO3	3
CO3	Analyze the intricacies of integrating HV and LV components of vehicle	PO1, PO6	4
CO4	Understand the overview of system engineering/system validation	PO1, PO3	2

Syllabus:

Introduction to serial communication protocols: SPI I2C CAN, CAN standard, CAN message: Arbitration, message types, valid frame, error checking CANbus: Transceiver features, CAN physical layer, CAN connectors, Bit Timing, Error Handling, High Layer Protocols: IEC 61851, SAE J2601, Vehicle to Vehicle communication protocols Common Sensors modules used in EV: Air Bag, ABS, Window Mirror, Cruise Control, Transmission control, CAN Interface with Sensor Modules Power Distribution Box, Components like HVDC Relays connections, Insulation Monitoring Devices Fuses, BTMS, Driveline Cooling, Coolant tanks, Level Sensors, Vehicle Wiring, Terminals, Electrical Distribution Boards, Temperature Considerations for wiring, Cable selection, Instrument Panel, HVIL,24V converters, Junction boxes or Fuse Boxes, Fuses, derating, EMI and EMC. V cycle, reliability calculations, DFMEA/FMEA analysis, Design for manufacturing, servicing & data analytics, supply chain management

Text books:

1."A History of Electric Vehicles" by Nigel Burton, Edition -1, Crowood Publisher.

2."Electric Cars: The Ultimate Guide for Understanding the Electric Car And What You Need to Know" by Brad Durant

Reference Books:

1."Electric Vehicle Technology Explained" by James Larminie and John Lowry

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AI & IT FOR ELECTRIC VEHICLE

Course Code: 21EE3241 **L-T-P-S: 3-0-0-0**
Credits: 3 **Pre-Requisite: Nil**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Demonstrate IoT devices and tools	PO4	2
CO2	Operate the cloud system Environment	PO4	3
CO3	Utilize AI and ML Techniques	PO2	3
CO4	Utilize AI techniques for EV Applications	PO7	3

Syllabus:

IoT Devices and Enabling Technologies: Sensor Devices- temperature, vibration, irradiance, wind speed, PIR, proximity, current, voltage Controllers, Actuators, Networking and Communication Protocols, Data analytics using AI and ML for - smart cities, smart grid, smart building, electrical vehicles Cloud Computing: Basics-Cloud systems, Cloud computing protocols, Role of Web services, Deployment Models- Public, Community, Hybrid, Private Clouds, Cloud Analytics over Thingspeak, Google Firebase, AWS-console, Functions. Database Services-Relational DBMS, RDS Services. AI and ML on Cloud: Data Pre-processing techniques in Machine Learning, Data-handling, importing libraries, Data pre-processing using python, Missing data, Categorical Data. Regression and Classification algorithms in ML. Cloud based Real- time Monitoring systems, M2M communications, Case Studies Applications: Electric Vehicle Battery state estimation, health monitoring, SOL determination, Power management, Charging optimization and Electric Drive applications, Online vehicle Assistance

Text books:

1. Artificial Intelligent Techniques for Electric and Hybrid Electric Vehicles, Chitra A., P. Sanjeevikumar, Jens Bo Holm-Nielsen and S. Himavathi

2. Internet of Things An Application Based approach Using Arduino Platform and Firebase by SOURAV KUMAR BHOI, Independently published (May 31, 2018)

3. Hybrid Electric Vehicles-Principles and Applications with practical perspectives, Chris Mi, M. Abdul Masrur and David Wenzhong Gao, Wiley Publications,1 edition 2011

4. AWS Certified Machine Learning Specialty: MLS-C01 Certification Guide By Somanath Nanda, Weslley Moura · 2021

Reference Books:

1. Electric and Hybrid Vehicles power sources, models, sustainability, infrastructure and the market, Edited by Gianfranco Pistoia, Elsevier 1 edition 2010.

2. Electric and Hybrid Vehicles Design Fundamentals, by Iqbal Hussain, CRC Press2nd edition, 2010. 7. Role of Single Board Computers (SBCs) in Rapid IoT Prototyping, By G. R. Kanagachidambaresan · 2021

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MOOCS Courses Proposed for Y22 Admitted Batch of B.Tech EEE

S.No	Course Name	Platform	Category	LTPS	Contact Hours	New/Existing
1	Fundamentals of Electric vehicles: Technology & Economics	NPTEL	Employability	2-0-0-0	32	New
2	Electrical Equipment and Machines: Finite Element Analysis	NPTEL	Career Advancement	2-0-0-0	32	New
3	A brief introduction of Micro – Sensors	NPTEL	Career Advancement	1-0-0-0	16	New
4	Mapping Signal Processing Algorithms to Architectures	NPTEL	Career Advancement	3-0-0-0	40	New
5	GRAPHIC DESIGN	Course Eaa	Career Advancement	3-0-0-0	40	Existing
6	SMART CITIES - MANAGEMENT OF SMART URBAN INFRASTRUCTURES	Course Eaa	Employability	3-0-0-0	40	Existing
7	INTRODUCTION TO SELF DRIVING CAR	Course Eaa	Career Advancement	3-0-0-0	40	Existing
8	LEARN SPANISH: BASIC SPANISH VOCABULARY	Course Eaa	Employability	2-0-0-0	40	Existing
9	RUSSIAN FOR BEGINNERS	Course Eaa	Employability	2-0-0-0	40	Existing
10	LEARN CHINESE: HSK TEST PREPARATION	Course Eaa	Employability	2-0-0-0	40	Existing

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Y22 B.Tech EEE- Honor Dgree Courses									
Course Code	Course Title	Specialization	Category	L	T	P	S	Cr	CH
21EE2105	HVDC & FACTS	GET,SGT,EVT,IA	PC	3	0	0	0	3	3
21EE2205	Power Quality	GET,SGT,EVT,IA	PC	3	0	0	0	3	3
21EE3105	Restructured Power Systems	GET,SGT,EVT,IA	PC	3	0	0	0	3	3
21EE3234	Wide Area Monitoring and Control	SGT	PE	3	0	0	0	3	3
21EE4133	Smart Appliances and Smart Cities	SGT	PE	3	0	0	0	3	3
21EE3224	Floating Solar and Off-Shore Wind Technologies	GET	PE	3	0	0	0	3	3
21EE4123	Microgrids Dynamics And Control	GET	PE	3	0	0	0	3	3
21EE3244	Switched Mode Power Supply Design	EVT	PE	3	0	0	0	3	3
21EE4143	Advanced Electric Drives	EVT	PE	3	0	0	0	3	3
21EE3214	Data Science Applications for Automation	IA	PE	3	0	0	0	3	3
21EE4113	Machine Learning Applications for Automation	IA	PE	3	0	0	0	3	3
21EE4201	Capstone Project	GET,SGT,EVT,IA	PR	0	0	10	0	5	10

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Y22 B.Tech- Course structure for Minor Degrees offerd by EEE Department

B.Tech MINOR in Portable Power Supplies (offered to BT, ECE, ECS, ME)

Sl No	Course Code	Course Title	L	T	P	S	Cr	CH
1		CRT-1	3	0	2	0	4	5
2		CRT-2	2	0	0	0	2	2
3	20EE1201	Basic Electrical and Elecronics Engineering	3	1	2	0	5	6
4	21EE3251	Non Isolated Power Converters	2	0	0	0	2	2
5	21EE3252	Isolated Power Converters	3	0	2	0	4	5
6	21EE3244	Switched Mode Power Supply Design	3	0	0	0	3	3
7	21EE4151	Power Mangement in Embedded systems	3	0	2	0	4	5
8	21EE4202	Capstone Project	0	0	4	0	2	4
		Total	19	1	12	0	26	32

B.Tech MINOR in Green Energy System (offered to CE, ECE, ECS,ME)

Sl No	Course Code	Course Title	L	T	P	S	Cr	CH
1		CRT-1	3	0	2	0	4	5
2		CRT-2	2	0	0	0	2	2
3	20EE1201	Basic Electrical and Elecronics Engineering	3	1	2	0	5	6
4	21EE3225	Renewable Enegry and Energy storage systems	3	0	0	0	3	3
6	21EE3223	Energy Management and Green Buildings	3	0	0	0	3	3
5	21EE4124	Micro-grids	2	1	2	0	4	5
7	21EE4121	AI and IoT for Green Energy Integration	3	0	0	0	3	3
8	21EE4202	Capstone Project	0	0	4	0	2	4
		Total	19	2	10	0	26	31

B.Tech MINOR in Cyberphysical Systems (AI&DS, CSE, CS &IT, ECE, ECS, IoT)

Sl No	Course Code	Course Title	L	T	P	S	Cr	CH
1		CRT-1	3	0	2	0	4	5
2		CRT-2	2	0	0	0	2	2
3	20EE2104	Mathematical Transforms for Signal Processing	2	1	0	0	3	3
5	21EE3212	Industrial Internet of Things	3	0	0	0	3	3
4	21EE3215	Foundations of Cyber Physical Systems	3	0	0	0	3	3
6	21EE3216	CPS Networks & protocols	3	0	2	0	4	5
7	21EE4114	Cyber Security	3	0	0	0	3	3
8	21EE4202	Capstone Project	0	0	4	0	2	4
		Total	19	1	8	0	24	28

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B.Tech MINOR in Electric Vehicles (offered to ECE, ECS,ME)								
Sl No	Course Code	Course Title	L	T	P	S	Cr	CH
1		CRT-1	3	0	2	0	4	5
2		CRT-2	2	0	0	0	2	2
3	20EE1201	Basic Electrical and Elecronics Engineering	3	1	2	0	5	6
4	21EE3241	Power Train Design for Electric Vehicle	3	0	0	0	3	3
5	21EE3245	Battery Management and Charging Technology for Electric Vehicles	3	0	2	0	4	5
6	21EE4141	AI and IoT for Electric Vehicle	3	0	0	0	3	3
7	21EE4142	Communication Protocols & Testing of Electric Vehicle	3	0	0	0	3	3
8	21EE4202	Capstone Project	0	0	4	0	2	4
		Total	20	1	10	0	26	31
B.Tech MINOR in Smart Electric Grid (offered to AI & DS, CSE, CS & IT, ECE,ECS, IOT)								
Sl No	Course Code	Course Title	L	T	P	S	Cr	CH
1		CRT-1	3	0	2	0	4	5
2		CRT-2	2	0	0	0	2	2
3	20EE1201	Basic Electrical and Elecronics Engineering	3	1	2	0	5	6
4	21EE3232	Distributed Energy Resources and Smart Grids	3	0	0	0	3	3
5	21EE3233	Energy Management Systems and Scada	3	0	0	0	3	3
6	21EE4131	Smart Grid Communication and Cybersecurity	3	0	0	0	3	3
7	21EE4133	Data Science Applications for Smart Grid	3	0	2	0	4	5
8	21EE4202	Capstone Project	0	0	4	0	2	4
		Total	20	1	10	0	26	31

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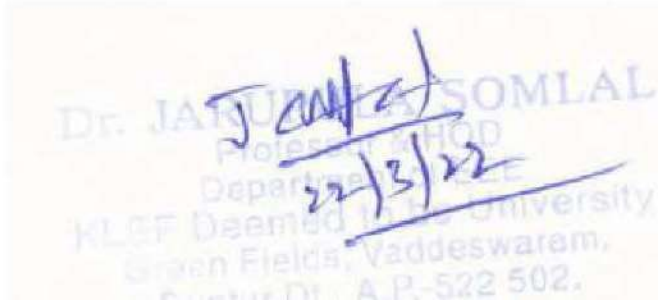
CURRICULUM STRUCTURE FOR Y22 M.TECH POWER ELECTRONICS & POWER SYSTEMS

Sl	Course Code	Course Title		L	T	P	Cr	Employability/Entrepreneurship/Skill Development	New / Retained
1	22EE5111	Analysis of Power Converters	PCC	3	1	2	5	Employability	New
2	22EE5112	Advanced Power System Analysis and Protection	PCC	3	1	0	4	Employability	New
3	22EE5113	Modelling and Analysis of Electrical Machines	PCC	3	1	0	4	Employability	New
4	22EE5104	Embedded Controllers and Applications	PCC	3	0	2	4	Employability	New
5	22EE5211	Advanced Electrical Drives	PCC	3	0	2	4	Employability	New
6	22EE5212	Power System Stability and Control	PCC	3	1	2	5	Employability	New
7	22EE5213	Grid Integration of Renewable Energy systems	PCC	3	1	0	4	Employability	New
8	22EE5204	AI and IOT for Modern Electrical Systems	PCC	3	1	0	4	Employability	New
9		PROFESSIONAL ELECTIVE-1		3	0	0	3	Employability	New
10		PROFESSIONAL ELECTIVE-2		3	0	0	3	Employability	New
11		PROFESSIONAL ELECTIVE-3		3	0	0	3	Employability	New
12		PROFESSIONAL ELECTIVE-4		3	0	0	3	Employability	New
13	22IE5249	SEMINAR		0	0	4	2	Employability	New
14	22CY1001	TERM PAPER		0	0	4	2	Skill development	New
15	22EE2103	DISSERTATION (PART-I)		0	0	36	18	Employability	New
16	22UC3105	DISSERTATION (PART-II)		0	0	36	18	Employability	New
Total Credits							86		
Elective-1									
1	22EE51A1	RELIABILITY ENGINEERING	PE-1	3	0	0	3	Employability	New
2	22EE51A2	APPLICATION OF PYTHON PROGRAMMING IN ELECTRICAL SYSTEMS	PE-1	2	0	2	3	Skill development	New
3	22EE51A3	ENERGY MANAGEMENT SYSTEMS	PE-1	3	0	0	3	Employability	New
4	22EE51A5	DISTRIBUTED GENERATION AND MICRO-GRIDS	PE-1	3	0	0	3	Employability	New
Elective-2									
1	22EE51B1	OPTIMIZATION TECHNIQUES	PE-2	3	0	0	3	Employability	New
2	22EE51B2	ADVANCED CONTROL THEORY	PE-2	3	0	0	3	Employability	New
3	22EE51D3	DEREGULATED POWER SYSTEMS	PE-2	3	0	0	3	Employability	New
4	22EE51D4	MICROGRID DYNAMICS AND CONTROL	PE-2	3	0	0	3	Employability	New
Elective-3									
1	22EE52A1	DIGITAL SIMULATION OF POWER ELECTRONIC SYSTEMS	PE-3	3	0	0	3	Employability	New
2	22EE52A2	SWITCHED MODE POWER SUPPLY AND PWM TECHNIQUES	PE-3	3	0	0	3	Employability	New
3	22EE52C3	FACTS & POWER QUALITY	PE-3	3	0	0	3	Employability	New
4	22EE52C2	INTELLIGENT CONTROL TECHNIQUES	PE-3	3	0	0	3	Employability	New
Elective-4									
1	22EE52D1	SMART GRID TECHNOLOGIES	PE-4	3	0	0	3	Employability	New
2	22EE52D2	ENERGY CONSERVATION & AUDIT	PE-4	3	0	0	3	Employability	New
3	22EE52D3	SMART APPLIANCES AND SMART CITIES	PE-4	3	0	0	3	Employability	New
4	22EE52D4	INTERNET OF THINGS AND SMART GRID ANALYTICS	PE-4	3	0	0	3	Employability	New



22EE511: ANALYSIS OF POWER CONVERTERS

L-T-P-S: 3-1-2-0 **Credits: 5** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
1	Analyze the various high power controller converters and power factor correction.	PO2/PSO1	4
2	Analyze the performance of Switch-Mode PWM and different control techniques for Inverters	PO1/PSO1	4
3	Analyze the operation of multi-level to inverters and Z-source inverter.	PO-5/PSO1	3
4	Understand the various applications of power converters with solar systems	PO-2/PSO1	2
5	Demonstrate and test basic power electronic converters by hardware realization and MATLAB software.	PO-3/PSO1	3

HIGH POWER ELECTRONIC CONVERTERS: Multi-pulse SCR Rectifiers, Performance parameters - Six-pulse, 12-pulse and 24- pulse SCR rectifier, Effect of line and leakage inductances, Power factor control. Pulse Width Modulated Rectifiers: Properties of ideal rectifier, realization of near ideal rectifier, control of the current waveform PWM, single phase and three-phase converter systems.

SWITCH-MODE DC-AC INVERTERS: Basic Concepts- PWM Principles- Sinusoidal Pulse Width Modulation in Single Phase Inverters-Choice of carrier frequency in SPWM- Bipolar and Unipolar Switching - Blanking Time -Maximum Attainable DC Voltage - Switch Utilization. Six step inverters, voltage control & PWM strategies, and implementation aspects, Modification of power circuit for Four quadrant operation,Pulse width modulation techniques (hysteresis, SVM), Selective Harmonic Reduction Techniques. **MULTILEVEL INVERTERS AND IMPEDANCE SOURCE INVERTERS:** Multilevel concept – Classification of multilevel inverters – Diode clamped multilevel inverter –improved diode Clamped inverter –Flying capacitors multilevel inverter - Cascaded multilevel inverter -Multilevel inverter -features of multilevel inverters – comparisons of multilevel converters. – PWM techniques for MLI.- Quasi –Z source Inverters, control methods **POWER CONVERTERS APPLICATIONS:** Lighting, pumping and refrigeration Systems: Electronic ballast, LED power drivers for indoor and outdoor applications. PFC based grid fed LED drivers, PV / battery fed LED drivers. PV fed power supplies for pumping and refrigeration Applications.

Text books:

1. M.H. Rashid : Power Electronics Handbook, Butterworth-Heinemann, 4th edition, 2017.
2. N. Mohan, T.M. Undeland, W.P. Robbins: Power Electronics: Converters, Applications, John Wiley & Sons, 3rd edition, 2003.

Reference Books:

1. Umanand, L.: Power Electronics: Essentials and Applications, John Wiley India, 1st Edition, 2009.
2. Jayant Baliga B: Fundamentals of Power Semiconductor Devices, Springer, 1st Edition 2008.

22EE5112: ADVANCED POWER SYSTEM ANALYSIS AND PROTECTION

L-T-P-S: 3-1-0-0 **Credits: 4** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO No:	CO	PO/PSO	BTL
1	Understand the modeling aspects of power system components and form the network matrices	PO1	3
2	Apply mathematical methods for the solution of Power flow problem	PO3	4
3	Analyze of power system with symmetrical and unsymmetrical faults	PO4	3
4	Apply digital relaying algorithms for protection of power system	PO-4	3

Network Modeling- Conditioning of Y Matrix, Method of successive elimination, Triangular factorization. **Load flow analysis**- AC-DC load flow-Single and three phase methods-Sequential solution techniques and extension to multiple and multi-terminal DC systems, Load flow with FACTS devices, Distribution load flow

Fault studies- 3-ϕ analysis of balanced and unbalanced faults-fault calculations-Short circuit faults-open circuit faults. **System Contingency Analysis** – Z_{bus} Method in Contingency Analysis, Adding and Removing Multiple Lines, PiecewiseSolution of Interconnected Systems, Analysis of Single Contingencies, Analysis of Multiple Contingencies,

Protection of Power System Equipment :- summation transformer, phase-sequence current segregating network.Load shedding and frequency relays; Out of step relaying; Re-closing and synchronizing - adaptive protection – integrated protection and control.

Digital Protection: Developments in computer relaying – mathematical basis for protective relaying algorithms, Fourier Transforms – Discrete Fourier transforms –Walsh - Hadamard, Haar - wavelet transforms, digital relaying algorithms,Working principles of numerical relays

TEXT BOOKS:

1. Grainger, J. J. and Stevenson, W. D. 'Power System Analysis' Tata McGraw Hill, New Delhi, 2003.
2. Badri Ram & DN Viswakarma, "Power System Protection & Switch Gear", Tata McGraw Hill Publishing Company Limited, New Delhi (1995).

REFERENCE BOOKS:

1. Grainger, J. J. and Stevenson, W. D. 'Power System Analysis' Tata McGraw Hill, New Delhi, 2003.
2. Pai, M. A., 'Computer Techniques in Power System Analysis', Tata McGraw Hill, New Delhi, 2006.
3. P. Venkatesh,B V Manikandan,S Charles Raja and A Srinivasa Rao, "Electric Power System Analysis, Security & Deregulation", PHI, 2012.
4. Digital Protection for Power Systems A.T.Johns and S.K.Salman, 1995.

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22EE5113: MODELING AND ANALYSIS OF ELECTRICAL MACHINES

L-T-P-S: 3-1-0-0 **Credits: 4** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply the basic concepts of Electromagnetic Energy Conversion Principles to DC Machines	PO1	3
CO2	Understand the performance of electrical machines through mathematical modeling	PO2	2
CO3	Illustrate the dynamic behaviour of electrical machines under different operating conditions	PO2	3
CO4	Analysis of special machines	PO2	4

Principles of Electromagnetic Energy Conversion, General expression of stored magnetic energy, co-energy and force/torque, example using single and doubly excited system. The Primitive Machine Equations. Mathematical model of a separately excited DC motor, DC series motor and DC Shunt motor- Voltage and torque equation of dc machine.

Calculation of air gap mmf and per phase machine inductance using physical machine data; Induction machine: Three phase symmetrical induction machine in phase variable form; Application of reference frame theory to three phase symmetrical induction Machine. Dynamic direct and quadrature axis model in arbitrarily rotating reference frames.

Three phase salient pole synchronous machines in phase variable form. Voltage and torque equation of salient pole synchronous machine including damper winding in stator reference frame.Voltage and torque equation of salient pole synchronous machine including damper winding in rotor reference frame. Determination of Synchronous Machine Dynamic Equivalent Circuit Parameters.

Permanent magnet synchronous machine: Surface permanent magnet (square and sinusoidal back emf type) and interior permanent magnet machines. Construction and operating principle, dynamic modeling and self-controlled operation; Analysis of Switch Reluctance Motors. Analysis and dynamic modeling of two phase asymmetrical induction machine and single phase induction machine.

Text Books:

1. Charles Kingsley, Jr., A.E. Fitzgerald, Stephen D.Umans, 'Electric Machinery', Tata McgrawHill, 5th Edition, 1992.

2. Generalized Theory of Electrical Machines – P.S.Bimbra- Khanna publications-5th edition 1995

Reference Books:

1. R. Krishnan, 'Electric Motor & Drives: Modeling, Analysis and Control', Prentice Hall of India, 2nd Edition, 2001.

2. Miller, T.J.E., 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, 1st Edition, 1989

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22EE5104: Embedded Controllers and Applications

L-T-P-S: 3-0-2-0 Credits: 4 Pre-Requisite: NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply Programming of 8051 Microcontroller for general purpose applications	3	3
CO2	Apply programming concepts of 8051 for interfacing peripherals	3	3
CO3	Demonstrate Architecture and Programming of PIC Microcontoller	3	3
CO4	Apply programming concepts of 8051 and PIC Microcontroller for interfacing peripherals	3	3
CO5	Apply programming concepts of the 8051and PIC microcontroller	3,5	3

SYLLABUS:

8051 Microcontroller functional aspects: Microcontroller families, 8051 Architecture- Signal Description, Register organization, Internal RAM, Special Function Registers, Addressing modes, Instruction set, Interrupts, Timer/Counter module, Serial Data Communication module, and RS-232C Standard.

8051 Programming & Interfacing:, Simple Programs involving Arithmetic and Logical Instructions, Timers/Counters, Serial Communication & Interrupts. Matrix Key Board interface, Stepper Motor interface, LCD interface

PIC Microcontroller functional aspects: Introduction, Architectural overview, Memory organization, interrupts and reset, I/O ports, Timers, C Programming PIC microcontroller

PIC microcontrollers Interface Applications: DAC Interfacing, ADC Interfacing, Digital relaying, Closed loop control of dc motor, speed encoder interface using CCP module

TEXT BOOKS:

1.Mazidi&McKinley "The 8051 Micro controller and Embedded systems: using assembles and C, 2nd edition,2007.

2. Mazidi &McKinley, "PIC Microcontroller and Embedded Systems: Using assembly and C for PIC 18", 1st edition, 2008

REFERENCE BOOKS:

1. Rajkamal, "Microcontrollers - Architecture, Programming, Interfacing & System Design", 2nd edition, Pearson Education,2009.

2. Ted Van Sickle, "Programming Microcontrollers in C", 2nd edition, 2001.

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22EE5211: ADVANCED ELECTRICAL DRIVES

L-T-P-S: 3-0-2-0 | Credits: 4 | Pre-Requisite: NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
1.	Understand the modeling of AC machines	PO1,PO2	2
2.	Contrast the speed control performance of 3-Phase induction and synchronous motor drive using vector control methods	PO1,PO2	4
3.	Analyze the dynamic behavior of SRM motor drives under various control methods	PO1,PO2	4
4.	Distinguish the performance of BLDC Motor drive using various control techniques	PO1,PO2	4
5	Analyze the applications of Python programming for electrical engineering applications	PO2	4

Syllabus:

FIELD ORIENTED CONTROL OF INDUCTION MOTOR DRIVES - Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect methods – Flux vector estimation - Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy. **SENSORLESS VECTOR CONTROL OF INDUCTION MOTOR**: Slip and Speed Estimation at Low performance, Rotor Angle and Flux-linkage Estimation at high performance -rotor Speed Estimation Scheme- estimators using rotor slot harmonics, Model Reference adaptive systems, Extended Kalman Filter. **CONTROL OF SYNCHRONOUS MOTOR DRIVES**: Self control-margin angle control-torque control-power factor control-Brushless excitation systems - SRM Structure-Stator Excitation-techniques of sensor less operation-convertor topologies-SRM Waveforms-SRM drive design factors-Torque controlled SRM-Torque Ripple-Instantaneous Torque control -using current controllers-flux controllers. **CONTROL OF BLDC MOTOR DRIVES**: principle of operation of BLDC Machine, Sensing and logic switching scheme, BLDM as Variable Speed Synchronous motor-methods of reducing Torque pulsations -Three-phase full wave Brushless dc motor -Sinusoidal type of Brushless dc motor - current controlled Brushless dc motor Servo drive.

TEXT BOOKS

1. Electric Motor Drives Modeling, Analysis & control -R. Krishnan- Pearson Education

2. Modern Power Electronics and AC Drives –B. K. Bose-Pearson Publications

3. Sensorless Vector Direct Torque control –Peter Vas, Oxford University Press

REFERENCES BOOKS

1. Modern Power Electronics and AC Drives –B. K. Bose-Pearson Publications-
2. Power Electronics control of AC motors – MD Murphy & FG Turn Bull Pergman Press -1st edition-1998
3. W.Leonhard, "Control of Electrical Drives", Narosa Publishing House, 1992
4. VedamSubramanyam, "Electric Drives – Concepts and Applications", Tata McGraw-Hill publishing company Ltd., New Delhi, 2002

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22EE5212: POWER SYSTEM STABILITY& CONTROL

L-T-P-S: 3-1-2-0 **Credits: 5** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
1	Analyze Synchronous Machine modeling	PO-1	4
2	Analyzing power system stability	PO-2	4
3	Analyze Small signal stability	PO2	4
4	Analyze Excitation control and Voltage Stability	PO-2	4

SYLLABUS:

POWER SYSTEM STABILITY: Basic Concepts and Definitions, Classifications,Review of Steady state and Transient state stability, Numerical method to determine transient stability, classical model of a multi machines systems. Introduction to Frequency Stability.

SMALL SIGNAL STABILITY: Small signal stability of a single machine infinite bus system, Effects of excitation systems, Power system stabilizers, Sub Synchronous Resonance.

EXCITATION CONTROL: Typical Excitations configurations and Automatic Voltage regulators, Effect of excitation on (a) Power limits, (b) Transient stability, (c) Dynamic stability, Basic Concepts Related to Voltage Stability – Voltage Collapse – Voltage Stability Analysis – Prevention of Voltage Collapse.

Security control- Security analysis and monitoring, generator and line outages by linear sensitivity factors, **State estimation**- Power system state estimation, Weighted least square state estimation, state estimation of AC network, Treatment of bad data – network observability and pseudo measurements.

TEXT BOOKS:

1. Power System Stability and Control – Prabha Kundur, TATA McGRAW – HILL, 2006.
2. Power System Stability by Kimbark, Vol- I, II & III – 1968, Dover Publication Inc, Newyork-1968.

REFERENCE BOOKS:

1. Power System Dynamics Stability & Control – K.R.Padiyar, 2nd Edition, B.S. Publication 2002.
2. Power System Control and Stability – P. M. Anderson & A.A. Fouad, 2nd Edition, Wiley IEEE press-2002.

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22EE5213: GRID INTEGRATION OF RENEWABLE ENERGY SYSTEMS

L-T-P-S: 3-1-0-0 **Credits: 4** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand renewable energy Systems	PO5	2
CO2	Apply grid integrated techniques for solar PV System.	PSO1	3
CO3	Apply grid integrated techniques for wind energy System.	PSO1	3
CO4	Understand grid operation and control methods and standards.	PO7	2

Syllabus:

Introduction to renewable energy systems, environmental aspects of electric energy conversion, impacts of renewable energy generation on environment, need of integrating large renewable energy sources, issues related to integration of large renewable energy sources.Need of power electronic equipment's in grid integration, converter, inverter, chopper, ac regulator and cycloconverters for AC/DC conversion. **Solar-Photovoltaic (PV)** cells-characteristics, variability, energy conversion principles, electrical modelling, optimal power extraction, shading effect, Stand-alone PV system, Grid connected PV system, Design of PV system-load calculation, array sizing, selection of converter/inverter, battery sizing. **Wind energy systems:** variability, principles of wind energy extraction, electromechanical energy conversion, characteristics of wind turbines, voltage regulation. Control of standalone system and Grid connected system (Voltage and frequency control). Islanding, and reconnecting. Primary frequency control in large systems, Fault ride through.

Grid operation and Control: Scheduling and dispatch, Forecasting, reactive power and voltage control, frequency control, operating reserve, storage systems, electric vehicles, CERC and CEA orders (technical and safety standards)

Text Books:

1. Integration of Alternative sources of Energy, Felix A. Farret and M. Godoy Simoes, IEEE Press – Wiley-Interscience publication, 2006.
2. Grid integration of solar photovoltaic systems, Majid Jamil, M. Rizwan, D.P.Kothari, CRC Press (Taylor & Francis group), 2017

Reference Books:

1. Renewable Energy Grid Integration, Marco H. Balderas, Nova Science Publishers, New York, 2009.
2. Wind Power Integration connection and system operational aspects, B. Fox, D. Flynn L. Bryans, N. Jenkins, M. O' Malley, R. Watson and D. Milborrow, IET Power and Energy Series 50 (IET digital library), 2007
3. Power Generation, Operation, and Control, Allen J. Wood, Bruce F. Wollenberg, Gerald B. Sheblé, John Wiley & Sons, New York, 2013 (3rd edition)

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22EE5204: AI and IoT for Modern Electrical Systems

L-T-P-S: 3-1-0-0 **Credits: 4** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Demonstrate IoT devices and tools	PO4	2
CO2	Operate the cloud system Environment	PO4	3
CO3	Utilize AI and ML Techniques	PO2	3
CO4	Utilize AI techniques for electrical systems	PO6	3

Syllabus:

IoT Devices and Enabling Technologies: IoT Architecture, IoT Infrastructures -Sensor Devices, Actuators, IoT protocols and software's- MQTT, UDP, MQTT-brokers, publish subscribe modes, HTTP, COAP, XMPP and gateway protocols, IoT point to point communication technologies, Selection of Wireless technologies - 6LoWPAN, Zigbee, WIFI, BT, BLE,SIG,NFC, LORA, Lifi and Widi.

Cloud Computing: Basics-Cloud systems, Cloud computing protocols, Role of Web services, Deployment Models- Public, Community, Hybrid, Private Clouds, Cloud Analytics over Thingspeak, Google Firebase, AWS-console, Functions. Database Services-Relational DBMS, RDS Services.

AI and ML on Cloud: Data Pre-processing techniques in Machine Learning, Data-handling, importing libraries, Data pre-processing using python, Missing data, Categorical Data. Regression and Classification algorithms in ML. Cloud based Real- time Monitoring systems, M2M communications, Case Studies **AI for Electrical Systems:** AI and Machine learning algorithms for Renewable technologies-PV MPP techniques, RMSE and MAPE analysis for short term irradiance, solar energy and load forecasting, temperature forecasting. Wind speed forecasting, Intelligent Energy Management System of Hybrid Solar/Wind/Battery Power Sources, Electric vehicle-BMS, case studies- smart cities, smart grid, smart building, electrical vehicles

Text Books:

1. AI and IoT in Renewable Energy, **Shaw**, R.N., **Mendis**, N., **Mekhilef**, S., **Ghosh**, A,Springer, 2011
2. Sensors and Actuators – D. Patranabis – 2nd Ed., PHI, 2013
3. Applications of AI and IoT in Renewable Energy, R.N., **Mendis**, N., **Mekhilef**, S., **Ghosh**, A, Elsevier, 2021

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22EE51A1: RELIABILITY ENGINEERING

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO 1	Understand the system reliability concepts	PO-8	2
CO 2	Apply the frequency and duration techniques for component repairable system.	PO-9	3
CO 3	Apply the network reliability concepts to generation system reliability analysis.	PO-8	3
CO 4	Apply the network reliability concepts to transmission and distribution system reliability analysis.	PSO-2	3

Network Modelling and Reliability Analysis: Reliability concepts – exponential distributions – meantime to failure – series and parallel system – MARKOV process – recursive technique - Bath tub curve - reliability measures MTTF, MTTR, MTBF.**Frequency & Duration Techniques:**Frequency and duration concept – Evaluation of frequency of encountering state, mean cycle time, for one , two component repairable models – evaluation of cumulative probability and cumulative frequency of encountering of merged states. **Generation System Reliability Analysis:** Reliability model of a generation system– recursive relation for unit addition and removal – load modeling - Merging of generation load model – evaluation of transition rates for merged state model – cumulative Probability, cumulative frequency of failure evaluation – LOLP, LOLE. **Transmission System Reliability Analysis:** System and load point reliability indices – Weather effects on transmission lines – Weighted average rate and Markov model.: **Distribution System Reliability Analysis:** Basic Techniques – Radial networks – Evaluation of Basic reliability indices, performance indices - Load point and system reliability indices – Customer oriented, loss and energy oriented indices – Examples. Parallel Configuration: Basic techniques – Inclusion of bus bar failures, scheduled maintenance – Temporary and transient failures – Weather effects –Evaluation of various indices – Examples.

Text Books:

1. R. Billinton, R.N.Allan, "Reliability Evaluation of Power systems" second edition, Springer.
2. Charles E. Ebeling, "An Introduction to Reliability and Maintainability Engineering", TATA Mc Graw- Hill – Edition.

Reference Books:

1. R. Billinton, R.N.Allan, "Reliability Evaluation of Engineering System", Plenum Press, New York.
2. Eodrenyi, J., "Reliability modelling in Electric Power System", John Wiley, 1980

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22EE51A2: Application of Python Programming in Electrical Systems

L-T-P-S: 2-0-2-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand Conditionals, Iterables, Regex, Files, Error Handling, Data Structures, Algorithm design and Object-Oriented Python	3	2
CO2	Apply object-oriented programming, Python Standard Library, SciPy's optimization and Signal Processing and Linear algebra	3,6	3
CO3	Understand Data Analysis using Pandas. Apply supervised Learning and Unsupervised Learning techniques using Scikit-Learn	1,3	3
CO4	Analyse real world electrical engineering problems using pandapower and PyPSA for power system modeling, analysis and optimization.	3	4
CO5	Analyze the applications of Python programming for electrical engineering applications	3	4

SYLLABUS:

Algorithm Design and Recursion, Searching, Recursive Problem Solving, Conditionals, Iterables & Regex in Python, Python Objects I: Strings, Python Objects II: Lists, Tuples and Loops, File Input/Output, Errors and Exceptions, Python Objects III: Dictionaries and Sets, An Introduction to Object-Oriented Programming, Stacks, queues, Linked Lists. Bubble, Quick, and Merge Sort.

Object oriented programming and classes, constructor, Inheritance – Implementing a subclass, Classes and polymorphism, Recursive calls to methods, Class variables, class methods, Class for Vectors in the Plane, Class for Complex Numbers, Classes for Numerical Differentiation, Classes for Numerical Integration, Python Standard Library, SciPy's optimization and Signal Processing. Linear Algebra: solve systems of linear equations, eigenvalues, and eigenvectors. Case study: analysis of vibrating strings or atoms Scikit-learn, Manipulating Tabular Data Using Pandas, Supervised Learning: Classification and Regression. Unsupervised Learning: Clustering, **Predictive Modelling / Machine Learning**: predictive algorithms, regression analysis, and clustering analysis from large databases.

Circuit analysis for series and parallel RLC circuits using PySpice, Power System stability and Analysis.Generating Graphical User Interface (GUI). Data Acquisition and Instrumentation Control: using a Raspberry Pi / Arduino and python code

Textbooks:

1. Object-Oriented Programming in Python —https://pythontextbok.readthedocs.io/en/1.0/
2. Christian Hill - Learning Scientific Programming with Python-Cambridge University Press (2020)
3. Robert Johansson, Numerical Python: Scientific Computing and Data Science Applications with Numpy, SciPy and Matplotlib, Apress (2019)

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22EE51A3: ENERGY MANAGEMENT SYSTEMS

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand data acquisition components of power system	PO-2	2
CO2	Understand energy data monitoring, reporting and communication	PO-2	2
CO3	Apply supervisory control for energy management	PO-5	3
CO4	Understand Energy management center functions	PO-1	2

General Theory: Purpose and necessity, general structure, data acquisition, transmission and monitoring, general powersystem hierarchical structure, overview of the methods of data acquisition systems, commonly acquired data, transducers, RTUs, data concentrators, various communication channels, cables, telephone lines, power line carrier, microwaves, fiber- optical channels and satellites.**Supervisory and Control Functions:** Data acquisitions, status indications, measured values, energy values, monitoring alarm and event application processing. Control function: ON/OFF control of lines, transformers, capacitors and applications in process industry, valve, opening, closing etc. Regulatory functions: set points and feed-back loops, time tagged data, disturbance data collection and analysis, calculation and report preparation. **MAN- Machine Communication:** Operator consoles and VDUs, displays, operator dialogues, alarm and event loggers, mimic diagrams, report and printing facilities. **Data bases - SCADA, EMS and network data bases:** SCADA system structure - local system, communication system and central system, Configuration- non-redundant single processor, redundant dual processor, multi control centers, system configuration. Performance considerations: real time operation system requirements, modularization of software programming languages.**Energy Management Center** Functions performed at a centralized management center, production control and load management, economic dispatch, distributed centers and power pool management.

Textbooks:

1. TorstenCegrell, Power System Control Technology, Prentice Hall International, 1986

2. Stuart A. Boyer, SCADA: Supervisory Control And Data Acquisition, The Instrumentation, Systems and Automation Society, 4th edition, 2009.

3. Krishna Kant, Computer-Based Industrial Control, PHI Learning,2nd edition, 2013.

4. Bela G. Liptak, Instrument Engineers Handbook, Volume 3: Process Software and Digital Networks, CRC Press, 4th edition, 2011.

5. Behrouz Forouzan, Data Communications and Networking, McGraw-Hill,5thedition, 2012.

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22EE515: DISTRIBUTION GENERATION & MICRO GRIDS

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	CO Description	BTL	PO Mapping
CO1	Understand the current scenario of Distributed Generation and the need to implement DG sources.	2	2,3,4
CO2	Investigate the different types of RES as DGs.	3	2,3,4
CO3	Appraise the grid integration ,interfaces and technical impacts of DGs upon transmission and distribution systems , its Power quality & relaliability	3	2,3,4,5
CO4	Understand comprehensively about different types of Storage systems	2	3,4,5

Syllabus

INTRODUCTION , PLACING AND SIZING THE DISTRIBUTED ENERGY RESOURCES: Need for Distributed generation, renewable sources in distributed generation, current scenario in Distributed Generation, Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems.

RENEWABLE ENERGY SOURCES Wind Power-Photovoltaic and Thermo-solar power-Biomass Power, Fuel cells types, types of Tidal power generation schemes, mini and micro hydro power schemes.

GRID INTEGRATION , INTERFACES AND IMPACTS OF DGS: Grid integration of DGs – Different types of interfaces - Inverter based DGs - Aggregation of multiple DG units. – Transmission systems, Distribution systems, Deregulation – Impact of DGs upon protective relaying.**POWER QUALITY AND RELIABILITY IN DER**: Wiring, special wiring and connectors, Battery Management System (BMS), Power Electronics circuit connections, Thermal Management, safe temperature range.

ENERGY STORAGE AND CONTROL TECHNIQUES: Energy Storage for use with Distributed Generation-Battery Storage, Capacitor Storage, ultra-capacitors and Mechanical Storage: Flywheels, Pumped and Compressed Fluids. Control Techniques for DER integration systems- Standards and codes for interconnection- future structure of grid.

Reference Books:

1. "Distributed Power Generation, Planning & Evaluation" by H. Lee Willis & Walter G. Scott, 2000 Edition, CRC Press Taylor & Francis Group.
2. "Renewable energy power for a sustainable future" by Godfrey Boyle ,2004 Oxford University Press in association with the Open university.
3. Godoy Simoes, Felix A.Farret, 'Renewable Energy Systems – Design and Analysis with Induction Generators', CRC press.
4. Robert Lasseter, Paolo Piagi, ' Micro-grid: A Conceptual Solution', PESC 2004, June 2004

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22EE51B1: OPTIMIZATION TECHNIQUES

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand classical optimization techniques, describe clearly the problems with and without constraints, identify its parts and analyze the individual functions, Feasibility study for solving an optimization problem.	4	2
CO2	Apply mathematical translation of the verbal formulation of an optimization problem and design algorithms of linear programming problems, the repetitive use of which will lead reliably to finding an approximate solution.	4	3
CO3	Analyze and measure the performance of an algorithm of different methods to solve non-linear programming problems, study and solve optimization problems.	4	4
CO4	Analyze optimization techniques using algorithms. Investigate study, develop, organize and promote innovative solutions for various applications.	4	4

Syllabus:

Classical Optimization Techniques: Single variable optimization, multi-variable optimization with no constraints, with equality and inequality constraints, Karush- Kuhn- Tucker constraints.

Linear Programming (LP): Geometry of LP problem, graphical solution, simplex algorithm, two-phases of simplex algorithm, duality, dual simplex method, quadratic programming.

Non-Linear Programming: One-dimensional optimization – Fibonacci method, golden section method, quadratic and cubic interpolation methods, Newton's method.Unconstrained optimization - Steepest descent method, conjugate gradient method, Davidon-Fletcher-Powell method. Constrained Optimization - Augmented Legrangian multiplier method, Branch and bound method

Non-traditional Optimization Methods and Applications: Genetic algorithms (G A), G A Operators, G A for constrained optimization. Particle swarm optimization (PSO).

Text Books:

1. S.S. Rao, 'Engineering Optimization : Theory andPractice.III Edition, New Age International (p) Limited Publications

2. Kalyanmoy Deb, 'Optimization for Engineering Design', PHI Learning Private Limited.

Reference Books:

1. PurnachandraBiswal, ' Optimization in Engineering', Scitech Publications (India) PVT Ltd.

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22EE51B2: Advanced Control Theory

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
1	Apply the mathematical representation to dynamic systems	PO2	3
2	Apply the techniques to design the controllers	PO1	3
3	Apply the techniques to identify non linear system stability	PO-5	3
4	Apply the algorithms for stability analysis	PO-2	3

Mathematical Preliminaries and State Variable Analysis:Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen values, Eigen Vectors and a Canonical form representation of Linear systems – The concept of state – State space model of Dynamic systems – Time invariance and Linearity – Non uniqueness of state model – State diagrams for Continuous-Time State models – Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and it's properties. Complete solution of state space model due to zero input and due to zero state.

Controllability and Observability: General concept of controllability – Controllability tests, different state transformations such as diagonalization, Jordon canonical forms and Controllability canonical forms for Continuous-Time Invariant Systems – General concept of Observability – Observability tests for Continuous-Time Invariant Systems – Observability of different State transformation forms. State Feedback Controllers and Observers: State feedback controller design through Pole Assignment, using Ackkermans formula– State observers: Full order and Reduced order observers.

Non-Linear Systems: Introduction – Non Linear Systems – Types of Non-Linearities – Saturation – Dead-Zone – Backlash – Jump Phenomenon etc; Linearization of nonlinear systems, Singular Points and its types– Describing function–describing function of different types of nonlinear elements, – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, Stability analysis of nonlinear systems based on phase-plane method.

Stability Analysis: Stability in the sense of Lyapunov, Lyapunov's stability, and Lypanov's instability theorems – Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.

TEXT BOOKS:

1. M. Gopal, Modern Control System Theory by – New Age International – 1984
2. Ogata. K, Modern Control Engineering by– Prentice Hall – 1997
3. N K Sinha, Control Systems– New Age International – 3rd edition.

REFERENCE BOOKS:

1. Donald E. Kirk, Optimal Control Theory an Introduction, Prentice – Hall Network series – First edition.

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22EE51D3: DEREGULATED POWER SYSTEMS

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
1	Understand the market operations in the electricity market under deregulated environment, Open Access Same-time Information System (OASIS) and Available Transfer Capability (ATC).	PO-1	2
2	Analyze the concepts of Electricity Pricing.	PO-5	4
3	Analyze the Power System Operation in Competitive Environment and Market Power.	PO-5	4
4	Analyze the concepts of Transmission Pricing and Congestion pricing.	PSO-1	4

SYLLABUS

Key Issues in Electric Utilities Introduction – Restructuring models – Independent System Operator (ISO) – Power Exchange - Market operations – Market Power – Standard cost – Transmission Pricing – Classification of congestion management methods, Calculation of ATC, Non-market methods, Market based methods, Nodal pricing– Management of Inter zonal/Intra zonal Congestion. Open Access Same-time Information System (OASIS)Structure of OASIS - Posting of Information – Transfer capability on OASIS. **Available Transfer Capability (ATC)** Transfer Capability Issues – ATC – TTC – TRM – CBM Calculations – Calculation of ATC based on power flow. **Electricity Pricing** Introduction – Rolled-in transmission pricing methods- Marginal transmission pricing paradigm, , Composite pricing paradigm, Merits and de-merits of different paradigms,-Electricity Price Volatility Electricity Price Indexes – Challenges to Electricity Pricing – Construction of Forward Price Curves – Short-time Price Forecasting. **Power System Operation in Competitive Environment** Introduction – Operational Planning Activities of ISO- The ISO in Pool Markets – The ISO in Bilateral MarketsOperationalPlanning Activities of a GENCO. **Market Power :**Introduction - Different types of market Power– **Exercising Market Power** - Examples,**Transmission Cost Allocation Methods :**Introduction - Postage Stamp Rate Method - Contract Path Method - MW-Mile Method – Unused Transmission Capacity Method - MVA-Mile method – Comparison of cost allocation methods.

TEXT BOOKS:

1. Loi Lei Lai, "Power System Restructuring and Deregulation", John Wiley & Sons Ltd., England, 2001.
2. Kankar Bhattacharya, "Operation of Restructured Power System", Math H.J. Boller and JaapE.DaalderKulwer Academic Publishers, 2001.

REFERENCE BOOKS:

1. Mohammad Shahidehpour and Muwaffaqalomoush, "Restructured Electrical Power Systems", Marcel Dekker, Inc., 2001.
2. P. Venkatesh,B V Manikandan,S Charles Raja and A SrinivasaRao, "Electric Power System Analysis, Security & Deregulation", PHI, 2012

22EE51D4: MICRO GRID DYNAMICS AND CONTROL

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	CO Description	BTL	PO Mapping
CO1	To understand of AC and DC microgrids	2	PO3,PSO1
CO2	To apply the dynamic modelling of microgrids	3	PO2,PO3, PSO1
CO3	To apply the different hierarchical control schemes for microgrid system and communication implementation of hierarchical control	3	PO2,PO3, PSO1
CO4	To apply the stability in microgrids and alternate options for stability improvement in microgrids	3	PO2,PO3, PSO1

Syllabus

Introduction: Introduction to the concept of microgrid, the overview of the structure and architecture of microgrid with brief control, operational aspects. Till date pilot microgrid projects and their outcomes. Dynamic modelling of individual components in AC and DC microgrids, state space modal analysis and influence of system parameters on the microgrid dynamics, brief concept on the design of microgrid stabilizers to improve stability

Hierarchical control scheme for microgrids: Control Objectives in AC Microgrids, bottleneck with only local control, need of secondary and tertiary control, implementation of hierarchical control with centralized and distributed control schemes for AC and DC microgrids. Advantages and disadvantages of centralized and distributed control schemes.

Multi-microgrid coordination and control: AC-AC, AC-DC and DC-DC microgrid clustering, coordinated control schemes in multi-microgrids, frequency, voltage regulations and volt-VAR support.

Control of Smart Power Grid System: Load Frequency Control (LFC) in Micro Grid System – Voltage Control in Micro Grid System – Reactive Power Control in Smart Grid. Case Studies and Test beds for the Smart Grids.

Reference Books:

1. N. D. Hatziargyriou, "Microgrids Architecture and control", John Wiley & Sons
2. H. Bevrani, B. François, and T. Ise, "Microgrid Dynamics and Control", John Wiley & Sons
3. P. Kundur, "Power System Stability and Control", McGraw-Hill

22EE52A1: Digital Simulation of Power Electronic Converters

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Design of non-isolated and isolated DC-DC converters	PO1,PO2	4
CO2	Understand the working of Resonant converters	PO1,PO2	2
CO3	Modelling of non-isolated DC -DC converters	PO1,PO2	3
CO4	Design of closed loop controls for switched mode power supplies	PO1,PO2	4

SYLLABUS :

Non isolated dc-dc converters: Introduction to dc-dc power supplies-Analysis and design of Buck, Boost, Cuk and SEPIC converters in continuous and discontinuous conduction modes-verification of theoretical analysis of converters using simulation tools

Isolated dc-dc converters: Introduction to dc-dc power supplies with isolation- Analysis and design of Forward and fly-back, Push-Pull, Half bridge and full-bridge converters in continuous and discontinuous conduction modes-verification of theoretical analysis of converters using simulation tools

Resonant converters: Introduction to soft switching techniques, analysis and design of load resonant converters-Series load resonant converter-parallel load resonant converter and hybrid resonant converter - Resonant switch converter- Zero current switching, Zero voltage switching and Zero voltage switching with clamped voltage, comparison of Resonant converter topologies.

Modeling of Non isolated dc-dc converters:

Introduction to small signal Analysis- small signal Analysis of Buck, Boost , Buck-Boost converters in continuous and discontinuous conduction modes using averaged switch models, stability analysis of converters using transfer functions (open loop) derived from small signal Analysis

Closed loop control of converters: Introduction to control of switch mode dc power supplies, voltage feedback, voltage feed forward, current mode PWM control of DC-DC converters, power supply protection and electrical isolation in feedback loop

Text books:

1. Power Electronics Converters, applications & devices- Mohan, Undeland Robbins, Wiley Publications, 2003
2. Power Electronics by Daniel W.Hart , Tata McGraw-Hill publication.2011

Reference Books:

1. Power – Switching Converters; Second Edition by Simon Ang & Alejandro Oliva, CRC Publications,2005
2. Fundamentals of Power Electronics-R.W.Erickson and D.Maksimovic-second edition –kluwer publishers,sixth printing-2004.
3. Power Electronics and applications by L. Umanand Wiley India publications.2009

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22EE52A2: Switched Mode Power Supply and PWM Techniques

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

=CO No	Course Outcome (CO)	PO	Blooms Taxonomy Level (BTL)
CO1	Understand Pspice modelling of power semiconductor devices and passive components behaviour with protection circuits.	PO1,PO2/ PSO1	2
CO2	Analyse performance of AC-DC controlled, uncontrolled converters and DC-DC converters using Pspice and MATLAB Simulink model.	PO1,PO2/ PSO1	4
CO3	Evaluate DC-AC converters performance using modern simulation tools.	PO1,PO2/ PSO1	4
CO4	Analyse AC voltage controller and cyclo-converter performance with programming and simulation tools.	PO1,PO2/ PSO1	4

SYLLABUS:

MODELLING OF POWER ELECTRONIC DEVICES: General purpose circuit analysis software – Methods of analysis of power electronic systems - Transients and the time domain analysis with Pspice – Fourier series and harmonic components – Pspice modelling of diode, BJT,MOSFET,IGBT, SCR,TRIAC in simulation. Diode with R, R-L, R-C and R-L-C load with ac supply. Modelling of SCR, TRIAC and IGBT, simulation of driver and snubber circuits. **SIMULATION OF AC-DC CONVETERS USING PSPICE AND MATLAB SIMULINK**: Modelling of single phase and three-phase uncontrolled and controlled (SCR) rectifiers- simulation of converter fed DC drives-computation of performance parameters: harmonics, power factor, angle of overlap. **SIMULATION OF DC-DC CONVERTERS USING PSPICE AND MATLAB SIMULINK:**Modelling of Chopper circuits- Simulation of thyristor choppers with voltage, current and load commutation schemes- Simulation of chopper fed dc motor- computation of performance parameters. **SIMULATION OF DC-AC CONVERTERS USING PSPICE AND MATLAB SIMULINK:**Modelling of single and three phase inverters circuits – Space vector representation- Pulse-width modulation methods for voltage control- Simulation of inverter fed induction motor drives. **SIMULATION OF AC-AC CONVERTERS USING PSPICE AND MATLAB SIMULINK:**Modelling of AC voltage controllers, and Cyclo-converters- Simulation of AC voltage controllers and Cyclo-converters feeding different loads-Computation of performance parameters.

TEXT BOOKS:

1. Rashid, M., "Simulation of Power Electronic Circuits using PSPICE", Prentice Hall Inc., 2006
2. M. B. Patil, V. Ramnarayanan and V. T. Ranganathan., "Simulation of Power Electronic Converters", 1st Edition, Narosa Publishers, 2010.
3. John Keown., "Microsim, Pspice and circuit analysis"-Prentice Hall Inc., third edition, 1998.

REFERENCE BOOKS:

1. Robert Ericson, 'Fundamentals of Power Electronics', Chapman & Hall, 1997.
2. IssaBatarseh, 'Power Electronic Circuits', John Wiley, 2004Simulink Reference Manual, Math works, USA.
3. Rashid, M., "Power Electronic Circuits, Devices and Applications", Pearson Education Inc.,2004.

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22EE52C3: FACTS & Power Quality

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

Co.No:	Course Outcomes	PO/PSO	BTL
CO 1	Understand the importance of FACTS devices and their applications to the Power Systems.	PO1,PO2/ PSO1	2
CO 2	Analyse the static shunt and series compensation and operation of devices under this category.	PO1,PO2/ PSO1	4
CO3	Apply DSTATCOM for power quality restoration	PO1,PO2/ PSO1	3
CO4	Apply combined compensation techniques for power quality restoration and fault ride through.	PO1,PO2/ PSO1	4

FACTS CONCEPT AND GENERAL SYSTEM CONSIDERATIONS: Introduction to Facts devices, Basic types of FACTS Controllers, benefits from FACTS controllers. **STATIC SHUNT COMPENSATION:** Objectives of shunt compensation, Methods of controllable VAR generation, variable impedance type static VAR generators (SVC): TCR, TSR, TSC, FC-TCR, TSC-TCR, STATCOM, Comparison between SVC and STATCOM, STATCOM.**STATIC SERIES COMPENSATION: Objectives** of series compensation, variable impedance type static series controllers: GCSC, TSSC, TCSC, TCVR and TCPAR.

LOAD COMPENSATION USING DSTATCOM - Compensating single phase loads – Ideal three phase shunt compensator structure –Generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced –Realization and control of DSTATCOM – DSTATCOM in Voltage control mode. **SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM**-Rectifier supported Dynamic Voltage Restorer – DC Capacitor supported DVR – DVR Structure – voltage Restoration – Series Active Filter – Unified Power Quality Conditioner- Wind power interconnection requirement - Fault ride through techniques.

TEXT BOOKS:

1. FACTS: Modelling and Simulation in Power Networks, By Enrique Acha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Pérez, César Angeles-Camacho WILEY
2. K.R.Padiyar "FACTS Controller in power Transmission and Distribution" New Age Int Publisher,2007
3. ArindamGhosh "Power Quality Enhancement Using Custom Power Devices", KluwerAcademic Publishers, 2002
4. R.C. Duggan, Mark.F.McGranaghan,SuryaSantoas and H.WayneBeaty, "Electrical Power System Quality", McGraw-Hill, 2004.

REFERENCES

1. Ned Mohan et.al "Power Electronics" John wiley& Sons,2 nd edition ,2002
2. T.J.E Miller, "Reactive power control in electric Systems" John willey& sons,1982.
3. Derek A. Paice , "Power Electronics Converter Harmonics :Multipulse Methods for CleanPower",Wiley,1999.
4. Ewald Fuchs, Mohammad A. S. Masoum Power Quality in Power Systems and Electrical.

22EE52C2: INTELLIGENT CONTROL TECHNIQUES

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	CO Description	BTL	PO Mapping
CO1	Understand concepts of ANN and various learning	2	1
CO2	Learn about Genetic Algorithm, ACO and Tabu search concepts	2	3
CO3	Understand the concepts of Fuzzy	2	3
CO4	Learn about Fuzzy logic controller and design using MATLAB	3	1

Syllabus

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch - Pitts neuron model, simple perceptron, Adaline and Madaline, Feed - forward Multilayer Perceptron. Learning and Training the neural network. Networks: Hopfield network, Self - organizing network and Recurrent network. Neural Network based controller, Case studies.

Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other than GA search techniques like tabu search and ant - colony search techniques for solving optimization problems.

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to Fuzzy logic modeling and control of a system. Fuzzification, inference and defuzzification. Fuzzy knowledge and rule bases.

Fuzzy modelling and control schemes for nonlinear systems. Self - organizing fuzzy logic control. Implementation of fuzzy logic controller using Matlab fuzzy - logic toolbox. Stability analysis of fuzzy control systems. Intelligent Control for SISO/MIMO Nonlinear Systems. Model Based Multivariable Fuzzy Controller.

Reference Books:

1. Simon Haykins, Neural Networks: A comprehensive Foundation, Pearson Edition, 2003.
2. T.J.Ross, Fuzzy logic with Fuzzy Applications, Mc Graw Hill Inc, 1997.
3. David E Goldberg, Genetic Algorithms.
4. M.T.Hagan, H. B. Demuth and M. Beale, Neural Network Design, Indian reprint, 2008

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22EE52D1: SMART GRID TECHNOLOGIES

L-T-P-S: 3-0-0-0 Credits: 3 Pre-Requisite: NIL

Mapping of Course Outcomes with PO/PSO

CO No	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO1	Understand the basic concepts of smart grid, terminology, challenges and initiatives.	PO1/PSO2	2
CO2	Identify various smart operations of power system structure, components, and monitoring techniques.	PO2/PSO2	3
CO3	Apply smart metering and advanced metering infrastructure with monitoring, protection and measuring units.	PO2/PSO2	3
CO4	Illustrate various communication protocols and cyber-security importance in smart grid.	PO4/PSO2	2

INTRODUCTION TO SMART GRID: Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid.

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

SMART METERS AND ADVANCED METERING INFRASTRUCTURE: Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection. High Performance Computing for Smart Grid Applications

COMMUNICATION SYSTEMS: Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD computing to make Smart Grids smarter, Cyber Security for Smart Grid.

TEXT BOOKS

1. Stuart Borlase "Smart Grid: Infrastructure, Technology and Solutions", CRC Press 2017.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley 2012.

REFERENCES BOOKS

1. Control and Optimization Methods for Electric Smart Grids, Aranya Chakraborthy, Marija D Ilic Editor, Springer Publications.
2. Smart Grid Fundamentals of Design and Analysis, James Momoh, Wiley IEEE Press, Ed 2012.

22EE52D2: ENERGY CONSERVATION & AUDIT

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO

CO No	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO1	Understand the concept of Energy Audit and Energy Management	PO-2	2
CO2	Analyze the various characteristics of energy efficient motors	PO-3	4
CO3	Analyze the different energy instruments and importance of power factor improvement	PO-3	4
CO4	Analyze the economic aspects of electrical energy	PO-2	4

BASIC PRINCIPLES OF ENERGY AUDIT: Energy audit- definitions, concept, types of audit, energy index, cost index, pie-charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit. **ENERGY MANAGEMENT:**

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting - Energy manger, Qualities and functions, language, Questionnaire - check list for top management. Demand side management. **ENERGY EFFICIENT MOTORS:** Energy efficient motors,- factors affecting efficiency, loss distribution, constructional details, characteristics - variable speed, variable duty cycle systems, RMS hp- voltage van at ion-voltage unbalance- over motoring- motor energy audit. **POWER FACTOR IMPROVEMENT, LIGHTING AND ENERGY INSTRUMENTS:** Power factor - methods of improvement, location of capacitors, PF with non linear loads, effect of harmonics on PF , PF motor controllers - Good lighting system design and practice, lighting control, lighting energy audit - Energy Instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, application of PLC's. **ECONOMIC ASPECTS AND ANALYSIS:** Economics Analysis - Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis - Energy efficient measures-calculation of simple payback method, net present worth method - Power factor correction, lighting - Applications of life cycle costing analysis, return on investment.

TEXT BOOKS:

1. W.C.Turner, "Energy management hand book", John wiley and sons Energy management and good lighting practice: fuel efficiency- book let 12-EEO
2. W.K. Murphy, G- MckayButier worth, "Energy management", Heine mann publications, 2007.

REFERENCE BOOKS:

1. Paulo Callaghan, "Energy management", Mc-graw Hill Book company, 1st edition, 1998
2. Giovanni and Petrecca, "Industrial Energy Management: Principles and Applications", The Kluwer international series-207 (1999)
3. Howard E.Jordan, "Energy-Efficient Electric Motors and their applications", Plenum pub corp; 2nd ed. (1994)

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22EE52D3: Smart Appliance and Smart Cities

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO

CO#	Course Outcome	PO/PSO	BTL
CO1	Evaluate the characteristics of smart home appliances.	5/2	4
CO2	Understand the essential elements of smart cities	2/2	2
CO3	Analyze the Characteristics of a Smart City	2/1	4
CO4	Apply the Designing, and Implementing a Smart City	5/2	3

Syllabus:

Modern Domestic Appliances Solid State Lamps: Introduction - Review of Light sources - white light generation techniques, Characterization of LEDs for illumination application. Power LEDs- High brightness LEDs- Electrical and optical properties. LED driver considerations-Power management topologies - colour issues of white LEDs- Dimming of LED sources, BLDC motors for pumping and domestic fan appliances, inverter technology-based home appliances, Smart devices and equipment.

Smart-cities Smart city pilot projects, essential elements of smart cities, active distribution networks, microgrids, distribution system automation, Reliability and resiliency studies, decentralized operation of power network.

Characteristics of a Smart City- Public Administration and Services: Health and Public Safety , Culture and Education,
Smart Grids, Street Lighting, Energy and Efficiency, Mobility and Transportation,
Water and Environmental, Buildings and Homes

Planning, Designing, and Implementing a Smart City-Resident-Centric Solutions,Robust Communication,Partnerships , Funding.
Smart City Standards and Initiatives,Smart City Examples, Smart City Challenges and Success Factors

Text Books:

1. Vinod Kumar Khanna, "Fundamentals of Solid State Lighting", CRC press, 1st Edition, 2014.
2. S. Borlase, "Smart Grids, Infrastructure, Technology and Solutions", CRC Press, 1st Edition, 2013.
3. Smart Grids Advanced Technologies and Solutions, Second Edition by Stuart Borlase, CRC Press Tyalor and Francis

Reference Books:

1. Craig Di Louie, "Advanced Lighting Controls: Energy Saving Productivity, Technology & Applications", Fairmont Press, Inc., 1st Edition, 2006.
2. Robert S Simpson, "Lighting Control: Technology and Applications", Focal Press, 1st Edition, 2003
3. Chang-liang Xia, "Permanent Magnet Brushless DC Motor Drives and Controls", John Wiley & Sons Singapor

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22EE52D4: INTERNET OF THINGS AND SMART GRID ANALYTICS

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	CO Description	BTL	PO Mapping
CO1	Apply network protocols and standards.	3	1,1
CO2	Analyze IoT architecture and data analytics architecture	4	2,1
CO3	Analyze applications of IoT to Smart Grids	4	2,1
CO4	Analyze the Big Data Analytics	4	2,1

Syllabus

Introduction: IoT Data Link Protocols, Network Layer Routing Protocols, Network Layer Encapsulation Protocols, Session Layer Protocols, IoT Management Protocols, Security in IoT Protocols, IoT Challenges.

Architecture: Introduction, Architectural Approaches, Business Architecture, Functional Architecture, Application Architecture, Data and Analytics Architecture, Technology Architecture, Security and Governance.

Applications to Smart Grid: Energy monitoring, energy harvesting, smart parking, smart medium access in mobile IOT.

Attributes of Big Data: Volume of data, velocity of data, variety of data; Overview of big data analytics, benefits of big data analytics, big data analytics for smart grids, big data analytics tools.

Reference Books:

1. Al-Turjman, Fadi, "Smart Grid in IoT-enabled Spaces: The Road to Intelligence in Power", CRC Press
2. Misra, Sudip, and Samaresh Bera, "Smart Grid Technology: A Cloud Computing and Data Management Approach", Cambridge University Press
3. Geng, Hwaiyu, ed, "Internet of things and data analytics handbook", John Wiley & Sons
4. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-On Approach", VTP Inc.
5. Amita Kapoor and Aditya P. Mathur, "Internet of Things: Architecture and Building Blocks", CRC Press

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CURRICULUM STRUCTURE FOR
Y22 M.TECH ELECTRIC VEHICLE TECHNOLOGY

sl	Course Code	Course Title	Category	L	T	P	S	Cr	CH	Employability/Entrepreneurship/Skill Development	New / Retained
1	22EE51011	ELECTRIC VEHICLE POWER TRAIN DESIGN	PCC	3	1	0	0	4	4	Employability	New
2	22EE5102	BATTERY MODELLING AND STATE ESTIMATION	PCC	3	1	2	0	5	6	Employability	New
3	22EE5103	MECHANICAL DESIGN OF VEHICLE	PCC	3	0	2	0	4	5	Employability	New
4	22EE5104	EMBEDDED CONTROLLERS AND APPLICATIONS	PCC	3	0	2	0	4	5	Employability	New
5	22EE5211	ADVANCED ELECTRICAL DRIVES	PCC	3	1	2	0	5	6	Employability	New
6	22EE5202	FAULT DIAGNOSIS & CONTROL OF ELECTRIC VEHICLE	PCC	3	1	0	0	4	4	Employability	New
7	22EE5203	CHARGING STATION DESIGN	PCC	3	0	2	0	4	5	Employability	New
8	22EE5204	AI AND IOT FOR MODERN ELECTRICAL SYSTEMS	PCC	3	1	0	0	4	4	Employability	New
9		PROFESSIONAL ELECTIVE-1	PEC	3	0	0	0	3	3	Employability	New
10		PROFESSIONAL ELECTIVE-2	PEC	3	0	0	0	3	3	Employability	New
11		PROFESSIONAL ELECTIVE-3	PEC	3	0	0	0	3	3	Employability	New
12		PROFESSIONAL ELECTIVE-4	PEC	3	0	0	0	3	3	Employability	New
13	22IE5249	SEMINAR	PR	0	0	4	0	2	4	Employability	New
14	22CY1001	TERM PAPER	PR	0	0	4	0	2	4	Skill development	New
15	22EE2103	DISSERTATION (PART-I)	PR	0	0	36	0	18	36	Employability	New
16	22UC3105	DISSERTATION (PART-II)	PR	0	0	36	0	18	36	Employability	New
	Total Credits							**86**			
	Elective-1										
	22EE51A1	RELIABILITY ENGINEERING	PEC	3	0	0	0	3	3	Employability	New
	22EE51A2	APPLICATION OF PYTHON PROGRAMMING IN ELECTRICAL SYSTEMS	PEC	2	0	2	0	3	3	Skill development	New
	22EE51A3	ENERGY MANAGEMENT SYSTEMS	PEC	3	0	0	0	3	3	Employability	New
	22EE51A4	EV SYSTEM AND WIRING DESIGN	PEC	3	0	0	0	3	3	Employability	New
	Elective-2										
	22EE51B1	OPTIMIZATION TECHNIQUES	PEC	3	0	0	0	3	3	Employability	New
	22EE51B2	ADVANCED CONTROL THEORY	PEC	3	0	0	0	3	3	Employability	New
	22EE51B3	MODEL BASED DESIGN FOR ELECTRICAL SYSTEMS	PEC	3	0	0	0	3	3	Employability	New
	22EE51B4	MICRO ELECTRO MECHANICAL SYSTEMS	PEC	3	0	0	0	3	3	Employability	New
	Elective-3										
	22EE52A1	DIGITAL SIMULATION OF POWER ELECTRONIC SYSTEMS	PEC	3	0	0	0	3	3	Employability	New
	22EE52A2	SWITCHED MODE POWER SUPPLIES	PEC	3	0	0	0	3	3	Employability	New
	22EE52A3	ADAPTIVE CONTROL SYSTEMS	PEC	3	0	0	0	3	3	Employability	New
	22EE52A4	AUTOMOTIVE SECURITY	PEC	3	0	0	0	3	3	Employability	New
	Elective-4										
	22EE52B1	GREEN ENERGY FOR ELECTRIC VEHICLE TECHNOLOGY	PEC	3	0	0	0	3	3	Employability	New
	22EE52B2	AUTONOMOUS VEHICULAR TECHNOLOGY	PEC	3	0	0	0	3	3	Employability	New
	22E52B3	HYBRID & FUEL CELL VEHICLES	PEC	3	0	0	0	3	3	Employability	New
	22EE52B4	EV IN SMART GRID	PEC	3	0	0	0	3	3	Employability	New

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22EE5101: ELECTRIC VEHICLE POWER TRAIN DESIGN

L-T-P-S: 3-1-0-0 **Credits: 4** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the History, Economics, Environmental issues and power train of Electric Vehicles	5	1
CO2	Analyze the dynamics of EV	2	4
CO3	Select and size the power train for 2W	1	3
CO4	Select and size the power train for 4W	1	3

Syllabus:

HISTORY, ECONOMIC & ENVIRONMENTAL IMPACT OF ELECTRIC VEHICLE

History of EV, Case studies on Economic and Environment aspects of EV, EV markets – Supply and demand, Economical analysis with case study, Environmental impact analysis with case study. Impact of different transportation technologies on environment and energy supply.

Power train components: BEV, HEV, PHEV and FCEV including working of Fuel cell, **Super capacitor, energy management, Hybrid sources.**

INTRODUCTION TO EV DYNAMICS

Motion and dynamic equations of electric vehicles, General description of vehicle movement, Vehicle resistance, Dynamic equation, Tire Ground Adhesion and maximum tractive effort, different drive cycles for, Drive cycles for vehicle emission, fuel consumption and performance testing.

2W POWER TRAIN SIZING

Chassis, differential and transmission selection for different drive trains, Battery, converter and motor drive sizing for different 2W drive trains. Analysis on the effect of sizing of different components for different drive cycles

4W POWER TRAIN SIZING

Chassis, differential and transmission selection for different drive trains, Battery, converter and motor drive sizing for different 4W drive trains. Analysis on the effect of sizing of different components for different drive cycles

Text books:

1. "A History of Electric Vehicles" by Nigel Burton, Edition -1, Crowood Publisher.
2. "Electric Cars: The Ultimate Guide for Understanding the Electric Car And What You Need to Know" by Brad Durant

Reference books:

1. "Electric Vehicle Technology Explained" by James Larminie and John Lowry.

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22EE5102: Battery Modelling and State Estimation

L-T-P-S: 3-1-2-0 **Credits: 5** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand the specifications and Li-ion chemistry	1	2
CO2	Understand the key functions of Battery management systems	1	2
CO3	Develop Enhanced Self Correcting (ESC) Model of battery	6	4
CO4	Develop Algorithms for SOC estimation of battery	5	4
CO5	Analyse Modelling and state estimation through experimental techniques	3	4

Syllabus:

Battery specifications and L-ion chemistry

Battery specifications, cell-module-pack formation and specification calculation, working principle of Li-ion cell, materials used for various components of Li-ion cell, different li-ion chemistries and there specification comparison

Functions of battery-management systems

BMS architecture, BMS functionality: Sensing and High Voltage Control, Protection-isolation, overvoltage, overcurrent protection, Performance-Battery pack energy and power calculations using HPPC, Balancing- passive and active cell balancing, Interface, and Diagnostics

Battery Modelling

Simple OCV model, Rint model, Thevinins model, Hysteresis effect and ESC model of battery cell.Charge, discharge tests to determine battery cell parameters,

SOC estimation

Stoichiometry for SOC estimation, Look-table method and Coulomb counting methods and their limitation for accurate state estimation. Linear and nonlinear Kalman filter based estimation techniques

Text books:

1. Battery management systems: Battery Modeling ,Gregory L.Plett, Artech house, 2015.
2. Battery management systems: Equivalent circuit methods ,Gregory L.Plett, Artech house, 2015.

Reference books:

1. Hybrid Electric vehicles-Principles and Applications with practical perspectives, Chris Mi, M. AbdulMasrur and David Wenzhong Gao, Wiley Publications,*1*edition 2011
2. Electric and Hybrid Vehicles power sources, models, sustainability, infrastructure and the market, Edited by Gianfranco Pistoia, Elsevier 1 edition 2010.
3. Electric and Hybrid Vehicles Design Fundamentals, by Iqbal Hussain, CRC Press2nd edition, 2010.

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22EE5103: Mechanical design of Vehicle

L-T-P-S: 3-0-2-0 Credits: 4 Pre-Requisite: NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Identify different car body and body materials.	1	3
CO2	Identify design features of frame, front axle, and steering system	2	3
CO3	Model Suspension and Wheel system for vehicle	1	3
CO4	Model the braking system for vehicle	2	3

Syllabus:

CAR BODY, BODY MATERIALS AND TRIM MECHANISMS: Classification of Car Body: Saloon-Convertibles-Limousine-Estate Car-Racing and Sports Car- Car Body Construction- Electric Car Body Construction-Steel Sheet-Timber-Plastic-GRP- Properties of Materials-Corrosion-Anticorrosion Methods-Selection of Paint and Painting Process-Body Trim Items- Body Mechanisms. **LAYOUT, FRAME, FRONT AXLE AND STEERING SYSTEM:** Basic Construction of Chassis, Types of Chassis Layout with Reference to Power Plant Location and Drive-Various Types of Frames-Loads Acting on Vehicle Frame-Materials for Frames- Types of Front Axles and Stub Axles-Front Wheel Geometry-Castor-Camber-King Pin Inclination and Toe In-Toe Out-Condition for True Rolling Motion-Ackerman's and Davis Steering Mechanisms- Reversible and Irreversible Steering-Over Steer and Under Steer-Different Types of Steering Gear Boxes- Power Assisted Steering. **SUSPENSION SYSTEM, WHEELS AND TYRES**: Requirements of Suspension System-Types of Suspension-Constructional Details and Characteristics of Single Leaf-Multi–Leaf Spring-Coil Spring and Torsion Bar-Rubber-Pneumatic and Hydro Elastic Suspension-Independent Suspension System-Shock Absorbers-Types of Wheels-Wheel Rims-Construction of Tyres and Tyre Specifications. **BRAKING SYSTEM**: Need for Brake System-Stopping Distance-Leading and Trailing Shoes-Braking Torque-Types and Constructional Details-Drum Brakes and Disc Brakes-Hydraulic Braking System- Mechanical Braking System-Pneumatic Braking System-Power Assisted Braking System-Anti Lock Braking System.

Text books:

1. Donald E. Malen, 'Fundamentals of Automobile Body Structur Design'SAE International, 2011.
2. Geoff Davies, 'Materials for Automobile Bodies', Butterworth-Heinemann, 2012.

Reference books:

1. 1. Powloski J, 'Vehicle Body Engineering', Business Books Ltd., 1998.
2. James E Duffy, 'Body Repair Technology for 4-Wheelers',Cengage Learning, 2009.
3. Crouse and Anglin, 'Automotive Mechanism', 9th Edition. Tata McGraw-Hill, 2003.
4. Jack Erjavec, 'A Systems Approach to Automotive Technology', Cengage Learning Pub.,2009
5. T. K. Garrett, K. Newton and W. Steeds, 'Motor Vehicle', Butterworth, Heinemann, 13th Edition, 2000.

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22EE5104: Embedded Controllers and Applications

L-T-P-S: 3-0-2-0 **Credits: 4** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply Programming of 8051 Microcontroller for general purpose applications	3	3
CO2	Apply programming concepts of 8051 for interfacing peripherals	3	3
CO3	Demonstrate Architecture and Programming of PIC Microcontoller	3	3
CO4	Apply programming concepts of 8051 and PIC Microcontroller for interfacing peripherals	3	3
CO5	Build Assembly languiage and C language programming Applications of 8051 and PIC microcontroller	3,5	3

SYLLABUS:

8051 Microcontroller functional aspects: Microcontroller families, 8051 Architecture- Signal Description, Register organization, Internal RAM, Special Function Registers, Addressing modes, Instruction set, Interrupts, Timer/Counter module, Serial Data Communication module, and RS-232C Standard.

8051 Programming & Interfacing: Simple Programs involving Arithmetic and Logical Instructions, Timers/Counters, Serial Communication & Interrupts. Matrix Key Board interface, Stepper Motor interface, LCD interface

PIC Microcontroller functional aspects: Introduction, Architectural overview, Memory organization, interrupts and reset, I/O ports, Timers, C Programming PIC microcontroller

PIC microcontrollers Interface Applications: DAC Interfacing, ADC Interfacing, Digital relaying, Closed loop control of dc motor, speed encoder interface using CCP module

TEXT BOOKS:

1. 1.Mazidi&McKinley "The 8051 Micro controller and Embedded systems: using assembly and C, 2nd edition,2007.
2. Mazidi&McKinley, "PIC Microcontroller and Embedded Systems: Using assembly and C for PIC 18", 1st edition, 2008

REFERENCE BOOKS:

1. Rajkamal, "Microcontrollers - Architecture, Programming, Interfacing & System Design", 2nd edition, Pearson Education,2009.
2. Ted Van Sickle, "Programming Microcontrollers in C", 2nd edition, 2001.

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22EE5211: ADVANCED ELECTRICAL DRIVES

L-T-P-S: 3-1-2-0 **Credits: 5** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
1.	Understand the modeling of AC machines	PO1,PO2	2
2.	Contrast the speed control performance of 3-Phase induction and synchronous motor drive using vector control methods	PO1,PO2	4
3.	Analyze the dynamic behavior of SRM motor drives under various control methods	PO1,PO2	4
4.	Distinguish the performance of BLDC Motor drive using various control techniques	PO1,PO2	4
5	Analyze the applications of Python programming for electrical engineering applications	PO2	4

Syllabus:

FIELD ORIENTED CONTROL OF INDUCTION MOTOR DRIVES - Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect methods – Flux vector estimation - Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy. **SENSORLESS VECTOR CONTROL OF INDUCTION MOTOR**: Slip and Speed Estimation at Low performance, Rotor Angle and Flux-linkage Estimation at high performance -rotor Speed Estimation Scheme- estimators using rotor slot harmonics, Model Reference adaptive systems, Extended Kalman Filter. **CONTROL OF SYNCHRONOUS MOTOR DRIVES**: Self control-margin angle control-torque control-power factor control-Brushless excitation systems - SRM Structure-Stator Excitation-techniques of sensor less operation-convertor topologies-SRM Waveforms-SRM drive design factors-Torque controlled SRM-Torque Ripple-Instantaneous Torque control -using current controllers-flux controllers. **CONTROL OF BLDC MOTOR DRIVES**: principle of operation of BLDC Machine, Sensing and logic switching scheme, BLDM as Variable Speed Synchronous motor-methods of reducing Torque pulsations -Three-phase full wave Brushless dc motor -Sinusoidal type of Brushless dc motor - current controlled Brushless dc motor Servo drive.

TEXT BOOKS

1. Electric Motor Drives Modeling, Analysis & control -R. Krishnan- Pearson Education

2. Modern Power Electronics and AC Drives –B. K. Bose-Pearson Publications

3. Sensorless Vector Direct Torque control –Peter Vas, Oxford University Press

REFERENCES BOOKS

1. Modern Power Electronics and AC Drives –B. K. Bose-Pearson Publications-
2. Power Electronics control of AC motors – MD Murphy & FG Turn Bull Pergman Press -1st edition-1998
3. W.Leonhard, "Control of Electrical Drives", Narosa Publishing House, 1992
4. VedamSubramanyam, "Electric Drives – Concepts and Applications", Tata McGraw-Hill publishing company Ltd., New Delhi, 2002

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22EE5202: FAULT DIAGNOSIS & CONTROL OF ELECTRIC VEHICLE

L-T-P-S: 3-1-0-0 **Credits: 4** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Apply characteristics of sensors and actuators used for electric vehicle control	1,3	2
CO2	Apply usage of microcontroller for digital control of electric vehicle	1,5	2
CO3	Apply communication protocols for data communication in electric vehicle control system	5	3
CO4	Model fault diagnosis system for electric vehicle	5	3

Syllabus:

Sensors and actuators: Sensors: Accelerometers, Wheel speed, Brake pressure, Seat occupancy, Motor speed, Steering wheel angle, Vehicle speed, Throttle position, Turbine speed, Temperature, Mass air flow (MAF) rate, Throttle plate angular position, and Air bag sensors, Actuators: Relays, Solenoids, motors and piezoelectric force generators, Chassis control systems , Automatic transmission control systems Micro-controller functions PIC controller basics: Ports, Timer/Counters, Interrupts, Watchdog timers and PWM Development of control algorithms for different automotive subsystems: Look-up tables and maps, Need of maps, Procedure to generate maps, Fuel maps/tables, Ignition maps/tables, Motor calibration, Torque table, Dynamometer testing. Communication protocols and Infotainment systems Overview of automotive communication protocols, CAN, LIN , Flex Ray, MOST , Ethernet, D2B and DSI, Communication interface with ECUs, Interfacing techniques and Interfacing with infotainment gadgets, Relevance of Protocols such as TCP/IP for automotive applications, Wireless LAN standards such as Bluetooth, IEEE 802.11x communication protocols for automotive applications. Infotainment Systems: Application of telematics in automotive domain, Global positioning systems (GPS) and General packet radio service (GPRS).Fault Diagnosis Fundamentals of Diagnostics, Basic wiring system and Multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system, Fault finding and corrective measures, Electronic transmission checks and Diagnosis, Diagnostic procedures and sequences, On-board and off-board diagnostics in Automobiles, OBDII, Concept of DTCs, DLC, MIL, Freeze Frames, History Memory, Diagnostic tools, Diagnostic protocols KWP2000 and UDS.

Text Books:

1. Williams. B. Ribbens: "Understanding Automotive Electronics", 6th Edition, Elsevier Science, Newnes Publication, 2003.
2. Robert Bosch: "Automotive Electronics Handbook", John Wiley and Sons, 2004

Reference Books:

1. Ronald K Jurgen: "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 1999.
2. James D. Halderman: "Automotive Electricity and Electronics", PHI Publication..
3. Allan Bonnick: "Automotive Computer Controlled Systems, Diagnostic Tools and Techniques", Elsevier Science, 2001
4. G. Meyer, J. Valldorf and W. Gessner: "Advanced Microsystems for Automotive Applications", Springer, 2009

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22EE5203: CHARGING STATION DESIGN

L-T-P-S: 3-0-2-0 Credits: 4 Pre-Requisite: 22EE5101

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Interpret Power electronic converters for electric vehicle charging	1,2	2
CO2	Develop control algorithms for various electric vehicle charging modes	1,3	3
CO3	Demonstrate charging station infrastructure	1,6	3
CO4	Demonstrate installation of charging station	1	2

Syllabus:

Charger Topologies

Charging time and charging speed, Defining power levels- Normal charging, Semi-fast charging, Overview of power levels ,DC conductive charging, AC conductive charging, Low power Charger, Automotive standard charger, High power topologies, Multi-port Charger.

Power Electronics for EV Battery Charging

Forward/ Flyback Converters, Half-Bridge DC–DC Converter, Full-Bridge DC–DC Converter, Power Factor Correction, Bidirectional Battery Chargers, Dual active bridge dc-dc converter, Solar charging station.

Charging Modes

Constant-current charging, Constant-voltage charging, Pulse Charging, Reflex charging, Float charge, Trickle Charge, Load management at charging station and peak load management

Charging Infrastructure

Charger - Existing National & International Charger Architecture Standards - SAE J1773, VDE-AR-E 2623-2-2, JEVS G105-1993 (CHAdeMO), CCS, Type-1 AC, Type-2 AC, Bharat DC-001, Bharat AC-001. Cords and Cables, Earthing, Fault Protection, Testing, Charging Safety, Protection against electric shock, Digital Communication between EV and Charging Station.

Installation

Govt. of India guideline on Public Charging Stations, IEC Standards- 60068-2(1, 2, 14, 30), 61683, 60227, 60502, 60947 part I,II, III and 61215.

Site assessment, EVSE Typical Site Plans, Design Guidelines and Site Drawings, Planning Considerations, Station Configuration, Selection and erection of electrical equipment - Isolation, switching and control.

Text books:

1. Power Electronics by Daniel W.Hart.
2. Power Electronics for Renewable Energy Systems, Transportation and industrial Applications by Haitham Abu-Rub, Mariusz Malinwoski, Kamal Al-Haddad.

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22EE5204: AI and IoT for Modern Electrical Systems

L-T-P-S: 3-1-0-0 **Credits: 4** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Demonstrate IoT devices and tools	PO4	2
CO2	Operate the cloud system Environment	PO4	3
CO3	Utilize AI and ML Techniques	PO2	3
CO4	Utilize AI techniques for electrical systems	PO6	3

Syllabus:

IoT Devices and Enabling Technologies: IoT Architecture, IoT Infrastructures -Sensor Devices, Actuators, IoT protocols and software's- MQTT, UDP, MQTT-brokers, publish subscribe modes, HTTP, COAP, XMPP and gateway protocols, IoT point to point communication technologies, Selection of Wireless technologies - 6LoWPAN, Zigbee, WIFI, BT, BLE,SIG,NFC, LORA, Lifi and Widi.

Cloud Computing: Basics-Cloud systems, Cloud computing protocols, Role of Web services, Deployment Models- Public, Community, Hybrid, Private Clouds, Cloud Analytics over Thingspeak, Google Firebase, AWS-console, Functions. Database Services-Relational DBMS, RDS Services.

AI and ML on Cloud: Data Pre-processing techniques in Machine Learning, Data-handling, importing libraries, Data pre-processing using python, Missing data, Categorical Data. Regression and Classification algorithms in ML. Cloud based Real- time Monitoring systems, M2M communications, Case Studies **AI for Electrical Systems:** AI and Machine learning algorithms for Renewable technologies-PV MPP techniques, RMSE and MAPE analysis for short term irradiance, solar energy and load forecasting, temperature forecasting. Wind speed forecasting, Intelligent Energy Management System of Hybrid Solar/Wind/Battery Power Sources, Electric vehicle-BMS, case studies- smart cities, smart grid, smart building, electrical vehicles

Text Books:

1. AI and IoT in Renewable Energy, **Shaw**, R.N., Mendis, N., **Mekhilef**, S., **Ghosh**, A,Springer, 2011
2. Sensors and Actuators – D. Patranabis – 2nd Ed., PHI, 2013
3. Applications of AI and IoT in Renewable Energy, R.N., **Mendis**, N., **Mekhilef**, S., **Ghosh**, A, Elsevier, 2021

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22EE51A2: Application of Python Programming in Electrical Systems

L-T-P-S: 2-0-2-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Understand Conditionals, Iterables, Regex, Files, Error Handling, Data Structures, Algorithm design and Object-Oriented Python	3	2
CO2	Apply object-oriented programming, Python Standard Library, SciPy's optimization and Signal Processing and Linear algebra	3,6	3
CO3	Understand Data Analysis using Pandas. Apply supervised Learning and Unsupervised Learning techniques using Scikit-Learn	1,3	3
CO4	Analyse real world electrical engineering problems using pandapower and PyPSA for power system modeling, analysis and optimization.	3	4
CO5	Analyze the applications of Python programming for electrical engineering applications	3	4

SYLLABUS:

Algorithm Design and Recursion, Searching, Recursive Problem Solving, Conditionals, Iterables & Regex in Python, Python Objects I: Strings, Python Objects II: Lists, Tuples and Loops, File Input/Output, Errors and Exceptions, Python Objects III: Dictionaries and Sets, An Introduction to Object-Oriented Programming, Stacks, queues, Linked Lists. Bubble, Quick, and Merge Sort.

Object oriented programming and classes, constructor, Inheritance – Implementing a subclass, Classes and polymorphism, Recursive calls to methods, Class variables, class methods, Class for Vectors in the Plane, Class for Complex Numbers, Classes for Numerical Differentiation, Classes for Numerical Integration, Python Standard Library, SciPy's optimization and Signal Processing. Linear Algebra: solve systems of linear equations, eigenvalues, and eigenvectors. Case study: analysis of vibrating strings or atoms Scikit-learn, Manipulating Tabular Data Using Pandas, Supervised Learning: Classification and Regression. Unsupervised Learning: Clustering, **Predictive Modelling / Machine Learning**: predictive algorithms, regression analysis, and clustering analysis from large databases.

Circuit analysis for series and parallel RLC circuits using PySpice, Power System stability and Analysis.Generating Graphical User Interface (GUI). Data Acquisition and Instrumentation Control: using a Raspberry Pi / Arduino and python code

Textbooks:

1. Object-Oriented Programming in Python —https://pythontextbok.readthedocs.io/en/1.0/
2. Christian Hill - Learning Scientific Programming with Python-Cambridge University Press (2020)
3. Robert Johansson, Numerical Python: Scientific Computing and Data Science Applications with Numpy, SciPy and Matplotlib, Apress (2019)

22EE51A4: EV SYSTEMS AND WIRING DESIGN

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	CO Description	BTL	PO Mapping
CO1	Apply CATIA and AutoCAD tools for EV system wiring.	3	1,7
CO2	Understand the wiring routing and optimal weights of wiring.	2	3,4
CO3	Understand the electrical connections and safety consideration for EV	2	3,4
CO4	Apply the concept of BMS and thermal management of EV	3	7 & 1

Syllabus

Catia V5 and Electrical AutoCAD: 3D model of a wiring harness - 2D harness drawing using Electrical AutoCAD - different wires and cables, connectors, splices, and other components, wire colors, labels, installation, and maintenance.

Wire routing and optimization: Routing methods and strategies, shortest path, most direct path, and optimal path methods, Electromagnetic compatibility, wire routing affects the electromagnetic compatibility (EMC), routing optimization, reduce weight and space

Electrical connections: and splices- Types of electrical connections, Crimping tools, and techniques, Soldering techniques, Wire splicing methods. Safety considerations: insulation, grounding, and protection against electrical shock and fire.

High-Voltage Wiring, special wiring and connectors, Battery Management System (BMS), Power Electronics circuit connections, Thermal Management, safe temperature range.

Reference Books:

1. Shaun Bryant, AutoCAD Electrical Essential Training, linkedin, 2015
2. Kirstie Plantenburg , Introduction to CATIA V6, SDC Publications,2014
3. Gaurav Verma, Matt Weber, AutoCAD Electrical 16 Black Book, USA 2015
4. Robert Bosch GmbH-Editors, Bosch Professional Automotive Information, 2007
5. R Bosch GmbH , AUTOMOTIVE HANDBOOK, R Bosch GmbH Editors,2022

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22EE51B2: Advanced Control Theory

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
1	Apply the mathematical representation to dynamic systems	PO2	3
2	Apply the techniques to design the controllers	PO1	3
3	Apply the techniques to identify non linear system stability	PO-5	3
4	Apply the algorithms for stability analysis	PO-2	3

Mathematical Preliminaries and State Variable Analysis:Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen values, Eigen Vectors and a Canonical form representation of Linear systems – The concept of state – State space model of Dynamic systems – Time invariance and Linearity – Non uniqueness of state model – State diagrams for Continuous-Time State models – Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and it's properties. Complete solution of state space model due to zero input and due to zero state.

Controllability and Observability: General concept of controllability – Controllability tests, different state transformations such as diagonalization, Jordon canonical forms and Controllability canonical forms for Continuous-Time Invariant Systems – General concept of Observability – Observability tests for Continuous-Time Invariant Systems – Observability of different State transformation forms. State Feedback Controllers and Observers: State feedback controller design through Pole Assignment, using Ackkermans formula– State observers: Full order and Reduced order observers.

Non-Linear Systems: Introduction – Non Linear Systems – Types of Non-Linearities – Saturation – Dead-Zone – Backlash – Jump Phenomenon etc; Linearization of nonlinear systems, Singular Points and its types– Describing function–describing function of different types of nonlinear elements, – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, Stability analysis of nonlinear systems based on phase-plane method.

Stability Analysis: Stability in the sense of Lyapunov, Lyapunov's stability, and Lypanov's instability theorems – Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.

TEXT BOOKS:

1. M. Gopal, Modern Control System Theory by – New Age International – 1984
2. Ogata. K, Modern Control Engineering by– Prentice Hall – 1997
3. N K Sinha, Control Systems– New Age International – 3rd edition.

REFERENCE BOOKS:

1. Donald E. Kirk, Optimal Control Theory an Introduction, Prentice – Hall Network series – First edition.

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22EE51B3: Model based Design for Electrical Systems

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
1	Apply principle of system model derivation and finite element analysis	PO2	3
2	Model DC machines using computer aided design principles	PO1	3
3	Model advanced motors using computer aided design principles	PO-5	3
4	Model electric vehicles using computer aided design principles	PO-2	3

Syllabus:

BASIC CONCEPTS OF DESIGN: Introduction; Specification; Output coefficient; Importance of specific loadings; Electrical Materials: Conducting Materials, Insulating Materials and Magnetic Materials; Magnetic circuit calculations; General procedure for calculation of Amp-Turns; Heating and Cooling; Modes of heat dissipation; Standard ratings of Electrical machines; Ventilation in rotating machines; Quantity of cooling medium; Types of enclosures; General design procedure; Steps to get optimal design. Application of finite element method in design. **SIMULATION AIDED DESIGN OF DC MACHINES** Introduction; Flowcharts and programs for computer aided design of DC machines. 2D FEM open-source software-based DC machine part design **SIMULATION AIDED DESIGN OF INDUCTION MOTOR &SPECIAL MACHINES** Introduction; Flowcharts and programs for simulation aided design of Induction motor, 2D FEM open-source software-based Induction motor part design, computer aided design of BLDC, SRM and PMSM motors **MODEL BASED SYSTEM DESIGN FOR ELECTRIC VEHICLE CONVERSION** Introduction, EV conversion prototyping development, EV conversion ECU design and in-the-loop testing, EV conversion tuning and diagnostic method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.

TEXT BOOKS:

1. M. Gopal, Modern Control System Theory by – New Age International – 1984
2. R. Krishnan, 'Electric Motor & Drives: Modeling, Analysis and Control', Prentice Hall of India, 2nd Edition, 2001.

REFERENCE BOOKS:

1. Donald E. Kirk, Optimal Control Theory an Introduction, Prentice – Hall Network series – First edition.
2. N K Sinha, Control Systems– New Age International – 3rd edition.

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22EE51B4: MICRO ELECTRO MECHANICAL SYSTEMS

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	CO Description	BTL	PO Mapping
CO1	Understand the fundamentals of Micro Electro Mechanical Systems (MEMS).	2	1
CO2	Understand standard micro fabrication techniques.	2	3
CO3	Discuss the mechanical and electrical behaviors of MEMS.	3	3
CO4	Discuss sensing and actuation techniques of MEMS system.	3	1

Syllabus

Introduction to MEMS: Overview of MEMS, new trends in engineering and science, micro and nano scale systems, intrinsic characteristics of MEMS, elements of MEMS: micro sensors and micro actuators, microelectronics fabrication process, energy domains, materials for MEMS: silicon, polymers, metals; Packaging and integration: glass encapsulation, MEMS process integration strategies, applications of micro and nanoelectromechanical systems.

Fabrication Technologies: Surface micromachining: Sacrificial layer processes, micro motors; Bulk micromachining: micro needles, micro nozzles; Etching: dry etching, plasma etching; Wet etching: principle and process architect; High Aspect-Ratio Processes: LIGA process, Deep Reactive Ion Etching (DRIE); Thin film deposition: Chemical Vapor Deposition (CVD), Physical Vapor Deposition (PVD); Evaporation and sputtering.

Mechanical concepts: Crystal planes and orientation, Internal force analysis, mechanical properties of silicon and related thin films, flexural beam bending analysis under simple loading conditions, torsional deflections, spring constant and resonant frequency. **Electrical concepts:** semiconductor materials, calculation of charge carrier concentration, conductivity and resistivity of semiconductor.

Sensing and Actuation Techniques: Micro sensors: Electrostatic sensor, principle of parallel plate capacitors and its applications, Thermal sensor: Fundamentals of thermal transfer, thermal bimorph principle, Piezoresistive sensor: Materials, piezoresistivity, Piezoelectric sensor: Materials and Piezoelectric effect, Micro actuators: Actuation using thermal forces, Actuation using shape memory alloys, Actuation using piezoelectric crystals, Actuation using electrostatic forces (Parallel plate, torsion bar), Actuation using electrostatic forces (Comb drive actuators), Micromechanical motors and pumps. Case studies.

Reference Books:

1. Chang Liu,"Foundation of MEMS", 2 nd edition, Pearson Education Inc.,2012
2. Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", 2nd edition, Tata McGraw Hill, 2008.
3. Reza Ghodssi, Pinyen, "MEMS Materials and Processes Handbook", Springer Science Business Media, 2011.
4. Rai-Choudhury P., "MEMS and MOEMS Technology and Applications", Prentice Hall of India Learning Private Limited, 2009.

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22EE52A1: Digital Simulation of Power Electronic Converters

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Design of non-isolated and isolated DC-DC converters	PO1,PO2	4
CO2	Understand the working of Resonant converters	PO1,PO2	2
CO3	Modelling of non-isolated DC -DC converters	PO1,PO2	3
CO4	Design of closed loop controls for switched mode power supplies	PO1,PO2	4

SYLLABUS :

Non isolated dc-dc converters: Introduction to dc-dc power supplies-Analysis and design of Buck, Boost, Cuk and SEPIC converters in continuous and discontinuous conduction modes-verification of theoretical analysis of converters using simulation tools

Isolated dc-dc converters: Introduction to dc-dc power supplies with isolation- Analysis and design of Forward and fly-back, Push-Pull, Half bridge and full-bridge converters in continuous and discontinuous conduction modes-verification of theoretical analysis of converters using simulation tools

Resonant converters: Introduction to soft switching techniques, analysis and design of load resonant converters-Series load resonant converter-parallel load resonant converter and hybrid resonant converter - Resonant switch converter- Zero current switching, Zero voltage switching and Zero voltage switching with clamped voltage, comparison of Resonant converter topologies.

Modeling of Non isolated dc-dc converters:

Introduction to small signal Analysis- small signal Analysis of Buck, Boost , Buck-Boost converters in continuous and discontinuous conduction modes using averaged switch models, stability analysis of converters using transfer functions (open loop) derived from small signal Analysis

Closed loop control of converters: Introduction to control of switch mode dc power supplies, voltage feedback, voltage feed forward, current mode PWM control of DC-DC converters, power supply protection and electrical isolation in feedback loop

Text books:

1. Power Electronics Converters, applications & devices- Mohan, Undeland Robbins, Wiley Publications, 2003
2. Power Electronics by Daniel W.Hart , Tata McGraw-Hill publication.2011

Reference Books:

1. Power – Switching Converters; Second Edition by Simon Ang & Alejandro Oliva, CRC Publications,2005
2. Fundamentals of Power Electronics-R.W.Erickson and D.Maksimovic-second edition –kluwer publishers,sixth printing-2004.
3. Power Electronics and applications by L. Umananand Wiley India publications.2009

22EE52A3: Adaptive Control Systems

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
CO1	Outline elements of propbability and Stochastic processes	PO2/PSO1	2
CO2	Demonstrate parametric and non-parmetric system models	PO2/PSO1	2
CO3	Interpret adaptive control techniques to linear systems	PO2/PSO1	2
CO4	Apply adaptive control process and asses stability of linear systems	PO2,PO5/PSO2	3

Elements of probability theory: definition of probability and random variable, probability functions, expected value, mean and covariance, independence and correlation, Gaussian distribution and its properties. **Stochastic processes and system models:** Elements of the theory of stochastic processes, mean value function and covariance kernel, independent and correlated stochastic processes, stationery and non sequence model, Gaussian white process. **Non parametric methods & parametric methods:** Nonparametric methods: Transient analysis-frequency analysis-Correlation analysis-Spectral analysis. Liner Regression: The Lease square estimate-best liner unbiased estimation under linear constraints-Prediction error methods: Description of Prediction error methods-Optimal Prediction –relationships between Prediction error methods and other identification methods theoretical analysis. **Adaptive control schemes** Introduction – users- Definitions-auto tuning-types of adaptive control-gain scheduling controller-model reference adaptive control schemes – self tuning controller. MRAC and STC: Approaches – The Gradient approach – Lyapunov functions – Passivity theory – pole placement method Minimum variance control – Predictive control. **Adaptive control and application:** Stability – Convergence – Robustness – Application of adaptive control, direct model reference adaptive control. Introduction: Basic approaches to adaptive control. Applications of adaptive control. Identification: Error formulations linear in the parameters. Direct adaptive control: Linear error equations with dynamics. Gradient and pseudo-gradient algorithms. Strictly positive real transfer functions. Kalman-Yacubovitch-Popov lemma, Passivity theory.

TEXT BOOKS:

1. Dan Simon, "Optimal State Estimation", Wiley Intersience, 2006.
2. S. Sastry and M. Bodson, Adaptive Control: Stability, Convergence, and Robustness, Prentice-Hall, 1989.

REFERENCE BOOKS:

1. K.J. Astrom and B. Wittenmark, Adaptive Control, Addison-Wesley, 2nd edition, 1995.
2. I.D. Landau, R. Lozano, and M. M'Saad, Adaptive Control, Springer Verlag, London, 1998.
3. Meditch, "Stochastic Optimal Linear Estimation and Control" Mc-Graw Hill Company, 1969.
4. K.S. Narendra and A.M. Annaswamy, Stable Adaptive Systems, Prentice-Hall, 1989.
5. P.E. Wellstead& M.B. Zarrop, Self-Tuning Systems: Control and Signal Processing, J. Wiley & Sons, Chichester, England, 1991

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22EE52A4: AUTOMOTIVE SECURITY

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	CO Description	BTL	PO Mapping
CO1	Understand the methods of cryptography	2	1
CO2	Understand the importance of embedded security	2	3
CO3	Understand the network security issues in automotive network.	2	3
CO4	Understand the requirement of firmware resiliency in automotive application.	2	1

Syllabus

Introduction: Introduction to cryptography, Classical Cryptosystem, Block Cipher Data Encryption Standard (DES), Triple DES, Modes of Operation, Stream Cipher. Advanced Encryption Standard (AES), Introduction to Public Key Cryptosystem, Diffie-Hellman Key Exchange, Knapsack Cryptosystem, RSA Cryptosystem. Embedded Security: Introduction-Authentication, Integrity and Confidentiality, Properties of secure system Security elements(JIL), importance of keys in security, customization challenges, distribution of keys, tools and examples. (cryptoAuthlib).

Protecting IP in cloud connected world: Protection of IP, CODE isolation, encryption, hardware security, trustonic expertise tool for IP protection.

Automotive Network security: Motivation for automotive network security, Automotive security, message authentication, Automotive security IC attributes, security challenges.

Firmware Resiliency in Automotive application: Automotive growth drivers, Firmware Vulnerabilities in automotive, Simplified protection, Automotive Platform firmware protection (secure boot controller). Firmware Vulnerabilities in data centre.

Reference Books:

1. Wiiliam Stallings, "Cryptography and Network security Principles and practices ", 4th Edition, prentice hall, November 16,2015.

E- resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs16/preview
2. https://www.microchip.com/en-us/solutions/embedded-security
3. https://vimeo.com/371395354
4. https://vimeo.com/391579350?alild=eyJpljoiK1V6Z1M0VTRldVR3SmlPaCIsInQiOiJMbWx YM1prT2ZQNXhTemVoWEFkRVRBPT0ifQ%253D%253D
5. https://vimeo.com/400991351?alild=eyJpljoiN2I1Z2N2c0pBNUlodmFsZyIsInQiOiJ5bFlzT3 lVUnVkRjNRSlpXd0xJNmRBPT0ifQ%253D%253D
6. SHIELDS UP! Webinar #27: Platform Firmware Resiliency in Automotive Applications (2822370) (on24.com)
7. https://page.microchip.com/FY21Q2-ShieldsUP-HardGates_LP-ShieldsUp-Webinar3.html
8. SHIELDS UP! Webinar #33: Data Center Security Solutions (2977322) (on24.com)

22/3/22

22EE52B1: GREEN ENERGY VEHICLE TECHNOLOGY

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
1	Understand the basic concepts of thermos dynamics	1,3	2
2	Understand Renewable Energy Sources	1,3	2
3	Understand Energy Storage Technology	1,6	2
4	Understand Charging Technology and Future scope of EV	2,3	3

Syllabus:

Introduction:- Review of thermodynamics; Energy Demand and Supply Outlook; Climate Change: projections and risks. Non-renewable Energy sources (Coal, Oil, Natural Gas, Nuclear) and their impact on the environment (climate change , atmospheric pollution, radioactive waste);

Renewable Energy Sources - Wind, Solar PV, Solar-Thermal, Geo-thermal, Hydropower – technology and deployment; Carbon Neutral Fuels – biomass to fuel conversion, biofuel combustion technology, hydrogen as fuel, CO2 to fuel conversion, fuel cell technology;

Energy Storage Technology – chemical storage and battery technology, electro-mechanical storage, thermal storage; Energy Efficiency and Emission Reduction – Use of Exergy to optimize energy use, Clean Combustion Technology, Carbon Capture and Storage, Energy efficient buildings, Life Cycle Assessment (LCA), Distributed Energy and Smart Grid systems.

Charging Technology and Future scope of EV: Sizing the drive system, Energy Management Strategies, Automotive networking and communication, EV charging standards, V2G, G2V, V2B, V2H. Business: E-mobility business, electrification challenges, Business- E-mobility business, electrification challenges, Connected Mobility and Autonomous Mobility- case study E-mobility Indian Roadmap Perspective

Text Books:

1. Autonomous Driving: How the Driverless Revolution will Change the World, by Andreas Herrmann, Walter Brenner, Rupert Stadler, ISBN-10 1787148343, ISBN-13 978-1787148345, Emerald Publishing Limited, 26 March 2018.
2. Autonomous Vehicles: Technologies, Regulations, and Societal Impacts, George Dimitrakopoulos, Aggelos Tsakanikas, Elias Panagiotopoulos, Paperback ISBN: 9780323901376, eBook ISBN: 9780323901383, 1st Edition – April 14, 2021, Elsevier.
3. Driverless: Intelligent Cars and the Road Ahead (MIT Press) 1St Edition, by Hod Lipson , Melba Kurmanr), ISBN-13: 978-0262035224, ISBN-10: 0262035227, September 23, 2016.).

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21/9/22

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22EE52B2: AUTONOMOUS VEHICULAR TECHNOLOGY

L-T-P-S: 3-0-0-0 Credits: 3 Pre-Requisite: NIL

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
1	Understand the the concepts of Autonomous Vehice Technology	1,3	2
2	Understand the concept of remote sensing and the types of sensor technology needed to implement remote sensing	1,3	2
3	Understand the concept of wireless standards and the fundamentals of on-board vehicle networks	1,6	2
4	Apply fundamentals of sensor data fusion as it relates to ADAS and Become familiar with modern vehicle display/cluster technology	2,3	3

Syllabus:

Introduction – SAE autonomous Level Classification-Examples-Application of Autonomous Vehicle Advantages and Disadvantages of Autonomous Vehicles.

Connected and Autonomous Vehicle Technology: Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy.

SENSORS, PERCEPTION AND VISUALISATION: Introduction to sensors, perception and visualisation for autonomous vehicles-Sensor integration architectures and multiple sensor fusion-AI algorithms for sensing and imaging-neural networks.

Wireless Networking and Applications to Vehicle Autonomy : Overview of wireless technology Basics of Computer Networking – the Internet of Things , Wireless Networking Fundamentals , Integration of Wireless Networking and On-Board Vehicle Networks, Review of On-Board Networks – Use & Function,

HUMAN FACTORS AND ETHICAL DECISION MAKING: Introduction to Human Factors-Human Performance: Perception and Attention-Situation Awareness and Error-Human Reliability: Driver Workload and Fatigue-Emotion and Motivation in Design-Trust in Autonomous Vehicles and Assistive Technology-Designing ADAS Systems-Driverless Vehicles and Ethical Dilemmas: Human Factors and Decision Making Software-Application of Human Factors in Autonomous Vehicles. International and national regulatory frameworks for CAV and their safe operation.

Text Books:

4. Autonomous Driving: How the Driverless Revolution will Change the World, by Andreas Herrmann, Walter Brenner, Rupert Stadler, ISBN-10 1787148343, ISBN-13 978-1787148345, Emerald Publishing Limited, 26 March 2018.
5. Autonomous Vehicles: Technologies, Regulations, and Societal Impacts, George Dimitrakopoulos, Aggelos Tsakanikas, Elias Panagiotopoulos, Paperback ISBN: 9780323901376, eBook ISBN: 9780323901383, 1st Edition – April 14, 2021, Elsevier.
6. Driverless: Intelligent Cars and the Road Ahead (MIT Press) 1St Edition, by Hod Lipson , Melba Kurmanr), ISBN-13: 978-0262035224, ISBN-10: 0262035227, September 23, 2016.).

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Dr. JARUTHU ASOMLAL

22EE52B3: Hybrid & Fuel Cell Vehicles

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	Course Outcome	PO/PSO	BTL
1	Understand the basics of conventional vehicle and history of HEV	1,3	2
2	Discriminate various motors used for HEV	1,3	4
3	Identify various energy storage systems for HEV	1,6	2
4	Understand the function of EMS in HEV	2,3	2

Syllabus:

Introduction to Hybrid Electric Vehicles:

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

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

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Energy Storage System: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. **Case Studies:** Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text Books:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.

References Books:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.
3. Iqbal Hussain, CRC Press, Taylor & Francis Group, Second Edition (2011).

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22EE52B4: EV IN SMART GRID

L-T-P-S: 3-0-0-0 **Credits: 3** **Pre-Requisite: NIL**

Mapping of Course Outcomes with PO/PSO:

CO#	CO Description	BTL	PO Mapping
CO1	Understand the fundamentals of Plug in Electric Vehicle technologies	2	1
CO2	Understand the cyber security of Plug in Electric Vehicle technologies in Smart Grid	2	3
CO3	Understand the impact of plug in electric vehicles on power system	2	3
CO4	Understand the PEV Load and Its Impact on Static Voltage Stability	2	1

Syllabus

Plug-in Electric Vehicle Technologies: PEV Technologies, PEV Systems, impacts, Smart Charging Infrastructure, Integration of PEVs to Electric Grid Promotional Programs on PEVs. **Wireless Power Transfer (WPT) for Electric Vehicles (EVs):** Wireless Energy Transfer Methods, Inductive Coupling Versus Magnetic Resonance Coupling, Modelling the WPT System, WPT for EV Charging, Stationary WPT for EV Charging, Dynamic WPT for EV Charging

Cyber Security of Plug-in Electric Vehicles in Smart Grids: Application of Intrusion: Detection Methods, Smart Grids with PEVs, Communication Infrastructure, Communication Standards, Cyber Security Challenges, Data Attacks and Intrusions in PEV Communications, Intrusion Detection Methods, Application to the Detection of Malicious PEV Penetration Level.

Impact Evaluation of Plug-in Electric Vehicles on Power System: Probabilistic PEV Charging Demand, Fast Charging Points, Probabilistic Arrivals, Probabilistic PEV Charging Demand, Probabilistic Grid Impact of Fast Chargers. **PEV Load and Its Impact on Static Voltage Stability**:Modeling of PEV Charging Load, Introduction to Power System Load Characteristics, Modeling of the PEV Charging Load, Effects of Charger Resistances on Load Model Parameters, Newton Raphson Power Flow with PEV Load, Impact of PEV Charging Load on System Static Voltage Stability, Voltage Stability Theory, Static Voltage Stability Analysis, Mitigating PEV Charging Impacts through Voltage Control, Mitigating PEV Charging Impact through Proper Planning.

The Response of Large-Scale EV Charging Loads to Frequency: Introduction Characteristics of EV Charging Loads, Current Related Research of EVs on FR , EVs' Advantages in FR ,The Current Related Research of FR Based on the Coordination Among EVs, AGC, BESSs Properties of FR Resources ,Traditional FR Resources ,Large-Scale Energy Storage Devices ,EV/BESS FR Resource, Coordinated Control Strategy for EVs/BESSs ,Coordination Principle ,Implementation Method for Coordinated FR, Case Study and Results , Simulation Model and Parameters, Simulations of Power System FR The Asynchronous Response of Small-Scale Charging Facilities to Grid Frequency, Formulation of the Proposed Control Method . Demonstration of coordination, Demonstration of equality.

Reference Books:

1. Sumedha Rajakaruna, FarhadShahnia and Arindam Ghosh, "Plug In Electric Vehicles in Smart GridsIntegration Techniques", Springer Science + Business Media Singapore Pte Ltd., 2015.
2. Canbing Li, Yijia Cao, YonghongKuang and Bin Zhou, "Influences of Electric Vehicles on Power System and Key Technologies of Vehicle-to-Grid", Springer-Verlag Berlin Heidelberg, 2016.
3. Qiuwei Wu, "Grid Integration Of Electric Vehicles In Open Electricity Markets", John Wiley & Sons, Ltd, 2013.

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Technical Proficiency Training - I

Modification in Syllabus

CO	REMOVED	UPDATED
CO1		
CO2	Recursive calls to methods, Class variables, class methods, Overriding magic methods, Abstract classes, and interfaces, Class for Vectors in the Plane, Class for Complex Numbers, Classes for Numerical Differentiation, and Classes for Numerical Integration	Array Handling through NumPy, Plotting an Visualization, Implementing Numerical Methods
CO3	Data Structures- Stacks, queues, and sorting techniques, i.e. Bubble, Quick, and Merge Sort.	OOPS through Python, Implementing Data Structures through OOPS, Sci Py, Scikit-Learn, Pandas Libraries
CO4		

Mapping of Course outcomes with student outcomes

CO. No.	Course outcome	PO/PSO	BTL
CO 1	Implement Python Operators, Conditional statements, Collection Data Types and Functions	PO-1, PO-2/1	2
CO 2	Implementing Array through NumPy, Plotting, Visualization through matplotlib and Numerical Methods.	PO-1, PO-2/1	4
CO 3	Implementing OOPS through Python, Data Structures through OOPS, Sci Py, Scikit- Learn, Pandas Libraries.	PO-1, PO-2/1	4
CO 4	Analyse real world applications in Energy management, Electric drives, smart grid and automation using machine learning algorithms with Python.	PO-1, PO-2/2	3

SYLLABUS:

Python Operators and Conditional statements, Python Collection Data Types, Handling Functions, Array Handling through NumPy, Plotting and Visualization, Implementing Numerical Methods, OOPS through Python, Implementing Data Structures through OOPS, Sci Py, Scikit- Learn, Pandas Libraries, Unsupervised Machine Learning algorithms with Python, Supervised Machine Learning algorithms with Python, Python and ML applications for Energy Management, Electric Drives, smart grid, and automation.

Textbooks:

1. Robert Johansson, "Numerical Python: Scientific Computing and Data Science Applications with Numpy, SciPy and Matplotlib", Apress(2019).
2. R. Nageswara Rao, "Core Python Programming",Edition 2, John Wiley, 2018.
3. Christian Hill - Learning Scientific Programming with Python-Cambridge University Press (2020)
4. Dave Kuhlman, A Python Book: Beginning Python,A dvanced Python, and Python Exercises, Open Source, MIT, 2013
5. Wei-Meng Lee - Python Machine Learning, Wiley, 2019

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KLEF								
Department of EEE								
Value Added Courses Proposed for AY 2022-23								
S.No	Certificate Course Title	Offered to	Training Offered by which Company	Certification Offered by which Company	Specialisation domain of department	Level Level I: beginners (suggested for II Year) Level II: Medium (For III Years) Level III: Advanced (for IV Years)	Category (Employability/ Career Advancement/E ntrepreneur ship)	Course duration in hours
1	IoT Essentials	II EEE (Even Sem)	In -house certified trainer	KLEF, IEEE	GET	Level I	Employability	30
2	Embedded IOT Applications for Green Energy Systems	III EEE (Odd sem)	In -house certified trainer	KLEF, IEEE	GET	Level II	Employability	40
3	Edge Computing Capstone Project	III EEE (Even sem)	In -house certified trainer	KLEF, IEEE	GET	Level III	Employability	40
4	IoT Fundamentals	II EEE (Even Sem)	Entuple	Entuple	SGT	Level I	Employability	36
5	IoT and Data Science for Smart Grid	III EEE (Odd sem), II EEE (Even Sem)	Entuple	Entuple	EVT	Level II	Employability	36
6	Machine Learning applications to Smart Gris	III EEE (Odd sem)	Entuple	Entuple	EVT	Level III	Employability	40
7	EV Power Train Design	II EEE (Even Sem)	Decibels Lab Pvt Ltd	Decibels Lab Pvt Ltd	EVT	Level I	Employability	40
8	Battery Management Systems	III EEE (Odd sem)	Decibels Lab Pvt Ltd	Decibels Lab Pvt Ltd	EVT	Level II	Employability	40
9	Electric Vehicle Design	III EEE (Even sem)	Decibels Lab Pvt Ltd	Decibels Lab Pvt Ltd	EVT	Level III	Employability	40

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KLEF				
Department of EEE				
AICTE-SLA PARAKH Courses Proposed for Y22 Admitted Batch of B.Tech EEE				
S.No	**Course Name**	**Platform**	**Category**	**Implementation**
1	Algorithms	AICTE SLA	Employability	1. Acquire logins from Skill Department 2. Sensitize students on applicable courses 3. Undergo assesments 4. Utilize for bench marking as applicale
2	Object Oriented Proramming	AICTE SLA	Employability	
3	Programming and Data Structures	AICTE SLA	Employability	
4	Control System	AICTE SLA	Career Advancement	
5	Wireless Sensor Network	AICTE SLA	Career Advancement	

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Equivalence of Mr. Gopi Raja- Y14 Batch EEE-B.Tech Student

SEMESTER	Course Code	Course Name	L	T	P	Cr	Remarks
I SEMESTER	11-ES104	ENGINEERING GRAPHICS WITH CAD	0	0	4	2	A
	13-BS102	DIFFERENTIAL EQUATIONS	3	1	0	4	F(22)-Extrapolation
	13-ES101	PROBLEN SOLVING THROUGH PROGRAMMING	3	0	2	4	C
	13-ES102	MEASUREMENTS	3	0	2	4	B
	13-ES103	ENGINEERING MATERIALS	3	0	0	3	C
	13-HS101	ENGLISH	2	0	2	3	A
	13-HS104	HUMAN VALUES	2	0	0	2	B
	TOTAL					**22**	
II SEMESTER	11-BS104	ENGINEERING CHEMISTRY	3	0	2	4	B
	11-BS105	ECOLOGY AND ENVIRONMENT	2	0	0	2	A
	13-BS101	LINEAR ALGEBRA AND MULTIVARIATE CALCULUS	3	0	2	4	B
	13-BS103	ENGINEERING PHYSICS	3	0	2	4	B
	13-ES105	WORKSHOP PRACTICE	0	0	4	2	O
	13-ES106	ENGINEERING MACHANICS	3	0	2	4	A
	13-HS102	LANGUAGE AND REASONING SKILLS	2	0	2	3	A
	TOTAL					**23**	
III SEMESTER	13BS201	MATHEMATICAL METHODS	3	0	0	3	F(17)-Extrapolation
	13EC201	DESIGN OF ELECTRONIC SYSTEMS	3	0	2	4	C
	13EE201	DC MACHINES AND TRANSFORMERS	3	0	2	4	B
	13ES203	NETWORK THEORY	3	0	2	4	A
	13ES205	SIGNAL PROCESSING	3	0	2	4	D
	13ES201	THERMODYNAMICS	3	0	0	3	C
	TOTAL					**22**	
IV SEMESTER	13ES202	OBJECT ORINETED PROGRAMMING THROUGH JAVA	3	0	2	4	F(22)-Extrapolation
	13ES204	DATA STRUCTURES	3	0	2	4	C
	13EC205	ANALOG ELECTRONIC CIRCUITS	3	0	2	4	C
	13BS202	COMPLEX VARIABLES AND DISCRETE MATHEMATICS	3	0	0	3	C
	13EE202	FIELDS AND NETWORKS	3	0	2	4	D
	13EE203	AC MACHINES	3	0	2	4	A
	13AC201	ENERGY AND SOCIETY	2	0	0	0	S
	TOTAL					**23**	
V SEMESTER	11EE203	ELECTRICAL POWER GENERATION AND DISTRIBUTION	3	0	2	4	B
	11EE205	ELECTRICAL POWER TRANSMISSION	3	0	2	4	A
	11EE303	POWER ELECTRONICS	3	0	2	4	A
	11EE304	CONTROL SYSTEM	3	0	2	4	C
	13EC203	BASICS OF DIGITAL SYSTEMS	3	0	2	4	To be doen(NR) - Work equivalence-benchmarking his participation in the Global Entrepreneurship Challenge and won the third place
	11OE414	DISASTER MANAGEMENT(OE-1)	3	0	0	3	B
	13AC202	EMPLOYABILITY SKILLS	1	0	2	2	A
		TOTAL				**25**	
VI SEMESTER	11EC311	MICROPROCESSORS AND MICRO CONTROLLERS	3	0	2	4	F(15)-Extrapolation
	11EE302	POWER SYSTEM ANALYSIS	3	0	2	4	F (32)-Extrapolation
	11EE307	ELECTRICAL DRIVES	3	0	2	4	C
	11EE333	SOLAR ENERGY (PE-1)	3	0	0	3	D
	11EE337	WIND ENERGY (PE-2)	3	0	0	3	C
	13AC202	ADVANCED EMPLOYABILITY SKILLS	2	0	0	2	C
	13TP401	TERM PAPER	0	0	4	2	A
	13AC302	QUANTATIVE APPTITUDE AND REASONING(NC COURSE)	0	0	0	S	Completed
	TOTAL					**22**	
	11OE408	IRP PATENT AND LAWS(oe2)	3	0	0	3	F (27)-Extrapolation
	11HS211	ORGANIZATION MANAGEMENT(OE3)	3	0	0	3	F (36)-Extrapolation

VII AND VIII SEMESTER	12OE453	NANO MATERIALS AND TECHNOLOGY(OE-4)	3	0	0	3	F (33)-Extrapolation
	11EE435	HDVC AND FACTS (pe-3)	3	0	0	3	A
	11EE341	NUCLEAR ENERGY (pe5)	3	0	0	3	C
	11EE437	ENERGY CONSERVATION AND AUDIT(pe4)	3	0	0	3	A
	11EE305	POWER SYSTEM PROTECTION	3	0	2	4	F (22)-Extrapolation
	11EE402	POWER SYSTEM OPERATION AND CONTROL	3	0	2	4	F (30)-Extrapolation
	13PS401	PROJECT WORK/PRACTICE SCHOOL	0	0	24	12	O
		INDUSTRIAL TRAINING	0	0	0	S	S
		Empowerment and Entrepreneurship				S	S
		Certification course-2 – IOT				S	To be done- can be given work equivalence benchmarking his Bsec startup pitch award at start AP 2019
		VOLLEY BALL				S	S
	TOTAL					38	
						175	

16/4/2022

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