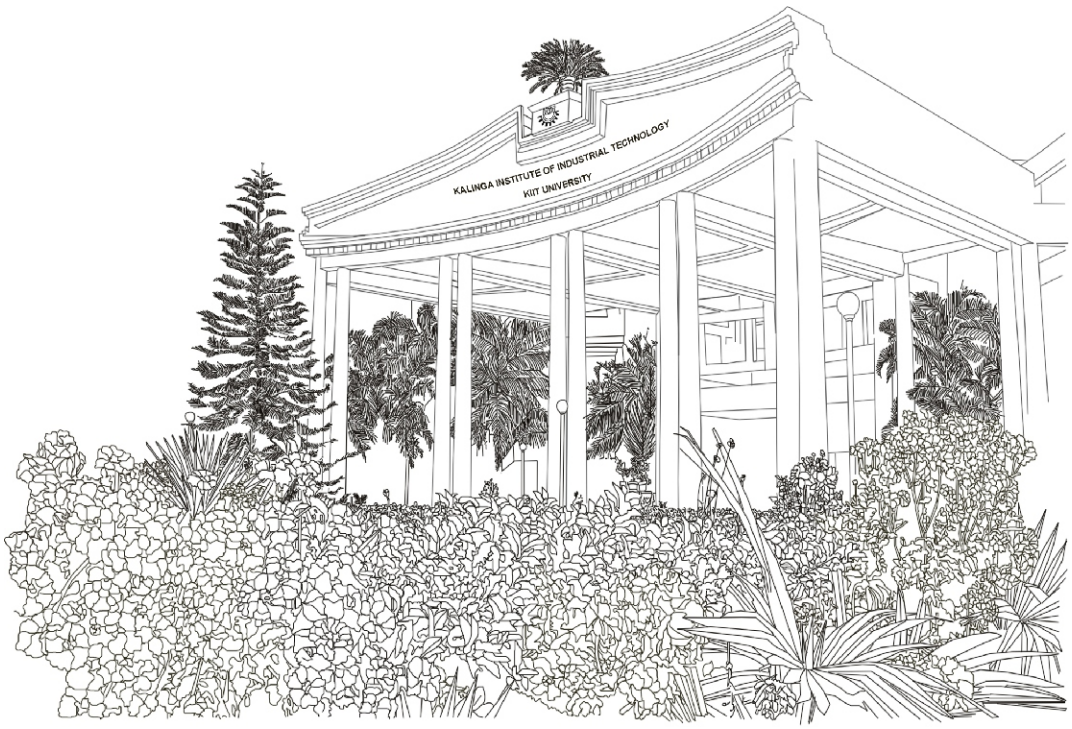
ACADEMIC CURRICULA 2022- 2023

BACHELOR'S DEGREE PROGRAMME

B.Tech.(Hons. / Res.) in

Electrical Engineering

Curricula & Syllabi



Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University U/S 3 of UGC Act, 1956
Bhubaneswar, Odisha, India

ACADEMIC CURRICULA
UNDERGRADUATE DEGREE PROGRAMME
B.TECH.
SCHOOL OF ELECTRICAL ENGINEERING
[2022-2023]

Course Structure and Detailed Syllabi
For B.Tech Students Admitted in the
Academic Session
2022-2023

Kalinga Institute of Industrial Technology(KIIT)
Deemed to be University U/S 3 of UGC Act,1956
Bhubaneswar, Odisha, India

Vision

To deliver world-class education and research in Electrical Engineering, with particular regard to their application in industry, healthcare and commerce in a diverse society.

Mission

1. To prepare students for professional career, higher studies and entrepreneurship.
2. To facilitate students in Electrical Engineering for utilization of technical knowledge and skills, to analyze, solve problems and generate new ideas and products in academia and industry.
3. To motivate students in multi disciplinary research work through continuous learning and to build skills beyond curriculum in the areas of emerging Technologies.
4. To impart the essential skills of leadership, teamwork, communication and ethics.

Programmes Offered by the School: B.Tech in Electrical Engineering (Honours/Research)

Programme Education Objectives(PEOs)

The Program Educational Objectives for the B. Tech program in Electrical Engineering are:

1. Graduates will be able to address complex problems and apply learned skills in wide range of career opportunities in industries and academics.

2. Graduates will be able to fulfill the needs of society in solving technical problems using engineering principles, tools and practices, in an ethical and responsible manner.

3. Graduates will develop leadership skills in the workplace and function professionally in a globally competitive world.

Programme Outcome (PO)

The Program Outcomes and Program Specific Outcomes are:

1. Engineering knowledge: Ability to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Ability to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/Development of solutions: Ability to design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations on complex problems: Ability to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Ability to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Ability to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Ability to understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team: Ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Ability to communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Ability to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs):

1. Demonstrate knowledge and hands-on competence in the area of characteristics, operations, analysis, design of electrical machines and their applications in industry and other fields.

2. Demonstrate knowledge of analysis, design and implementation of electrical circuits, electronic circuits, power electronic circuits, measurements, control systems in different electrical systems.

3. Enhance the knowledge in generation, transmission, distribution, protection of electric power, installation, operation and maintenance of power system components with respect to competitive tariff for economic project viability and climate change issues and to understand the need for renewable energy systems for developing clean energy and sustainable technologies.

Guidelines for UG Engineering Curriculum – 2022

The curricula for B.Tech. courses have been designed following the general principles of curricular design and developing certain guiding strategies in order to build in the engineering graduate attributes in the courses.

Principles in Designing the Curricula

The overriding principles in designing the new curricula are that the curricula must (1) Impart specialized and interdisciplinary knowledge and creative problem-solving skills; (2) Reflect aspirations of the society

to turn out technology-ready and socially conscious graduates to anticipate and avoid future problems; (3) Leverage the strengths and help making up the weaknesses of the university; (4) Inform the students about new technologies and the emerging social, environmental, and global forces, and (5) Give students the confidence to work in teams and in multi-cultural settings.

Key Graduate Attributes

Engineers are agents of social change. They interact with the common man to know and define the current and the looming future problems, develop sustainable design solutions using their science and engineering skills, and implement sustainable solutions. Thus, the graduating students must (1) Acquire knowledge and skills—both technical and soft skills such as communication, leadership, and skills of working in multi-cultural, interdisciplinary teams; (2) Develop the mental disposition to understand, conceptualize, and define complex, real-world problems; (3) Be independent, critical thinkers to inquire into the root causes of the problems; (4) Analyse the relevant data and social, economic, and political forces influencing these problems; (5) Synthesize knowledge and diverse perspectives and approaches to find technically and financially viable, sustainable, creative, ethical solutions by evaluating novel alternatives; (6) Use project planning and scheduling methods, establish institutional mechanisms, and communicate the plans and schedules and inspire the concerned individuals to implement the solutions; (7) Imbibe professional values and ethics, and (8) Be life-long learners with empathy for others.

Strategies for Curriculum Design

Strategies to design the curricula include (1) Understanding the dominant technological and social changes in the world, (2) Incorporating recommendations of the National Education Policy 2020 with respect to design of curricula, (3) Adding the novel features and best curricular practices of leading universities and institutes in India and abroad, (4) Recognizing the UGC and AICTE guidelines and ABET recommendations; (5) Using the opportunities that KIIT offers for multi- and inter-disciplinarity education, and (6) Delivering the key attributes and skills which the graduating students should be equipped with.

The Structure of the Curricula

The undergraduate engineering curricula are designed to inculcate in the students the graduate attributes indicated above. The curricula include (1) foundational subjects in the fields of humanities, social sciences, science, engineering science, and vocational courses, (2) depth subjects—both core and electives related to the respective disciplines, (3) open electives in diverse fields of humanities, arts, science, engineering, social science, management, law, public policy, media studies, etc., and (4) practice-

based subjects. These subjects reflect a mix of theory, hands-on laboratory practice, short- and long-duration projects, field visits, internship, and extra- and co-curricular activities. The Institute has created many avenues for students to organize, lead, and actively participate in social, cultural, and techno-management functions to develop soft social and behavioural skills.

UG Programmes Offered by the Schools of Technology

The B. Tech. (Hons.) and B. Tech. (Res.) programmes offered by various Schools of Technology are tabulated below.

Name of the School	B. Tech. (Hons.) and B. Tech. (Res.) Programmess Offered
School of Civil Engineering	Civil Engineering
School of Computer Engineering	Computer Science and Engineering Information Technology Computer Science and Communication Engineering Computer Science and Systems Engineering
School of Electrical Engineering	Electrical Engineering
School of Electronics Engineering	Electronics and Telecommunication Engineering Electronics and Computer Science Engineering Electronics and Electrical Engineering
School of Mechanical Engineering	Mechanical Engineering Mechanical (Automobile Engineering) Mechatronics Engineering Aerospace Engineering

Highlights of the Curricula

1. The curricula allow the students to opt for either a B. Tech. (Hon.) degree or a B. Tech. (Res.) degree.
2. All the B. Tech. curricula have total of 160 – 165 credits.
3. The curricula provide for a Minor in selected areas if students fulfil additional credit requirements.
4. With the inclusion of many Humanities, Arts, and Social Science (HASS) subjects, the curricula are HASS-rich.
5. The curricula provide flexibility in many forms. The students can choose subjects from a large number science, HASS, and engineering electives. They can also choose subjects from lists of professional electives and open electives. The professional electives allow the students to concentrate in selected areas, whereas the open electives allow the students to opt for minors.

6. To ensure an all-round development of students, the curricula have included subjects like Yoga, Universal Human Values, a Community/Environment-based Project, a Vocational Elective, Industry 4.0 Technologies, and K-Explore that consider students' co- and extra-curricular activities for evaluation.
7. The curricula have included subjects like Scientific and Technical Writing and Research Methods and Ethics to instill research and research communication skills in the students.
8. The curricula have also provided for independent projects in the last three semesters to train the students in the art and science of identifying pressing problems and finding their sustainable solutions.

Notes and Guidelines

Science Core

Science forms the foundation of engineering. Subjects related to physical, chemical, biological, environmental, and mathematical sciences are covered in the first four semesters in the form core and elective subjects. The core subjects in science are the following:

Semester I/II: Physics, Chemistry, Science of Living Systems, Environmental Science, Differential Equations and Linear Algebra, Transform Calculus and Numerical Analysis, Physics Lab, and Chemistry Lab.

Semester III: Probability & Statistics

Semester IV: Selected Topics in Mathematics (Syllabi to be different for different Schools)

Engineering Science Core

Engineering science subjects provide a bridge between science and engineering. The related subjects are included as both core and electives. The semester-wise distribution of the core engineering science subjects is given below.

Semester I/II: Basic Electronics, Programming & Data Structures or Programming Lab, Engineering Drawing & Graphics, Workshop Practice, and Engineering Lab
Half the number of experiments in Engineering Lab will relate to Basic Electronics and the other half to the subject the student picks from the list of Engineering Elective I subjects.

Semester III: Industry 4.0 Technologies

HASS Core

The curricula include HASS subjects as both core and electives. The HASS subjects that improve the written and rhetoric skills, life skills and research skills of students are included as core subjects.

Semester-wise distribution of these subjects are given below:

The semester-wise distribution of language- and human values-related subjects is given below:

- Semester I/II: English (to develop language skills and skills for making critical analysis of English literature)
- Semester I/II: Communication Lab (to develop skills of Listening, Speaking, and Writing)
- Semester I/II: Yoga (to bring about unity of mind and body)
- Semester III: Scientific and Technical Writing (to develop skills of writing varieties of scientific and technical documents)
- Semester VI: Universal Human Values (to develop and respect human values) and Engineering Professional Practice (to understand roles and responsibilities of engineers and the ethical and selected legal issues)
- Semester VIII: Research Methods and Ethics (for B. Tech. (Res.) students)

Professional Core

Professional core subjects form the backbone of an engineering discipline. Every School of Technology decides the list of core subjects that its students must credit. These can be theory and laboratory subjects. These subjects are diffused in Semester III through Semester VI.

Engineering Professional Practice, a professional core subject, is included as a HASS Elective but will be taught by engineering faculty.

Research Core

Students pursuing B. Tech. (Res.) programme have to go through a course on Research Methods and Ethics, which is offered in Semester VII.

Science, Engineering Science, and HASS Electives

Options are available to the students to choose subjects from lists of science, engineering science, and HASS electives. Their distributions in the curricula are as under:

- Semester I/II: Science Electives, Engineering Electives I and II, and HASS Electives I.
- Semester IV: HASS Electives II
- Semester V: HASS Electives III
- Semester VI: HASS Electives IV

HASS Elective I includes Community/Environment-based project as one of the subjects. Done as a group work, the subject gives the students an opportunity to connect with the community and the environment, learn and prioritize their problems, and define them in ways that make them amenable to scientific

analysis and pragmatic solution.

The lists of Science, Engineering Science, and HASS electives will be available in the ERP. Before a semester begins the Institute will announce the subjects that will be offered in that semester and the students will have to give their choice of electives out of the offered subjects.

Vocational Elective

Vocational Elective courses provide engineering students a deeper appreciation of the practical aspects of engineering and allow them to relate their theoretical knowledge with practical skills. This subject is included in Semester III. A student must opt for one of the vocational electives which will be announced at the beginning of a semester.

Open Electives

Open electives allow students to choose subjects from lists of subjects offered by all the Schools. It is through these subjects that a student can pursue his or her latent interests in specific areas and work towards earning a Minor in an area which is outside his (or her) major engineering branch (if the subjects are selected in specific designated areas). These subjects are offered in Semester V through Semester VIII:

Semester V:	K-Explore—Practice-based Open Elective I
Semester VI – VIII:	Open Electives II, III, and IV

K-Explore

It is a 1-Credit Practice-based Open Elective that allows the students to use the scope that the Clubs and the Societies of KIIT University provides to learn the skills of Dance, Music, Photography, etc. and of conducting seminars and conferences through training, practice, and direct involvement.

Minor

The curricula allow a student to earn a Minor in an area outside the core discipline in which he (or she) has registered. For example, a student doing B. Tech in Mechanical Engineering (his/her parent branch) can choose to have a Minor in Computer Science Engineering. To get a Minor, a student must

(i) Get the fourth semester CGPA of 7.0 or more,

(ii) Successfully fulfill the coursework requirement for at least six theory subjects and two credit Lab/project subjects in an area or discipline other than the one for which he (or she) is registered, and

(iii) Complete at least 20 Credits of coursework in that area.

Thus, if a student has taken threeOpen Electives in one area other than his (or her) own then he (or she) must choose three theory subjects and two Lab/project subjects in that area in the Fourth year.

If no Lab subject is available in that Minor, then the student must choose an additional theory subject with at least 2 Credits. Students having no backlogs till the end of Semester 4 and a minimum CGPA of 7.0 will only be allowed to opt for the Minor scheme. Students opting for Minor have to mandatorily attend a minimum of 75% Theory and Lab classes (as the case may be) failing which the Minor option will be withdrawn.

Professional Electives

Professional elective subjects provide the students the opportunity to concentrate in certain specific areas of their interest. These subjects are offered in Semester V through Semester VIII for B. Tech. (Hons.) students (total 15 credits) and in Semester V through Semester VI for B. Tech. (Res.) students (total 9 credits). The distribution of these subjects is given below:

Semester V: Professional Electives (6),

Semester VI: Professional Electives (3),

Semester VII: Professional Electives Theory (3 Credits) for only B. Tech (Hons.) students

Semester VIII: Professional Core Theory (3 Credits) for only B. Tech (Hons.) students

Research Electives

The students pursuing B. Tech. (Res.) degree may need specialized knowledge in the areas of their theses. For this reason, the curriculum provides for two research electives to be selected in Semester VII and Semester VIII. Every School prepares a list of Research Electives and announces, at the beginning of every semester, the subject which will be offered in that semester. The student is required to select the electives from out of these offered lists.

Summer Internship

Internship exposes the students to the realities of engineering systems. Every student must go through at least 60 days of internship. It can be taken in an industrial organization or at an institute of higher learning in the summer breaks after the second year and/or after the third year. Internship carries 2 Credits. And the grade secured by a student appears in the Semester VII Grade Sheet of the student.

Projects

Projects allow the students to work under the supervision of a faculty advisor and apply their acquired knowledge to solve the real-world problems. They define problems, mine information from past works, conceptualize forces and factors that impact the problems, develop design solutions, and demonstrate the effectiveness of the solutions. Semester-wise distribution of this subject is given below:

Semester VI: Mini Project (2 Credits)
Semester VII: Project I (5 Credits)
Semester VIII: Project II (9 Credits for B. Tech. (Hons.) and 12 Credits for B. Tech. (Res.))

Semester-away Provision for Project II

The Institute sometimes allows a student to carry out the fourth-year project (Project II) away from the University campus if the following conditions are satisfied:

- This provision applies to Project II.
- That means a student can avail of this provision in Semester VIII.
- The project must be done either in an industrial unit or in an academic institution.
- The organization in which the student wishes to carry out the project must give in writing that it will provide all facilities (office space, equipment, instrument, data, and travel and stay facilities, if possible) for the student to do the project. In addition, it will also identify a senior and competent employee of the organization to whom the student will report.
- The faculty supervisor must recommend the student's application for availing the semester-away provision.
- A co-supervisor from the organization may be appointed for the project.
- The intending student gives an undertaking that he (or she) will
  - Remain in constant touch with the faculty supervisor,
  - Send monthly progress reports to the supervisor,
  - Give seminar presentations, whenever required.
  - Collect class notes, read books, and prepare for and appear at the examinations (online, if necessary). The student must also do and submit all home assignments given by the teachers and give seminar presentation (online) if necessary.
- Since Semester VIII curricula have one theory subject (B. Tech. (Res.)) and two theory subjects (B. Tech. (Hons.)) students, a student applying for this provision will be exempted from attending the lectures on these subjects. But the student must give an undertaking that it will be his (or her) responsibility to collect class notes, read books and other reading materials, submit all home assignments, give seminar presentations (online if required) and prepare for and appear at the examinations.

SCHEME I
FIRST SEMESTER

Theory							
Sl. No.	**Course Code**	**Subject**	**L**	**T**	**P**	**Total**	**Credit**
1	PH10001	Physics	3	0	0	3	3
2	MA11001	Differential Equations and Linear Algebra	3	1	0	4	4
3		Science Elective	2	0	0	2	2
4		Engineering Elective II	2	0	0	2	2
5	LS10001	Science of Living Systems	2	0	0	2	2
6	CH10003	Environmental Science	2	0	0	2	2
Total Credit (Theory Subjects)						**15**	**15**
Practical							
1	PH19001	Physics Lab	0	0	2	2	1
2	CS13001	Programming Lab	0	2	4	6	4
Sessional							
1	CE18001	Engineering Drawing & Graphics	0	0	2	2	1
Total Credit (Practical & Sessional subject)						**10**	**6**
Total Credit (Semester)						**25**	**21**

SCHEME I
SECOND SEMESTER

Theory							
Sl. No.	**Course Code**	**Subject**	**L**	**T**	**P**	**Total**	**Credit**
1	CH10001	Chemistry	3	0	0	3	3
2	MA11002	Transform Calculus and Numerical Analysis	3	1	0	4	4
3	HS10001	English	2	0	0	2	2
4	EC10001	Basic Electronics	2	0	0	2	2
5		Engineering Elective I	2	0	0	2	2
6		HASS Elective I	2	0	0	2	2
Total Credit (Theory Subjects)						**15**	**15**
Practical							
1	CH19001	Chemistry Lab	0	0	2	2	1
2	EX19001	Engineering Lab	0	0	2	2	1
Sessional							
1	ME18001	Workshop	0	0	2	2	1
2	YG18001	Yoga	0	0	2	2	1
3	HS18001	Communication Lab	0	0	2	2	1
Total Credit (Practical & Sessional subject)						**10**	**5**
Total Credit (Semester)						**25**	**20**

SCHEME II
FIRST SEMESTER

Theory							
Sl. No.	**Course Code**	**Subject**	**L**	**T**	**P**	**Total**	**Credit**
1	CH10001	Chemistry	3	0	0	3	3
2	MA11001	Differential Equations and Linear Algebra	3	1	0	4	4
3	HS10001	English	2	0	0	2	2
4	EC10001	Basic Electronics	2	0	0	2	2
5		Engineering Elective I	2	0	0	2	2
6		HASS Elective I	2	0	0	2	2
Total Credit (Theory Subjects)						**15**	**15**
Practical							
1	CH19001	Chemistry Lab	0	0	2	2	1
2	EX19001	Engineering Lab	0	0	2	2	1
Sessional							
1	ME18001	Workshop	0	0	2	2	1
2	YG18001	Yoga	0	0	2	2	1
3	HS18001	Communication Lab	0	0	2	2	1
Total Credit (Practical & Sessional subject)						**10**	**5**
Total Credit (Semester)						**25**	**20**

SCHEME II
SECOND SEMESTER

Theory							
Sl. No.	**Course Code**	**Subject**	**L**	**T**	**P**	**Total**	**Credit**
1	PH10001	Physics	3	0	0	3	3
2	MA11002	Transform Calculus and Numerical Analysis	3	1	0	4	4
3		Science Elective	2	0	0	2	2
4		Engineering Elective II	2	0	0	2	2
5	LS10001	Science of Living Systems	2	0	0	2	2
6	CH10003	Environmental Science	2	0	0	2	2
Total Credit (Theory Subjects)						**15**	**15**
Practical							
1	PH19001	Physics Lab	0	0	2	2	1
2	CS13001	Programming Lab	0	2	4	6	4
Sessional							
1	CE18001	Engineering Drawing & Graphics	0	0	2	2	1
Total Credit (Practical & Sessional subject)						**10**	**6**
Total Credit (Semester)						**25**	**21**

LIST OF ELECTIVES

Engineering Elective I							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	CE10001	Basic Civil Engineering	2	0	0	2	2
2	ME10003	Basic Mechanical Engineering	2	0	0	2	2
3	EE10002	Basic Electrical Engineering	2	0	0	2	2

Engineering Elective II							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	EE10001	Elements of Machine Learning*	2	0	0	2	2
2	ME10001	Engineering Mechanics	2	0	0	2	2
3	EC10003	Biomedical Engineering	2	0	0	2	2
4	EE10003	Basic Instrumentation	2	0	0	2	2

*Not for students of Computer Engineering

Science Elective							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	CH10005	Nanoscience	2	0	0	2	2
2	PH10003	Smart Materials	2	0	0	2	2
3	LS10003	Molecular Diagnostics	2	0	0	2	2
4	PE10002	Science of Public Health	2	0	0	2	2
5	MA10003	Optimization Techniques	2	0	0	2	2

HASS Elective I							
Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	HS10013	Society, Science, and Technology	2	0	0	2	2
2	HS10202	Essential of Management	2	0	0	2	2
3	HS10121	Shades of Economics	2	0	0	2	2
4	HS10123	Indian Economy Post Liberalisation	2	0	0	2	2
5	SO10043	Socio-Political Environment	2	0	0	2	2
6	PS10043	Thinking Perspectives	2	0	0	2	2
7	PS10045	Creativity, Innovation and Entrepreneurship	2	0	0	2	2
8	EX17001	Community/Environment-based Project	2	0	0	2	2

SEMESTER- III

Theory							
Sl. No	**Course Code**	**Subject**	**L**	**T**	**P**	**Total**	**Credit**
1	EX20003	Scientific and Technical Writing	2	0	0	2	2
2	MA21001	Probability and Statistics	3	1	0	4	4
3	EE21001	Electric Circuit Analysis	3	1	0	4	4
4	EE20003	Electrical Machine-1	3	0	0	3	3
5	EE20005	Measurement and Sensor Technology	3	0	0	3	3
6	EE20007	Analog and Digital Electronics Circuit	3	0	0	3	3
Total credit (Theory Subjects)						**19**	**19**
Practical							
1	EE29001	Electric Circuit Laboratory	0	0	2	2	1
2	EE29003	Measurement and Sensor Laboratory	0	0	2	2	1
3	EE29005	Analog and Digital Circuit Design Laboratory	0	0	2	2	1
Total credit (Practical Subjects)						**06**	**03**
Sessional/Vocational							
1		Vocational Electives	0	0	2	2	1
Total credit (Vocational Subjects)						**02**	**01**
Total Practical & Sessional/Vocational						**08**	**04**
Total Credit (Semester)						**27**	**23**

SEMESTER- IV

Theory							
Sl. No	**Course Code**	**Subject**	**L**	**T**	**P**	**Total**	**Credit**
1		HASS Elective II	3	0	0	3	3
2	MA21006	Vectors,Differential Equations and Complex Analysis	3	1	0	4	4
3	EE20002	Electrical Machine-II	3	0	0	3	3
4	EE20004	Linear Control System	3	0	0	3	3
5	EE20006	Signal and System	3	0	0	3	3
6	EX20001	Industry 4.0 Technologies	2	0	0	2	2
Total credit (Theory Subjects)						**18**	**18**
Practical							
1	EE29002	Electrical Machines Laboratory	0	0	2	2	1
2	EE29004	Control System Laboratory	0	0	2	2	1
Total credit (Practical Subjects)						**04**	**02**
Sessional/Vocational							
1	EE28002	Electrical System Modeling Using MATLAB	0	0	2	2	1
Total credit (Vocational Subjects)						**02**	**01**
Total Practical & Sessional/Vocational						**06**	**03**
Total Credit (Semester)						**24**	**21**

SEMESTER- V

Theory							
Sl. No	**Course Code**	**Subject**	**L**	**T**	**P**	**Total**	**Credit**
1	HS30101	Engineering Economics	3	0	0	3	3
2		HASS Elective III	3	0	0	3	3
3	EE31001	Transmission and Distribution of Electric Power	3	1	0	4	4
4	EE30001	Power Electronics	3	0	0	3	3
5		Professional Elective -I	3	0	0	3	3
6	HS30401	Universal Human Values	3	0	0	3	3
Total credit (Theory Subjects)						**19**	**19**
Practical							
1	EE39001	Power Electronics Laboratory	0	0	2	2	1
Total credit (Practical Subjects)						**02**	**01**
Sessional/Vocational							
1	EE38001	Industrial Automation Using PLC	0	0	2	2	1
2	EE38003	Data Structures and Programming Paradigms	0	0	2	2	1
	EE38005	System Design using IOT	0	0	2	2	1
3		K-Explore (Practice-oriented Open Elective I)	0	0	0	0	1
Total credit (Vocational Subjects)						**06**	**04**
Total Practical & Sessional/Vocational						**08**	**05**
Total Credit (Semester)						**27**	**24**

SEMESTER- VI

Theory							
Sl. No	**Course Code**	**Subject**	**L**	**T**	**P**	**Total**	**Credit**
1	EE30004	Microprocessors and Embedded System	3	0	0	3	3
2	EE30002	Principles of Communication Engineering	3	0	0	3	3
3	EE31002	Power System Operation control and Protection	3	1	0	4	4
4		Professional Elective -II	3	0	0	3	3
5		Professional Elective-III	3	0	0	3	3
6		Open Elective II/ (MI-1)	3	0	0	3	3
Total credit (Theory Subjects)						**19**	**19**
Practical							
1	EE39002	Power Systems Laboratory	0	0	2	2	1
2	EE39004	Electric Drives Laboratory	0	0	2	2	1
	EE39006	Microprocessor Laboratory	0	0	2	2	1
Total credit (Practical Subjects)						**06**	**03**
Sessional/Vocational							
1	EE37002	Mini Project	0	0	4	4	2
Total credit (Vocational Subjects)						**04**	**02**
Total Practical & Sessional/Vocational						**10**	**05**
Total Credit (Semester)						**29**	**24**

SEMESTER- VII (For Honours Options Students)

Theory							
Sl. No	**Course Code**	**Subject**	**L**	**T**	**P**	**Total**	**Credit**
1		Professional Elective-IV	3	0	0	3	3
2		Open Elective III/ (MI-2)	3	0	0	3	3
3	EX40003	Engineering Professional Practice	2	0	0	2	2
4		(MI-3)	(3)	(0)	(0)	(3)	(3)
5		(MI-4)	(3)	(0)	(0)	(3)	(3)
Total credit (Theory Subjects)						**08**	**08**
Sessional/Vocational							
1	EE48001	Internship	0	0	0	0	2
2	EE47001	Project-1	0	0	10	10	5
		(Project/Lab –Minor)	(0)	(0)	(4)	(4)	(2)
Total Practical & Sessional/Vocational						**10**	**07**
Total Credit (Semester)						**18**	**15**

SEMESTER- VIII (For Honours Options Students)

Theory							
Sl. No	**Course Code**	**Subject**	**L**	**T**	**P**	**Total**	**Credit**
1		Professional Elective-V	3	0	0	3	3
2		Open Elective IV/ (MI-5)	3	0	0	3	3
3		(MI-6)	(3)	(0)	(0)	(3)	(3)
Total credit (Theory Subjects)						**06**	**06**
Sessional/Vocational							
1	EE47002	Project-II	0	0	18	18	9
Total Practical & Sessional/Vocational						**18**	**09**
Total Credit (Semester)						**24**	**15**

SEMESTER- VII (For Research Options Students)

Theory							
Sl. No	**Course Code**	**Subject**	**L**	**T**	**P**	**Total**	**Credit**
1		Research Elective I	3	0	0	3	3
2		(MI-2)	(3)	(0)	(0)	(3)	(3)
3	EX40003	Engineering Professional Practice	2	0	0	2	2
4	EX40001	Research Methods and Ethics	3	0	0	3	3
5		(MI-3)	(3)	(0)	(0)	(3)	(3)
6		(MI-4)	(3)	(0)	(0)	(3)	(3)
Total credit (Theory Subjects)						**08**	**08**
Sessional/Vocational							
1	EE48001	Internship	0	0	0	0	2
2	EE47003	Research Project-1	0	0	10	10	5
		(Project/Lab –Minor)	(0)	(0)	(4)	(4)	(2)
Total Practical & Sessional/Vocational						**10**	**07**
Total Credit (Semester)						**18**	**15**

SEMESTER- VIII (For Research Options Students)

Theory							
Sl. No	**Course Code**	**Subject**	**L**	**T**	**P**	**Total**	**Credit**
1		Research Elective II	3	0	0	3	3
2		(MI-5)	(3)	(0)	(0)	(3)	(3)
3		(MI-6)	(3)	(0)	(0)	(3)	(3)
Total credit (Theory Subjects)						**03**	**03**
Sessional/Vocational							
1	EE47004	Research Project-II	0	0	24	24	12
Total Practical & Sessional/Vocational						**24**	**12**
Total Credit (Semester)						**27**	**15**

PROFESSIONAL ELECTIVES

PE-I

Sl. No	Code	Subject	Credit
1	EE30011	Electromagnetic Field Theory	3
2	EE30013	Industrial Applications of Electric Energy	3
3	EE30015	IoT for Electrical Engineering	3
4	EE30017	Neural Network and Fuzzy Logic	3
5	EE30019	Modern Control System	3

PE-II

Sl. No	Code	Subject	Credit
1	EE30012	Sensors and Actuators	3
2	EE30014	Power Generation and Control	3
3	EE30016	Renewable Energy Resource	3
4	EE30018	Restructuring of Power System	3
5	EE30020	Energy Audit and Accounting	3

PE-III

Sl. No	Code	Subject	Area
1	EE30022	Special Machines and its control	Drives and Electric Vehicle
	EE30024	Electric Drives and Control	
2	EE30026	Distribution System Planning and Automation	Power system
	EE30028	HVDC and FACTS	
3	EE30030	Solar Energy Utilization	Renewable energy
	EE30032	Sustainable Energy and Applications	

PE-IV

Sl. No	Code	Subject	Area
1	EE40007	Inverter and SMPS	Drives and Electric Vehicle
	EE40009	Industrial Automation	
2	EE40011	Digital Protection System	Power system
	EE40015	Computer Aided Power System(CAPS)	
3	EE40013	Wind and Biomass Energy	Renewable energy
	EE40017	Tidal and Small Hydro Power	

PE-V

Sl. No	Code	Subject	Area
1	EE40008	Principles of Harmonics Elimination and Application	Drives and Electric Vehicle
	EE40010	Electric Vehicles Technology	
2	EE40012	Smart Grid	Power system
	EE40014	Energy Management and SCADA	
3	EE40016	Economics Planning of Energy Systems	Renewable energy
	EE40018	Waste Management and Energy Recovery	

Research Elective-I

Sl. No	Code	Subject	Area
1	EE40019	Power Converter Analysis and Design	Drives and Electric Vehicle
	EE40021	Battery Management System	
2	EE40023	Power Quality	Power system
	EE40025	State estimation and security	
3	EE40027	Renewable Energy resources assessment and forecasting	Renewable energy
	EE40029	Wind Turbine and Aerodynamics	

Research Elective-II

Sl. No	Code	Subject	Area
1	EE40020	Digital System Design using FPGA	Drives and Electric Vehicle
	EE40022	Vehicle Charging Technology	
2	EE40024	Distributed generation of Microgrid	Power system
	EE40026	Synchrophasors Application to Power System	
3	EE40028	Grid Integration and Control	Renewable energy
	EE40030	Energy Systems Modelling and Analysis	

HASS ELECTIVE

HASS Elective II

Sl. No	Code	Subject	Credit
1	HS 20220	Organizational Behaviour	3
2	HS20222	Human Resource Management	3
3	HS 20120	Economics of Development	3
4	HS 20122	International Economic Cooperation	3

HASS Elective III

Sl. No	Code	Subject	Credit
1	HS30223	Business Ethics and Corporate Governance	3
2	HS30225	Leadership and Team Effectiveness	3
3	HS30125	Market Structure and Pricing Policies	3
4	HS30127	Pragmatic Inquiry	3
5	HS30129	Economic Analysis of Decision Rules	3
6	HS30131	Economics of Health and Education	3
7	HS30421	Gender Studies	3
8	HS30423	Tribal Resource Management	3
9	HS30425	Indian Knowledge System	3

Vocational courses offered by School of Civil Engineering

Sl. No.	Course Code	Subjects
1	CE28001	Building Drawing, Estimation & Costing (for Civil Engineering Students)
2	CE28003	GIS & GPS Applications (For other branch students)

Vocational courses offered by School of Computer Science Engineering

Sl. No.	Course Code	Subjects
1	CS28001	Web Design

Vocational courses offered by School of Electrical Engineering

Sl. No.	Course Code	Subjects
1	EE28011	Industrial wiring and control panel design
2	EE28013	Installation, operation and maintenance of solar power system
3	EE28015	Domestic wiring and home automation
4	EE28017	Cyber physics application in industrial IOT
5	EE28019	Industrial Control and Remote Monitoring

Vocational courses offered by School of Electronics Engineering

Sl. No.	Course Code	Subjects
1.	EC28001	Computational Photography
2.	EC28003	Sound Engineering
3.	EC28005	Sensors for Automation
4.	EC28007	PCB Design

Vocational courses offered by School of Mechanical Engineering

Sl. No.	Course Code	Subjects
1	ME28011	Additive Manufacturing(3-D Printing)
2	ME28013	Die development by CNC milling
3	ME28015	Concept Car Manufacturing
4	ME28017	Development of Autonomous Wheeled Robots
5	ME28019	Modelling of Micro-Wind turbine by 3D CAD Design

K-EXPLORE OPEN ELECTIVE COURSES OFFERD KSAC

Sl. No.	Course Code	Subjects
1	SA38001	Robotics
2	SA38003	Web Designing
3	SA38005	Civil-Tech
4	SA38007	Circuit Design & Control
5	SA38009	Indian Classical, Folk and Bollywood Dance
6	SA38011	Indian Classical & Western Music
7	SA38013	Graphic Designing & Editing
8	SA38015	Art & Craft
9	SA38017	Theatre & Street Play
10	SA38019	Film Making
11	SA38021	Debating, Public Speaking& Anchoring
12	SA38023	Creative Writing
13	SA38025	Photography & Videography
14	SA 38027	Fashion Styling
15	SA 38029	Culinary Arts
16	SA 38031	Quiz Activity
17	SA 38033	Social Outreach
18	SA 38035	Health and Emergency Care

OPEN ELECTIVES AND MINORS

Civil Engineering

Course Code	Open Elective Courses	Pre-requisite	Minor in			
			Water Resources Management	Urban Environmental Management	Geohazard Mitigation and Management	Urban Transportation Management
SEMESTER – VI						
CE30072	Fundamentals of Project Management	Nil				
CE30074	Elements of Surface Hydrology	Nil				
CE30076	Environmental Pollution and Control	Nil				
CE30078	Municipal Solid Waste Management	Nil				
CE30052	Surface & Groundwater Hydrology	Nil	X			
CE30054	Water Supply & Quality Management	Nil		X		
CE30056	Geomaterial characterization	Nil			X	
CE30058	Highway Material Characterization	Nil				X
SEMESTER – VII						
CE40081	Disaster Management	Nil				
CE40083	Coastal Management	Nil				
CE40085	Basic Groundwater Hydrology	Nil				
CE40087	Clean water & Sanitation	Nil				
CE40065	Geo-hazards Risk Management	Nil			X	
CE40051	Basic Fluid Mechanics & Hydraulics	Nil	X			
CE40053	Remote Sensing & GIS	Nil	X	X		
CE40055	Irrigation Water Management	Nil	X			
CE40057	Urban Waste Management	Nil		X		
CE40059	Urban Storm Water Management	Nil		X		
CE40061	Landslide hazards and protection	Nil			X	
CE40063	Earthquake hazards and mitigation	Nil			X	
CE40067	Traffic Analysis and Management	Nil				X
CE40069	Railway and Airport Planning	Nil				X
CE40071	Road Safety Analysis	Nil				X
SEMESTER – VIII						
CE40082	Global Warming & Climate Change	Nil				
CE40084	Construction Materials & Specifications	Nil				
CE40086	Natural Resources Management	Nil				
CE40088	Basic Transportation Engineering	Nil				
CE40050	Gender & Legal Aspects in Water Resources Management	Nil	X			
CE40052	Environmental Impact Assessment & Auditing	Nil	X	X		X
CE40054	Air Pollution Control & Management	Nil		X		
CE40056	Groundwater contamination and remediation	Nil			X	
CE40058	Geotechnical instrumentation and monitoring	Nil			X	
CE40060	Fundamentals of Urban Transportation Planning	Nil				X

Minor Lab / Project (Students pursuing 4 years B.Tech. Hons or B.Tech. Research program along with Minor program)

Course Code	Course	Pre-requisite	Minor Specialization			
			Water Resources Management	**Urban Environmental Management**	**Geohazard Mitigation and Management**	**Urban Transportation Management**
CE49001	Water Resources Lab	Nil	X			
CE49003	Environmental Quality Lab	Nil		X		
CE49005	Geomaterial Lab	Nil			X	
CE49007	Highway Infrastructure Lab	Nil				X

Computer Science and Engineering

Semester VI			
Course Code	**Open Elective Courses**	**Pre-requisite**	**Minor in Computer Science**
CS30001	Design and Analysis of Algorithms	Nil	
CS30018	Software Engineering Fundamentals	Nil	
CS30020	Essentials of Computer Science	Nil	
CS30022	Object Oriented Programming	Nil	
CS30024	Fundamentals of Data Structures	Nil	
CS30011	Computational Intelligence	Nil	
CS40002	Nature Inspired Computing	Nil	

Semester VII			
Course Code	**Open Elective Courses**	**Pre-requisite**	**Minor in Computer Science**
CS30001	Design and Analysis of Algorithms	Nil	
CS30018	Software Engineering Fundamentals	Nil	
CS30020	Essentials of Computer Science	Nil	X
CS30022	Object Oriented Programming	Nil	
CS30024	Fundamentals of Data Structures	Nil	X
CS30011	Computational Intelligence	Nil	
CS40002	Nature Inspired Computing	Nil	

Semester VIII			
Course Code	**Open Elective Courses**	**Pre-requisite**	**Minor in Computer Science**
CS30001	Design and Analysis of Algorithms	Nil	X
CS30018	Software Engineering Fundamentals	Nil	
CS30020	Essentials of Computer Science	Nil	
CS30022	Object Oriented Programming	Nil	
CS30024	Fundamentals of Data Structures	Nil	
CS30011	Computational Intelligence	Nil	
CS40002	Nature Inspired Computing	Nil	

Minor Lab / Project (Students pursuing 4 years B.Tech. Hons or B.Tech. Research program along with Minor program)

Course Code	Courses	Pre-requisite
CS39008	Computing Laboratory	Nil

Electrical Engineering

SEMESTER – VI					
Course Code	**Open Elective Courses**	**Pre-requisite**	**Minor in**		
			Electrical Engineering	**Smart Electric Vehicles**	**Industrial IoT**
EE30034	Network Analysis	Nil	X	X	X
EE30016	Renewable Energy Resources	Nil	X	X	
EE30036	Solar Power Technology	Nil			
EE30038	Introduction to Electrical Machines	Nil	X	X	X
EE30040	Energy and Environment	Nil			
EE20007	Analog and Digital Electronics Circuits	Nil	X	X	
EE20005	Measurements and Sensors Technology	Nil	X		
SEMESTER – VII					
EE40031	Fuel Technology	Nil			
EE40033	Energy Audit and Management	Nil	X		
EE20004	Linear Control System	Nil	X	X	X
EE30012	Sensors and Actuators	Nil		X	X
EE40035	Energy Storage Technology	Nil	X	X	
EE30004	Microprocessors and Embedded System	Nil	X		
EE40020	Digital System Design using FPGA	Nil		X	X
EE30022	Special Machines and control	Nil		X	
EE40044	Hybrid Electric Vehicles	Nil		X	
EE40042	Robotics and Control	Nil			X
EE40047	Cyber security	Nil			X
EE40048	Wireless network systems	Nil			X

SEMESTER – VIII					
EE30007	Power Transmission and Distribution	Nil	X		
EE30001	Power Electronics	Nil	X		
EE30024	Electric Drives and Control	Nil	X		
EE40041	Power System Protection	Nil	X		
EE40046	IoT in Electric Vehicles	Nil		X	
EE40022	Vehicle Charging Technology	Nil		X	
EE40045	Hydrogen and fuel cell technology for Electric and hybrid Vehicle	Nil		X	
EE40049	IoT in Industry	Nil			X
EE40050	Smart Bio-Medical Instruments	Nil			X
EE40051	Bio-Inspired Algorithm	Nil			X
EE40052	IoT Sensors and Protocols	Nil			X

Minor Lab / Project (Students pursuing 4 years B.Tech. Hons or B.Tech. Research program along with Minor program)

Course Code	Course	Pre-requisite	Minor Specialization		
			Electrical Engineering	**Smart Electric Vehicles**	**Industrial IoT**
EE29002	Electrical Machines Laboratory	Nil	X		
EE39001	Power Electronics Laboratory	Nil	X		
EE49001	Power System Protection Lab	Nil	X		
EE49005	Electric Vehicles Laboratory	Nil		X	
EE49003	IoT Laboratory	Nil		X	X
EE49002	Sensors and Control Laboratory	Nil		X	X
EE39007	PLC Laboratory	Nil			X

Electronics Engineering

SEMESTER – VI

Course Code	**Open Elective Courses**	**Pre-requisite**	**Minor in**			
			Minor in Communication and Networking	**Minor in VLSI and Embedded System**	**Minor in Applied Machine Learning**	**Minor in Cyberphysical Systems**
EC30014	Circuits, Signals and Communication	NIL	X	X	X	X
EC30016	Introduction to Sensor Technology	EC10001				X
EC30018	Evolution of Communication Technology	NIL				
EC30020	Electronics and PCB Design	NIL				
EC40001	Optimization Techniques in Engineering	NIL				

SEMESTER – VII

Course Code	Open Elective Courses	Pre-requisite	Minor in			
			Minor in Communication and Networking	Minor in VLSI and Embedded System	Minor in Applied Machine Learning	Minor in Cyberphysical Systems
EC40031	Principles of Opto-Electronics	EC30014/EC10001				
EC40033	Principle of Modern Communication Systems	EC30014/EC10001				
EC40023	Consumer Electronics	EC30014/EC10001				
EC40025	Fundamentals of Data Acquisition Systems	NIL				
EC40027	Embedded System Design and Applications	EC10001		X	X	X
EC40029	Communication Network Fundamentals	EC21002/EC20008/EC30014	X			
EC20007	Semiconductor Technology	Nil		X		
EM30011	Data Mining	Nil			X	
EM30009	Data Analytics	Nil				X
EC300013	Optical and Satellite Communication	EC21002/EC20008	X			
EC30011	Digital System Design with Verilog	EC10001		X		
EC30010	Information Theory and Coding	EC20008/EC30014	X			
EM40006	Cybersecurity	Nil				X
EM40008	Bioinformatics	LS10001			X	

SEMESTER – VIII

Course Code	Open Elective Courses	Pre-requisite	Minor in			
			Minor in Communication and Networking	Minor in VLSI and Embedded System	Minor in Applied Machine Learning	Minor in Cyberphysical Systems
EC40004	Quantum Engineering	NIL		X		
EC40020	Essence of Biomedical Signal Processing	MA11001 MA11002				
EC40022	Imaging Techniques	NIL				
EC30019	Mobile Ad Hoc Network	EC21002/EC20008	X			
EM40010	Optimization Methods in Machine Learning	MA11001 MA11002 MA21001			X	
EC30021	Industrial IoT	EC20002/EC30004				X
EM30004	Machine learning based Signal Processing	MA21001/ EC20001	X	X	X	X

Minor Lab / Project (Students pursuing 4 years B.Tech. Hons or B.Tech. Research program along with Minor program)

Course Code	Course	Pre-requisite	Minor Specialization			
			Minor in Communication and Networking	Minor in VLSI and Embedded System	Minor in Applied Machine Learning	Minor in Cyberphysical Systems
EC39002	Wireless Communication and Networking Lab	Nil	X			
EC29002	Communication Engineering Lab	Nil	X			
EC39001	VLSI Design Lab	Nil		X		
EC29005	Digital System Design Lab	Nil		X		
EC39004	Electronics Design Lab	Nil				X
EM47003	Project	Nil			X	X

Mechanical Engineering

SEMESTER – VI					
Course Code	Open Elective Courses	Pre-requisite	Minor in		
			Mechanical Engineering	Manufacturing Engineering	Industrial Engineering and Management
ME30050	Kinematics and Dynamics of Machinery	Nil	X		
ME20005	Material Science and Engineering	Nil		X	
ME30016	Supply Chain Management	Nil			X
ME30052	Introduction to Fluid Mechanics and Heat Transfer	Nil			
ME30054	Renewable Energy Sources	Nil			
ME30056	Finite Element Method for Engineers	Nil			
ME30058	Introduction to Composite Materials	Nil			
SEMESTER – VII					
ME40061	Engineering Metrology	Nil		X	
ME30005	Industrial Engineering and Operations Research	Nil	X	X	
	Manufacturing Processes	Nil	X	X	
ME40063	Quality Engineering	Nil			X
ME40065	Project Management	Nil			X
ME40067	Operations Research	Nil			X
ME40069	Thermodynamics and Hydraulic Devices	Nil	X		
ME40071	Biomechanics	Nil			
ME40073	Fundamentals of Computational Fluid Dynamics	Nil			
ME40075	Automobile Technology	Nil			

SEMESTER – VIII					
ME40062	Work System Design	Nil			X
ME30018	Power Plant Engineering	Nil	X		
ME40064	Mechanical System Design	Nil	X		
ME30015	Additive Manufacturing	Nil		X	
ME40066	Industrial Automation and Robotics	Nil		X	
ME40068	Production, Planning and Control	Nil			X
ME40070	Mechatronic Systems	Nil			
ME40072	Robotics	Nil			
ME40074	Computer Controlled Manufacturing Systems	Nil			

Minor Lab / Project (Students pursuing 4 years B.Tech. Hons or B.Tech. Research program along with Minor program)

Course Code	Open Elective Courses	Pre-requisite	Minor Specialization		
			Mechanical Engineering	Manufacturing Engineering	Industrial Engineering and Management
ME49011	Thermo fluids Lab	Nil	X		
ME28003	Manufacturing Practices	Nil	X	X	
ME49013	Metrology and Instrumentation Lab	Nil		X	
ME48011	Operations Research Sessional	Nil			X
ME49016	Work System Design Lab.	Nil			X

Humanities

SEMESTER – VI			
Course Code	Open Elective Courses	Pre-requisite	Minor in
			Financial Economics (Using Data Analytics)
HS30150	Foundations of Modern Macroeconomics	Nil	
HS30152	Money and Financial Markets	Nil	X
HS30154	Poverty to Prosperity	Nil	
HS30250	Organizational Change and Development	Nil	
HS30050	Indian Literature in Translation (ILT)	Nil	
HS30052	Climate Change Fiction	Nil	
HS30054	Introduction to Science Fiction	Nil	
SEMESTER – VII			
HS40151	Econometrics for Business Data Analysis	Nil	X
HS40153	Financial Economics	Nil	X
HS40155	Corporate Finance	Nil	X
HS40157	Employment, Employability and Growth	Nil	
SEMESTER – VIII			
HS40156	Public Economics	Nil	X
HS40158	Advanced Econometrics	Nil	X
HS47160	PROJECT	Nil	X
HS40162	Economic Inequality	Nil	

SEMESTER – VI			
Course Code	**Minor Courses**	**Pre-requisite**	**Minor in** Sustainable Development
CE30078	Municipal Solid Waste Management	Nil	
EE30032	Sustainable Energy and Applications	Nil	
HS30154	Poverty to Prosperity	Nil	X
EE30030	Solar Energy Utilization	Nil	
SEMESTER – VII			
CE40087	Clean Water & Sanitation	Nil	X
CE40065	Geo-Hazards Risk Management	Nil	X
EE40013	Wind and Biomass Energy	Nil	X
HS 40157	Employment, Employability and Growth	Nil	X
SEMESTER – VIII			
LS40002	Industrial Ecology and Design for Sustainability	Nil	X
EE40018	Waste Management and Energy Recovery	Nil	
HS40162	Economic Inequality	Nil	X

OPEN ELECTIVE COURSES OFFERD BY SCHOOL OF APPLIED SCIENCE

Theory							
Sl. No.	**Course Code**	**Subjects**	**L**	**T**	**P**	**Total**	**Credit**
1	MA30002	Advanced Numerical Techniques	3	0	0	3	3
2	CH40002	Composite Materials And Structures	3	0	0	3	3
3	MA40001	Finite Element Analysis	3	0	0	3	3
4	LS30002	Industrial Ecology And Design For Sustainability	3	0	0	3	3
5	PH40001	Quantum Computing	3	0	0	3	3
6	CH30002	Sustainable Energy And Environment	3	0	0	3	3
7	CH40001	Solid Waste Management	3	0	0	3	3

OPEN ELECTIVE COURSES OFFERD BY SCHOOL OF LAW

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	LW30910	Law of Patent	3	0	0	3	3
2	LW30904	Law of Contract	3	0	0	3	3
3	LW30908	Intellectual Property Rights Law	3	0	0	3	3
4	LW30914	Environmental Law	3	0	0	3	3
5	LW30918	Copyright Law	3	0	0	3	3
6	LW30920	Information Technology Law	3	0	0	3	3

OPEN ELECTIVE COURSE OFFERD BY SCHOOL OF PUBLIC HEALTH

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	PE30002	Health and Wellbeing	3	0	0	3	3

OPEN ELECTIVE COURSES OFFERD BY SCHOOLOF RURAL MANAGEMENT

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	RM30152	Sustainable Rural Development	3	0	0	3	3
2	RM20152	Food Security	3	0	0	3	3

OPEN ELECTIVE COURSES OFFERD BY SCHOOL OF MANAGEMENT

Sl. No.	Course Code	Subjects	L	T	P	Total	Credit
1	BM30102	Training and Development	3	0	0	3	3
2	BM30202	Financial Management	3	0	0	3	3
3	BM30302	Marketing Management	3	0	0	3	3
4	BM30602	Basics of Management Information System	3	0	0	3	3
5	BM30702	Entrepreneurship	3	0	0	3	3
6	BM30802	Production and Operations Management	3	0	0	3	3

Theory Subjects (1st year)

PHYSICS

Course Code :PH10001
Credit :3
L-T-P : 3-0-0
Prerequisite: Nil

COURSE OBJECTIVE

This subject is designed to enrich the basic knowledge of engineering students in the field of physics and to support the engineering and research programs. The subject will also help the students to develop mathematical models to understand the behavior of physical systems and phenomena.

COURSE OUTCOMES

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

CO1 :Learn the basic concepts of oscillation, waves, wave function and fields,
CO2 :Understand the principles of wave phenomena in light and matter, and the quantum mechanics,
CO3 :Apply the principles of oscillation, superposition of waves, electromagnetic theory, and quantum mechanics in different fields,
CO4 :Analyze different types of particle motion in different media,
CO5 :Evaluate the problem-solving skills for the topics learnt, and
CO6 :Develop critical thinking ability supported by the learned concepts of Physics.

COURSE CONTENT

Oscillation
Damped Harmonic Oscillation (underdamped, overdamped and critically damped), Energy decay, Relaxation time, Quality factor, Forced oscillation, Resonance, Coupled oscillations, Applications.

Waves and Interference
Wave equation, Superposition of waves, Interference of light, Types of interference: Division of wavefront and division of amplitude.

Interference in thin films
Wedge shaped thin film, Newton's rings and their applications, Michelson interferometer, Applications.

Diffraction
Diffraction and its applications, Types of diffraction, Fraunhofer diffraction by a single slit, Plane diffraction grating (condition of maxima, minima), Maximum order of observable spectra, Absent spectra, and Dispersive power, Applications.

Quantum Mechanics
Dual nature of radiation and matter, de Broglie hypothesis for matter waves, Phase velocity and Group velocity, Heisenberg's uncertainty principle and applications, Wave function and its interpretation, Concepts of operators, Schrodinger's time-dependent and time-independent equations, Postulates of Quantum mechanics, Particle in one-dimensional box and applications, Quantum tunnelling and applications.

Electromagnetic Theory
Vector calculus: scalar and vector field, Gradient, divergence and curl, Line, surface and volume integrals, Gauss divergence and Stoke's theorem, Maxwell's equations in differential and integral form with necessary derivations. Electromagnetic wave equations, Transverse nature of electromagnetic waves.

Laser and Fiber Optics
LASER: Properties and applications, Spontaneous and stimulated emission, Meta-stable state, Population inversion, Pumping, Three and four-level Laser, Ruby Laser.

Optical fiber
Principle, Construction, Types of optical fiber, Acceptance angle, Numerical aperture, Applications.

Text Book

1. B. K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Publication, New Delhi, 2nd Edition 2022, ISBN-13: 978-81-953536-7-5.

Reference Books

1. D J Griffiths, Introduction to Electrodynamics, Pearson Education, 4th Edition, 2015.
2. L. I. Schiff and J. Bandhyopadhyay, Quantum Mechanics, Tata McGraw-Hill Publications, 4th Edition, 2014, ISBN-9781259062865.
3. A K Ghatak, Optics, Tata McGraw-Hill Publications, 4th Edition, 2008, ISBN: 9780070262157.
4. A. Beiser, Concepts of Modern Physics ,Tata McGraw-Hill Publications, 6th Edition, 2002, ISBN 10: 0071234608.
5. R K Gaur and S. L. Gupta, Engineering Physics, Dhanpat Rai Publications, New Delhi, 2nd Edition, 2012, ISBN-10: 8189928228.

CHEMISTRY

Course Code : CH10001
Credit : 3
L-T-P :3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

This course is designed to enrich the students with the basic concepts in Chemistry and to strengthen their fundamentals which will support them to pursue education and research in engineering. The course will help the students to conceptualize alternative sources of energy by electrochemical means and use the instrumental techniques to explore chemical products.

COURSE OUTCOMES

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

CO1 : Rationalize bulk properties and processes using thermodynamic consideration and apply the knowledge to decide the feasibility of a given process,
CO2 : Analyze the kinetics of multistep reactions as well as the theories of reaction rates,
CO3 : Understand the importance of catalysis and their mechanism of action and applications,
CO4 : Apply the principles of electrochemistry to evaluate properties, such as pH, solubility Product, etc. and understand the working principle of modern batteries,
CO5 :Apply different spectroscopic techniques, such as UV-Vis, IR and NMR, for structural Elucidation, and
CO6 : Differentiate between smart and intelligent materials.

COURSE CONTENT

Chemical Equilibrium and Thermodynamics
Introduction, Internal energy, Enthalpy, Entropy and free energy, Dependence of free energy on temperature and pressure, Gibbs-Helmholtz equation, Free energy change and equilibrium constants, Van't Hoff isotherm and isochore, Clapeyron- Clausius equation, Partial molar properties, Chemical potential, and Gibbs-Duhem equation.

Chemical Kinetics
Rate of reaction and rate laws of multiple reactions (steady-state approximation), and of parallel, opposing and consecutive reactions; Theories of reaction rate: Collision theory, Lindemann modification, Absolute reaction rate; Catalysis: Types, theories, and kinetics of enzyme catalysis (Michaelis-Menten mechanism).

Spectroscopy
UV-Vis spectroscopy: Beer-Lamberts law, Types of transition, Concept of auxochrome and chromophores, Factors affecting λ_{max} and, Woodward-Fieser rules for calculation of λ_{max} in diene systems; IR spectroscopy: Types of vibration, Hooks law, detection of functional groups like C=C, -OH, -NH_2 and -C=O;

NMR Spectroscopy
Basics of NMR Spectroscopy: Theory, Chemical shift, Shilding-deshilding effect, Structural elucidation of simple compounds.

Electrochemical Energy Systems
Types of electrodes, electrode/cell potential; Nernst equation and application to: find electrode and cell potential, equilibrium constant, solubility product and pH; Modern batteries: Fuel cells (AFCs, PEMFs, SOFCs, MCFCs), Zn-air battery, Li-ion battery, Na-ion battery, Ni-MH battery.

Smart and Intelligent Materials
Introduction to smart materials, Properties and types of smart materials, Structures, System intelligence-components and classification of smart structures, Common smart materials and associated stimulus-response, Application areas of smart systems.

Text Book

1. S Chawala, Engineering Chemistry, Dhanpat Rai and Co, 4th Edition, ISBN: 9788177001938.

Reference Books

1. S Agarwal, Engineering Chemistry: Fundamentals and Applications, Cambridge University Press, ISBN: 9781107476417.
2. S. Chakroborty, S. Sen, and S. Mittal, Engineering Chemistry, Cengage Learning India Pvt. Ltd., ISBN: 9386668645.
3. B.R. Puri, L.R Sharma, and M. S. Pathania, Principles of Physical Chemistry, Vishal Publishing Co., 47th Edition, ISBN: 978-9382956013.
4. R M. Silverstein, Fransis X, Webster, D J Kiemle, Spectrometric Identification of Organic compounds, -Jhon Wiley& Sons, INC, 7th Edition.
5. S Glasstone, Elements of Physical chemistry-, Macmillan publishers, 2nd Edition ISBN: 978-0333038437.
6. D.J. Leo, Engineering Analysis of Smart Material Systems, Wiley 2007, 1st Edition ISBN: 978-0471684770.

ENVIRONMENTAL SCIENCE

Course Code :CH10003
Credit :2
L-T-P :2-0-0
Prerequisite :Nil

COURSE OBJECTIVE

This course is designed to create awareness in the students on monitoring, assessment, and management of environmental pollutants. The subject will also make the students aware of more benign chemistry, i.e.,green chemistry, and help them to understand the implementation of Environmental Impact Assessment (EIA).

COURSE OUTCOMES

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

CO1 : Understand the components and composition of the environment along with the radiation balance model,
CO2 : Rationalize the different types of pollutants, their sources, effects, and control measures,
CO3 : Develop the idea of water purification strategies,
CO4 : Identify toxic wastes and conceptualize the principles of solid waste management,
CO5 : Conceptualize the principles of green chemistry and implement them in the synthesis of advanced material, to reduce pollution, and
CO6 :Provide for Environmental Impact Assessment (EIA) requirements before planning a project.

COURSE CONTENT

Overview of the Environment

Overview of the environment, terminologies, Components of Earth: Lithosphere, atmosphere, hydrosphere and biosphere, Concept of black body radiation and albedo, eZro-dimensional energy balance model.

Air Pollution and Control

Primary and secondary air pollutants, CFC, Smog (oxidizing and reducing), Important environmental issues: Depletion of the ozone layer, Acid Rain, Greenhouse effect and global warming, Control measures: Baghouse filter, Cyclone separator, Electrostatic precipitator, Catalytic converter, and Scrubber.

Water Pollution and Control

Types and sources of water pollutants, wastewater treatment techniques: Ultrafiltration, aerobic and anaerobic treatment, Reverse osmosis, Electrodialysis, Ddisinfection by chlorination, Ozonization, Modern water purification system, Water quality parameters like hardness, Water softening process (permutit), WHO guidelines for drinking water.

Soil Pollution and Solid Waste Management

Soil pollution: Sources of pollutants and mitigation measures. Types of solid wastes: Heavy metal, bio-medical and radioactive wastes, Toxic and biochemical effects of solid wastes, Solid waste management (landfilling, incineration, and composting).

Green Chemistry and EIA

Basic principles of green chemistry with examples, Matrices to explain greenness, R^4M^4 model, life cycle analysis. Importance, scope and principles of EIA with a case study.

Text Book

1. A. K. De, Environmental Chemistry, New Age International Publishers, 9th Edition.

Reference Books

1. S. Chakroborty, D. Dave, and S. S. Katewa, Environmental Chemistry-, Cengage Learning India Pvt. Ltd., 1st Edition.
2. Aloka Debi,Environment Science and Engineering, Universities Press,2nd Edition.
3. Erach Bharucha, Textbook of Environment studies for undergraduate courses, Universities Press, 2nd Edition.
4. D. De and D. De, Fundamentals of Environment and Ecology, S. Chand &Co, 2013.
5. Jain and Jain, Engineering Chemistry, Dhanpat Rai,Publishing Company.
6. S.C. Santra, Environmental Science,New Central Book Agency, ISBN: 9788173814044.

DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA

Course Code :MA11001
Credit :4
L-T-P :3-1-0
Prerequisite :Nil

COURSE OBJECTIVE

The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equations and linear algebra. It aims to equip the students to tackle advanced level of mathematics and applications that they would find useful in their disciplines.
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COURSE OUTCOMES

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

CO1 : Understand the concept of modelling and formulation of Differential equation of physical problems,
CO2 : Apply different methods to solve ODE problems involving growth-decay, cooling effects and electrical circuits etc,

CO3 : Develop an ability to solve $2^{nd}$and higher order ODEs,
CO4 : Apply the knowledge of special function in engineering problems,
CO5 : Use the essential tool of matrices and linear algebra in a comprehensive manner, and
CO6 : Apply the knowledge of Eigen value and Eigen vector in the field of engineering and also get the concept of complex matrices.

COURSE CONTENT

Ordinary Differential Equations of First Order
Introduction and formation of differential equations, Overview: Variable separable, homogeneous, equations reducible to homogeneous form.Exact differential equations, equations reducible to exact form, linear differential equations, equations reducible to linear form (Bernoulli's equation). Applications of differential equations: Growth-Decay Problem, Newton's Law of Cooling, Mixing problem, Orthogonal trajectories.

Linear Differential Equations of second order
Second order linear homogeneous equations with constant coefficients; differential operators; solutions of homogeneous equations; Euler-Cauchy equation; linear dependence and independence; Wronskian; Solutions of non-homogeneous equations: general solution, complementary function, particular integral; solution by variation of parameters; undetermined coefficients. Applications of 2nd order differential equations in Electric circuit.

Special Functions
Improper Integrals for one variable, some test for convergence of improper integrals, Gamma function, Properties, Beta function, Relation between Gamma and Beta functions. Radius of convergence of power series, Legendre equation. Legendre polynomial. Recurrence relations and Orthogonality property of Legendre polynomial. Bessel's equation, Bessel's function, Recurrence relation.

System of Linear Equations and Vector Space
Linear system of equations; rank of matrix; consistency of linear systems; Solution of system of linear equations: Gauss elimination, inverse of a matrix by Gauss Jordan method, Vector Space, Sub-space, Basis and dimension, linear dependence and independence, Linear transformation.

Matrix-Eigen value problems
Eigen values, Eigen vectors, Eigen basis, quadratic form; Hermitian, Skew-Hermitian forms; similar matrices; Diagonalization of matrices.

Text Book

1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley INC, 10th Edition,2011.

Reference Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition.
2. H.K. Das, Introduction to Engineering Mathematics, S.Chand & Co Ltd, 11th Edition.
3. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publications 2007.
4. J. Sinha Roy and S. Padhy, A course on ordinary & partial differential Equation, Kalyani Publication, 3rd Edition.

TRANSFORM CALCULUS AND NUMERICAL ANALYSIS

Course Code :MA11002
Credit :4
L-T-P :3-1-0
Prerequisite :Nil

COURSE OBJECTIVE

The objective of this course is to familiarize the students with the methods of Laplace and Fourier transformation and various numerical techniques to solve engineering problems.

COURSE OUTCOMES

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

CO1 : Apply Laplace Transform to problems in the field of science and engineering,
CO2 : Use Fourier series and Transform as a tool to solve differential equations,
CO3 : Estimate the error in the results obtained in the numerical methods,
CO4 : Solve nonlinear equations that arise in engineering problems and interpolation,
CO5 : Know various numerical methods of differentiation and integration, and
CO6 :Apply numerical solution of differential equations and systems of linear equations.

COURSE CONTENT

Laplace Transforms
Laplace Transform, Inverse Laplace Transform, Linearity, Transform of derivatives and integrals, Unit Step function, Dirac delta function, Second shifting theorem, Differentiation and integration of transforms, Convolution, Solution of ODEs and integral equation by Laplace transform.
Fourier Series and Transform: Fourier series, Arbitrary periods, Even and odd functions, Half range expansions, Fourier integral, Cosine and sine transforms, Fourier Transform, Inverse Fourier Transform, Linearity, Fourier Transform of derivative, Convolution.

Approximations & Errors
Approximation of numbers by truncation and rounding-off, Types of errors.
Numerical solution of Nonlinear equations: Solutions by Bisection Method, Fixed Point Iteration Method, Newton-Raphson Method, Regula-Falsi and Secant Method, Rate of Convergence of Secant & Newton-Raphson Method.

Interpolation & Approximation Finite Differences, Operators and Relation between them. Interpolation: Newton's forward and backward difference interpolation, Newton's divided difference interpolation and Lagrange interpolation.

Numerical Differentiation & Integration: Numerical differentiation of first- and second-order equations using difference table. Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules, Gauss-Legendre's two-point and three -point formulae. Error in Numerical Integration.

Numerical Solution to ODE
Taylor's (OK?) series Method, Euler's Method, Modified Euler's Method, Runge-Kutta Methods of order 2 and 4, Reduction of second-order ODE to system of first-order ODEs and its solution by R-K method of order four.
Solution of System of Linear Equations,Solutions by Gauss-Seidel and Gauss-Jacobi methods.

Text Books

1. E Kreyszig,Advanced Engineering Mathematics by Wiley, INC, 10^{th} Edition.
2. Jain, Iyenger and Jain, Numerical Methods for Scientific and Engineering Computation, New age International (P) Ltd., 6^{th} Edition.

Reference Books

1. B.S. Grewal, Khanna ,Higher Engineering Mathematics, Publishers, 44^{th} Edition.
2. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publications, 2007.
3. A, Thangapandi and Somasundaram, Numerical Methods, Scitech Publishers, 2^{nd} Edition.

SCIENCE OF LIVING SYSTEMS

Course Code :LS10001
Credit :2
L- T-P :2-0-0
Prerequisite :Nil

COURSE OBJECTIVE

The objective of the course is to enrich the basic knowledge of students in the field of biology and use that knowledge to support the engineering and research programs. Besides, the course also helps to learn methodology to establish models for various biological phenomena and apply the aforementioned models to predict/analyse the functionality of various systems.

COURSE OUTCOMES

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

CO1 : Learn the typical characteristics that distinguish life forms and analyze life process at cellular level,
CO2 : Apply concepts on structure and function of simple biomolecules in life processes
CO3 : Understand different process involved in life and analyse their effects,
CO4 : Analyse different biological phenomena and relate them to engineering applications,
CO5 : Comprehend different physiological functions and relate them to computer-based techniques, and
CO6 : Implement concepts of biology and their relevance to engineering and technology.

COURSE CONTENT

Cellular Organization of a Living Organism
Biology in engineering, The Living World: Biodiversity of living world, Microorganisms, Cell as the basic unit of life, Cell theory, Structure and function of Prokaryotic and Eukaryotic cells, Cell growth and reproduction, Homeostasis, Concept of gene, Basic structure and function of chromosomes.

Molecular and Biochemical Basis of an Organism
Chemical Context of Life: Water, Carbon, Structure and Function, Types of bonding, Bio-macromolecules (Carbohydrates, Proteins, Amino acids, Lipids and Nucleic acids), Protein synthesis, Cell differentiation, Stem cells and their applications.

Enzymes, Photosynthesis, Metabolism and Bioenergetics
Enzymes: Introduction, structure, properties, Classification, Mechanism of enzyme actions, Factors affecting enzyme action, Strategies utilized by enzymes to affect catalysis. Photosynthesis: Introduction, pigments, process of photosynthesis, Mechanism of photosynthesis (light reaction and dark reaction). Metabolism and Bioenergetics: Anabolism and catabolism.

Nervous system, Immune system and Cell Signaling
Nervous system: Introduction, History of neuroscience, Types of glial cells, Nerve cells - Neurons, Organization of the nervous system, Action potential, Diseases of the nervous system, Computer-based Neural Networks. Immune system: Introduction, Innate Immunity, Adaptive or acquired immunity, Diseases of the immune system, Immune engineering. Cell signaling: General principles of cell signaling.

Molecular Machines, Biosensor and Bioremediation
Molecular Machines: Introduction, Molecular motors and Machines, F0F1-ATP synthase motors, Cytoskeleton associated motors. Biosensors: Concept of biosensor, Working principle, Types of biosensors, Glucose biosensors, Bio-detectors: DNA detection biosensor, Detection of pollutants, Biosensor in food industry. Bioremediation: Introduction, Role of microorganisms, Factors determining bioremediation, Types – *in situ/ex situ,* Advantages and disadvantages, Biofuel.

Text Book

1. S. Thyagarajan, N. Selvamurugan, M.P Rajesh, R.A Nazeer, Richard W. Thilagarajan, S. Bharathi and M.K. Jaganathan, Biology for Engineers, McGraw Hill Education (India),7thEdition, 2022.

Reference Books

1. P. H. Raven and G.B. Johnson. Biology (Indian Edition), Tata McGraw Hill Education Publication,13th Edition, 2023.
2. E D. Enger, Feederick C, Ross and David B. Bailey. Concepts of Biology,Tata McGraw-Hill Publication, 14th Edition, 2011.
3. Neil A. Campbell and Jane B. Recee, Biology, Pearson Education, 8th Edition , December 2007.
4. Cecie Starr, Biology Concepts and Application, Thomson Books, 6th Edition, January 2006.

ENGLISH

Course Code : HS10001
Credit :2
L-T-P :2-0-0
Prerequisite :Nil

COURSE OBJECTIVE

The objective of the course is to develop and improve, in the students, the skills of active listening, speaking, reading, and writing in English, through lecture classes and practice sessions, and improve their professional communication abilities. The course will help the students to enhance their critical thinking and situational communicative skills through the study of contemporary social issues depicted in literature.

COURSE OUTCOMES
After successfully completing the course, the students will be able to
CO1 : Apply verbal and non-verbal modes of communication effectively in practical Situations,
CO2 : Retain a grammatically correct and logical flow while drafting reports and other technical pieces of writing,
CO3 : Develop competence in reading and comprehension,
CO4 :Implement active listening responses in professional practice,
CO5 :Utilize neutral accent in English pronunciation successfully,
CO6 :Understand situational and conversational English used for different purposes and contents.

COURSE CONTENT

Professional Communication

Process of Communication: Definition, Explanation & Diagram, Difference Between General and Technical Communication; Methods of Communication (Verbal & Non-Verbal); Non-Verbal Communication (Kinesics, Proxemics, Chronemics, Oculesics, Olfactics, Gustorics, Haptics, and Iconics); Paralanguage; Flow of Communication (Formal & Informal); Levels of Communication; and Barriers of Communication (Intrapersonal, Interpersonal, and Organizational).

Basics of Grammar and Writing Skills

Error Detection in Sentences: Articles, Prepositions, Tense, Subject-Verb Agreement, Active and Passive Voice; Use of Punctuation: Full Stop, Comma, Colon, Semi-colon, Single & Double Inverted Commas, Exclamation & Interrogation Marks, Hyphens and Dashes, and Ampersand;
Paragraph Writing – Components; Writing Bias-free English; Business Letters: Enquiry, Claim/Complaint, and Order; Technical Reports: Formats, Style & Referencing; and Reading Techniques: Skimming, Scanning, Intensive & Extensive Reading.

Basic Sounds of English

Hearing & Listening: Types of Listening – Appreciative, Empathetic, Critical, Comprehensive, Superficial, Differences between Listening & Hearing; Introduction to Basic Sounds of IPA: Symbols of IPA, Types of Vowels & Consonants; and Problem Sounds & Mother Tongue Influence: Concept of MTI with Examples.

English Literature

Short Story – O. Henry: 'Gift of the Magi;'Short Story – Ismat Chughtai: 'Sacred Duty;'; Poem – Robert Frost: 'Stopping by Woods on a Snowy Evening;'Poem – Tennessee Williams: 'We Have Not Long to Love;' and Drama: William Shakespeare: Merchant of Venice.

Text Book

1. M. Ashraf Rizvi, Effective Technical Communication, Tata McGraw Hill Education Publication, 2005.

Reference Books

1. Sidney Greenbaum. The Oxford Grammar (English). Oxford University Press, 1st Edition. 2005.
2. S Verma,Technical Communication for Engineers, Vikas Publishing House,2015.
3. R Dove,The Penguin Anthology of 20th Century American Poetry,Penguin Books. 2013.
4. The Merchant of Venice (The New Cambridge Shakespeare). Mahood & Lockwood eds. CUP. 2018.

BASIC ELECTRONICS

Course Code :EC10001
Credit :2
L-T- P :2- 0- 0
Prerequisite :Nil

COURSE OBJECTIVE

The subject is designed to familiarize students of all branches to the all-pervasive field of Electronics, enable them to carry out research in interdisciplinary fields involving semiconductor devices, and utilize the knowledge in solving practical problems in real life in today's age of electronics.

COURSE OUTCOMES

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

CO1 :Understand the properties of semiconductor and current conduction mechanism,
CO2 :Comprehend the working of P-N junction diodes; identify different diode circuits and analyze them,
CO3 :Understand the working of different types of transistors,
CO4 : Know about OP-AMP and its applications,
CO5 : Analyze the working of op-amp using either inverting or non-inverting configurations, timing circuit, regulated power supply ICs, and their applications,
CO6 : Realize the importance of various analog and digital electronic systems and electronic devices.

COURSE CONTENT

Semiconductors, Diodes and Transistors

Properties of semiconductor materials, Applications of semiconductors as p-n junction diode, Diode characteristics and breakdown mechanisms, Half-wave and full-wave rectifiers with filters, Zener diode, Transistor constructions, operations and their characteristics. Transistor biasing, amplifiers, and load line analysis, Concepts of JFET and MOSFET.

Operational Amplifier (Op-amp) and applications

Introduction to Op-amp and its Characteristics. Application of Op-Amp as Inverting amplifier, Non-inverting Amplifier, Summing, Difference amplifier and comparator

Introduction to Digital Electronics

Different number systems and its conversions, Logic gates and truth tables of OR, AND, NAND, EX-OR. Combinational circuit and Sequential circuit.

Miscellaneous Electronic Devices

SCR, Opto-electronic devices and fiber techniques, Introduction and description of sensor performance, Fundamentals of analog communication techniques (AM and FM).

Text Book

1. J Millman, Christos C. Halkias & C D. Parikh, Integrated Electronics: Analog and digital circuits and Systems , 9th Edition, 2021.

Reference Books

1. R. L. Boylestad & L. Nashelsky, Electronic Devices & Circuits,PHI,7th Edition,2021
2. D. A. Bell. Electronic Devices and Circuits.(Oxford)5th Edition,2021.
3. D. Chattopadhyay and P. C. Rakshit. Fundamentals & Applications ,New Age International, 15th Edition 2021.

Laboratory and Sessional Subjects (1st Year)

PHYSICS LABORATORY

Course Code : PH19001
Credit : 1
L- T-P : 0-0-2
Prerequisite : Nil

COURSE OBJECTIVE

This lab course covers different measurement techniques of various parameters using the instruments i.e. interferometer, spectrometer, spherometer, screw gauge, vernier calliper, microscope, and telescope. It includes the application of photoelectric effect and photovoltaic effect in photo cell and solar cell respectively. Evaluation of the mechanical strength of materials by calculating elastic constants such as Young's modulus, rigidity modulus and Poisson's ratio are also included. This course provides hands on training for the usage of electrical, optical and mechanical systems for various measurements with precision and analysis of the experimental data by graphical interpretation and error calculation.

COURSE OUTCOMES

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

CO1 : Understand the wave nature of light through experiments based on interference and diffraction Phenomena,
CO2 : Apply the laws of quantum physics to understand the photoelectric emission using the particle nature of light,
CO3 : Characterize photovoltaic cells to find out efficiency in terms of power output,
CO4 : Evaluate mechanical properties of materials using their elastic properties,
CO5 : Apply the principles of optics such as refraction, total internal reflection to calculate refractive index and related parameters,and
CO6 : Use the principles of oscillation to understand phenomena such as damping, resonance and to determine the factors (such as gravity, elasticity etc) affecting the time period of various oscillators.

COURSE CONTENT
Topics

- Measurement by vernier callipers, screw gauge, spherometer: A review
- Determination of wavelength (λ) of a monochromatic light by Newton's ring experiment.
- Determination of wavelength (λ) and difference (dλ) between wavelengths of sodium D-lines by Michelson's interferometer.
- Determination of grating element (e+d) of a plane diffraction grating.
- Determination of Planck's constant using photocell.
- Study of the characteristics of a photo cell.
- Study of the characteristics of a solar cell.

- Determination of Young's modulus (Y) of a material by bending of beam method.
- Determination of Poisson's ratio (σ) of rubber.
- Determination of rigidity modulus (η) of a material by dynamic method.
- Determination of refractive index (μ) of a transparent liquid by Boy's method.
- Determination of numerical aperture of optical fibre.
- Determination of acceleration due to gravity (g) by bar pendulum.
- Determination of damping coefficient, relaxation time and quality factor of damped harmonic oscillation by simple pendulum.
- Measurement of velocity of sound in air using resonance column method.
- Studies on dielectric/multi-ferroic materials (Open ended)
- Diffraction studies using Laser sources (Open ended)

Reference Materials

1. Physics laboratory instruction manual, School of Applied Sciences, Department of Physics, KIIT Deemed to be University, Bhubaneswar.
2. S. L. Gupta and V. Kumar, 2018, Practical Physics, Pragati Prakashan, 33rd Edition, ISBN: 978-93-87151-58-1.

CHEMISTRY LABORATORY

Course Code : CH19001
Credit : 1
L-T-P : 0-0-2
Prerequisite : Nil

COURSE OBJECTIVE

This lab course covers different types of chemical experiments ranging from volumetric analysis to spectroscopic techniques. This course provides the students with hands-on training in many of the advanced spectroscopic and analytical techniques in chemistry. The experiments in the course span over diverse applications in chemistry. It contains experiments dealing with environmental chemistry, volumetric analysis, organic and inorganic synthesis, electrochemistry, and spectroscopy.

COURSE OUTCOMES

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

CO 1 : Handle different chemicals with proper safety protocols in an advanced Chemistry laboratory,
CO 2 :Learn and apply basic techniques used in Chemistry laboratory for preparation, purification and identification,
CO 3 : Analyze the kinetics of 1st order reactions and estimate the rate constant,
CO 4 : Use different instrumental techniques such as Conductometry, pH-metry, Potentiometry and Colorimetry,
CO 5 : Analyse basic water quality parameters like hardness, dissolved oxygen, alkalinity, chloride, ferrous iron contents etc,and
CO 6 : Rationalize and learn the spectroscopic and synthesis techniques in chemistry.

COURSE CONTENT
Topics

- Estimation of total hardness in a given water sample in terms of calcium and magnesium hardness by EDTA method.
- Estimation of the amount of NaOH and Na_2CO_3 present in a given mixture solution
- (a) Determination of the strength of $KMnO_4$ solution by using standard sodium oxalate solution. (b) Determination of the amount of Ferrous (Fe^{2+}) ions present in the Mohr's salt solution by using standard $KMnO_4$ solution.
- Determination of the amount of dissolved oxygen present in a given water sample by Winkler's method.
- Finding the strength of Fe^{2+} present in the supplied Mohr's salt solution by potentiometric titration.
- Determination of the rate constant of acid-catalyzed hydrolysis of ethyl acetate.
- Determination of the chloride ion (Cl^-) present in a given water sample by the argentometric method.
- Finding the strength of supplied acid by pH-metric titration against a standard alkali.
- Finding the strength of a given hydrochloric acid solution by titrating it against standard sodium hydroxide solution conducto-metrically.
- Verification of Beer Lambert's Law and application of this law to determine the unknown concentration of a given solution.
- Determination of the concentration of ferric ions (Fe^{3+}) in a given water sample by a spectrometric method using KCNS as color developing agent.
- Determination of the Isoelectric point (pI) of glycine amino acid.
- Synthesis of transition metal complexes and characterization by using IR and ^{1}H-NMR. (Open ended)
- Determination of the concentration of different ions (cations and anions) in a given water sample by colorimetry. (Open ended).
- Application of potentiometric titrations (Open ended).

Reference Materials

1. Chemistry laboratory Instruction manual, School of Applied Sciences, KIIT Deemed to be University
2. Vogel's Quantitative Chemical Analysis, J. Mendham, R.C. Denney J. D. Barnes, M.J.K. Thomas, 6th Edition, Longman
3. Standard methods for examination of water and wastewater, 23rd Edition, APHA.

COMMUNICATION LABORATORY

Course Code : HS18001
Credit : 1
L-T-P : 0-0-2
Prerequisite : NIL

COURSE OBJECTIVE
This subject is designed to enrich the basic knowledge of engineering students in the field of communication and to support the engineering and research programs.

COURSE OUTCOMES

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

CO1 : Use English grammar correctly and unambiguously in technical writing,
CO2 : Apply verbal and non-verbal modes of communication effectively in practical situations,
CO3 : Have a basic understanding of the communication process and to know the practical implementations in the workplace,
CO4 : Retain a logical flow while drafting reports and other technical pieces of writing,
CO5 : Develop competence in reading and comprehension, and
CO6 : Be familiar with English pronunciation and use neutral accent successfully.

COURSE CONTENT

Reading Comprehension

Understanding meaning and sequence of ideas in written language
Activity based on matching, multiple choice questions, open close, appropriate headings.

Time & Tense + Subject-Verb Agreement
Applying correct grammar in everyday writings.

Vocabulary Building (Mind Mapping/PhrasalVerbs)
Developing vocabulary through associating key ideas, and learning idioms and phrases.

Listening Comprehension
Interpreting meaning and syntax in spoken language.

E-mailWriting
Formulating appropriate e-mails with relevant salutation, language &conclusion

Resume Writing/ Video Resume
Creating suitable, job-orientedresume

Thematic Speaking:
Practising and implementing theme-based individual speaking skills.
Power Point Presentation
Developing skills to design and deliver engaging, informative and impactful presentations
Class Participation.

WORKSHOP

Course Code : ME18001
Credit : 1
L-T-P : 0-0-2
Prerequisite(s) : Nil

COURSE OBJECTIVE

This workshop practice is designed to impart students the basic knowledge on manufacturing or developing a given object irrespective of their branch of engineering. While furnishing the given object, students will familiar with various mechanical operations and the respective tools or machines. This course involves four different sections namely Fitting, Welding, Turning and Sheet metal which cover both conventional and advanced tools to provide students the updated manufacturing experience. Students are also advised with various safety precautions to be followed during a specific manufacturing practice. At the end, students will also gain knowledge on different advanced machines such as CNC machine tools and 3D printing.

COURSE OUTCOMES

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

CO1 : Practice different operations related to fitting shop,
CO2 : Use different welding tools to prepare a given type of joint,
CO3 : Demonstrate various turning operations including taper turning and knurling using a conventional lathe machine,
CO4 : Design a tray and prepare it using sheet metal equipment involving soldering,
CO5 : Appraise different operations using a CNC machines,and
CO6 : Interpret different advanced machines such as 3D printing/additive manufacturing.

COURSE CONTENT

Topics

- Turning operations
- Sheet metal operations
- Fitting
- Welding

ENGINEERING DRAWING & GRAPHICS

Course Code : CE18001
Credit : 1
L T P : 0 0 2
Prerequisite : Nil

COURSE OBJECTIVE

The objective of this course is to provide students with knowledge and abilities to design a 3D object on 2D paper by hand sketching method and by means of computer aided drafting software.

COURSE OUTCOMES

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

CO1 : Use common drafting tools properly,
CO2 : Select, construct and interpret appropriate drawing scale as per the situation,
CO3 : Draw orthographic projections of points, lines and planes,
CO4 : Draw orthographic projection of solids like cylinders, cones, prisms and pyramids,
CO5 : Develop the section of solids for practical situations, and
CO6 : Communicate ideas effectively using Computer Aided Drafting.

COURSE CONTENT
Topics

- Introduction to Engineering graphics
- Lettering
- Projection of points & lines
- Line inclined to both the planes
- Projection of planes
- Introduction to Computer Aided Drafting
- Projection of solids
- Section of solids
- Development of surface

Textbook

1. K. Venugopal,Engineering Drawing + AutoCAD New Age Publishers, 1st Edition, 2011.

Reference Book

1. S. N. Lal Engineering Drawing with an Introduction to AutoCAD, Cengage India Private Limited, 1st Edition, 2017.

PROGRAMMING LABORATORY

Course Code :CS13001
Credit : 4
L-T-P : 0-2-4
Prerequisite(s) :Nil

COURSE OBJECTIVE

The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves lab component which is designed to give the student hands-on experience with the concepts.

COURSE OUTCOMES

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

CO1 : Have fundamental knowledge of computers hardware and number systems withcommands in Linux,
CO2 : Write, compile and debug programs in C language.
CO3 : Design programs involving decision structures, loops, and functions.
CO4 : Construct arrays to store, manipulate, search and display data.
CO5 : Apply the dynamics of memory by the use of pointers.
CO6 : Use different data structures and create/update basic data files.

COURSE CONTENT
Topics

- Basic linux commands
- Operators and Expressions
- Branching statements (if-else, switch).
- Control statements (looping - for, while, do-while).
- Arrays
- Character Arrays (strings).
- Functions.
- Pointers and Dynamic Memory Allocation.
- Structures and Unions
- File Handling

SCIENCE ELECTIVE

NANOSCIENCE

Course Code :CH10005
Credit :2
L-T-P :2-0-0
Prerequisite :Nil

COURSE OBJECTIVE

This course is designed to educate, inspire, and motivate young students about nanoscience, nanotechnology, and their applications. The course provides information on the latest innovations in this field to get insights into the nanomaterials synthesis/fabrication and applications that can be achieved at a nanoscale.

COURSE OUTCOMES

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

CO1 : Learn fundamental aspects of nanoscience,
CO2 : Classify different types of nanomaterials based on their dimension and composition
CO3 : Understand different synthesis techniques to grow nanomaterials,
CO4 : Analyse nanomaterials using different characterisation techniques,
CO5 : Apply the acquired knowledge to design new materials, and
CO6 : Evaluate the importance of nanoscience in engineering applications.

COURSE CONTENT

Introduction

Concept and Classifications based on dimensions and compositions, Significance of nanosize: Surface area to volume changes; Properties changing with size (reactivity, melting point, catalytic, electrical, optical),Nanoscience in nature,and Quantum dots as data storage.

Synthesis of nanomaterials

Top-down synthesis (Mechanical method-ball milling, Photolithography, Laser ablation, sputtering), Bottom up (pyrolysis, sol-gel, CVD, self-assembly), Green synthesis (metallic nanoparticles, metal oxides), Biosynthesis.

Characterization

XRD-X-ray generation, Working principle (Bragg's law), Peak broadening in nanomaterials (Scherrer formula), Electron microscopy (SEM, TEM)—high energy electron generation, electron optics, Scanning Electron Microscopy (SEM)—secondary, back scattered, EDX, Transmission Electron Microscopy (TEM)—bright field imaging, dark field imaging, and Selected area diffraction pattern.

Applications

Cosmetics—ZnO, SiO_2, TiO_2 Nanoparticles in cosmetics, SiO_2 TiO_2 in toothpaste, silver, gold, copper nanoparticles in skin care product; *Medical Fields*—MRI, CT scan contrast enhancement agent, Drug and gene delivery system, Magnetic hyperthermia treatment; *Agriculture*—Nano-pesticides, herbicides, and fungicides, Food packaging; *Aerospace and Aviation Industries*—Carbon nanotubes (CNT)nanocomposites, Metal Nanoparticle-Polymer composites, SiC Nanoparticle reinforced alumina (high temperature strength, creep resistance); and *Nanomaterials for Environmental Remediation*—Degradation/removal of pollutants.

Text Book

1. B S Murty, P Shankar, Baldev Raj, B B Rath and James Murday,Textbook of Nanoscience and Nanotechnology, 1st Edition, 2012, ISBN-13: 978-8173717383.

Reference Books

1. Luisa Filipponi and Duncan Sutherland.,Nanotechnologies: Principles, Applications, Implications and Hands-on Activities, Edited by the European Commission Directorate-General for Research and Innovation Industrial technologies (NMP) program, 2012, ISBN: 978-92-79-21437-0.
2. Charles P. Poole Jr., Frank J. Owens., Introduction to Nanoscience and Nanotechnology, An Indian Adaptation,3rd Edition, 2020, ISBN-13: 978-9354240201.
3. P. I. Varghese, T. Pradeep. A Textbook of Nanoscience and Nanotechnology,Tata McGraw Hill Education, 2017, ISBN: 9781259007323.

SMART MATERIALS

Course Code :PH10003
Credit :2
L-T-P :2-0-0
Prerequisite :Nil

COURSE OBJECTIVE

This course is designed with the objective of enabling engineering students to get a flavour of advances in materials science. The knowledge of smart materials learnt by the students in the course will let them to realize the usefulness of various new-age materials for technological advances and allow them to explore further in their higher semesters. This course will help them bridge the gap between traditional text book science put into physics, chemistry, etc. and the state-of-the-art science of materials.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO1 : Learn about smart materials, their properties and applications,
CO2 : Understand types of smart material based on their electrical and magnetic properties,
CO3 : Characterize piezoelectric,ferroelectric and multiferroic materials,
CO4 : Identify novel functions of smart materials,
CO5 : Apply the acquired knowledge of smart materials in different applications, and
CO6 : Evaluate the importance of smart materials in day-to-day life.

COURSE CONTENT

Introduction to Smart Materials

common smart materials and associated stimulus-response, Classification: active and passive, Piezoelectric, Shape-memory alloys, Photo-responsive polymers, Electroactive polymers, Magnetostriction and Electro-strictriction, Thermo-responsive polymers, Dielectric elastomers, Halochromic, Thermoelectric materials; Application areas of smart materials: Space, health care and biomedical sectors.

Piezoelectric Materials: Piezoelectric Effect

Direct and Converse, Piezoelectric coefficients, Piezoceramics, Piezopolymers, Piezoelectric Materials as Sensors, Actuators etc.

Shape-memory Alloys

Shape memory alloys (SMAs) and properties, Phase change in SMAs, Shape memory effect: One-way and two-way, binary, and ternary alloy systems, Applications.

Chromic Materials

Photochromic, Thermochromic, Electrochromic, Magneto-chromic and Piezo-chromic Materials.

Multiferroic Materials

Multiferroics definitions, Ferroic phases, Magnetoelectric coupling; Type-I and Type-II multiferroics, Mechanism: Charge ordering, lone pair, geometric effect, and spin driven mechanism; Multiferroic materials, Applications.

Text Book

1. B. K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Publication, New Delhi, 2nd Edition 2022, ISBN-13: 978-81-953536-7-5.

Reference Books

1. Mohsen Shahinpoor, Fundamentals of Smart Materials, 2020, Royal Society of Chemistry, ISBN**:** 9781782626459.

2. M. Schwartz, Smart Materials, 1st Edition, 2008, CRC Press, ISBN 9781420043723.

MOLECULAR DIAGNOSTICS

Course Code :LS10003
Credit : 2
L-T-P :2- 0-0
Prerequisite :Nil

COURSE OBJECTIVE

The objective of the course is to understand methods and techniques that are used to study biological processes in living beings. They include experimental and methodological approaches, protocols and tools for biological research.

COURSE OUTCOMES

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

CO1 : Learn the basics of Genes, Chromosomes, DNA, RNA and proteins along with their Aberrations,
CO2 : Understand the principles and working mechanisms of various instruments used in the study of biological processes in living things,
CO3 : Apply the knowledge of different diagnostics methods for quantitative estimation of xenobiotics (drugs and their metabolites) and biotics (proteins, DNA, metabolites) in biological systems,
CO4 : Analyze the recent developed techniques which are required for gene editing and their Applications,
CO5 : Evaluate the role of various bio-analytical techniques in environmental studies, biomedical sciences, life sciences, molecular biology, and biotechnological research, and
CO6 : Implement the knowledge of diagnostics in designing point-of-care instruments for different diseases.

COURSE CONTENT

Biomolecules
Overview of DNA, RNA, and Proteins, Chromosomal structure & mutations, DNA polymorphisms; and Gene and Genetic errors.

Molecular Basis of Diseases
Infectious, non-infectious; Diagnosis- traditional, modern tools, Concepts of molecular diagnostics.

Molecular Diagnosis and Techniques
DNA fingerprinting, Auto-antibody fingerprinting, Southern blotting, PCR, Real-time PCR and variations; Nucleic acid sequencing: New generations of automated sequencers, CRISPR technology and its use in diagnostics and gene editing.

Protein Diagnostics Techniques
Antigen-antibody reactions, ELISA, variations of ELISA; Western blotting.

Point-of-Care Devices
Biosensors and nano-biosensors for disease and metabollites detection.

Text Book

1. M K. Campbell, S O. Farrell, O M. McDougal, AE Biochemistry, Cengage Publisher,9th Edition 2017, ISBN-13: 9789814846448.

Reference Books

1. N Rifai, Andrea Rita Horvath and Carl T. Wittwer, Principles and Applications of Molecular Diagnostics,2018, Elsevier Publisher, 1st Edition, 2018.
2. K G Ramawat & Shaily Goyal, Molecular Biology and Biotechnology, ISBN9788121935128 Publisher S Chand & Co., 2nd Edition, 2010.
3. H Lodish, Arnold Ber, Molecular Cell Biology, WH Freeman Publisher, 8th Edition, 2016, ISBN-10 9781464187445.

SCIENCE OF PUBLIC HEALTH

Course Code :PE10002
Credit :2
L-T-P :2-0-0
Prerequisite :Nil

COURSE OBJECTIVE

The objective of this course is to orient the students to core scientific disciplines in public health practice.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO1 : Understand and enlist the scientific approaches in public health,
CO2 : Understand and apply the epidemiologic and biostatistical science in evidence synthesis,
CO3 : Understand and apply the environmental health science in public health practice,
CO4 : Understand and apply the social and behavioral science in public health practice,
CO5 : Understand and apply the health economic and health management principles in setting priority for resource allocation, and
CO6 : Understand and apply the health economic and health management principles in health system optimization.

COURSE CONTENT

Scientific Approaches to Public Health
Health and public health concepts, Science and practice of applied public health: Scientific disciplines as part of interdisciplinary public health, Examples of use of behavioral model in changing the community perception of public health interventions

Social and Behavioral Sciences in Public Health
Social and behavioral determinants of health and disease, WHO and CDC models of social determinants of health, Disease and social status, Disease and poverty, Social interventions for good health.

Health behavior change models for public health interventions, Health Belief Model, Transtheoretical Model. The theory of planned behavior, Health communication to improve the outcome of public health interventions

Environment Health Sciences in Public Health
Environment & climate change, Ecosystem, Lifestyle anddietary effects on health, food safety and sanitation, Environmental pollution, waste disposal andtreatment.

Epidemiology and Data Science in Public Health
Epidemiology and achievements in public health, Measurements in Epidemiology—Incidence and prevalence, Causation and association, and Measures of association.

Outline of study designs (including cross-sectional study design, case-control study design, cohort study design and randomized control trials); Introduction to confounding and bias; Screening tests- validity and reliability methods.

Management and Economic Sciences in Public Health

Systems approach (input, process and outcome) in public health. Health management information system, Horizontal and vertical integration of public health interventions, Public-Private mix.

Understanding community, Community health related needs assessment, Community orientation and Community mobilization, Introduction to digital health.

Text Books

1. R Detal, Oxford Textbook of Global Public Health, Oxford, 7th Edition, 2021.
2. K Parks, Textbook of Preventive and Social Medicine, M/S Banarsidas Bhanot Publishers, . 26th Edition, 2021.

Reference Books

1. Robert H. Friis,. Essentials of Environmental Health, Jones & Bartlett Publishers, 2018
2. Warrier S,. InformationandCommunicationTechnologiesin PublicHealthASociologicalStudy,CBS Publishers,2020.
3. BakerJJ.BakerRW,DworkinNR, HealthCareFinance:BasicToolsforNon-financialManagers., JonesandBartlettPublishers,Inc,5thedition.2017.
4. RossTK, PracticalBudgetingForHealthCare:AConciseGuide, JonesandBartlettPublishers,Inc,2020.

OPTIMIZATION TECHNIQUES

Course Code :MA10003
Credit :2
L-T- P :2-0-0
Prerequisite :Nil

COURSE OBJECTIVE

To familiarise the students with a few rudimentary and popular optimization techniques to enable them to solve resource-constrained real world problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO1 :Know the concept of Linear programming problem (LPP) and will able to formulate linear programming problem,
CO2 :Understand the basic terminology and concepts of solving LPP,
CO3 :Solve LPP by simplex method,
CO4 :Know the concept of duality in Optimization technique,
CO5 :Apply optimization technique to solve transportation problem, and
CO6 :Solve assignment problem.

COURSE CONTENT

Linear Programming
Mathematical foundations and basic definitions, Linear optimization: Formulation and graphical solution of linear programming problems, Simplex method, Duality.

Transportation:
General structure of a transportation problem, Finding initial basic feasible solution by North-West corner rule, Least-Cost method and Vogel's Approximation Method, and Testing for optimality.

Assignment Problem
Hungarian assignment method, Unbalanced assignment problems, Restrictions in assignment, Travelling Salesman model.

Text Book

1. H.A. Taha, Operation Research, An Introduction, Pearson Education, 10th Edition.

Reference Books

1. K. Gupta, Kanti Swarup, and Man Mohan .,Operations Research, P., S.Chand &Co, 2004.
2. N. S. Kambo, Mathematical Programming Techniques.,East West Press, 1997.
3. R. Fletcher., Practical Methods of Optimization, 2nd Ed., John Wiley, 1987.
4. Hanif D, Sherali, M. S. Bazarra. & J.J. Jarvis, Linear Programming and Network Flows, Wiley Publication. 2nd Edition.

ENGINERING ELECTIVE I

BASIC CIVIL ENGINEERING

Course Code :CE10001
Credit :2
L-T-P :2 0 0
Prerequisite :Nil

COURSE OBJECTIVE

The course is designed to provide an overview of different aspects of civil engineering profession , namely, surveying, materials, structural, and geotechnical engineering, hydraulics and water resources, environmental engineering, and transportation engineering and their roles in the societal development.

COURSE OUTCOMES

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

CO1 : Understand the importance and practical applications of different types of surveying,
CO2 : Learn about the different construction materials and understand the philosophy of structural analysis and design,
CO3 : Understand engineering behaviour of soil and types of foundations,
CO4 : Understand different hydraulics, hydrological and water resources engineering applications,
CO5 :Learn about the management strategies of wastewater and solid waste, and
CO6 :Understand the basics of different types of highways, railways, ports and harbours.

COURSE CONTENT

Introduction

Role of civil engineers in designing, building, and maintaining infrastructure and improving quality of life,Specializations in the civil engineering and their specific roles.

Surveying

Plans, maps, scales, divisions of surveying, classification of surveying, leveling, and advanced methods of surveying.

Construction Materials & Structural Engineering

Different construction materials and their uses, structural analysis and design philosophy.

Geotechnical Engineering

Overview on origin of soil, engineering properties and their classification; Soil exploration; Foundations: Their importance and purpose; Factors to consider in foundation design and stability of slopes; and Improving site soils for foundation use.

Hydraulics & Water Resources Engineering

Overview of fluid properties, open channel flow, surface and groundwater hydrology, and irrigation infrastructures.

Environmental Engineering
Types of waste water, Principles of wastewater management, Types of solid waste, and Principles of solid waste management.

Transportation Engineering
Classification of highways, Typical construction methods of roads, traffic surveys and their applications in traffic planning, Railways, Ports and Harbours.

Text Book

1. Er. Shrikrishna A. Dhale and Er. Kiran M. Tajne, Basics of Civil Engineering, S. Chand & Co., 1st Edition, 2014.

Reference Books

1. S. S. Bhavikati, "Basic Civil Engineering" by New Age International Publisher, 1st Edition, 2021.
2. M. S. Palanichamy "Basic Civil Engineering", Tata McGraw-Hill Publication.

BASIC MECHANICAL ENGINEERING

Course Code :ME10003
Credit :2
L-T-P :2-0-0
Prerequisite :Nil

COURSE OBJECTIVE

The course is designed to give an overview of the fundamental aspects of mechanical engineering so that a student pursuing any branch of engineering will realize the possibilities that the branch of mechanical engineering offers.

COURSE OUTCOMES

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

CO1 : Understandthe basic principles of thermodynamics,
CO2 : Develop an understanding of fluid machines like turbine and pump,
CO3 : Determine stress and strains in a component subject to a load,
CO4 : Understand the working and design aspect of power drives,
CO5 : Recognize appropriate material for a particular engineering application, and
CO6 : Understand the fundamentals of manufacturing processes.

COURSE CONTENT

Concepts of Thermodynamics
Systems, properties, state, and cycle, Thermodynamic equilibrium and quasi-static process, First law of thermodynamics for closed system, First law of thermodynamics for open/flow systems, Second law of thermodynamics, Kelvin Plank statement, Clausius statement, and Basic concept of entropy

Fluid Mechanics and Hydraulic Machines
Introduction to fluids, Properties of fluids, Pressure variation with depth, Bernoulli's equation and its applications, and Introduction to hydraulic turbines and pumps.

Mechanics of Materials
Stress, Strain, Stress-Strain diagrams for ductile and brittle materials, Elastic constants, Hooks Law, Factor of Safety, One-dDimensional loading of members of varying vross sections.

Power Transmission
Gear, , Belt, and Chain Drives, Shaft under varying loading conditions, Introduction to robots, Applications of robotics, Basic robot motions, Sensors and Actuators.

Manufacturing Processes
Introduction to engineering materials, Types and classification of materials, Properties of materials, Introduction to casting, forming, forging, rolling, extrusion and welding, Introduction to machine tools, NC, CNC, and 3-D Printing.

Text Book

1. P Kumar, Basic mechanical Engineering, Pearson Education, 2nd Edition, 2018

Reference Books

1. J K Kittur and G D Gokak, Elements of Mechanical Engineering Willey, 1st Edition, 2015.
2. B Agrawal, C M Agrawal ,Basic Mechanical Engineering, Willey, 1st Edition, 2011.

BASIC ELECTRICAL ENGINEERING

Course Code :EE10002
Credit :2
L-T-P :2-0-0
Prerequisite :Nil

COURSE OBJECTIVE

The course is designed to provide to the students a comprehensive overview of the basics of the electrical engineering discipline. In particular, the course includes fundamental aspects of DC, AC and magnetic circuit analysis, working principles and applications of machines, and safety measures used in various electrical apparatus and appliances.

COURSE OUTCOMES

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

CO1 : Familiar with the concept of DC circuit,
CO2 : Understand the concepts of AC circuits,
CO3 : Analyze the three phase circuit,
CO4 : Interpret the behavior of magnetic circuits,
CO5 : Remember the principles and operation of electrical machines, and
CO6 : Know the concepts of electrical safety and protection systems.

COURSE CONTENT

D. C. Circuits
Kirchhoff's law, Source transformation, Star-delta transformation and equivalent resistance of the circuits, Mesh and Nodal analysis, Superposition theorem.

A.C. Circuits
Peak, average, R.M.S. values of sinusoidal quantities, Peak factor, Form factor, Phase difference,Phasor representation,AC through R, L, C, AC Series Circuit (RL, RC, RLC), Three-phase AC circuits: Voltage, current and powerin star and delta connections.

Electromagnetic Circuits
Magnetizing Force,Reluctance, Permeance, Magnetic field, Magnetic permeability,Analogy between Electric Circuits and Magnetic Circuits. Series magnetic circuit, BH curve.

Scope and Safety Measures
Electrical Energy Scenario in India,Application of Transformer, Three-phase and single-phase induction Motors, Power ratings of air conditioners, PCs, laptops, printers, refrigerator, washing machine, different lamps, electricity tariff, calculation of electricity bill for domestic consumer.

Personal Safety Measures
Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

Equipment Safety Measures
Working principles of fuse and miniature circuit breaker (MCB), Residual Current Circuit Breaker (RCCB).

Text Books

1. V K Mehta, Rohit Mehta, Principles of Electrical Engineering and Electronics S Chand and Company, New Delhi ,Revised Edition 2013.
2. D.C. Kulshreshtha, Basic Electrical Engineering Tata Mcgraw publication, 1st Edition 2011.

Reference Book

1. Sanjeev Sharma, Basics Electrical Engineering I.K.International, New Delhi ,Third Reprint 2010.
2. T.K. Nagasarkar and M.S. Sukhija Basic Electrical Engineering, , Oxford University press, 3rd Edition 2017.

ENGINERING ELECTIVE II

ELEMENTS OF MACHINE LEARNING

Course Code :EE10001
Credit :2
L-T-P :2- 0-0
Prerequisite :Nil

COURSE OBJECTIVE

Today, we have access to massive data which get generated through information and computer technology in our connected world. Most of these data lie unused and often overwhelm us due to their size and variety. The objective of this course is to introduce to the students to the field of learning from data, discovering data patterns, converting them into knowledge, and applying it to solve real-world problems.

COURSE OUTCOMES

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

CO1 : Demonstrate fundamentals of machine learning,
CO2 : Identify data types, apply suitable processing and visualize using suitable methods,
CO3 : Describe Unsupervised Learning and apply clustering techniques,
CO4 : Describe Supervised Learning and apply classification techniques,
CO5 : Demonstrate perceptron and Multi-layer Perceptron models, and
CO6 :Apply machine learning techniques for real world requirement.

COURSE CONTENT

Introduction
Importance and Applications of Machine Learning, Supervised, Unsupervised, Reinforcement Learning and Evolutionary Learning.

Data Analysis
Measurement Scales and Data Types; Visualization, Pre-processing and Transformation of Data; Dimensionality Reduction; and Data (Dis)Similarity.

Unsupervised Learning
K-means and Density-based,Clustering Methods.

Supervised Learning
K-Nearest Neighbour, Decision Tree by Qualitative and Quantitative(information Gain method); Evaluation by Confusion Matrixof Supervised Learning Methods.

Learning with Neural Networks
Perceptron, Multi-layer Perceptron and, Error Backpropagation Learning.

Textbooks

1. Gopal, M., Applied Machine Learning, McGraw Hill Education, 2018
2. Pradhan, M. and U. D. Kumar,Machine Learning Using Python,Wiley India Pvt.Ltd, 2019.

Reference Books

1. Alpaydin, E., Introduction to Machine Learning, 3rd Edition, The MIT Press, 2014.
2. Bishop. C M, Pattern Recognition and Machine Learning, Springer, 2006.
3. Jain, V. K., Big Data Science Analytics and Machine Learning, Khanna Publishers, 2021
4. Mitchell, T. M.,Machine Learning, McGraw Hill, 1997.
5. Müller, A. C.,Introduction to Machine Learning with Python, O'Reilly Media, Inc, 2016
6. Raschka, S. and V. Mirjalili, Python Machine Learning, 3rd Edition, Packt Publishing, 2019.
7. Shalev-Shwartz, S. and S. Ben-David ,Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.

ENGINEERING MECHANICS

Course Code :ME10001
Credit :2
L-T-P :2-0- 0
Prerequisite :Nil

COURSE OBJECTIVE

Engineering Mechanics is a specialized need-based extension of Applied Physics and uses the principles of Statics and Dynamics. The objective of this course is to build the foundational knowledge of the students which is required for the design of mechanical systems. In particular, the course will cover aspects of analysis of rigid body, frame and machine under the action of force system, and analysis of free body diagram of a system whether at rest or in motion

COURSE OUTCOMES

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

CO1 : Draw complete and correct free-body diagrams and write the appropriate equations from the free-body diagram,
CO2 : Use scalar analytical techniques for analyzing forces and moments in mechanical systems,
CO3 : Analyze forces in statically determinate structures such as trusses, frames and problems related to friction,
CO4 : Determine the centroid and second moment of area,
CO5 : Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple and practical problems, and
CO6 : Solve real life problems by using mathematics, physical laws and theorems.

COURSE CONTENT

Concurrent Forces in a Plane

Introduction to Engineering Mechanics, Free-body diagrams,Composition and resolution of forces, Methods of moments. Friction:Concept of friction, Wedge friction.

Force Analysis of Plane Trusses

Methods of joints, Method of Sections,Centroid: Parallel forces in a plane, Centroid of plane figures, Theorem of Pappus, and Centroid of composite plane figures.

Moment of Inertia

Moment of Inertia of plane figures, Parallel axis theorem, Perpendicular axis theorem, and Moment of Intertia of composite figures.

Principle of Virtual Work

Equilibrium of Ideal Systems, Virtual work.

Dynamics of Particles

Differential equations of rectilinear motion, Free vibration, D'Alembert's Principle, Momentum and Impulse, Work & Energy, Conservation of energy, Impact.

Curvilinear Motion

Normal and tangential acceleration, Motion of a projectile, Work and Energy in curvilinear motion.

Rotation of a Rigid Body

Kinematics of rotation, Rotation under the action of a constant moment.

Text Book

1.S Timoshenko, D. H Young & J.V. Rao, Engineering Mechanics, Tata McGraw-Hill Publication 5th Edition, 2017.

Reference Books

1. IH Shames .,Engineering Mechanics (Statics and Dynamics) , Prentice Hall, 4th Edition, 2005.
2.. S.S. Bhavikatti, Engineering Mechanics –New Age International,8th Edition, 2021.
3. S. Rajasekaran and G. Sankarasubramanian Engineering Mechanics (Statics and Dynamics),Vikas publishing House, 3rd Edition, 2017.

BIOMEDICAL ENGINEERING

Course Code :EC10003
Credit :2
L-T-P :2-0- 0
Prerequisite :Nil

COURSE OBJECTIVE

Biomedical Engineering is a multidisciplinary field that combines knowledge available in a wide range of disciplines such as engineering, medicine, and societal science. The course focuses on innovating newer equipment and technologies to improve human health and enhance health care facilities in a holistic manner.

COURSE OUTCOMES

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

CO1 : Apply knowledge of basic engineering and biology to solve the problems,
CO2 : Knowledge of human body about cell, potential and organs of body,
CO3 : Develop a thorough understanding on principles of bio-instrumentation,
CO4 : Explain the role of bio-potential electrodes, and design of sensors,
CO5 : Differentiate and analyse the biomedical signal sources, and
CO6 : Knowledge about imaging techniques used in hospital.

COURSE CONTENT

Introduction and Overview
Introduction to biomedical engineering, Applications of biomedical engineering.

The Human Body
cCll-structure and function, Tissue & organs, Bio-potentials, Action potential, Major human systems (musculoskeletal, circulatory, nervous, and respiratory system)

Bio-instrumentation
Instruments in medical practice, Man-instrumentation system, Basic components, Linear network analysis, Bioelectric amplifier (OpAmp, isolation amplifier, instrumentation amplifier), Bio-instrumentation design, and Intelligent medical instrumentation.

Biomedical Electrodes and Sensors
Ssignal acquisition, Bio-potential measurements, Active and passive sensors, and Electrodes for biophysical sensing (Ag-AgCl, surface electrodes, microelectrodes), transducers, sensors.

Biomedical Signals, Imaging and Informatics
Bioelectric phenomena, Sources of biomedical signals, Origin of biopotentials, Basics of bio-signal processing, noise, Interference, Electrical safety issues, Principle of medical imaging techniques, such as X-ray, US, MRI, CT scan, and nuclear imaging, and Fundamentals of bio-informatics.

Text Book

1. John D. Enderle & Joseph D. Bronzino Introduction to Biomedical Engineering, Academic press, 3rd Edition, 2012.

Reference Books

1. Joseph D. Bronzino, Donald R. Peterson,The Biomedical Engineering Handbook, CRC press, 4th Edition 2015.
2. G.S. Sawhney, Fundamentals of Biomedical Engineering, New Age International (P) Ltd, 2011.

BASIC INSTRUMENTATION

Course Code : EE10003
Credit : 2
L-T-P : 2-0-0
Prerequisite : Nil

COURSE OBJECTIVE

The course is designed to impart, to the students, the principles of analog and digital measuring instruments which include the working mechanisms of sensors and transducers and their applications in industrial and biomedical systems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO1: Know the basics of measuring instruments,
CO2: Measure different electrical quantities,
CO3: Understand the working principles of optical and electrical transducers and sensors,
CO4: Understand the working of electrical transducers and sensors,
CO5: Apply the transducers in industrial applications, and
CO6: Use instruments in biomedical applications.

COURSE CONTENT

Analog and Digital Instruments
Basics of measuring instruments, Types of analog instruments, Measurement of voltage, current, power and energy in single and three phase circuits; Digital Instruments: Digital voltmeter, Digital multimeter, Timer/counter, and Time, phase and frequency measurements in oscilloscope.

Sensors and Transducers
Optical sources and detectors: LED, photo-diode, light dependent resistor; Basics of fiber optic sensing, IR Sensors.Resistive, capacitive, inductive, piezoelectric, and Hall effect sensors, Temperature transducers: Thermocouple, RTD , and thermistor.

Transducers in Industrial Applications
Measurement of displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure, flow, liquid level, pH, conductivity and viscosity.

Instruments in biomedical applications
ECG, Blood Pressure measurement, CT Scan, and Sonography

Text Book

1. R. K. Rajput ,Electrical and Electronic Measurements and Instruments,S Chand Publication, 4th Edition, 2015,William David Cooper,Electronic Instrumentation and Measurement Techniques, by PHI, 2010.

Reference Books

1. Er. R.K. Jain, Mechanical and Industrial Measurements (Process Instrumentation and Control), Khanna Publishers, 1995.
2. A.K Sawhney, A course in Electrical and Electronics Measurements and Instrumentation Dhanpat Rai Publication, 10th Edition, 2012.
3. D Patranabis, Sensors And Tranducers, PHI Publication, 2ndEedition, 2017.

HASS ELECTIVE I

SOCIETY, SCIENCE AND TECHNOLOGY

Course Code : HS10013
Credit : 2
L-T-P : 2-0 -0
Prerequisite : Nil

COURSE OBJECTIVE

There is a circular relationship between society, science, and technology. Society creates a need and an ambience to develop science and technology, and science and technology create means to meet societal needs and new opportunities to make human life better. Studying this relationship is the objective of this subject. The subject will expose, before the students, the past developments of science and technology and the social forces that played a dominant role in making these developments possible and the way these were used in the society. The subject will also present the ethical principles that underlie the development and use of science and technology in the society.

COURSE OUTCOMES

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

CO1 : Understand the forces that shape the development of science and technology,
CO2 : Understand the major milestones of scientific discoveries have impacted human thought processes,
CO3 : Understand the effect of technological developments in societal transformation,
CO4 : Analyse the contribution of Science and Technology in solving societal and Environmental problems,
CO5 : Evaluate the ethical issues related to abuse of science and technology,
CO6 : Apply the skills learned to suggest solutions to global problems linked to science and Technology.

COURSE CONTENT

Introduction

Human Curiosity to Know the Truth of Nature, Need to Improve Quality of Life, Emergence of Science and Technology, Characteristics of Society, Science, and Technology, and Impact of Science and Technology on the Society.

Scientific Discoveries

Milestone Scientific Discoveries of the Past and the Ways They Impacted Human Thought Process and Culture; Scientific Method, Developing a Theory, and Making of a Discovery; Discoveries in the Physical, Biological, and Mathematical Sciences; Normal Science, Paradigms, Anomalies, Crisis and Emergence of Scientific Theories, and Scientific Revolutions.

Technological Developments
Milestone Developments of Technologies and the Ways They Transformed the Society. Stories of Technological Developments such as Steam Engines, Electricity, Semiconductors, and IoT.

Science and Technology in the Service of the Society
Contributions of Science and Technology to Solving Societal, Environmental, and Global Problems. Successes and Limitations, and Abuses and Control of Science and Technology; Ethical Considerations.

Text Book

1. Bucchi, M., Science In Society: An Introduction to Social Studies of Science, Routledge Publication, 1st Edition,2004.

Reference Books

1. Collins, H. and T. Pinch, The Golem: What You Should Know about Science, 2nd Edition, New York: Cambridge University Press,1998.
2. Collins, H. and T. Pinch,The Golem: What You Should Know about Technology, 2nd Edition. New York: Cambridge University Press, 2014.
3. Kuhn, T. S.,The Structure of Scientific Revolutions, 4th Edition, Chicago University Press, 2012.
4. Hatton, J. and P. B. Plouffe, Eds., Science and Its Ways of Knowing, New Jersey: Prentice Hall,1997.
5. Moskovites, M., Ed., Science and Society, Ontario: House of Anansi Press Limited,1997
6. Sismondo, S. An Introduction to Science and Technology Studies, 2nd Edition. Maldon, MA: Blackwell Publishing, 2009.
7. Sarukkai, S. What Is Science?, New Delhi: National Book Trust, India, 2012.
8. USSR Academy of Sciences Science and Society, Moscow: Nauka Publishers, 1989.

SOCIO-POLITICAL ENVIRONMENT

Course Code : SO10043
Credit : 2
L-T-P : 2-0-0
Prerequisite : Nil

COURSEOBJECTIVE

The objective of this paper include providing basic knowledge on socio-political environment of India and to equip the students with an understanding of their roles, duties and responsibilities in a democratic set up.

COURSE OUTCOMES

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

CO1 : Understand contemporary Indian social problems,
CO2 : Understand the roles and functions of the three political institutions in our democratic up,
CO3 : Familiarize the students with the Rights and Duties enlisted in the Indian Constitution,
CO4 : Grasp the interrelationships among political, social and economic issue,
CO5 :Visualize contemporary changes in Political Institutions,
CO 6 : Realize the importance of equity, equality, and dignity in a democratic system.

COURSE CONTENT

Social Problem in India

Meaning and Definition of Social Problems, Characteristics, Causes and Consequences, Problems of Poverty, Unemployment, Population growth, Problems of Women and Aged, Corruption and Nepotism, Illiteracy, Substance Abuse, and Terrorism.

Social Stratification

Equity and Equality, Caste, Religion, Class, Gender Discrimination, Urban Slums.

Political Institutions

Meaning and Basic Concepts of Political Institutions: Legislative, Executive and Judiciary Systems of the Indian Constitution.

Fundamental Rights and Duties

Fundamental Rights and Duties in Indian Constitution, Directive Principles of State Policy.

Contemporary Changes in Political Institutions

Changing Role of the Government in Contemporary India, Role of Government in the Formation of National and International Policies and Their Impact on Business and Trade.

TextBooks

1. C. N. Shankar Rao, S.Chand., Indian Social Problems, by S.cahand Publication,2017
2. M. Laxmikanth., Constitution of India,Cengage Learning,2020.
3. Himanshu Roy &M.PSingh Indian Political System, Pearson publisher,4th Edition,2018.
4. Ram Ahuja ,Social Problems inI ndia, Rawat publisher,4th Edition,2014.

Reference Books

1. Our Parliament, Subhash C Kashyap, NBT, 2021.
2. Social Stratification, Dipankar Gupta (Ed), Oxford India Publication, 1997.
3. Modernisation of Indian Tradition, Yogendra Singh, Rawat Publication, 1986.

THINKING PERSPECTIVES

Course Code : PS10043
Credit : 2
L-T-P : 2-0-0
Prerequisite : Nil

COURSE OBJECTIVE

Cognition plays a significant role in **accumulation and processing of information.** This subject provides an in-depth understanding of some of the cognitive processes in terms of current theories, models and applications. It helps learners to understand the importance of these cognitive processes and the rationale behind cognition, problem solving, critical thinking, and scientific thinking. It facilitates students to identify and analyze the key conceptual and theoretical frameworks underpinning cognitive process.

COURSE OUTCOMES

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

CO1 : Understand the definition and scope of cognition, problem solving, and creativity,
CO2 :Understand the theories related to cognition, decision making, and critical thinking,
CO3 :Understand the classic and current experimental research in cognitive processes,
CO4 :Develop skills essential in designing and conducting experiments in cognition, reasoning, and problem solving,
CO5 :Understand various aspects of critical thinking, scientific thinking, and design thinking process,
CO6 :Apply the knowledge of cognitive processes to one's own personal life and to real life issues.

COURSE CONTENT

Basics of Cognition

A Brief History, Emergence of Modern Cognitive Approach, Thinking, Basic Elements of Thought: Forming Concepts, Propositions, Images.
Reasoning, some Basics sources of error, Information-processing approach, connectionist approach, evolutionary approach, ecological approach.

Memory Processes and Critical Thinking

Organization of Long Term Memory, Forgetting, Retrieval and Metamemory; Proactive and Retroactive inference; Amnesia and Retrieval, Flashbulb Memory, Eyewitness Memory, Traumatic Memory, False Memories.

Phases of Critical Thinking: Intellectualization, Suggestion, Hypothesis, Reasoning, and Testing, Critical Thinking Abilities: Thinking, Observational, and Questioning and Dispositions, Critical Thinking Skills: Analysis, Communication, Creativity, Problem-solving Skills, and Open-mindedness.

Systems Thinking and Scientific Thinking

System Definition and Characteristics, Approaches to System Modelling, Causal-Loop Diagramming, System Archetypes, Micro world and Learning Laboratory, The Learning Organization and the Fifth Discipline, Systems Thinking Study, Examples.

Characteristics of Science: Systematic observation and experimentation, Inductive and deductive reasoning, Lessons from Scientific Thinking: Empirical Evidence, Logical Reasoning.

Creativity and Designing Thinking

Creative Thinking, Stages in Creative Thinking, Nature of Creative Thinking, Features of Creativity—Novelty, Originality and Usefulness, Guilford's Measure of Creativity—Fluency, Flexibility, and Originality, Barriers to Creativity, Enhancing Individual and Organizational Creativity.

Designing Thinking as a Process of Problem Solving: Defining Problems, Challenging Assumptions, Developing Concepts, identifying Alternative Strategies and Solutions, Prototyping, and Experimenting Problem Solving through Innovative Solutions, Stages of Design Thinking—Empathize, Define, Ideate, Prototype and Test.

Text Books

1. Solso, R. L.,Cognitive Psychology, Pearson Education, 6th Edition. 2004.
2. Baron, R. A. Psychology,Pearson Education, 5th Edition, 2002
3. Rathus, S.A. Introductory Psychology Wadsworth Cengage,5th Edition, 2016.
4. Ciccarelli, S. & White, N.J, Psychology 5th Edition, Pearson Education.2017
5. The Fifth Discipline: The Art & Practice of the Learning Organization, Cengage Publication,2nd Edition, 2006.
6. Cross, N., Design Thinking: Understanding How Designers Think and Work, Berg Publishers.

Reference Books

1. Baddley, A.,Human memory: Theory and practice. New York Psychology Press,1997.
2. Treror, A.,The psychology of language: From data to theory. Taylor Francis,2002
3. Smith, E.E. &Kosslyn, Cognitive psychology: Mind and brain. Prentice Hall,2007.
4. Tripathi, A.N. &Babu, Nandita (2008). Cognitive processes. In Misra, G. Psychology
5. in India: Advances in Research, Vol. 1,Pearson Education.
6. Vaid, J., & Gupta, Ashum,Exploring word recognition in a semi-alphabetic script: the
7. case of Devanagari. Brain and Language, 81, 679-690.

CREATIVITY, INNOVATION AND ENTREPRENEURSHIP

Course Code : PS10045
Credit : 2
L-T-P : 2 0 0
Prerequisite : Nil

COURSE OBJECTIVE

The course is designed for students who want to enhance their creative and innovative skills and apply them to prepare business plans to form entrepreneurial enterprises. More specifically, the course is designed to help students to stimulate creativity in themselves and learn the impact of innovation on growth creation and design thinking in real-world business situations. In this course, the concepts of entrepreneurship and the environment in which the entrepreneurs act will be developed along with business plans and business models for start-ups.

COURSE OUTCOMES

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

CO1 : Understand the key elements of creativity and innovation,
CO2 : Visualize the impact of innovation on growth creation,
CO3 : Apply creative and design thinking to real-world business situations,
CO4 :Create a foundation of entrepreneurship development and its theories,
CO5 : Develop business plans and business models to start entrepreneurial enterprises,
CO6 :Analyze the business plan and implement it in real field.

COURSE CONTENT

Introduction

Definitions, Importance, and Relationships among Creativity, Innovation, and Entrepreneurship; Examples.

Creativity

Definitions, Importance, and Relationships among Creativity, Innovation, and Entrepreneurship; Examples, Creative Thinking and Stages of Creative Thinking, Barriers to Creativity, Enhancing Individual Creativity, Guilford's Usual Unusual Test, Psychometric Approaches to Tests of Creativity, Structured tools of Creativity (Developing Creative Focus, Exercising Mind, Setting Directions, Suspending Rules, Thinking Differently, Establishing Formatted Work Space, Stimulating Mechanisms, Utilizing Experiences.

Innovation

Innovation, Benefits, Keys to Successful Innovations, Types of Innovation, Barriers to Innovation, Methods of Generating Ideas, Design Thinking. Creative Problem Solving, and Measures of Innovation.

Entrepreneurship

Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur, Intrapreneur, Social Entrepreneur, Case Study on the Entrepreneurial Excellence of N. R. Narayan Murthy, Introduction to Agricultural, Rural, Tourism, Social and Digital Entrepreneurship, Entrepreneurial Motivational Behavior (Creativity, Self-Efficacy, Locus of Control, Risk Taking, Leadership, Communication),

Converting Ideas into Products/Services with Differentiating Features, Niche Market, Design of the Products/Services, Bootstrap Marketing, Formulation of Business Plan, Business Model, Financial Planning, and Sources of Finance.

Practical classes will be devoted to organizing practicing sessions on creativity, case study discussion sessions and market analysis sessions on generating novel ideas, and developing and presenting business plans. Students, in groups, will design a new product/service, do a bootstrap market study, develop a business plan, and make an elevator pitch.

Text Books

1. Khanka, S. S. Creativity, Innovation, and Entrepreneurship, S.Chand .
2. Praveen Gupta, Business Innovation, S. Chand , 2007

Reference Books

1. Barringer B. R. and R. Duane, Entrepreneurship: Successfully Launching New Ventures: Pearson Prentice Hall, Ireland, 3rd Edition 2009.

2. Duening, T. N., R. D. Hisrich, and M. A. Lechter , Technology Entrepreneurship: Taking Innovation to the Marketplace, Elsevier, Amsterdam, 2nd Edition 2015.
3. Harrington, H. J., Creativity, Innovation, and Entrepreneurship: The Only Way to Renew Your Organization, Routledge, 2019.

ESSENTIALS OF MANAGEMENT

Course Code : HS10202
Credit : 2
L-T-P : 2-0-0
Prerequisite : Nil

COURSE OBJECTIVE

This course explores the basic concepts and processes of management. Students will learn the importance of management in their professional life from the stories on the evolution and practices of management. Students will examine the fundamental roles and processes of planning, organizing, staffing, directing and controlling that comprise the managers' role. This course also examines the fundamentals of marketing and financial management for the success of the organization. This course will make an attempt to introduce students to the business environment and strategic management process to understand the nuances of business. Students will develop skills related to the manager's function as required in today's competitive environment.

COURSE OUTCOMES

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

CO1 :Learn different approaches, theories and stories of various practitioners of management and know how such knowledge could be applied to achieve goals of Organizations within the changing environment,
CO2 : Understand the core functions of management in order to facilitate efficient and effective decision making both at individual and organizational level,
CO3 : Identify the human resource requirement of the organization for achieving its objective effectively,
CO4 : Synthesize various marketing and financial skills and techniques in order to be successful in corporate world,
CO5 : Assess the business environment and understand the importance of various types of business environment for better decision making,
CO6 : Acquire the lesson learnt in strategic management process for strategic decision making by leveraging the core competencies of the organization.

COURSE CONTENT

Evolution of Management Thoughts
Concept, Scope and Significance of Management; Classical Approach; Scientific, Bureaucratic & Administrative theory of Management; Neo-classical and Modern Approach; Contribution of Management Practitioners

Functions of Management (Part I)
Nature, scope and significance of Planning; Types of Planning; Process of Planning; Barriers to effective planning; Decision making: concept, types and process; Organizing: concept and significance; Delegation of authority; Authority vs. Responsibility; Structure of Organization: departmentalization, Centralization vs. Decentralization

Functions of Management (Part II)
Concept of Staffing, Manpower planning and Job design; Recruitment and selection; Training and development; Performance Appraisal; Directing: Concept, Direction and Supervision; Controlling: Concept, Importance and levels; Process and types of controlling

Marketing and Financial Management
Marketing Mix (Product, place, price, Promotion); Market Segmentation; Introduction, scope, importance and functions of Financial management; Introduction to Financial statements: Profit and loss account; balance sheet

Business Environment and Strategic Management
Business environment: concept, importance, elements; Types of business environment; Strategic Management: Concept, Importance and levels of strategy; Process of Strategic Management

Text Books

1. S.A. Sherlekar & V.S. Sherlekar, Modern Business Organization & Management (Systems Approach) by Himalya Publishing House, 2018.
2. Harold Koontz and Heinz Weihrich ,Essentials of Management: an International Perspective by, McGraw Hills, 2020

Reference Books

1. K. Ashwathappa, Essentials of Business Environment, Himalaya Publishing House, 2017.
2. Joseph L. Massie, Essentials of Management Pearson Education India, Fourth edition, 2015.
3. Azhar Kazmi & Adela Kazmi, Strategic Management, McGrawHill, 5th edition 2020.

SHADES OF ECONOMICS

Course Code : HS10121
Credit : 2
L -T-P :2- 0-0
Prerequisite : Nil

COURSE OBJECTIVE

This course will provide technical students with knowledge in concepts of environmental economics, resource economics, and circular economy, allowing prosperity for present and future generations. The course will equip future engineers with skill to handle resources efficiently and effectively. Acquaint them with the contemporary trends in business settings and thereby innovate novel solutions to existing problems.

COURSE OUTCOMES

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

CO1 : Understand the economic drivers that shape the future of India,
CO2 : Understand sustainability issues related to usage of factor endowment,
CO3 : Ability to create linkage between Economics, Science and Technology,
CO4 : Apply knowledge, reasons and the need for regulating circular economy,
CO5 : Assess and analyses scope for global market opportunities,
CO6 : Explore yet to be unearthed employment opportunities.

COURSE CONTENT

Purple Economy: Economics of *Glocalization*
Introduction to colours and world of economics (including White, Blue, Black, Green, Purple, Grey, Red, Pink, Silver); Concept and definition of purple economy; Cultural footprint; Local and global cultural economy; Culture and well being; Rethinking employment and training in the purple economy; Vocal for Local; Make in India.

Grey Economy: Economics of Informal Sector
Concept and definition of grey economy; Introduction to formal and informal Sector; Formal and informal sector linkage; Labour absorption and dualism in economy; Theoretical and policy issues; Migration in informal sector.

Green Economy: Economics of Reduce, Reuse, and Recycle
Concept and definition of green economy; Green investment and green bond; Green technology and renewable resources; Carbon footprint; Waste management.

Blue Economy: Economics of Ocean Resources
Concept and definition of blue economy; The marine environment; Fisheries and aquaculture; Tourism; Ocean-based renewable sources of energy; Transportation and the blue economy; ; Pollution of water resources; Water resource management.

Black Economy: Economics of Unsanctioned Sector
Concept and definition of black money; Causes and consequences of black economy; Global black income generation; Extent of black money in India. Government measures to curb black money.

Text Book

1. S.K Mishra and V. K. Puri, Indian Economy. Himalaya Publishing House,2022, ISBN: 978-93-5596-423-6

Reference Books

1. Uma Kapila. Indian Economy:Economic Development and Policy. Academic Foundation ISBN-10 : 9332705550 and ISBN-13 : 978-9332705555,2022.
2. Taneja and Myer :Economics of development and Planning, Vishal Publishing Co. ISBN-13 : 978-9382956068.
3. Datt Gaurav & Mahajan Ashwani , Indian Economy,S Chand & Company Limited. 2017.
4. Adrian C. Newton, Elena Cantarello, An Introduction to the Green Economy. Science, Systems and Sustainability,2014
5. Shalini Goyal Bhalla. Circular Economy- (Re) Emerging Movement.,2020.
6. Somnath Hazra & Anindya Bhukta,The Blue Economy. An Asian Perspective. The Informal Economy: an Employer's Approach. The Informal Economy: an Employer's Approach. 2021.
7. The Purple Economy: An Objective, An Opportunity, 2013.
8. Tom Tietenberg, Lynne Lewis, Environmental and Natural Resource Economics. 2018.

INDIAN ECONOMY POST LIBERALISATION

Course Code :HS10123
Credit :2
L-T-P :2-0-0
Prerequisite : Nil

COURSE OBJECTIVE

Study of this course provides an extensive understanding of changing structure of Indian economy over time. This course targets to put emphasis on inclusive growth, reducing poverty, inequality and creating decent employment in the economy. This course will give an understanding about the issues faced by an economy in achieving sustainable development.

COURSE OUTCOMES
After successfully completing the course, the students will be able to

CO1 : Interpret the changing structure of Indian economy,
CO2 : Perceive the issues and challenges faced by Indian economy,
CO3 : Evaluate the policies and programmes required to achieve inclusive growth,
CO4 : Realise the importance of human capital in triggering economic development,
CO5 : Comprehend the state and role of external sector in strengthening Indian economy,and
CO6 : Help in achieving sustainable development for the economy.

COURSE CONTENT

Introduction and features

Changing structure of the Indian economy Changing paradigms of Development Strategies and Economic Reforms.

Poverty, Inequality and Employment

Various concepts and estimates of poverty; Income inequality; Problem of unemployment; Interface among growth, poverty and employment; Inclusive growth and Human Development; Sustainable Development Goals—Targets for reduction in Poverty, Inequality and Decent Employment.

Demographic Issues

Demographic trends, size and structure of population; Health and Education; Skill challenges and demographic dividends; Sustainable Development Goals—Targets forGreater Wellbeing and Better Human Capital.

Perspectives in Agriculture, Industry and Services

Agricultural growth performance and food security; Growth, trends and changing pattern of Indian industries, industrial reforms and policies; Services in India's growth process; Sustainable Development Goals—Targets for Inclusive and Sustainable Growth.

External Sector and Issues in Indian Public Finance

Foreign trade and trade policy; fiscal devolution,Indian Union Budget and Tax System

Text Book

1. Uma Kapila, Indian Economy Perfomance and Policies,academic foundation, 2020,ISBN:978-933270545

Reference Books

1. S.K. Mishra, and V. K. Puri, Indian Economy, Himalaya Publishing House,2022, ISBN: 978-93-5596-423-6
2. Gaurav Datt and Ashwani Mahajan,Indian Economy, GENERIC. Classic Edition,2022 ISBN-10 : 9352531299 ISBN-13 : 978-9352531295

COMMUNIT/ENVIRONMENT-BASED PROJECTS

Course Code :EX17001
Credit :2
L- T-P :0-0-4
Prerequisite :Nil

COURSE OBJECTIVE

This course is offered to give the students an opportunity to connect with the community and the environment, learn and prioritize their problems, and define the problems in ways that make them amenable to scientific analysis and pragmatic solution. Appreciating the community problems, visualizing and experiencing them in person, self-learning, applying to realities, searching for and finding implementable solutions are the primary benefits of this project-based subject.

COURSE OUTCOMES

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

CO1 :Identify need of the community,
CO2 :Formulate objective of a project,
CO3 :Communicate orally and through formal technical write-ups,
CO4 :Analyze and interpret data wherever essential,
CO5 :Provide an implementable solution to the problem, and
CO6 :Work in team following ethical manners.

COURSE CONTENT

The projects will be applied to problems uppermost in the minds of the community regarding the problems that they confront regularly. The problems may range from social inequality and social justice to lack of common services such as health, education, water, power, banking, and from lack of access to government subsidies and policies to deforestation and environmental problems.

ELECTRICAL MACHINE II

Course Code : EE20002
Credit :3
L-T-P :3-0-0
Prerequisite : Electric Circuit Analysis (EE21001), Electrical Machine I (EE20003)

COURSE OBJECTIVE
To understand construction, working principles, testing, characteristics and control of different DC & Synchronous machines and their industrial and domestic applications.

COURSE OUTCOMES

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

CO1: Understanding the Construction, principle, efficiency, armature reaction and characteristics of different DC machines.
CO2: Discuss the different winding diagrams of DC machines.
CO3: Applications of the different Speed Control methods, starters and Testing on DC Motors.
CO4: Understand the principle, armature reaction and phasor diagram of synchronous machines.
CO5: Determine the voltage regulation of Synchronous machines.
CO6: Know the methods of starting, V Curve and power stage of a Synchronous motor.

COURSE CONTENT

D C Generator
Principle of operation, Types of D.C Machines, Developed diagram, Equivalent ring diagram,Armature Winding, emf equation, Power Flow Diagram, Losses and Efficiency, Armature Reaction, Brush shift and its Effects, Methods to improve commutation, Interpoles, Commutation, Characteristics and applications of separately and self excited D.C Generator.

D C Motor
Principle of operation, Back emf, Torque and Speed, Characteristics and Applications of different D C motors, speed control of D C Motor, losses and Efficiency, Necessity of starters, Testing : Swinburne's Test and Hopkinson's Test, 3 point and 4 point starter,Rating of DC Machine.

Synchronous Generator
Principle of operation, Excitation systems for synchronous machines, Armature winding, pitch factor, distribution factor, winding Factor, EMF equation, Armature Reaction, Phasor Diagram of a loaded alternator, Voltage Regulation: EMF Method, MMF Method and Zero power factor method, Short Circuit Ratio, Blondel's two reaction theory, Phasor Diagram of salient pole Machine, Direct and quadrature axis reactance, power angle Characteristics of salient pole alternator, Determination of X_d and X_q (Slip Test), Parallel operation of Alternators

Three Phase Synchronous Motor
Principle of operation, Method of Starting, Equivalent Circuit and Phasor Diagram of cylindrical rotor, Power flow diagram, Construction of V curve and inverted V curves, Synchronous condenser and power factor correction, Power angle equation of for both salient and cylindrical rotor synchronous motor.

Text Books:

1. Electrical Machinery, P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.
2. Electrical Machines, by P. Purkait and I. Bandyopadhyay, Oxford University Press, 1st Edition 2017.
3. Electric Machinery, by E. Fitzagerald, C. M. Kingsley (Jr) and S. D. Umans, Tata McGraw Hill, 2003.

Reference Books:

1. Electrical Machines, Ashfaq Hussain, Dhanpat Rai, Delhi, 2nd Edition, 2008.
2. Electric Machines, C. I. Hubert, , Pearson Education, 2003.
3. A Text Book of Electrical Technology, Vol. –II, AC & DC Machines, By B. L Theraja, A. K Theraja, S. Chand and Sons, 2006.

ELECTRICAL MACHINE I

Course Code:EE20003
Credit :3
L-T-P :3-0-0
Prerequisite : Electric Circuit Analysis (EE21001)

COURSE OBJECTIVE

To understand construction, working principles, testing and connections of different transformers and induction motors and their industrial and domestic applications.

COURSE OUTCOMES

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

CO1: Evaluate the different losses, efficiency, regulation and different testing of a single phase transformer.

CO2: Develop the equivalent circuit and the phasor diagram ofa single phase transformer and an auto transformer.

CO3: Understanding the different connections and conversions of three phase transformers and parallel operation of single phase and three phase transformers.

CO4: Apply the principle to find the torque, losses, efficiency and different testing of three phase induction motor.

CO5: Analyse the performance characteristics, different methods of starting and speed control of three phase induction motor.

CO6: Understanding the construction and principle of operation of different single phase induction motors.

COURSE CONTENT

Single Phase Transformer

Principle of operation, Construction, Types, emf equation and Phasor diagrams of transformer at no load and load condition, Development of Equivalent Circuit, No Load Test, Short Circuit Test and Sumpner's Test. Voltage Regulation, Losses, Efficiency and all day Efficiency. Parallel operation of Transformer and applications.

Auto Transformer: Principle, Performance (Copper Saving, Phasor Diagram and equivalent circuit) and Applications.

Three Phase Transformer
Three Phase Transformer Connections and vector Group, open delta connection, Phase Transformation: 3 phase to 2 Phase, 3 phase to 6 phase and 3 phase to 12 phase, Parallel operation of three phase transformer.

Three Phase Induction Motor
Rotating Magnetic Field, Principle of operation and concept of slip, Comparison between transformer and induction motor, Types and Applications, Equivalent Circuit and Phasor Diagram, Torque, maximum torque, Torque-slip characteristics, Effects of variation of rotor resistance, Power stages of an induction motor, No load and Blocked rotor test, Circle Diagram, Methods of starting for squirrel cage and slip ring induction motor, Speed control of squirrel cage and slip ring induction motor.

Single Phase Induction Motor
Types, Double field Revolving Theory, capacitor start motor, capacitor start and run motor.

Text Books:

1. Electrical Machinery, P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.
2. Electric Machines, by Kothari. D P and I J Nagrath, 3rd Edition, Tata McGraw-Hill, New Delhi. 2004.
3. Electric Machinery, by E. Fitzagerald, C. M. Kingsley (Jr) and S. D. Umans, Tata McGraw Hill, 6th Edition 2003.

Reference Books:

1. Electrical Machines, Ashfaq Hussain, Dhanpat Rai, Delhi, 2nd Edition, 2008.
2. Electrical Machines, by P. K. Mukharjee and S. Chakravorti, Danpat rai Publication, 18th reprint 2013.
3. Electrical Machines, by P. Purkait and I. Bandyopadhyay, Oxford University Press. 1st Edition, 2017.

LINEAR CONTROL SYSTEM

Course Code : EE20004
Credit : 3
L-T-P : 3-0-0
Prerequisite : Electric Circuit Analysis (EE21001)

COURSE OBJECTIVE
To understand the control system model of physical systems, and to employ time domain and frequency domain analysis to determine the system stability, the steady state and transient response, also to realize the response of multi input and multi output system.

COURSE OUTCOMES

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

CO1: Illustrate different terminology of control system.
CO2: Develop the mathematical model of physical systems.
CO3: Analyze the time domain response of different systems.
CO4: Evaluate the stability of a system by classical methods.
CO5: Analyze frequency domain response of different linear dynamic system.
CO6: Understand the state space modeling and different types of compensators.

COURSE CONTENT

Introduction
Basic concept of control system: open loop and closed loop control system, differential equations and transfer function, Effect of feedback on gain, stability, sensitivity and noise of the system, order and type of the system.

Modeling of physical system
Mathematical modeling of mechanical system and electrical system, Analogous system, Translational and rotational mechanical system, Transfer function by block diagram reduction technique, Developing block diagram from a mathematical model, Signal flow graph terminology, construction & procedure, Transfer function from signal flow graph using Mason's gain formula, Time delay control system.

Time domain analysis
Time response of first order system, Response to the unit step input, unit ramp input, Time response of second order system for unit step input, Time response specification, steady state error & design specification, Error constant of second order system, Minimization of Errors through P, PI and PID controllers.

Concept of stability
The concept of stability, necessary condition for stability, Routh- Hurwitz stability criterion, Relative-stabilityanalysis.

Root Locus Technique
Root locus concept, construction of root locus, construction rules, Determination of gain from root locus.

Frequency domain analysis
Introduction, Polar plots, Bode plots, Nyquist stability criterion, Stability analysis.

Compensators
Realization of basic compensators, Cascade compensation and Feedback compensation.

State Space
Concept of state, State variable, State model, State space model for LTI system, Computation of State transition matrix.

Text Books:

1. Control System Engineering by Noran S Nise, John Wiley Publication, 6th Edition, 2012.
2. Modern Control Engineering by K. Ogata PHI publication, 5th Edition, 2010.

Reference Books:

1. Control Systems Engineering by R. Anandnatarajan and P. Ramesh Babu, SCITECH,4th edition, 2016.
2. Control Systems: Theory and applications by Smarajit Ghosh, Pearson. Publication 2012
3. Automatic control system by Hasan Saeed, 6th revised edition 2008, S.K. Kataria and Sons.
4. Modern Control Engineering. By D. Roy Choudhury PHI publication, 5th Edition,2009.
5. Automatic Control Systems by Benjamin C. Kuo, Prentice-Hall,7th Edition,2009.
6. Control System Engg, by I. J. Nagrath and M Gopal ,New age international publication, 4th Edition,2011.
7. Control System by D N Manik, Cengage Learning India Pvt, 2012.
8. Automatic control systems by Prof. B.S. Manke and S. N. Verma , Khanna publication, 2012

MEASUREMENT AND SENSOR TECHNOLOGY

Course Code : EE20005
Credit :3
L-T-P :3-0-0
Prerequisite : Basic Electronics (EC10001)

COURSE OBJECTIVES

To introduce the students the principle of measurement, theory of instruments andSensors, in depth knowledge in physical principles applied in sensing, measurement and acomprehensive understanding on how measurement systems are designed, calibrated, characterized, and analyzed.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO1: Illustrate the basics of electrical measuring instruments and their purposes.
CO2: Determine the unknown parameter using different bridges.
CO3: Understand the recent advancements in electronic and biomedical instruments.
CO4: Perform the measurement of strain, pressure and motion using sensors.
CO5: Utilize heat and temperature sensors in different applications.
CO6: Know about different industrial measurement systems.

COURSE CONTENT

Introduction to Electrical Measurement

Moving Iron type instrument, extension of range, Electrodynamometer type meter, Induction type wattmeter, VAR meter, Induction type energy meter, Electrodynamometer type power factor meter, Current transformers: Ratio and phase angle errors, phasor diagrams, uses.

DC and AC Bridge

General equation of bridge balance, Wheatstone bridge, Kelvin’s double bridge. Maxwell’s inductance, Anderson's bridge, Schering bridge, Errors.

Electronic and Biomedical Instruments
Electronic voltmeter: Block diagram, principle of operation, CRO: Block Diagram, Sweep Generator, use of CRO for measurement of frequency, phase, amplitude and rise time. Digital Frequency meter, Digital Multi-meter,Digital Energy Meter. Biomedical Instruments: ECG, Blood Pressure, Sonography.

Strain, Pressure and Motion Sensors
Resistance strain gauge, piezoelectric pressure gauge, characteristics. Capacitor plate sensor, inductive sensor, LDVT Accelerometer systems, rotation sensors, piezoelectric devices, Rotary encoders, Tachometers.

Heat and Temperature Sensors
Bimetallic strip, Bourdon temperature gauge, thermocouples, Resistance thermometers, thermostats, PTC thermistors, bolometer, Pyroelectric detector.

Industrial Sensors
Proximity detectors- inductive and capacitive, Ultrasonic photo beam detectors, Reed switch, magnet and Hall–effect units, Doppler detectors, liquid level detectors, flow sensors, smoke sensors.

Text Books:

1. A Course in Electrical and Electronics Measurement and Instrumentation by A. K. Sawhney, 10^{th}edition, Dhanpat Rai, 1994.
2. Ian R Sinclair, "Sensors and transducers", Third Edition, Newness Publishers, 2001.

Reference Books:

1. Electronics Instruments and Measurements – David A. Bell – PHI, 2012.
2. Electronic Instrumentation and Measurement Techniques, By William David Cooper, PHI, 2010.
3. 1. Jack P Holman, "Experimental Methods for Engineers", Seventh Edition, McGraw Hill, USA, 2001.
4. 2. Robert G Seippel, "Transducers, Sensors and detectors", Reston Publishing Company, USA, 1983.

SIGNALS AND SYSTEM

Subject Code : EE20006
Credit :3
L-T-P :3-0-0
Prerequisite : Differential Equations and Linear Algebra (MA11001)

COURSE OBJECTIVE
To describe various commonly used signals, mathematically understand how to perform different operations on them and analyses the signals using Fourier series and Fourier transform and Z transform.

COURSE OUTCOMES

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

CO1: Know various types of signals.
CO2: Understand continuous and discrete linear time invariant system .
CO3: Apply convolution and correlation techniques to different signals
CO4: Analyze the time domain responses of LTI systems.
CO5: Apply the Fourier Transformof continuous-time signals
CO6: Determine Z-transform to different signals.

COURSE CONTENT

Introduction

Definition of signal, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power. Elementary signals/Functions: exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sync functions.
Systems: Definition, Classification: linear and nonlinear, time variant and invariant, causal and non- causal, static and dynamic, stable and unstable, invertible.

Continuous and Discrete Linear Time Invariant System
Time domain representation of LTI System: System modeling: Input-output relation, definition of impulse response, convolution sum, convolution integral, Properties of convolution, Cross Correlation and Auto Correlation of signals.

Fourier Series and Fourier Transform
Fourier series representation of continuous time periodic signals, properties of Fourier series, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, properties of Fourier transforms.

SAMPLING
Representing a continuous signal by samples, Sampling theorem, Zero-order hold, Aliasing and its effect.Z TransformsZ–Transforms, Properties of Z-transforms, Region of Convergence in Z-Transform, Constraints on ROC for various classes of signals, Inverse Z-transform, Distinction between Laplace, Fourier and Z Transforms.

Text Books:

1. Signals and Systems – A.V. Oppenheim, A.S. Willsky and S.H. Nawab, 2nd Edition, Pearson, 2015.
2. Signals & Systems – Simon Haykin and Van Veen, Wiley, 2nd Edition,2002

Reference Books:

1. R.E.Zeimer, W.H.Tranter and R.D.Fannin, "Signals & Systems – Continuous and Discrete", Pearson, 2007.
2. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.
3. M.J.Roberts, "Signals & Systems Analysis using Transform Methods & MATLAB", Tata McGraw Hill, 2007.
4. Principles of Linear Systems and Signals, 2nd Edition, B. P. Lathi, 2009, Oxford.
5. Signals and Systems by J B Gurung, PHI, 2009.
6. Signals and Systems by T K Rawat, Oxford, 2010.

ANALOG AND DIGITAL ELECTRONICS CIRCUIT

Course Code : EE20007
Credit :3
L-T-P :3-0-0
Prerequisite : Basic Electronics (EC10001)

COURSE OBJECTIVES

The course gives an introduction to analysis of elementary analog and digital circuits. This course is intended to develop an understanding power amplifiers, tuned amplifiers and behavior of noise in an amplifier and their applications. It also provides the basic knowledge of digital logic levels to understand digital electronics circuits including Boolean algebra, logic gates, combinational logic, sequential logic concepts and their applications.

COURSE OUTCOMES

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

CO1: Understand different applications of P-N Junction diode.
CO2: Develop biasing circuits for BJT.
CO3: Apply Field Effect Transistor as an amplifier.
CO4: Analyze different power Amplifier circuit and different application of OP-AMP circuit.
CO5: Identify and understand various digital circuits.
CO6: Design basic combinational and sequential circuits.

COURSE CONTENT

Diode applications
Limiters, clippers, clampers, Zener diode applications: Voltage stabilizers.

Bipolar junction transistor
Analysis of transistor amplifier in CE configuration using BJT small signal model.

Field Effect Transistors
JFET structure and characteristics, MOS structure and characteristics, MOS as a switch CMOS as an inverter.

Power Amplifier and Feedback circuit
Types of amplifier and their equivalent circuit (VA, CA, Trans conductance and Trans resistance amplifier), Class A, B amplifier, Concept and types of feedback topology, Analysis of practical feedback amplifiers, Barkhausen criterion, RC and LC phase shift oscillator(qualitative description), output frequency of the oscillator.

Operational Amplifier
OP-AMP as differentiator and integrator circuit, OP-AMP as comparator, square wave generator using OP-AMP, Schmitt trigger, 555 timer.

Introduction to Digital Circuits
Logic Gates preview
Boolean Algebra:Logic operations**,** Axioms and Laws of Boolean Algebra, Duality, Reducing Boolean Expressions, Boolean Functions and their representation, Expansion of a Boolean Expression in SOP form and POS form.
Minimization of Switching Functions: Introduction, Two-variable K-Map, Three-variable K-Map, Four Variable K-Map, Don't care Combinations.

Combinational Logic Design
Introduction, Adders, Subtractors, Encoders, Decoders,Priority Encoder, Multiplexer, Demultiplexer.

Sequential Logic Design
Flip Flops: Latches and Flip Flops, Race Around Condition, Master Slave (Pulse-Triggered) Flip Flops, Flip Flop Excitation tables, Shift Registers and Counters

ADC and DAC
Introduction, Digital to Analog converter (Weighted Resistor type and R-2R ladder type), Analog to Digital converter (Flash type, Counter type and Successive approximation type).

Text Books:

1. Integrated Electronics- Analog and Digital Circuits and Systems, J. Millman&Halkias, C.D. Parikh, Mc-Graw Hill India, 2nd Edition, 2013 (10th Reprint).
2. Op-Amps and Linear Integrated Circuits - Ramakant A. Gayakward , Pearson, 4th Edition, May 2015.
3. Digital Logic and Computer Design – M. Morris Mano – PHI, 2011
4. Fundamentals of Digital Logic – Anand Kumar - PHI, 4th Edition, 2017

Reference Books:

1. Digital Principles and Applications – Malvino & Leach –TMH, 7th edition, 2011
2. Digital Fundamentals – T. L. Floyd & Jain – Pearson Education, 10th edition, 2011
3. Microelectronics circuits- A. S. Sedra and K. C. Smith- 5th Edition, 2011 - Oxford University Press.
4. Linear Integrated Circuits - D. Roy Choudhury and Shail B. Jain- 5th Edition- New Age International Publishers, 2018.
5. Foundations Of Analog and Digital Electronic Circuits:-Anant Agarwal, Elsevier India (2013)

ELECTRIC CIRCUIT ANALYSIS

Course Code : EE21001
Credit :4
L-T-P :3-1-0
Prerequisite : Physics (PH10001)

COURSE OBJECTIVE
To develop problem solving skills and understanding of circuit theory through the application of techniques and principles of electrical circuit analysis to common circuit problems.

COURSE OUTCOMES

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

CO1: Illustrate the basics of DC and AC circuits.
CO2: Analyze different electrical circuits using network theorems.
CO3: Inspect the magnetic coupled circuits.
CO4: Analyze the transients response in AC/DC circuits.
CO5: Evaluate different network parameters in two port networks.
CO6: Design different passive filter circuits.

COURSE CONTENT

DC and AC Circuits

DC circuit-Basic terminology- circuit, network, mesh, loop, node, junction, active network, passive network, lumped network, distributed network, bilateral element and unilateral element, linear and non linear network, Independent and dependent source**,** Source transformation, star-delta transformation, mesh analysis, nodal analysis.

AC circuit-Basic terminology-Amplitude, time period, frequency, phase, phase difference, average value, R.M.S value, form factor, peak factor, phasor representation of alternating quantities, Phasor Algebra, AC Series circuit, Resonance in AC series and parallel Circuit, concept of band width and Q-factor, Three phase AC circuits- voltage and current relations in star and delta connections.

Network Theorems for DC and AC Circuits

Superposition theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer theorem, Reciprocity Theorem.

Magnetic coupled circuits

Self and Mutual Inductance, Dot convention for coupled circuits and coefficient of coupling, Single Tuned coupled circuit.

Transient Response

Duality of circuits, Transient response for R-L, R-C and R-L-C circuits with both DC and AC excitation in time domain and Laplace transformation method.

Network Parameters

Network Configurations, Open Circuit, Short circuit, transmission and hybrid parameters, Condition of symmetry and reciprocity in two port network, Interconnection of two port networks (Series, Parallel and Cascade).

Filter-Design

Passive filters, Design of low pass, high pass, band pass, and band elimination filter.

Text Books:

1. Circuits and Networks Analysis and Synthesis (Second Edition) A Sudhakar ShyammohanS Palli, Tata McGraw-Hill, 2011.
2. Fundamentals of Electric Circuits, Charles K. Alexander, Matthew N.O. Sadiku, McGraw Hill Education; 5 edition (1 July 2013).

Reference Books:

1. Basic Circuit Analysis(Second Edition), John O'Malley, Schaum'sOutlines, Tata McGraw-Hill, 2010(Reprint).
2. Network Theory Analysis and Synthesis by Ravish R Singh, S. Chand Publication 1st edition 2023.
3. Network Analysisby M. E. Van Valkenburg, Pearson Education, 3rd Edition, 2006.

4. Engineering circuit analysis by William Hart Hayt Jack E Kemmerly Steven M Durbin
5. Networks and systems by D.Roy Choudhury, New Age Publication, 2nd Edition, June 2013.

POWER ELECTRONICS

Course Code : EE30001
Credit : 3
L-T-P : 3-0-0
Prerequisite : Analog and Digital Electronics Circuits (EE20007)

COURSE OBJECTIVE

It aims to familiarize readers with switching devices, power converters, and their uses in different power control systems.

COURSE OUTCOMES

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

CO1: Relate basic semiconductor physics to properties of power devices to identify for converter application.
CO2: Analyze performance of single phase and three phase controlled rectifiers.
CO3: Assess efficacy of various topologies of DC to DC converters.
CO4: Evaluate the control schemes for single phase and three phase Inverters.
CO5: Determine the quantitative outcomes of AC to AC voltage regulator.
CO6: Elaborate the merits and demerits of mid point type cyclo-converter.

COURSE CONTENT

Introduction to Power Electronics
Comparison of power devices operating in the switch mode to those operating in the active region.

Power Electronic Devices
Thyristor characteristics, Turn ON methods, Dynamic Characteristics of thyristors, Ratings, Protection, Snubber circuit, Two Transistor Model of thyristor, Characteristics and construction of Power MOSFETS, Characteristics and construction of IGBT, SiC based power devices and applications.

AC to DC Converters
Single Phase Converters – Half Wave with R, RL, RLE load and effect of free Wheeling diode, Single Phase half and full controlled full Wave converters with R and RLE Load, performance parameters of single phase AC to DC converters, Effect of source Inductance, 3 Phase half and fully controlled rectifiers, Power factor correction circuit.

DC to DC Converters
Step up and Step Down choppers, 4 quadrant choppers for control of DC motor. basic concepts of bi-directional converter,Forward and Flyback converters.

Inverters
Single Phase Half Bridge and Full Bridge Inverters, 3 Phase Inverters, 180° and 120^0 conduction, Voltage Control of inverters, Concept of multi level inverters, modulation techniques.

AC to AC Converters
Single phase AC Voltage regulator with R and RL load, Single phase mid-point type cyclo-converter with R-L Load.

Text Books

1. Power Electronics by M. H. Rashid, Pearson Education, 3rd Edition, 2009.
2. Power Electronics, by P S Bhimbra, Khanna Publishers, 5th Edition, 2011.
3. Fundamentals of Electric Drives, G.K. Dubey, Second Edition, Narosa Publishers, 2007.

Reference Books

1. Power Electronics, Converters, Applications and Design N. Mohan, Undeland and Robbins, John Wiley and Sons , 3rd Edition ,2009.
2. Modern Power Electronics by P. C Sen, S Chand Publisher- 2013.
3. Power Electronics K.R.Varmah and Chikku Abraham, Cengage Publications- 2014.
4. Power Electronics by M. D. Singh and K.B. Khanchandani, Tata McGraw - Hill publishers, 2nd edition, 2008.
5. Bimal K. Bose, Power Electronics and Motor Drives: Advances and Trends, Academic Press, Har/Cdr edition (13 September 2006).

PRINCIPLES OF COMMUNICATION ENGINEERING

Course Code : EE30002
Credit : 3
L-T-P : 3-0-0
Prerequisite : Signals and System (EE20006)

COURSE OBJECTIVE

The course aims at building fundamental concepts on the operation of analog and digital communication systems and their application in industries as well as research.

COURSE OUTCOMES

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

CO1: Understand the importance of Fourier analysis in communication systems.
CO2: Explain the fundamental concepts of analog and digital communication systems.
CO3: Develop the ability to compare the strengths and weaknesses of various communication systems.
CO4: Classify different types of AM (Analog Modulation) techniques and their principles.
CO5: Analyze different types of angle modulation schemes (FM and PM), their generation and detection.
CO6: Apply signal space representation in analysis of digital communication systems.

COURSE CONTENT

Application of probability and statistics in Communication

Random variables, Probability density function, Fourier transform of normal distribution and application in communication, signal to noise ratio, digital quantization and SNR, Power spectral density. Parseval's theorem, Power and energy transfer through a network.

Amplitude Modulation Systems

Frequency translation, recovery of baseband signals, amplitude modulation, maximum allowable modulation, the square law demodulator, spectrum of AM signal, balanced modulator, SSB modulation and generation, VSB, FDM, noise in AM.

Frequency Modulation System

Phase and frequency modulation and their relationship, frequency deviation, narrowband FM, wideband FM, Carson's rule for bandwidth, Armstrong and parameter variation methods of FM generation, noise in FM.

Digital Communication

Pulse modulation systems, sampling theorem, pulse amplitude modulation, quantization of signals, quantization error, pulse code modulation (PCM) system, companding, time-division multiplexing (TDM), DPCM, DM, ADM. Basic Digital Modulation Techniques: DM, ADM, DPCM, and ADPCM for speech, ASK, PSK, QAM, FSK, etc. Baseband Communication: Line coding, matched filter, correlation receiver, basics of inter-symbol interference, equalization.

Text Book

1. H. Taub, D. L Schilling, G. Saha, Principles of Communication System, Tata McGraw Hill, 3rd Edition 2008
2. A. B. Carlson, Communication Systems, McGraw-Hill , 5th Edition 2017

Reference Books

1. B.P. Lathi, Zhi Ding, Modern Analog and Digital communication Systems, Oxford , 4th Edition 2011
2. Michael Moher Simon Haykin, Communications Systems, Wiley , 5th Edition 2009

MICROPROCESSOR AND EMBEDDED SYSTEM

Course Code : EE30004
Credit :3
L-T-P : 3-0-0
Prerequisite : Analog and Digital Electronics Circuit (EE20007)

COURSE OBJECTIVE

The objective of this course is to teach students the fundamentals of microprocessors and microcontrollers. Additionally, the course discusses the fundamentals of advanced microcontrollers and different processor-related industrial applications.

COURSE OUTCOMES

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

CO1: Distinguish between 8 bit and 16 bit Microprocessors.
CO2: Practice in assembly language programs in 8085 and 8086 microprocessors.
CO3: Describe the architecture of 8051 microcontroller.
CO4: Analyze the different programs of 8051 microcontroller.
CO5: Acquire the knowledge of the AVR microcontrollers.
CO6: Demonstrate different applications of microprocessors and microcontrollers.

COURSE CONTENT

8085 and 8086 Microprocessors
History of microprocessor, Architecture of 8085, Fetchand execute operation,Addressing mode of 8085, Data Transfer Instruction, Arithmetic, Logical, remote, branch and machine control instructions, Development of 8085 assembly language programs, Interrupts of 8085, Memory and I/O interfacing, Architecture of 8086, Minimum and maximum mode configurations of 8086, Addressing modes of 8086, Instructions set of 8086, Assembly language programming of 8086.

8051 Microcontroller
Introduction, Architecture of 8051, Instruction-sets of 8051, Assembly language programming of 8051.

AVR Microcontroller
Introduction, Overview of AVR family, Architecture of AVR, Addressing modes of AVR, Assembly language programs of AVR.

Industrial Application of Microprocessors
ADC, DAC interfacing, Automation and control application, Digital PID controller, PWM control of a DC motor, Stepper motor control.

Text Book

1. B. Ram, “Fundamentals of Microprocessors and Microcontrollers ", 7th Edition, Dhanpat Rai publications, 2010.
2. Douglas V Hall Microprocessor and Interfacing, TMH publication.

Reference Books

1. Muhammad Ali Mazidi, Sepehr Naimi,"Sarmad Naimithe AVR Microcontroller And Embedded Systems Using Assembly and C" PHI,1st Edition, Inc, 2017.
2. R. Theagarajan "Microprocessors and Microcontrollers"-1st Edition, SCITECH publications (India) Private limited, 2004.
3. Desmukh , "Microcontrollers –Theory and Application"- 1st Edition, TMH Publication, 2005.
4. A. P. Mathur, "Introduction to microprocessors" e-TMH Publication – 3rd edition, 2011
5. Md. Rafiquzzaman, "Microprocessors & Microcomputer based System Design",2nd edition,1995.

TRANSMISSION AND DISTRIBUTION OF ELECTRIC POWER

Course Code : EE31001
Credit : 4
L-T-P : 3-1-0
Prerequisite : Electric Circuit Analysis (EE21001)

COURSE OBJECTIVE

To give the students requisite basic knowledge about the key parameters of transmission and distribution of modern power supply system, analyze the performance of transmission lines, cables, distribution systems and mechanically design the components of a power system.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO1: Understand the economic aspect and calculation of per unit value of a power system.
CO2: Evaluate the line constants in different configuration of overhead lines
CO3: Analyze the performance of transmission lines
CO4: Design the mechanical parameter of overhead transmission system
CO5: Analyze the corona loss, voltage distribution in different distribution modules and its performance of underground cables
CO6: Analyze the mathematical calculation of different types of fault and its effects.

COURSE CONTENT

Introduction to Power system
Power system layout and per unit calculation

Economic Aspects
Load curve, Load duration curve, Connected load, Maximum demand, Demand factor, Average demand, Load factor, Diversity factor, Plant capacity Factor, Plant Use Factor,

Line constants
Resistance, Inductance and capacitance of single phase and three phase line with symmetrical and unsymmetrical spacing, GMD and GMR calculation, Transposition of power line, Effect of earth on line capacitance, Charging current due to capacitance effect, Bundle conductors, Skin effect and Proximity effect.

Performance of Transmission line
Analysis of short, medium and long Transmission Line, ABCD constants and its calculation for Short, Medium and Long Transmission Line, Ferranti effect, surge Impedance and Surge Impedance Loading.

Mechanical Design of over head transmission lines
Types of conductor and insulator, Potential distribution over a string of suspension Insulators, String Efficiency, Methods of equalization of the potentials, Sag and Stress calculation, Effect of ice and wind loading, Vibration dampers.

Corona
Critical disruptive voltage, Visual critical voltage, Corona Power losses, Factors affecting corona, Advantages and Disadvantages of Corona.

Underground cable and Distribution Systems
Overhead line verses underground cables, Type and construction, Grading of cables, Insulation resistance of cable, Capacitance of three core cable, dielectric losses.

Classification of distribution system, Types of AC and DC distributors, Voltage drop and load calculation for concentrated and distributed loads, Feeder, Radial and ring main system, Economic choice of conductor, Kelvin's law.

Symmetrical and Unsymmetrical Fault Analysis
Introduction, Transients in transmission line, Symmetrical components, Sequence analysis of power system, Symmetrical Fault analysis, Unsymmetrical Fault analysis: L-G, L-L, L-L-G.Basics of Earthing and grounding system.

Text Books:

1. Electrical Power System, C.L. Wadhwa, New Age International (P) Limited, Publishers, 2009.
2. A Text Book on Power System Engineering, A. Chakrabarti, M.L. Soni, P.V. Gupta and U.S. Bhatnagar, Dhanpat Rai and Co., Reprint 2012.

Reference Books:

1. A Course in Power System, J. B. Gupta, S K Kataria and Sons Publishers and Distributors, 2011.
2. Power System Analysis and Design- By B. R. Gupta, S. Chand Publications, 3rd Edition, Reprint, 2003.
3. Principle of Power System by V.K.Mehta, S.Chand Publishers, 2012.
4. Elements of Power System Analysis, W.D. Stevenson Jr, TMH, 1982.
5. Overhead Power lines planning, design and construction, by F Kiessling, P Nefzger, J F Nolasco and U Kaintzyk, Springer- Verlag

POWER SYSTEM OPERATION CONTROL AND PROTECTION

Course Code : EE31002
Credit : 4
L-T-P : 3-1-0
Prerequisite :Transmission and Distribution of Electric Power (EE31001)

COURSE OBJECTIVE
This subject provides the basic knowledge of analyzing a power system by different studies and know the philosophy of protection and the methods to protect power system components.

COURSE OUTCOMES

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

CO1: Solve load flow problems.
CO2: Evaluate the economic operation of power generation system.
CO3: Understand power system stability
CO4: Know the philosophy of protection system
CO5: Analyze the protection scheme of alternator and transformer
CO6: Comprehend the protection scheme of busbar, feeder and protection against surges

COURSE CONTENT

Load Flow Studies
Bus classification, Nodal Admittance matrix, Formulation of load flow problem, Approximate load flow solution by Gauss-Siedel Method with and without PV bus, acceleration of convergence, Newton-Raphson Method, Decoupled and Fast decoupled method.

Economic Operation of Power System
Introduction, Optimal operation of generators, Distribution of load on various generating units, Penalty factor and Transmission loss as a function of plant generation.

Stability Analysis
Introduction to stability, Dynamics of synchronous machines, Swing equation, Power angle curve and its equation, Steady state stability, Equal area criterion, Effect of clearing time on stability.

Introduction: Philosophy of protection
Philosophy of protection, requirement of ideal protective scheme, different terms in protective systems, Basic elements in protective scheme, relay, principle of operation, types of relay, Requirement of circuit breakers, types of CB, characteristics of an electric arc, principle of AC and DC arc interruption, Recovery voltage, re-striking voltage, current chopping, resistance switching.
Alternator Protection
Different types of faults, differential protection with biasing, restricted earth fault protection, negative sequence protection, automatic field suppression and neutral circuit breakers.

Transformer Protection
Buchholz relay, Biased differential protection, restricted earth fault protection, harmonic restraint, protection of combined alternator and transformer.

Bus Bar Protection
Differential scheme for both phase and line faults, introduction to digital protective relay and microprocessor based relays.
Feeder protection
Time graded protection: radial, parallel and ring feeders; over current and earth fault protection,carrier current protection. Circulating current differential protection (Merz-Price protection) or percentage differential protection scheme, opposed.

Protection against Surges
Ground wire, Surge diverters: rod gap, horn gap lighting arresters, surge absorbers.

Text Books:

1. Electrical Power System, C.L. Wadhwa, New Age International (P) Limited, Publishers, 2009.
2. Modern Power System Analysis, I. J. Nagrath, D. P. Kothari, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 3rd Edition, 2003.
3. Fundamentals of Power System Protection", Y. G. Paithankar, S. R. Bhide, 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2011.

Reference Books:

1. Power System Analysis by T K Nagsarkar and M S Sukhija, 1st Edition, Eighth impression 2012, Oxford University Press.
2. Power System Analysis Operation and Control, Abhijit Chakrabarti, Sunita Halder, Third Edition, 2010, PHI Learning Private Limited.
3. Power System Protection and Switchgear by B Rabindranath and M Chander , Wiley Eastern 2017, 2nd Edition.
4. Power System Analysis- By John. J. Grainger & W. D. Stevenson, Jr., TMH, 2003 Edition, (15th Reprint).

POWER TRANSMISSION AND DISTRIBUTION

Course Code : EE30007
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

To give the students requisite basic knowledge about the key parameters of transmission and distribution of modern power supply system, analyze the performance of transmission lines, cables, distribution systems and mechanically design the components of a power system.

COURSE OUTCOMES

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

CO1: Understand the concept of complex power and per unit value of a power system.
CO2: Evaluate the line constants in different configuration of overhead lines.
CO3: Analyze the performance of transmission lines.
CO4: Design the mechanical parameter of overhead transmission system.
CO5: Analyze the corona loss and the performance of underground cables.
CO6: Determine the current and voltage distribution in different distribution modules.

COURSE CONTENT

Introduction

Single and 3-phase transmission, Concept of complex power, Per Unit system, Power System layout. Supply System: Comparison of AC and DC transmission, Advantage of high voltage transmission, Advantages and Disadvantages of EHV (AC) and HVDC Transmission.

Line constants

Resistance, Inductance of Single phase and three phase line with symmetrical and unsymmetrical spacing, GMD and GMR calculation, Transposition of power line, Capacitance of Single-phase line, Effect of earth on line capacitance, Charging current due to capacitance effect, Bundle conductors, Skin and Proximity effect.

Performance of Transmission line

Analysis of short, medium and long Transmission Line, ABCD constants and its calculation for Short, Medium and Long Transmission Line, Ferranti effect, Surge Impedance and Surge Impedance Loading, Line compensators.

Mechanical Design of overhead transmission lines

Types of conductors and insulator, Insulating materials, Potential distribution over a string of suspension Insulators, String Efficiency, Methods of equalization of the potentials, Sag and Stress calculation, Effect of ice and wind loading, Vibration dampers.

Corona

Critical disruptive voltage, Visual critical voltage, Corona Power losses, Factors affecting corona, Advantages and Disadvantages of Corona, Problem Discussion, Radio Interference between power and communication line.

Underground Cable

Overhead line verses underground cables, Type and construction, Grading of cables, Insulation resistance of cable, Capacitance of three core cable, dielectric losses.

Distribution Systems

Classification of distribution system, Types of AC and DC distributors, Feeder, Voltage drop and load calculation for concentrated and distributed loads, Radial and ring main system, Economic choice of conductor, Kelvin's law.

Text Book

1. Electrical Power System, C.L. Wadhwa, New Age International (P) Limited, Publishers, 2009.
2. A Text Book on Power System Engineering, A. Chakrabarti, M.L. Soni, P.V. Gupta and U.S. Bhatnagar, Dhanpat Rai and Co., Reprint 2012.

Reference Books

1. A Course in Power System, J. B. Gupta, S K Kataria and Sons Publishers and Distributors, 2011.
2. Power System Analysis and Design- By B. R. Gupta, S. Chand Publications, 3rd Edition, Reprint, 2003.
3. Principle of Power System by V.K.Mehta, S.Chand Publishers, 2012.
4. Elements of Power System Analysis, W.D. Stevenson Jr, TMH, 1982.

ELECTROMAGNETIC FIELD THEORY

Course Code : EE30011
Credit : 3
L-T-P : 3-0-0
Prerequisite : Physics (PH10001)

COURSE OBJECTIVE

Knowledge of physical interpretation, and ability to apply Maxwell's equations to determine field waves, potential waves, energy and charge conservation conditions.

COURSE OUTCOMES

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

CO1: Understand the concept of different coordinate systems.
CO2: Apply the different laws in Static Electric Field.
CO3: Apply Maxwell's equation for both static and time varying fields.
CO4: Derive the wave equation for lossless dielectric and determine Poynting vector.
CO5: Determine Standing-Wave Ratio in plane wave for normal and oblique incidence.
CO6: Calculate the parameters of transmission line.

COURSE CONTENT

Coordinate System and Vector Calculus
Rectangular, Cylindrical and Spherical Coordinate Systems, Gradient, Divergence and Curl operation.

Static Electrical Field
Coulomb's Law, Electric field intensity due to continuous line charge, surface charge and volume charge, method of images, Electric potential, equipotential surface , Gauss's law, Maxwell's Equation.

Electric Field in Different Materials
Continuity equation, Uniqueness Theorem, Poisson's and Laplace Equation.

Steady Magnetic Fields
Magnetic scalar and vector potential, Energy stored in magnetic field, Magnetic forces, Biot-Savart's law, Ampere's circuital law.

Time Varying Fields
Charged particle moving in a static magnetic field, Moving conductor in a static magnetic field, Faraday's law.
Electromagnetic Waves and Transmission Line Helmholtz's wave equation, wave propagation in lossless dielectric, Plane wave in free space, Poynting vector, Reflection and Refraction in plane wave, normal and oblique incidence, Transmission-line equations.

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Text Books

1. Engineering Electromagnetic by W.H. Hayt &John A. Buck, 7th Edition TMH, 2006
2. Elements of Electromagnetic by M. N. O Sadiku, 4th Edition, Oxford, 2010.

Reference Books

1. Electromagnetic waves and radiating Systems E.C Jordan & Balmin, 2nd Edition, PHI,2009
2. C. R. Paul, K.W. Whites, S. A. Nasor, Introduction to Electromagnetic Fields, 3rd Edition, TMH, 2011
3. Electromagnetic Field Theory by S. Salivahanan & S Karthie, Vikas Publisher 2016.
4. Electromagnetic Field Theory by Rohit Khurana, Vikas Publisher, 2015.

SENSORS AND ACTUATORS

Course Code :EE30012
Credit : 3
L-T-P : 3-0-0
Prerequisite : Measurement and Sensor Technology (EE20005)

COURSE OBJECTIVE

This course helps the students to have an exposure to sensors and its importance in the real world. Student will be able to understand basics of sensors, actuators and their operating principle and also have knowledge about simulation and characterization of different sensors.

COURSE OUTCOMES

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

CO1: Understand components of sensor and its selection criteria.
CO2: Select suitable sensors for measuring displacement and velocity.
CO3: Apply suitable sensor for force, weight and pressure measurement.
CO4: Choose suitable sensor for measurement of temperature, level and flow.
CO5: Know about different actuators and Electrical actuating systems.
CO6: Use micro sensor and micro actuators in different applications.

COURSE CONTENT

Introduction
Definition of sensor and transducer, classification, characteristics. Selection criteria of transducers. Smartsensor: Blockdiagram, features.

Displacement and velocity Measurement
Linear and rotary displacement sensors: Potentiometer, capacitive, inductive. Positionmeasurement: OpticalEncoder, proximitysensors.

Velocity measurement: Tachometer types, Stroboscope, Encoder
Measurement of Force, Weight and Pressure
Force and weight measurement : Strain gauge, load cell. Pressure measurement: Manometer types, Strain gauge, diaphragm gauge, capsule, bellows, bourdon tube, piezoelectric sensor.

Temperature measurement
Temperature scales, Mechanical thermometers: Filled insystems, Metallic expansion, Electrical thermometers: RTD, Thermo-couple, Semiconductor temperature sensors.

Level and Flow measurement
Mechanicalmethods: floatanddisplacer. Electricalmethods: Resistance,inductive, capacitance type.Ultrasonic level gauging. Basic principles of flow measurement. Differential pressure devices: orifice, venturi, flow nozzle, pitot tube, annubar.

Actuators
Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria.

Electrical actuating systems
Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors - AC motors - Single phase and 3 Phase Induction Motor; Synchronous Motor; Stepper motors - Piezoelectric Actuator.

Micro Sensors
Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors. Simulation and characterization of various sensors using COMSOL Multiphysics.

Micro actuators
Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of microactuators: Electrostatic, magnetic, fluidic, inversepiezoeffect.

Text Book

1. Industrial instrumentation and control, S.K.Singh, 3rd Edition,TMH

Reference Books

1. Transducers and Instrumentation, Murthy.D.V.S,2001,PrenticeHallofIndia.
2. Sensors and transducers, Patranabis.D,2003,PHI.
3. Microsystem Technology and Microrobotics, Sergej Fatikowand Ulrich Rembold, 1st edition, Springer-Verlag Berlin Heidelberg.
4. Shape memory actuators, Manfred Kohl, first edition, Springer.

INDUSTRIAL APPLICATIONS OF ELECTRIC ENERGY

Course Code : EE30013
Credit : 3
L-T-P : 3-0-0
Prerequisite : Electric Circuit Analysis (EE21001)

COURSE OBJECTIVE

This subject gives a comprehensive idea in utilization of electrical power such as drives, electric heating, electric welding and illumination, electric traction, electrolysis process.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO 1: Select the suitable motors for different applications.
CO 2: Analysis the different type of tariff based on load demand.
CO 3: Examine the characteristics and intensity of lightning systems for different types of lamps.
CO 4: Analyze various electrolytic processes.
CO 5: Understand the Process of different kinds of electric heating and electric welding.
CO 6: Know the application of different lamps.

COURSE CONTENT

Motor power rating and selection
General considerations in selecting motor power rating, Selection of motor capacity for continuous duty, Equivalent current, torque and power methods, Selection of capacity for short term and intermittent periodic duty.

Electric Tariff
Classification of costs, Formulation of Electric Tariff, Various kinds of Tariff, Economics of Generation, Load duration curve, Base load and peak load plants, Effect of Load Factor, diversity Factor and power factor on tariff.

Electric Heating and Welding
Advantages of electrical heating, Design of heating elements, Heating methods, Resistance Heating, Induction Heating, Dielectric Heating, Resistance furnace, Causes of failure of heating elements, Temperature control of resistance furnace, Arc furnace, Advantages of electric welding, Welding methods: Resistance welding, Electric arc welding, Atomic hydrogen welding, Modern welding techniques: Ultrasonic and Laser welding.

Illumination
Introduction, terminology in illumination: luminous flux, luminous intensity, lumen candela power, illumination lux, lamp efficiency, Brightness glare, Space height ratio, Polar curve, Laws of illumination, Co-efficient of utilization, Maintenance factor, Depreciation factor, Solid Angle, Types of Lamps: Arc Lamp, Incandescent lamp, Sodium vapor lamp, Mercury Vapor Lamp, Fluorescent Lamp, Neon Lamp, Types of Lighting Scheme, Flood Lightning, Street lightning, Compact Lighting Characteristics.

Electrolytic Processes
Fundamental principles, Faradays law of electrolysis, Extraction and refining of metals, Electro deposition.

Text Books
1. Generation, Distribution and Utilization of Electrical Power by C.L. Wadhwa, Wiley Eastern Ltd, New Delhi, 2006.
2. Utilization of Electrical Power and Electric Traction by J B Gupta, S K Kataria and Sons, Delhi, 2011.

Reference Books
1. Art & Science of Utilization of Electrical Energy by H. Pratab, Dhanpat Rai & Co.(P) Ltd. 2013.
2. Utilization of Electric power by Er. R K Rajput, Lakshmi publications Pvt. Ltd, 1st Edition 2006.
3. Electrical Technology volume – III, by B L Thereja, A.K Thereja, S Chand Publisher – 2013.

POWER GENERATION AND CONTROL

Course Code : EE30014
Credit : 3
L-T-P :3-0-0
Prerequisite : Electric Circuit Analysis (EE21001)

COURSE OBJECTIVE

This subject provides the basic knowledge of various types of power generating stations. Students will be able to know the know the philosophy of components of generating power stations, generation control, substations, tariff, and power factor improvement.

COURSE OUTCOMES

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

CO1: Understand various energy sources and their applications to power stations.
CO2: Discuss the requirement and description of various components used in different power generation station
CO3: Compare various sources of power generation and evaluate their power output.
CO4: Analyze the performance of the speed governing system
CO5: Elaborate on the process of testing and commissioning for different substation components.
CO6: Measure power factor and tariff in electrical power system.

COURSE CONTENT

Introduction

Introduction to different sources of Energy. Discussion on application of energy sources to power station.

Thermal Power Plant
Layout of thermal power plant, Main Equipment, Coal Handling plant, Boiler, Super heater, Reheater, Economizer,Air Preheater steam turbine,condenser, Ash handling plant, Cooling tower and ponds, Feed water heater, E.S.P, Power supply to auxiliaries. Governor, specific speed, Plant auxiliaries. Load frequency control,Turbine speed governing system,Modelling of speed governing system, Turbine model, generator model,load model, Integrated representation of various model,Excitation System: DC exciter, AC exciter, static exciter, AVR.

Hydro Power Plant
Classification according to (i) Water Flow (ii) Load (iii) Head, surge tank, Penstock, spillway, Tail Race, Types of turbine (i) Pelton turbine, (ii) Francis turbine, (iii) Kaplan turbine,Governor, specific speed, Plant auxiliaries.

Nuclear Power Plant
Location, Layout of nuclear power plant, Fission, Fusion, controlled chain reaction, Classification of Nuclear reactors –Advanced Gas cooled Reactor, Pressurized Water Reactor, Boiling Water Reactor, Fast Breeder Reactor, Reactor Control & Cooling.

Diesel Electric Power plant and Gas Turbine Power plant
Introduction, Selection of site, Layout and Main components, Application.

Electrical System
Testing and commissioning of generators and power transformers.HT, EHT, and LV Substation arrangements. Station batteries and battery chargers. Tariffs-Types, power factor improvement.

Text Book

1. Generation of Electrical Energy, B.R. Gupta, S.Chand Publication, 2009.
2. A course in power system, J.B.Gupta, S.K.Kataria and Sons Publication,2013.

Reference Books

1. 1.B.G.A. Skrotzki and W.A. Vopat, Power Station Engineering and Economy, McGraw Hill, Digitized on Dec 2007.
2. Nag's Power Plant Engineering, 5th Edition, By Sudipta De, McGraWHill , 2021

IOT FOR ELECTRICAL ENGINEERING

Course Code : EE30015
Credit : 3
L- T-P : 3-0-0
Prerequisite : Analog and Digital Electronics Circuit (EE20007) and Signal and System (EE20006)

COURSE OBJECTIVE

This course enhance both device-to-device interactions, as well as device-to-human interactions via the Internet. IoT systems facilitate controlling and monitoring devices from anywhere by integrating sensors, actuators, local processing and storage devices, wireless networks, Internet, and cloud computing and their applications in electrical engineering**.**

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO1: Identify the components of IoT.
CO2: Analyze various protocols of IoT.
CO3: Apply internet of things in power sector.
CO4: Examine schemes for the applications of IoT in home automation.
CO5: Demonstrate embedded development platform.
CO6: Create building blocks of Internet of Things and characteristics.

COURSE CONTENT

Introduction
Definition, Components in internet of things, Sensing and Actuation Anywhere, Anytime, Genesis of the Internet of Things, Power Sources, Internet Principles, Internet Communications: An Overview (IP, TCP, The IP Protocol Suite (TCP/IP), UDP), IP Addresses (DNS, Static IP Address Assignment, Dynamic IP Address Assignment, IPv6), MAC Addresses, TCP and UDP Ports.

The internet of things in the power sector
Asset Performance Management, Operational Optimization, Comprehensive Customer Services and Experiences

Advanced Embedded Development Platforms
System on Chip (SoC), ARM®, Raspberry Pi, Evolution of Pi and technical specification comparative study, GPIO Interfacing Cloud, Analytics & UI, Client Server Model, HTTP, Thingspeak, AWS, CloudMQTT.

Home Automation
Sensor based automated technologies, PIR Sensor, GSM module, Node MCU Module, Bluetooth module, Humidity sensor.

Text Books:

1. Designing the Internet of Things, Adrian McEwen, Hakim Cassimally, Wiley publication, 1st Edition, November 2013.
2. The Internet of Things in the Power Sector Opportunities in Asia and the Pacific, Ramamurthy, A. and Jain, P, 2017.

Reference Books:

1. The Internet of Things: A Survey, Journal on Networks, Luigi Atzori, Antonio Lera, Giacomo Morabito, Elsevier Publications, October, 2010.
2. The Internet of Things in the Cloud:A Middleware Perspective, Honbo Zhou, CRC Press-2012.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Springer, 2011.

RENEWABLE ENERGY RESOURCES

Course Code : EE30016
Credit : 3
L-T-P : 3-0-0
Prerequisite :Nil

COURSE OBJECTIVE

To facilitate the students to achieve a clear conceptual understanding of technical aspects of Renewable Sources of Energy.

COURSE OUTCOMES

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

CO 1: Understand the need of renewable energy sources for future requirements.
CO 2: Demonstrate on various solar thermal system applications.
CO 3: Apply the concept of solar PV for maximizing the energy efficiency.
CO 4: Describe the process of extraction of power from wind energy and biomass energy.
CO 5: Analyze the scope of Geothermal and Ocean energy.
CO 6: Reflect the concept of principle of operation of fuel cell and its applications.

COURSE CONTENT

Fundamentals of Energy

Energy Consumption and standard of living, Classification of Energy Resources, Importance of Non-Conventional Energy Sources, Common Forms of Energy, Advantages and Disadvantages of Conventional energy Sources, Environmental aspects of energy, Environment–economy-energy and sustainable development, Energy densities of fuels, Energy scenario in world and India.

Basics of Solar Energy, Solar Thermal and Photovoltaic Systems

Basics of Solar Energy: Extraterrestrial and Terrestrial Radiations, Depletion of Solar Radiation, Solar Time, Solar Radiations Measurement.

Solar Thermal Systems: Solar Collectors: Classification, Performance indices, Working of Flat plate collector and Evacuated Tube collector, various other types of Collectors, Solar Passive Space – Heating and Cooling Systems, Solar thermal energy applications in Water Heater, Cookers, Furnaces, Green House, Dryer and Distillation**.**

Solar Photovoltaic Systems: Solar Cell Fundamentals, P-N Junction, Generation of electron hole pair, Photoconduction, Solar Cell Characteristics, Effect of variation of isolation and temperature, Energy payback period, Solar Cell Classification, Solar Cell, Module, Panel and Array Construction, Cell mismatch and Effect of shadowing. Maximizing the Solar PV Output and Load Matching, Maximum Power Point Tracker (Perturb and Observance method and Incremental conductance method).

Wind and Biomass energy

Wind Energy: Origin of Winds, Nature of Winds, Wind Turbine Siting, Major Application of Wind Power, Power extraction from wind, Wind Turbine Types and Their Construction, Speed control strategies for wind turbine, Power versus wind speed Characteristics, Wind Energy Conversion Systems (WECS), Environmental aspects of wind energy, Wind energy programme in India.

Biomass Energy: Usable Forms of Biomass, their Composition and Fuel Properties, Biomass Resources, Energy Farming, Biomass Conversion Technologies, Urban Waste to Energy Conversion, Biomass Gasification, Biomass Liquefaction, Biomass to Ethanol Production.

Geothermal and Ocean energy, Fuel cells

Geothermal Energy: Applications, Origin, and Distribution of Geothermal Energy, Types of Geothermal Resources, Environmental aspects of Geothermal energy, Geothermal Energy in India

Ocean Energy: Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Environmental impact, Tidal Energy: Energy from tides, Tidal energy conversion scheme: single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy.

Wave energy: Power from wave, wave energy conversion devices, advantages and disadvantages of wave energy, Environmental impact

Fuel cells:Principle of working of various types of fuel cells and their working, performance and limitations, MHD (Magneto hydro dynamics) generation principles, advantages and disadvantages.

Text Book

1. B. H. Khan, “Non – Conventional Energy Resources” Tata Mc Graw Hill, 2nd edition 2009.
2. N. K. Bansal, Manfred Kleemann, Michael Meliss, “Renewable energy sources and conversion technology", Tata Mc Graw Hill, 1990.

Reference Books

1. Kothari D.P., “Renewable energy resources and emerging technologies”, Prentice Hall of India Pvt. Ltd, 2006.
2. Rai G.D, "Non-Conventional Energy Sources", Khanna Publishers, 4th Edition 2000.
3. Ashok V. Desai, "Nonconventional Energy", New Age International Publishers Ltd, Reprint 2003.

NEURAL NETWORK AND FUZZY LOGIC

Course Code : EE30017
Credit : 3
L-T-P : 3-0-0
Prerequisite : Science of Living Systems (LS10001) and Differential Equations and Linear Algebra (MA11001)

COURSE OBJECTIVE

To provide the student with the basic understanding of neural networks and fuzzy logic fundamentals and their application to Electrical Engineering.

COURSE OUTCOMES

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

CO1: Understand the basic model of Neural network.
CO2: Examine the different types of Neural network and their learning rules.
CO3: Demonstrate the feed forward neural network and application of BPA.
CO4: Know the concept of unsupervised neural network and its application.
CO5: Understand the concept of recurrent neural network and its application.
CO6: Design a fuzzy logic controller for real world.

COURSE CONTENT

Fundamentals of Artificial Neural Network
Introduction, Biological Neuron model, Characteristics of ANN,Basic neuron model, Classification, Feed forward and Recurrent topologies, Activation functions, Types of Learning algorithms: Supervised, Un-supervised, Hebbian, Widrow-Hoff, Perceptron, Delta and winner-take-all learning rules, Regression Techniques.

Feed forward Neural Network
Perceptron representation, Linear inseparable problem, overcoming the linear inseparable problem, feed forward model, multilayer network model, back propagation learning methods, mathematical effect of learning rule co-efficient, back propagation algorithm (BPA), factors affecting back propagation training, Learning difficulties and improvements, Application of back propagation algorithm.

Unsupervised Neural Network
Introduction, Competitive Learning, Vector Quantization, clustering and classification, SOM learning algorithm, gross berg layer and its training, Adaptive Resonance Theory (ART), Instar, Outstar, ART1, ART2.

Recurrent Neural Network
Architecture of Hopfield Network, Recurrent network configuration, energy function, basic concept of dynamic system, Hopfield network algorithm, General Concepts of Associative Memory, Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms, Storage and Recall Algorithm,BAM Energy Function.

Fuzzy Logic

Basic concept of fuzzy logic, Crisp set, Fuzzy set, crisp and fuzzy relation, crisp and fuzzy logic, Fuzzyfication, membership function, linguistic variable, universe of discourse, interference in fuzzy logic, fuzzy If-Then rule, defuzzyfication methods, fuzzy controller and applications.

Text Books

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Pai- PHI Publication. 2011
2. Introduction to Artificial Neural Systems- Jacek M.Zurada, Jaico Publishing House, 1997.

Reference Books

1. Neural and Fuzzy Systems: Foundation, Architectures and Applications, – N. Yadaiah and S. Bapi Raju, Pearson Education
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications," McGraw Hill, 1995.
3. B.Yegnanarayana, "Artificial Neural Networks," PHI, India, 2006.

RESTRUCTURING OF POWER SYSTEM

Course Code : EE30018
Credit :3
L-T-P :3-0-0
Prerequisite :Power System Operation Control and protection (EE31002)

COURSE OBJECTIVE

To explain basic concepts and issues related with restructuring and deregulation of power industry.

COURSE OUTCOMES

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

CO1: Understand the need of restructuring of power system, different entities in deregulated environment.
CO2: Acquire knowledge of basic concepts of economics and applied them to solve practical applications
CO3: Understand market models and mechanisms for electricity as a commodity
CO4: Realize the issues related with transmission congestion management, locational marginal pricing and ancillary management.
CO5: Analyze the issues like fairness and social welfare with reference to transmission system usage and loss allocation.
CO6: Appreciate the need of reforms in power sector with focus on Indian power sector.

COURSE CONTENT

Introduction to restructuring of power industry

Power Sector in India, Reasons for restructuring / deregulation of powerindustry ,Understanding the restructuring process, Introduction to issues involved in deregulation , Reasons and objectives of deregulation of various power systems across the world.

Fundamentals of Economics and Market Models

Introduction, Consumer behavior, Supplier behavior, Market equilibrium, Short-run and Long-run costs, Various costs of production, Relationship between short-run and long-run average costs, Perfectly competitive market Market models based on contractual arrangements, Comparison of various market models, Electricity vis-à-vis other commodities, Market architecture.

Congestion Management and Locational Marginal Prices

Introduction, Classification of congestion management methods Calculation of ATC, Non-market methods, Market based methods, Nodal pricing, Inter-zonal Intra-zonal congestion management, Price area congestion management, Fundamentals of Locational Marginal Pricing (LMP), LMP formulation and implementation, LMP using DCOPF.

Ancillary Service Management

Introduction to ancillary services Types of ancillary services Classification of ancillary services Load-generation balancing related services, Voltage control and reactive power support services, Black start capability services, Mechanism for ancillary services.

Pricing of Transmission Network Usage and Loss Allocation

Introduction to transmission pricing, Principles of transmission pricing, Classification of transmission pricing methods, Rolled-in transmission pricing methods, Marginal transmission pricing paradigm Introduction to loss allocation methods, classification of loss allocation methods Reforms in Indian power sector.

Text Book

1. Kankar Bhattacharya, Math H.J. Boller, JaapE. Daalder, 'Operation of RestructuredPower System' KlumerAcademic Publisher,2010.
2. Mohammad Shahidehpour, and Muwaffaqalomoush, - "Restructured electrical Power systems" Marcel Dekker, Inc., 2009.

Reference Books

1. Loi Lei Lai; "Power System Restructuring and Deregulation", John Wiley & Sons Ltd., England.
2. "Know Your Power", A citizens Primer On the Electricity Sector, Prayas Energy Group, Pune.
3. Sally Hunt, "Making Competition Work in Electricity", 2002, John Wiley Inc.

MODERN CONTROL SYSTEM

Course Code : EE30019
Credit : 3
L-T-P : 3-0-0
Prerequisite : Linear Control System (EE20004)

COURSE OBJECTIVE

To learn the methods for analyzing and designing the behaviour of linear and nonlinear control systems.

COURSE OUTCOMES

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

CO1: Understand state space modelling and find state solution
CO2: Check controllability and observability of the system and state feedback design
CO3: Realize Full order and reduced order observer design
CO4: Know about discrete time control system with its stability analysis
CO5: Study the nonlinear system'sbehaviour by phase plane and describing function method.
CO6: Analyze the stability of nonlinear control system

COURSE CONTENT

State Space and State Solution
Transfer Function Decomposition, Controllable Canonical Form, Observable Canonical Form, Cascade Form, Parallel Form, Non Uniqueness of State Model, Diagonalization: Similarity Transformation, State Solution, Concept of Controllability and Observability, Kalman and Gilbert Test, Stability, Pole assignment by state feedback using Ackermann's formula**.**

Observability and Stability
Duality between controllability and observability - Full order Observer based controller design. Reduced order observer design. Observability and observable canonical form - Design of full order observer using Ackermann's formula. Stability of a system.

Discrete Time Control Systems
Sampled Data Control Systems, Principle of Discretization: Impulse, Step Invariance Methods, Bilinear Transformation, Pulse transfer function, Relationship between s-plane and z-plane. Stability :Routh Hurwitz in Discrete Domain and Jury's Test.

Nonlinear control system
Introduction, Difference between linear and nonlinear system, Common physical nonlinearities, The phase plane method: Basic concepts, Singular points, Limit cycle and Jump resonance, Construction of phase trajectories, The describing function method: basic concepts, derivation of describing function, stability of nonlinear system using Lyapunov technique.

Text Books

1. Advanced Control System, by B. N. Sarkar, PHI Learning, Latest edition
2. Control System Engg, by I.J. Nagrath and M Gopal, New age international publication, Latest edition.

Reference Books

1. Digital Control and State Variable Methods, M. Gopal, TMH Publishers, Latest edition
2. Discrete time control systems by K. Ogata (PHI), Latest edition
3. Automatic Control Systems by Benjamin C Kuo, Prentice-Hall, Latest edition
4. Modern Control Engg. by K. Ogata PHI publication, Latest edition
5. Control systems Engineering by R.Ananda Natarajan and P.RameshBabu, SCITECH Publication, Latest edition

ENERGY AUDIT AND ACCOUNTING

Course Code :EE 30020
Credit : 3
L-T-P :3-0-0
Prerequisite :Electric Circuit Analysis (EE21001)

COURSE OBJECTIVE

The objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs and accounting the cost of energy.

COURSE OUTCOMES

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

CO1: Analyze the importance of energy audit.
CO2: Understand the concept of energy conservation and audit.
CO3: Apply the concept of accounting in energy audit.
CO4: Design the capacitor rating for power factor improvement.
CO5: Evaluate the energy efficiency of furnace and CHP System.
CO6: Create a report for an Economic Evaluation.

COURSE CONTENT

General Aspects
Indian Energy scenario, definition of energy conservation, management and audit,, Energy audit-need, Types of energy audit, Energy Audit Reporting Format ,Energy audit instruments, Energy Conservation schemes, Energy index, Cost Index, Representation of energy consumption.Economic and ecological implications on management & auditing systems, auditing on emission, pollution, safety and reliability.

Energy Utilization and Conversion System
Furnace: Classification of furnace, controlled atmosphere in furnace, furnace fuels, efficiency of energy in furnace, thermal efficiency, heat losses, reducing heat losses.
Combined heat and power systems: Characteristic of prime movers, heat and power requirement, economics of C.H.P. system

Industrial Heating
Resistance heating, Induction heating, arc Heating, dielectric and microwave atmosphere generators, radiant heating

Lighting
Lamp lifetime, efficient lighting
Motive power and power factor improvement
Cost of electrical Energy, Power factor improvement, Capacitor rating, sitting the capacitor, effect of power factor improvement. Hydraulic power system, Electrical Measurement, Temperature measurement and optimal start control.

Economic Analysis
Introduction, Basic Concepts, Interest Rate, Inflation Rate, Tax Rate ,Cash Flows, break even charts, Compounding Factors, Single Payment, Uniform-Series Payment, Economic Evaluation Methods Net, Present Worth, Rate of Return Benefit–Cost Ratio, Payback Period, Summary of Economic Analysis Methods, Life-Cycle Cost Analysis Method, General Procedure for an Economic Evaluation.Financing Options, Direct Purchasing, Leasing, Performance Contracting

Text Book
1. W.R. Murphy and G. McKay, "Energy management", Butterworth & Co Publishers, Oxford, UK, 2001.
2. Energy Audit of Building systems: An Engineering approach, by: Moncefkrarti, CRC PRESS, Second Edition, 2009.

Reference Books
1. A Workbook for Energy Management in building by: Tarik Al-Shemmeri, Wiley-Blackwell.
2. Energy audit: Thermal power, combined cycle, and co-generation plants, by: Y. Pabbi, TERI, 2011.
3. Energy Management Handbook, Seventh Edition, (Fairmont Press Inc., 2007) by WC Turner.
4. Bureau of Energy Efficiency (BEE) (2016); Study material for Energy managers and Auditors Examination: Paper I.

SPECIAL MACHINES AND CONTROL

Course Code :EE30022
Credit : 3
L-T-P :3-0-0
Prerequisite :Electrical Machine I (EE20003) and Electrical Machine II (EE20002)

COURSE OBJECTIVE

To understand the working of special machines like stepper motor, switched reluctance motor, BLDC motor & PMSM and Linear induction motor with proper design of controller for smart inverter used to control the above special machine.

COURSE OUTCOMES

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

CO1: Understand the operation of different special machines.
CO2: Select different special machines as part of control system components.
CO3: Analysis of Linear induction motor and its control.
CO4: Design digital controllers for different machines.
CO5: Apply the knowledge of axial and radial flux motor into a way of thinking to solve in real time applications.
CO6: Design smart Inverters and its sizing for grid and off grid connection.

COURSE CONTENT

Stepper Motors

Introduction, Hybrid stepping motor, construction, principles of operation, energization with two phase at a time, essential conditions for the satisfactory operation of a 2-phase hybrid steper motor ,very slow speed synchronous motor for servo control-different configurations for switching the phase windings-control circuits for stepping motors,an open-loop controller for a 2-phase stepping motor.

Linear Induction Motor
Development of a double-sided LIM from rotary type IM- A schematic of LIM drive for electric traction development of one-sided LIM with back iron-field analysis of a DSLIM fundamental assumptions.

Synchronous Motors
Construction- Principle of operation of Permanent Magnet Synchronous Motors – EMF and torque equations – Starting – Rotor configurations –Dynamic model, Synchronous Reluctance Motors: Constructional features–axial and radial flux motors – operating principle – characteristics.

Control of PMSM, BLDC and Switched Reluctance Motor
Bipolar optical sensor based control of Trapezoidal BLDC Motor, Sensorless control of BLDC motor, Torque ripple control of BLDC motor,Unipolar control for SRM, Torque ripple control of SRM.

Smart Inverters
Selection of power conditioning unit (PCU), Sizing of solar inverter for roof top and grid connected projects, Passive and active protection, IEC/IEEE /Grid Compliance of inverters, Grid-Connected Inverters vs. Stand-Alone Inverters.

Text Book
1. Miller, T. J. E., Brushless Permanent Magnet and Reluctance Motor Drives, Oxford Science Publications, 1989.
2. Kenjo, T., and Sugawara, A., Stepping Motors and their Microprocessor Controls, Oxford Science Publications, 1984.

Reference Books
1. Krishnan, R., Electric Motor Drives: Modeling, Analysis, and Control. Prentice Hall, (2001).
2. Krishnan, R., “Permanent Magnet and BLDC Motor Drives”, CRC Press, 2009.
3. Chang-liang, X., "Permanent Magnet Brushless DC Motor Drives and Controls", Jun 2012.

ELECTRIC DRIVES AND CONTROL

Course Code : EE30024
Credit : 3
L-T-P :3-0-0
Prerequisite :Power Electronics (EE30001)

COURSE OBJECTIVE

It aims to familiarize readers with steady-state performance, starting, dynamic and regenerative braking, plugging and reverse direction operation, speed control, sudden and temporary overloads, ambient conditions and mechanical coupling of machines.

COURSE OUTCOMES

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

CO1. Select the motors for different types of loads in industry.
CO2. Understand the various braking methods of electrical drives.
CO3. Know the applications of different electric motors.
CO4. Analyze the open loop and closed loop control techniques of different drives.
CO5. Understand different speed control techniques for various industrial drives.
CO6. Analyze the performance of Permanent Magnet Synchronous and Brushless DC motor drives.

COURSE CONTENT

Introduction
Basic elements of an electric drive, Four quadrant operation of an electric drive, Dynamics of motor load combination, Types of loads, Stable operating condition of various motor load combinations, Fundamental load torque equation, Speed and current limit control, Load curve, load equalization, motor selection and rating calculations.

DC Motor Drives
Review of characteristics of DC motors, Modification of characteristics of DC shunt and series motors, Concept of Electric Braking, Regenerative, Dynamic and Counter current braking of DC motors.
Control of DC motor drives
Open loop speed control, Closed loop Speed control, Closed loop speed and current control, Closed loop Torque control, Hysteresis controller, PI controller.
Solid State Control of DC drive
Chopper and rectifier based DC Separately excited motor and series motor drive control, four quadrant drive using dual converter.

Induction Motor Drives
Review of characteristics of three phase Induction motors, Modification of speed torque characteristics due to variation of stator voltage, Stator frequency and rotor resistance, Electric Braking of Induction Motors: Regenerative Braking, DC Dynamic braking and Plugging, Slip Power recovery.

Speed Control of Induction Motors
Control of IM by three phase AC-AC Voltage controller, PWM Voltage Source Inverter fed induction motor drives, Current source inverter fed induction motor drives, Comparison of VSI and CSI fed drives, slip compensation schemes, closed loop control (V/f control).

Synchronous and Brushless DC Motor Drives

Synchronous motors, cylindrical rotor, salient pole synchronous motor, permanent magnet synchronous motor, synchronous reluctance motor, Transients due to load disturbances, Braking, Permanent magnet AC motor drives, Sinusoidal PMAC motor drives, Brushless DC motor Drives.

Text Book

1. G.K. Dubey, Fundamentals of Electric Drives, Second Edition, Narosa Publishers, 2007.
2. S. K. Pillai: A First Course On Electrical Drives, New Age International Publishers, 2nd Edition, 2007.

Reference Books

1. Bimal K. Bose, Power Electronics and Motor Drives: Advances and Trends, Academic Press, Har/Cdr edition (13 September 2006).
2. N. K. De, P. K. Sen: Electric Drives, PHI Learning Pvt. Ltd., 7th Edition, 2004.
3. Modern Power Electronics and AC Drives by Bimal. K. Bose, PHI Publisher, 1st Edition, 2013.
4. S.A. Nasar, Boldea , Electrical Drives, CRC Press, Second Edition, 2006
5. M. A. El-Sharkawi , Fundamentals of Electrical Drives , Thomson Learning, 1st Edition, 2000.
6. R. Krishnan, Electrical Motor Drives, PHI, 2003

DISTRIBUTION SYSTEM PLANNING AND AUTOMATION

Course Code : EE30026
Credit : 3
L-T-P :3-0-0
Prerequisite :Transmission and Distribution of Electrical Power (EE31001)

COURSE OBJECTIVE

This course gives the complete knowledge of electrical distribution systems, the design of feeders, substations. It also gives conceptual knowledge on how to determine the performance of a distribution system through its important parameters i.e. voltage drops and power losses and the very important thing that protection of the system by means of protective devices and their co-ordination during the several fault conditions. it also specifies how to improve the voltage profiles and power factors of the system to better value using various voltage control and compensation techniques.

COURSE OUTCOMES

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

CO1 Know the concept of distribution planning.
CO2 Understand load forecasting techniques.
CO3 Identify appropriate substation location and its component.
CO4 Evaluate a distribution system for a given geographical service area.
CO5 Determine the location and optimum size of capacitor for distribution system.
CO6 Understand the concept of distribution system automation.

COURSE CONTENT

Planning and forecasting techniques

Methods of load forecasting: regression analysis, correlation analysis and time series analysis, Load management, tariffs and metering of energy.

Distribution Transformers: Types – Three phase and single phase transformers – connections Dry type and self- protected type transformers – regulation and efficiency. Sub Transmission Lines,

Distribution Sub–Stations: Distribution substationsBus schemes –description and comparison of switching schemes, Substation location and rating

Primary Systems

Types of feeders – voltage levels – radial type feeders.

Voltage Drop and Power Loss Calculations: Three phase primary lines – Copper loss – Distribution feeder costs – Loss reduction and Voltage improvement in rural networks.

Distribution Systems: Effects of series and shunt capacitors – justification for capacitors – Procedure to determine optimum capacitor size and location,

Distribution System Protection: Basic definitions – types of over current protection devices. Objective of distribution system protection.

Distribution System Automation

Reforms in power sector, Methods of improvement, Reconfiguration, Reinforcement, Automation, Communication systems, Sensors, Automation systems, Basic architecture of Distribution automation system, software and open architecture, RTU and Data communication , SCADA requirement and application functions, GIS/GPS based mapping of Distribution networks, Communication protocols for Distribution systems , Integrated sub, station metering system , Revenue improvement , issues in multi–year tariff and availability based tariff.

Text Books:

1. Turan Gonen : Electric Power Distribution Engg., Mc-Graw Hill,1986.
2. A. S. Pabla : Electric Power Distribution, TMH, 2000.

Reference books:

1. Shahnia, Farhad, Arefi, Ali, Ledwich, "Electric Distribution Network Planning",2018,Springer Nature Singapore Pte Ltd.
2. James Northcote-Green , Robert G. Wilson, ``Control and Automation of Electrical Power Distribution Systems", 1st Edition, September 22,2006 , Taylor and Francis Publisher.

HVDC AND FACTS

Course Code : EE30028
Credit : 3
L-T-P :3-0-0
Prerequisite : Transmission and Distribution of Electrical Power (EE31001) and Power Electronics (EE30001)

COURSE OBJECTIVE

To understand the configuration and working of HVDC & AC systems. To impart knowledge on application of shunt and series compensators to improve AC power transmission using FACTS devices.

COURSE OUTCOMES

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

CO1 Know the basic of HVDC transmission systems
CO2 Analyze converter configurations used in HVDC and list the performance metrices
CO3 Apply the control techniques to HVDC transmission systems
CO4 Analyze the reactive power requirement and harmonics with its elimination in HVDC system.
CO5 Realize the application of FACTS devices in power system.
CO6 Analyze shunt and series compensation in a transmission system.

COURSE CONTENT

HVDC Transmission
DC Power Transmission: Introduction, Need for power system interconnections, Types of DC links, relative merits, Components of a HVDC system, Modern trends in DCTransmission systems
Analysis of HVDC Converters
Pulse number, choice of converter configurations, Analysis of Graetz circuit with and without overlap, voltage waveforms, Analysis of two and three valve conduction mode, Converter Bridge characteristics, Inverter mode of operation, voltage waveforms.

Converter and HVDC Control
Principles of DC link control, Converter Control characteristics, Control hierarchy Constant current (CC) control, CIA control, CEA Control, firing angle control of valves, starting and stopping of a dc link, Power control.

Reactive Power and Harmonics in HVDC
Reactive power requirements in steady state, conventional control strategies, alternate control strategies, Sources of Reactive Power, harmonics and filters, Generation of harmonics, types of ac filters, DC filters for HVDC system.

Flexible AC Transmission Systems (FACTS)
FACTS concepts and general system conditions: Power flow in AC systems, Basic types of FACTS controllers, shunt and series controllers, Current source and Voltage source converters

Static Shunt Compensators
Objectives of shunt compensation, Methods of controllable VAR generation, Static Var Compensator, its characteristics, TCR, TSC, FC-TCR configurations, STATCOM, basic operating principle
Static Series Compensators
Objectives of series compensator, variable impedance type of series compensators, TCSC, TSSC and Combined Compensators. Introduction to Unified Power Flow Controller, Basic operating principles

Text Book:

1. Power System stability and Control, Prabha Kundur, McGraw Hill, Inc
2. HVDC Power Transmission Systems –Technology and System Interactions, K.R.Padiyar, New Age International Publishers
3. Understanding FACTS –Concepts and Technology of Flexible AC Transmission Systems, Narain G.Hingorani, Laszlo Gyugyi

Reference Book:

1. Sang, Y.H. and John, A.T., Flexible AC Transmission Systems, IEEE Press (2006).
2. EHVAC and HVDC Transmission Engineering and Practice – S.Rao.
3. High Voltage Direct Current Transmission, J. Arrillaga, Peter Pregrinu
4. Thyristor Based FACTS Controllers for Electrical Transmission Systems R. Mohan Mathur, Rajiv K. Varma Wiley 1 st Edition, 2002

SOLAR ENERGY UTILIZATION

Course Code : EE30030
Credit :3
L-T-P :3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

To provide a deep introduction about solar energy basics, principles, materials, theories and derivations about solar radiation, devices and its applications.

COURSE OUTCOMES

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

CO1: Analyze the mathematical modelling of the solar radiation pattern
CO2: Estimate solar radiations and its measurement methods
CO3: Understand the construction features of various solar collectors
CO4: Analyze the performance parameters of various solar collectors
CO5: Explore the various applications of solar energy
CO6: Categorize the different forms of the energy storage units

COURSE CONTENT

Solar Radiation

History of solar energy utilization - Solar radiation and modelling - Empirical equations for predicting the availability of solar radiation – Measurement of global, direct and diffuse radiation – Radiation computations on inclined surfaces – Angstrom's turbidity - Solar chart - Standard radiation scale.

Solar Radiation Measurement and Estimating

Measurement of solar radiation - Solar energy measuring instruments – Pyranometer – Pyrheliometer – Sunshine recorder - Estimation of average solar radiation - Ratio of beam and total radiation on tilted surface of that on horizontal surface.

Solar Collectors

Flat plate collector - Materials for flat plate collector and their properties - Thermal Analysis of Flat- plate Collector and Useful Heat Gained by the fluid - fin efficiency, collector efficiency, Heat Removal Factor, Focusing collectors, Types and applications of focusing collectors

Solar Energy Applications

Introduction and principle of operation of solar cooker, solar air heater, solar water heater, solar distillation, solar pond, solar thermal power generation, Greenhouse effect, Solar PV application

Storage of Solar Energy
Types of Energy Storage, Thermal Storage, Electrical Storage, Chemical Storage, hydro-storage

Text Book
1. Rai, G.D., Solar Energy Utilization, Khanna Publishers, N. Delhi, 2010.
2. Sukhatme S.P., Solar Energy, Tata McGraw Hills P Co.,3rd Edition, 2008

Reference Books
1. Jean Smith Jensen, Applied solar energy research: a directory of world activities and bibliography of significant literature, Volume2, Association for Applied Solar Energy, Stanford Research Institute, 2009.
2. Duffie, J.A., and Beckman, W.A. Solar Energy Thermal Process, John Wiley and Sons, NewYork, 2006. Jui Sheng Hsieh, Solar Energy Engineering, Prentice- Hall, 2007.

SUSTAINABLE ENERGY AND APPLICATIONS

Course Code : EE30032
Credit :3
L-T-P :3-0-0
Prerequisite : Nil

COURSE OBJECTIVE
Objective of this course is to inculcate in students an awareness of environmental issues and the global initiatives towards attaining sustainability. The student should realize the potential of technology in bringing in sustainable practices.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO1: Understand the relevance and the concept of sustainability and the global initiatives,
CO2: Explain the different types of environmental pollution problems and their sustainable solutions.
CO3: Discuss the environmental regulations and standards.
CO4: Outline the concepts related to conventional and non-conventional energy.
CO5: Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles
CO6: Know the various methods for increasing efficiency in building.

COURSE CONTENT

Sustainability
Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

Environmental Pollution
Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection.

Environmental management standards
ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.

Resources and its utilisation
Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy.
Sustainability practices
Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanisation, Sustainable cities, Sustainable transport.
Smart and Intelligent Materials

Text Book
1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning

Reference Books
1. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
2. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
3. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System

NETWORK ANALYSIS

Course Code : EE30034
Credit : 3
L-T-P : 3-0-0
Prerequisites : NIL

COURSE OBJECTIVE
To familiarize the basic theorems to analyzing electrical circuits, explain the concept of coupling in electric circuits and analyze the transient response of circuits with dc and ac input. Understand the concept of two port network and able to design filters.

COURSE OUTCOMES

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

CO1: Analyze different electrical circuits using network theorems.
CO2: Understand the magnetic couple circuits.
CO3: Apply the transients in DC/AC circuits.
CO4: Evaluate different parameters of two port networks
CO5: Know the concept of network topology
CO6: Design different passive filters

COURSE CONTENT

Network Theorems
Independent and dependent source**,** Source transformation, Maximum Power Transfer theorem (Both AC and DC Network), Reciprocity Theorem, Millman's Theorem and Tellegen's Theorem, Analysis of circuit with one nonlinear network.Thevenin's, Norton's and superposition theorem for AC circuits.

Magnetic coupled circuits
Self and Mutual Inductance, Dot convention for coupled circuits and coefficient of coupling, Single Tuned coupled circuit.Double Tuned coupled circuits.

Transient Response
Duality of circuits, Transient response for R-L, R-C and R-L-C circuits with both DC and AC excitation in time domain and Laplace transformation method.Analyze RLC transient behavior using MATLAB/P-Spice/Multisim.

Two-Port Networks
Network Configurations, Open Circuit, Short circuit, transmission and hybrid parameters, Condition of symmetry and reciprocity in two port network, Interconnection of two port networks (Series, Parallel &Cascade).Inter-relationship between parameters of two port network, Image parameters.

Network Topology
Concepts of Network graph, Tree, Co-Tree, Links and Twigs, Formation of incidence matrix [A] and loop matrix [B] Formation of Fundamental Cut-Set Matrix [QF], Tie-Set Matrix.Relation between branch voltage and current, loop current network topology analysis.

Filter Design
Passive filters, Design of low pass, high pass, band pass, and band elimination filter.Application of different electric filters, Concept of Active filter.

Text Books :

1. Network Analysisby M. E. Van Valkenburg, Pearson Education, 3rd Edition, 2006.
2. Networks and systems by D.Roy Choudhury, New Age Publication, 2nd Edition, June 2013.

Reference Books :

1. Circuits and Networks Analysis and Synthesis (Second Edition) A Sudhakar ShyammohanS Palli, Tata McGraw-Hill, 2011.
2. Basic Circuit Analysis(Second Edition), John O'Malley, Schaum'sOutlines, Tata McGraw-Hill, 2010(Reprint).
3. Fundamentals of Electric Circuits, Charles K. Alexander, Matthew N.O. Sadiku, McGraw Hill Education; 5 edition (1 July 2013).

SOLAR POWER TECHNOLOGY

Course Code : EE30036
Credit : 3
L-T-P : 3-0-0
Prerequisites : NIL

COURSE OBJECTIVE
The objective of solar power technology is to harness the energy from the sun and convert it into usable electrical power. Solar power technology aims to provide a sustainable and renewable energy source that can replace traditional fossil fuel-based energy generation methods.

COURSE OUTCOMES

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

CO1: Understand the historical development of solar energy utilization and approaches to harnessing solar energy
CO2: Know the semiconductor physics of solar cell
CO3: familier with different converters for grid integration
CO4: Apply the MPPT technique to extract maximum solar power
CO5: Understand various solar thermal systems and its applications
CO6: Analyze the balance of system components for efficient and optimal performance of solar thermal instalation

COURSE CONTENT

Introduction

Basics of solar energy, Brief History of solar energy utilization, various approaches of utilizing solar energy, Blackbody radiation, Relation between radiation field energy density and radiation spectrum, Planck's formula in energy unit, Maximum spectral density, Planck's formula in wavelength unit, Wien displacement law, Stefan Boltzmann law, Photoelectric effect, Einstein's theory of photons, Einstein's derivation of the black-body formula.

Solar Cells

Formation of a p-n junction, Space charge and internal field, Quasi - Fermi levels, The Shockley diode equation - Structure of a solar cell, The solar cell equation, Fill factor and maximum power, Various electron, hole-pair recombination mechanisms, Crystalline silicon solar cells, Thin film solar cells, organic solar cells**.**

Solar Photovoltaic System

Solar PV modules from solar cells, Balance of solar PV system, Inverters (DC/DC, DC/AC), Power conditioning, Maximum power point operation Balance of System (BOS) for PV module installation, Concentrated solar power (CSP) systems.Standalone PV system design, Grid-connected PV system.

Solar thermal systems

Solar Collectors, Solar Water Heater, Solar Passive Space – Heating and Cooling Systems, Solar Refrigeration and Air Conditioning Systems, Solar Cookers, Solar Furnaces, Solar Green House, Solar Dryer, Solar Distillation. Solar Thermo-Mechanical Systems, Balance of System Components.

Text Books :

1. Solar Photovoltaics, fundamentals Technoloies and Applications, by Chetan Singh Solanki, PHI, 2nd edition 2012
2. Jui Sheng Hsieh, Solar Energy Engineering, Prentice-Hall, 2007.

Reference Books :

1. Micheal Boxwell , Solar Electricity Handbook, Green Stream publishing (2010).
2. Rai G.D, Non-Conventional Energy Sources, Khanna Publishers, 4th Edition 2000.
3. Kothari D.P., Renewable energy resources and emerging technologies, Prentice Hall of India Pvt. Ltd,2006.

INTRODUCTION TO ELECTRICAL MACHINES

Course Code : EE30038
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

The objective of this course to enable the efficient and effective conversion of one form of energy into another form by using various DC and AC machine.

COURSE OUTCOMES

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

CO1: Know the principle of electromechanical Energy conversion system.
CO2: Understand the principle of operation and characteristics of DC generator.
CO3: Analuze the performace of DC motor through its characteristics
CO4: Analyze the performace of transformer by equivalent circuit
CO5: Know the oprtaion principle, torques and starting of 3 phase induction motor.
CO6: Understand the construction, operating principle and application of Synchronous Machine

COURSE CONTENT

Electromechanical Energy Conversion
Principle, Singly Excited Magnetic System and Doubly Excited Magnetic system, Physical concept of torque production, Electromagnetic torque and Reluctance torque.

DC Machines
DC Generator: EMF equation of dc generator, methods of excitation, armature reaction, interpoles and compensating winding, commutation, characteristics of separately excited and self excited dc generator, losses, condition for maximum efficiency. DC Motor: Working principle, voltage equation, condition for maximum power, characteristics, operating characteristics of dc motor, torque developed, speed control methods.

Transformers
Single Phase Transformer: Working principle, types, EMF equation, Transformer on no load and full load, vector diagram, exact and approximate equivalent circuit, O.C and S.C.test on transformer, Voltage regulation of transformer, losses and efficiency, condition for maximum efficiency, Auto transformer, 3 Phase transformers: connections (Y-Y, Y-Δ, Δ- Δ, Δ-Y).

3 Phase Induction Motor
Types, rotating magnetic field, principle of operation, slip, frequency of rotor current, rotor emf, rotor current, vector diagram and equivalent circuit, expression for torque, conditions for maximum torque, torque slip characteristics, starting torque in squirrel cage and slip ring motors, effect of change in supply voltage on torque, slip and speed , relation between full load torque and maximum torque, Power stages in induction motor, starting methods for 3 phase induction motor.

Synchronous Machine
Alternator: Basic principle, pitch factor, distribution factor, emf equation, alternator on load, voltage regulation: Synchronous impedance method. Synchronous motor: Basic principle.

Text Book

1. Electrical Machines, Ashfaq Hussain, Dhanpat Rai, Delhi, 2nd Edition, 2008.
2. Electrical Machinery, P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.

Reference Books:
1. Principles of Electrical power systems by J. B. Gupta
2. Text book of Electrical Machine by K R Sidhapura and D B Raval, Vikash, 1st edition, 2013.

ENERGY AND ENVIRONMENT

Course Code : EE30040
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

To understand the fundamentals of energy sources, energy use, energy efficiency, and resulting environmental implications of various energy supplies. To introduce various aspects of environmental pollution and its control. To understand the causes and remedies related to social issues like global warming, ozone layer depletion, climate change etc. To introduce various acts related to prevention and control of pollution of water and air, forest protection act, wild life protection act etc.

COURSE OUTCOMES

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

CO1: Understand energy scenario, energy sources, and their utilization.
CO2: Understand various methods of energy storage, energy management, and economic analysis.
CO3: Analyse the awareness about the environment and ecosystem.
CO4: Understand the environmental pollution along with social issues and acts
CO5: Analyze the social issues on the environment and its protection
CO6: Analyze the source of environment pollutions and its remedies

COURSE CONTENT

Basic Introduction to Energy
Energy and power, forms of energy, primary energy sources, energy flows, world energy production and consumption, Key energy trends in India: Demand, Electricity, Access to modern energy, Energy production and trade, Factors affecting India's energy development: Economy and demographics Policy and institutional framework, Energy prices and affordability, Social and environmental aspects, Investment.

Energy Storage Systems
Thermal energy storage methods, Energy saving, Thermal energy storage systems Energy Management: Principles of Energy Management, Energy demand estimation, Energy pricing Energy Audit: Purpose, Methodology with respect to process Industries, Characteristic method employed in Certain Energy Intensive Industries.

Environment
Introduction, Multidisciplinary nature of environmental studies- Definition, scope and importance, Need for public awareness. Ecosystem: Concept, Energy flow, Structure and function of an ecosystem. Food chains, food webs and ecological pyramids, Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems, Ecological succession.

Environmental Pollution
Definition, Cause, effects and control measures of - Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and Nuclear hazards, Solid waste Management, Disaster management Role of an individual in prevention of pollution, Pollution case studies.

Social Issues and the Environment
Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation. Group assignments: Assignments related to e-waste management; Municipal solid waste management; Air pollution control systems; Water treatment systems; Wastewater treatment plants; Solar heating systems; Solar power plants; Thermal hermal power plants; Hydroelectric power plants; Biofuels; Environmental status assessments; Energy status assessments etc.

Text Book

1. Textbook for Environmental Studies for Undergraduate Courses of all Branches of Higher Education University grant commission and Bharathi Vidyapeeth Institute of environment education and Research, Pune
2. Energy Management Audit & Conservation- for Module 2 Barun Kumar De Vrinda Publication 2nd Edition 2010

Reference Books

1. Energy Management Hand book Turner, W. C., Doty, S. and Truner, W. C Fairmont Press 7th Edition 2009
2. Energy Management Murphy, W. R Elsevier 2007
3. Energy Management Principles Smith, C. B Pergamum 2007
4. Environment pollution control Engineering C S Rao New Age International reprint 2015, 2nd edition
5. Environmental studies Benny Joseph Tata McGraw Hill 2nd edition\

INVERTER AND SMPS

Course Code : EE40007
Credit : 3
L-T-P :3-0-0
Prerequisite : Power Electronics (EE30001)

COURSE OBJECTIVE

The objective of this course is to teach students the concept of classical inverters, multilevel inverters, SMPS and their industrial applications.

COURSE OUTCOMES

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

CO1: Understand the concept of single phase inverter and its control
CO2: Realize the concept of three phase inverter and its operation
CO3: Know the concept of multilevel inverters, classifications and their operation
CO4: Apply the various PWM techniques to inverters
CO5: Analyze the switched mode converters and their mathematical modeling
CO6: Demonstrate different industrial applications of inverters and SMPS

COURSE CONTENT

Inverter

Half-bridge single phase inverter, Full-bridge single phase inverter, PWM single phase inverter, Uni-polar and Bipolar PWM Techniques for single phase inverter, Three phase inverter, 180 degree and 120 degree conduction mode of three phase inverter, PWM three phase inverter.

Multilevel Inverter

Concept of multilevel inverter, Cascaded H-Bridge, Diode-clamped and Capacitor clamped multilevel inverters, Switched Capacitor Multilevel Inverter, PWM Techniques for multilevel inverter. Industrial Applications of Multilevel Inverters

Switched Mode Power Converter (SMPS)

Isolated and non-isolated SMPS, Fly-back converter, Forward converter, Average modeling of converters, Small signal analysis to determine control to output transfer function for the converters. Industrial Applications of SMPS.

Text Book

1. Power Electronics: Circuits, Devices and Applications by M H Rashid, 3rd Edition, 2015, Pearson Education.
2. Elements of Power Electronics by Philip T. Krein, 2nd Edition, 2016, OXFORD University Press

Reference Books

1. Power Electronics: Converters, Application and Design by Mohan, Undeland, Riobbins, John Wiley and Sons, 3rd Edition, 2012.
2. Power Electronics by MD Singh, K.B. Khanchandani, TMH Education Private Limited, 2nd Edition, 2011.
3. Power Electronics Essentials and Applications by L Umanand, Wiley, 2009

PRINCIPLES OF HARMONIC ELIMINATION AND APPLICATION

Course Code :EE40008
Credit : 3
L-T-P : 3-0-0
Prerequisite :Power Electronics (EE 30001)

COURSE OBJECTIVE

Objective of the course is to introduce to the harmonic distortion problems which includes equipment overheating, motor failures, capacitor failure and inaccurate power metering and to understand harmonic elimination techniques using filters.

COURSE OUTCOMES

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

CO1: Comprehend the various terms related to harmonics and their standards.
CO2: Examine the causes of harmonic generation from electrical loads.
CO3: Investigate non-characteristic harmonics and inter-harmonics.
CO4: Analyze the effects of harmonics on different electrical components and systems.
CO5: Evaluate different harmonics measurement techniques.
CO6: Design filters for elimination of harmonics.

COURSE CONTENT

Introduction
Linear and nonlinear loads, introduction to different power quality issues, causes and their effects, definition- RMS value, average power, True power factor, K-factor, Phase Shift, Phase Sequence, Standards- factors influencing the development of standards, existing harmonic standards (IEC, IEEE), general harmonics indices(THD & TDD).

Causes of Harmonics
Transformer magnetizationnonlinearities,rotating machine harmonics, power electronics loads such as line-commutated converters- typical current waveforms and THD, switched mode power supplies- typical current waveforms and THD, harmonic spectrums of television receivers, microwaves, personal computers and printers, non-characteristic and inter-harmonics

Effect of Harmonics
Harmonic resonance in power systems, nuisance tripping, blown capacitor fuses and capacitor cells, degradation of internal capacitance, effects of harmonics on rotating machines, motor and torque pulsations, overheating, overloading neutrals, effect of harmonics on static power plant, effect of harmonics on consumer equipment, telephone interference.

Harmonic Measurement Methods
Harmonic monitoring, field measurements using voltage and current transducers, concept of harmonic phase angle displacement, harmonic symmetrical components, harmonic instrumentation.

Harmonics Mitigation Techniques
Passive filtering techniques, classification of passive filters, passive filter design methods, tuned filters,damped filters, analysis of different analytical techniques: FFT and DFT, concept of multi pulse converter, PWM for harmonic elimination.

Text Book

1. Arrillaga J. and Waston N.R., "Power System harmonics", Wiley Second Edition, U.S.A., 2003.
2. Prof. Mack Grady, "Understanding Power System harmonics"; Department of Electrical & Computer Engineering University of Texas at Austin, U.S.A., 2012.

Reference Books

1. "Power Systems Harmonics" by George J. Wakileh, Springer, 2001.
2. F. Z. Peng, "Harmonic sources and filtering approaches," IEEE Ind. Appl. Mag., vol. 7, pp. 18–25, 2001.
3. Power Electronics Converter Harmonics: Multipulse Methods for Clean Power, Derek A. Paice, Wiley-IEEE Press, 1999.

INDUSTRIAL AUTOMATION

Course Code : EE 40009
Credit : 3
L-T-P : 3-0-0
Prerequisite :Linear Control System(EE20004)

COURSE OBJECTIVE

The course covers both theoretical and practical aspect of industrial automation through PLC and SCADA for solving real time problems. This course offers learning of hydraulics systems, electrical controls and Programmable logic controllers.

COURSE OUTCOMES

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

CO1: Describe Industrial Measurement Systems
CO2: Determine the effect of parameters of controller on system performance.
CO3: Demonstrate the controller using different tuning methods.
CO4: Design the ladder logic of PLC according to the problem statement.
CO5: Analyze DCS and SCADA and their merits/demerits in an industrial automation.
CO6: Know application of controller in hydraulic and pneumatic systems.

COURSE CONTENT

Introduction
Introduction, Architecture of Industrial Automation Systems, Measurement Systems Characteristics, Data Acquisition Systems.

Controller tuning
Introduction to Automatic Control, PI controller, PD controller, PID controller tuning methods: Ziegler-Nichols tuning method, Cohen coon tuning method.

Automation
PLC (Programmable logic controllers): Overview, operation and architecture, PLC programming, Application examples.
DCS (Distributed control systems)
Overview, Advantages, Functional requirements of Distributed control systems, Communication for distributed control, Application examples.
SCADA (supervisory control and data acquisition)
Introduction to SCADA, SCADA system components, architecture and communication, SCADA applications.
Controllers in Industrial Instruments
Flow Control Valves, Hydraulic Control Systems - I, Hydraulic Control Systems - II, Industrial Hydraulic Circuit, Pneumatic Control Systems - I, Energy Savings with Variable Speed Drives

Text Book
1. Modern Control Engineering, 4th edition, Ogata, Prentice Hall of India, 2002.
2. Fundamentals of Industrial Instrumentation and Process Control, William C. Dunn, Tata McGraw Hill, 2009.

Reference Books
1. Chemical Process Control – Theory and Practice, Stephanopoulous, Prentice Hall of India Ltd, 1984.

ELECTRIC VEHICLE TECHNOLOGY

Course Code : EE40010
Credit : 3
L-T-P : 3-0-0
Prerequisite : Electrical Machine I (EE20003) and Electrical Machine II (EE20002)

COURSE OBJECTIVE
To understand and develop a vehicle model with a focus on the analysis of powertrain components and selection of battery systems for the Design of electric vehicles.

COURSE OUTCOMES

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

CO1: Know the historical background and resurgence of Electric Vehicles.
CO2: Examine the power train configurations utilized in EV systems.
CO3: Evaluate the control mechanisms employed in different traction motors for EVs.
CO4: Illustrate the fundamental principles and components of energy storage systems in EVs.
CO5: Analyse the various Types of Battery systems used in EVs.
CO6: Design of Electric Vehicle system, integrating multiple components and subsystems.

COURSE CONTENT

Introduction
A brief history of Electric vehicles, The Renaissance of EVs, social and environmental importance of electric vehicles.

EVs and HEVs
The basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis, Challenges, and key technologies of EVs.

Electric Propulsion System
Introduction to electric components used in electric vehicles, Configuration, and control of Induction Motor drives, Permanent Magnet Motor drives, and Switch Reluctance Motor drives, and trends in electric motors for EVs.

Energy Storage
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, 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, and selecting the energy storage technology, Communications, and supporting subsystems.

Battery systems and Design of EVs
Introduction to battery management systems used in electric vehicles, exploration of different battery management strategies, Comparison of different battery management strategies. Trends and developments in battery systems for EVs and Concept of tariff systemsused in charging stations.

Text Book

1. Husain, I. (2021). Electric and hybrid vehicles: design fundamentals. CRC press.
2. Emadi, A., Ehsani, M., & Miller, J. M. (Eds.). (2003). Vehicular electric power systems: land, sea, air, and space vehicles. CRC press.

Reference Books

1. Ehsani, M., Gao, Y., Longo, S., & Ebrahimi, K. M. (2018). Modern electric, hybrid electric, and fuel cell vehicles. CRC press.
2. Larminie, J., & Lowry, J. (2012). Electric vehicle technology explained. John Wiley & Sons.
3. Brenna, M., Foiadelli, F., & Zaninelli, D. (2018). Electrical railway transportation systems. John Wiley & Sons.
4. Chan, C. C., & Chau, K. T. (2001). Modern electric vehicle technology (Vol. 47). Oxford University Press on Demand.

DIGITAL PROTECTION SYSTEM

Course Code : EE40011
Credit : 3
L-T-P : 3-0-0
Prerequisite : Power System Operation Control and Protection (EE31002)

COURSE OBJECTIVE

It aims to give a comprehensive up-to-date presentation of the fundamentals of digital relays, concept of digital signal processing used in digital relays and various algorithms utilized in digital/numerical relays and protection.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO1: Know the digital system for relaying and signal processing.
CO2: Demonstrate the principle and communication protocol of numerical relay.
CO3: Examine in different monitoring protocols and architecture of relay.
CO4: Understand integrated digital substation control system.
CO5: Describe digital protection scheme of transmission line.
CO6: Familiar with different digital protection of power apparatus.

COURSE CONTENT

Principles of Numerical Relays

Introduction, block diagram of numerical relay, sampling theorem, correlation with a reference wave, least error squared (LES) technique, digital filtering, and numerical over current protection. Definition of a Numerical Protection System, Advantages of Numerical Relays, Procession Unit, Man-Machine Interface (MMI), Communication in Protection Relays, Information Handling with Sub-station Monitoring System (SMS), Digital / Numerical Relays, Different Types of Numerical Relays, Principles of Fault Locators.

Protection and Coordinated Control

Protection and Coordinated Control, Place of Personal Computer, Self-Monitoring and Post Fault Analysis, Workstations and Remote Communication, Alstom EPA Computer (Publication N.1.6918 B), PSCN 3020 Bay Module: Integrated Digital Sub-station Control System, Architecture, Interface to SCADA, Local Control Point: Man-Machine Interface, SPACE 2000-System for Protection and Automatic Control.

Reliability, Testing, and Maintenance for Numerical Relays

Reliability, Software Considerations, Redundancy, Privatization and Deregulation of Electrical Industry, Protective Relaying Capabilities, Maintenance, Opto-electronic Sensors.

Digital protection

Digital protection of Transmission line, Synchronous Generator and power transformer.

Text Book

1. Fundamentals of Power System Protection", Y. G. Paithankar, S. R. Bhide, 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2011.
2. Digital Protection, L.P Singh, New age International Publisher, 2nd Edition, 1997.

Reference Books

1. Protective Relaying: Principles and Applications, Fourth Edition, By J. Lewis Blackburn, Thomas J. Domin, CRC Press, Taylor and Francies.
2. Power System Protection Static Relays by T S M Rao, 2nd edition, Tata McGraw-Hill Education, 2005.

SMART GRID

Course Code : EE 40012
Credit : 3
L-T-P : 3-0-0
Prerequisite : Power System Operation Control and Protection (EE31002)

COURSE OBJECTIVE

To provide students with a working knowledge of fundamentals and development of Smart Grid, from the basic concepts of power systems.

COURSE OUTCOMES

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

CO1: Know the different elements of smart grid.
CO2: Demonstrate on Smart Grid Architecture.
CO3: Describe Synchro Phasor Measurement Unit.
CO4: Understand the wide area monitoring system of smart grid.
CO5: Analyse the load frequency control in micro grid.
CO6: Design control techniques for power quality improvement in smart grid.

COURSE CONTENT

Introduction to Smart Grid

Definition of smart grid, Components and architecture of smart grid design, Review of the proposed architectures for smart grid, The fundamental components of smart grid designs, Transmission automation, Distribution automation, Renewable integration.

Tools and Techniques for Smart Grid

Synchro Phasor Measurement Units (PMUs), Computational intelligence techniques, Distribution Generation Technologies

Communication Technologies and Smart Grid

Computational techniques, Static and dynamic optimization techniques, Introduction to communication technology, Evolutionary algorithms, Artificial intelligence techniques.

Control of Smart Power Grid System

Load Frequency Control (LFC) in micro grid system, Voltage control in micro gridsystem, Reactive power control in smart grid, Case studies and test beds for the smart grids.

Text Book

1. James Momoh, “SMART GRID, Fundamentals of Design and Analysis” IEEE press, 2013.
2. A. G. Phadke and J. S. Thorp, “Synchronized Phasor Measurements and their Applications”, Springer Edition, 2010

Reference Books

1. Gil Masters, "Renewable and Efficient Electric Power System", Wiley–IEEE Press, 2004.
2. T. Ackermann, "Wind Power in Power Systems", Hoboken, NJ, USA, John Wiley, 2005.
3. Clark W Gellings P.E. "The Smart Grid enabling energy efficiency and demand response", CRC Press, 2013.
4. Stuart Borlase, "Smart Grids, Infrastructure, Technology and Solutions", CRC Press, 2013.

WIND AND BIOMASS ENERGY

Course Code : EE40013
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

To provide a deep introduction about wind energy basics, wind energy conversion Technologies, Various types of Biomass energy sources and Biomass to energy conversion technologies.

COURSE OUTCOMES

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

CO1: Know the basics of wind energy conversion and their operating characteristics
CO2: Design the aerodynamics of wind rotor and wind turbine system
CO3: Analyse the use of different power electronics converters and electrical machines used in standalone wind energy conversion systems.
CO4: Analyze the nature and principles of bioenergy systems.
CO5: Prioritize the concept of waste management to energy production
CO6: Analyze the mechanism of different Biomass energy conversion technologies.

COURSE CONTENT

Wind Energy Basics and Types of Turbines

Sources of Energy: Renewable energy sources and features. Introduction to windenergy. Wind Turbine Sitting, General theories of wind machines: Basic laws and concept of aerodynamics, efficiency limit for wind energy conversion. Description and performances of horizontal axis wind turbine: Design of the blades and determination of forces acting on the wind power plant, power ~ speed and torque ~ speed characteristics of wind turbines, wind turbine control systems. Description and performances of vertical axis wind turbine

Wind Energy Power Conversion Technologies and applications
Conversion to electrical power: Induction and synchronous generators, grid connected and self-excited induction generator operation, generation schemes with variable speed turbines, constant voltage and constant frequency generation with power electronic control, Optimized control of induction generators and synchronous generators. Reactive power compensation, Types of converters, Type of wind energy conversion system, MPPT techniques for wind electrical systems.

Biomass Energy Source
Biomass energy sources, energy content of various Bio – fuels, Energy plantation, origin of Biomass photo synthesis process, Biomass Characteristics, Briquetting, Pelletization, Agrochemical, sustainability of Biomass.

Biomass Energy Conversion Technologies
Biomass Conversion Technologies, Urban Waste to Energy Conversion, Biomass Gasification: Types of gasifiers. Fixed bed gasifiers, Fluidized bed gasifiers. Biomass Liquefaction: Biomass to Ethanol Production, Bio Diesel from edible & non-edible oils, Production of Bio diesel from Honge & Jatropha seeds, Blending of Bio diesel, Performance analysis of diesel engines using bio diesel, Biogas production from waste Biomass, classification of Biogas digester, floating gasholder & fixed dome type.(Working Principle with diagram), Calculations for sizing the Biogas plant.

Text Book

1. S. N. Bhadra, D. Kastha, S. Banerjee, Wind Electrical Systems, Oxford Univ. Press , 2005
2. B. H. Khan, "Non – Conventional Energy Resources" Tata Mc Graw Hill, 2nd edition 2009.

Reference Books

1. Kothari D.P., "Renewable energy resources and emerging technologies", Prentice Hall of India Pvt. Ltd, 2006.
2. Rai G.D, "Non-Conventional Energy Sources", Khanna Publishers, 4th Edition 2000.
3. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.

ENERGY MANAGEMENT AND SCADA

Course Code : EE40014
Credit : 3
L-T-P : 3-0-0
Prerequisite : Power System Operation Control and Protection (EE31002)

COURSE OBJECTIVE
Energy management system provides the information about optimizing the performance of the generation including the economic aspects and monitoring and control the power system through computerized tools.

COURSE OUTCOMES

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

CO 1: Know recent developments in Energy management System.
CO 2: Understand economic load dispatch and unit commitment.
CO 3: Analyze the economic aspect of energy production.
CO 4: Demonstrate the knowledge of energy management to existing system.
CO 5: Understand optimization and control of power systems.
CO 6: Describe SCADA system.

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COURSE CONTENT

Introduction to Energy Management
Energy Management Centers and Their Functions, Architectures, Characteristics of Power Generating Units and Economic Dispatch, Unit Commitment (Spinning Reserve, Thermal, Hydro and Fuel Constraints), Solution techniques of Unit Commitment, Generation Scheduling with Limited Energy, Energy management system.

Economic Aspect
Energy Production Cost – Cost Models, Budgeting and Planning, Practical Considerations, Interchange Evaluation for Regional Operations, Types of Interchanges.

SCADA System
Introduction to Supervisory Control and Data Acquisition, SCADA Functional requirements and Components, General features, Functions and Applications, Benefits, Configurations of SCADA, RTU (Remote Terminal Units) Connections, Power Systems SCADA and SCADA in Power System Automation.

Text Book

1. Wood, A. J and Wollenberg, B. F, & sheble B.G."Power Generation Operation and Control", 2nd Edition John Wiley and Sons, 2003.
2. Handschin, Edmund, Petroianu& Alexandar. "Energy Management Systems", Springer Verlag, 1990

Reference Books

1. Green, J. N, Wilson, R, "Control and Automation of Electric Power Distribution Systems", Taylor and Francis, 2007.

COMPUTER AIDED POWER SYSTEMS

Course Code : EE40015
Credit : 3
L-T-P : 3-0-0
Prerequisite : Power System Operation Control and Protection (EE31002)

COURSE OBJECTIVE

This course is designed to give students the required knowledge to calculate the Ybus including transformer and model the network using graph theory. It also give the information how to compute Zbus and short circuit analysis using Zbus and the transient stability analysis of a power system

COURSE OUTCOMES

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

CO1: Formulate Bus admittance matrix during load flow study .
CO2: Model power system components using graph theory.
CO3: Analyze 3-phase network through different excitation.
CO4: Calculate the Bus impedance matrix (Z_{bus}) using bus impedance building algorithm.
CO5: Analyze the different fault study of 3-phase network using Z_{bus}.
CO6: Know the transient stability analysis.

COURSE CONTENT

Load Flow Study using Computer Techniques
Formation of Y_{bus} when regulating transformer present, Network matrices, Reference frame, Network graph, Tree, branch, Basic loop and Cut sets, Basic Incidence matrices, Augmented matrices, Primitive networks, Network matrices by Singular and Non-singular transformation with Bus frame of reference, Branch frame of reference, Loop frame of reference.

Three Phase Networks
Elements in impedance and admittance form, Balance excitation, Un-balance excitation, Transformation matrices for symmetrical components, Incidence and network matrix for 3-phase elements, Formation of Z bus, Addition of branch, Addition of link problems.

Representation of Three Phase Elements in Short Circuit Study
Short circuit study of balanced network by Z_{bus}, LG fault**,** L-L fault**,** 3-ph fault with and without fault impedance**,** Problems.

Transient stability Analysis
Load representation, Network performance equation, Swing equation, Machine equation, Solution techniques in transient stability study, RK 4^{th} order method, Problems.

Text Book

1. Computer Methods in Power System Analysis by Glenn W. Stagg, Ahmed H. El-Abiad, McGraw-Hill Book Company, International Editions, 2009.
2. Advanced Power System Analysis and Dynamics by L. P. Singh, New Age International (P) Limited, Publishers, Revised 4th Edition, 2011.

Reference Books

1. Power System Analysis by N.V.Ramana, Pearson Publication,2011
2. Computer application techniques in Power System by M.A.Pai, TMH, 2006.

ECONOMICS AND PLANNING OF ENERGY SYSTEM

Course Code : EE40016
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

The objective of the course is to know details about the Economics of energy and its planning .

COURSE OUTCOMES

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

CO1: Understand energy economics including data analysis, cost assessment and energy balance.
CO2: Calculate socioeconomic impacts on power generation cost through energy conservation programmes
CO3: Gain a comprenshive understanding on energy policies
CO4: Access the implecation of regional and national energy policies by applying the energy multiplier concept.
CO5: Develop a strong grasp of economic approach to environmental protection and management.
CO6: Forcast energy demand using appropriate madeling techniques.

COURSE CONTENT

Introduction to Energy Economics and Energy Conservation Programme
Basic concepts, energy data, energy cost, energy balance. Relevance of economic and financial viability evaluation of renewable energy technologies, law and elasticity of demand, theory of firm: Production function, output maximization, cost minimization and profit maximization principles.

Basic concepts of Energy Economics and Energy Conservation Programmes
Theory of market, National income and other macroeconomic parameters. Calculation of unit cost of power generation from different sources with examples, Ground rules for investment in Energy sector, Payback period, NPV, IRR and Benefit-cost analysis with example.
Socio-economic evaluation of Energy Conservation Programmes:Net Social Benefit considering Free riding concept and Rebound effects,

Introduction to Energy Policies
Overview of Energy Policies:National energy policy in the last plan periods, Energy use and Energy supply, Overview of renewable energy policy and the Five Year Plan programmes, Basic concept of Input-Output analysis, Concept of energy multiplier and implication of energy multiplier for analysis of regional and national energy policy.

Model and Analysis of different energy policies and forecasting of Energy Demand
Models and Analysis: Economic approach to environmental protection and management, Interdependence of energy, economy and environment, Modeling concepts and application of SIMA model and I-O model for energy policy analysis.

Forecasting of Energy Demand
Simulation and forecasting of futureenergy demand consistent with macroeconomic parameters in India. Basic concept of Econometrics and statistical analysis (Multiple Regression), Case studies on financial and economic feasibility evaluation of renewable energy projects.

Text Book

1. EA Diulio, Macroeconomic Theory, Schaum's Outline Series, 2nd Ed, McGraw-Hill Publishing Company (1990)
2. R Loulou, P R Shukla and A Kanudia, Energy and Environment Policies for a sustainable Future, Allied Publishers Ltd, New Delhi, 1997

Reference Books

1. J Parikh, Energy Models for 2000 and Beyond, Tata McGraw-Hill Publishing Company Ltd, New Delhi,1997
2. Energy Economics -A.V.Desai (Wiley Eastern) Energy Economics - Simple Payback Period, Time Value of Money, IRR, NPV, Life Cycle Costing, Cost of Saved Energy, Cost of Energy generated, Examples from energy generation and conservation.
3. Campbell, H. F., & Brown, R. P. (2003). Benefit-cost analysis: financial and economic appraisal using spreadsheets. Cambridge University Press.
4. Kandpal, T. C., & Garg, H. P. (2003). Financial evaluation of renewable energy technologies. MacMillam India Limited.

TIDAL AND SMALL HYDRO POWER

Course Code : EE40017
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

The objective of this course is to provide an understanding of the principles and technology involved in the design, operation, and maintenance of small hydro and tidal power plants

COURSE OUTCOMES

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

CO1: Understand the functioning of Hydro, Tidal, and Geothermal Energy systems.
CO2: Apply the knowledge in selecting the turbine according to site conditions.
CO3: Classify various Hydro power plant.
CO4: Estimate energy for various Tidal power plants.
CO5: Analyze the performance of different Tidal power plants.
CO6: Discuss the possible locations of SHP and Tidal energy around the globe.

COURSE CONTENT

Basic working principle of Hydro and Tidal power plant
Classification of Hydroelectric power plants: Large, small, mini, micro - Energy equation, Numerical problems. Tidal power, mean extractable power, Numerical problems, Introduction to geothermal energy, Selection of Sites.

Hydro power Energy System
Turbine Size, Types of Hydraulic turbines, Pelton Wheel, Francis Turbine, Propeller and Kaplan Turbines, Bulb Turbine, Specific Speed, Selection of turbines, Spillways, Surge Tanks, Water Hammer, Draft Tube, Schemes of Hydro Plants, Run-of-River Plants, Valley Dam Plants, High Head Diversion Plants, Pumped Storage Plants.

Tidal Power System
Introduction to tidal energy, Tidal characteristics, Tidal range, Components of tidal Power plant, Types of tidal power plants- single basin single effect plant, Single basin double effect plant, Double basin double effect plants, and tidal energy estimation.

Scope of Hydro and Tidal Power Energy System
Possible locations of SHP and Tidal energy around the globe, Limitations, Some case Studies.

Text Book

1. Nag P.K., "Power Plant Engineering" Tata McGraw Hill, 2nd Edition, 4th Fourth Reprint,2003.
2. Ocean Energy: Tidal and Tidal power- R.H. Charlier, Springer, 2009.

Reference Books

1. Small hydroelectric engineering practice- Bryan Leyland, CRC Press,2014.
2. Harvey, A., Brown, A. and Hettiarachi, P., "Micro Hydro Design Manual", Intermediate Technologym,1993.
3. GD Rai, "Non-Conventional Energy" Khanna publication, 2011.

WASTE MANAGEMENT AND ENERGY RECOVERY

Course Code : EE40018
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE
To enable the students to learn the sources and types of waste generation as well as acquaint the methods of collection, transport, processing and generation technologies.

COURSE OUTCOMES
After successfully completing the course, the students will be able to

CO1: Know the various sources of waste and waste management methods
CO2: Demonstrate proficiency in weast collection, transportation and processing techniques
CO3: Analyze different weast treatment methods and its environmental implication
CO4: Evaluate hazadeous weast sources potentioal environmental impacts and risk assessment techniques.
CO5: Compare various weast management techniques
CO6: Analyze environmental impact analysis to assess the weast management practice on air and water pollution.

COURSE CONTENT

Introduction
Sources, generation and estimation, types, compositions, Properties - physical, chemical and biological. Collection, Transfer stations, waste minimization, Recycling of municipal wastes, regulations.

Collection, Transportation And Processing Techniques
Onsite handling, storage, processing, types of waste collection mechanisms, Transfer stations - types and location, Manual component separation and other sepaation techniques.

Size Reduction
Aerobic Composting, Incineration for Medical /Pharmaceutical Waste. Land Fill Method- Types, Methods & siting consideration. Composition, characteristics, generation. Control of land fill leachate & gases, an environmental monitoring system for landfill gases.

Hazardous Waste
Definition, potential sources, impact on the environment, transportation regulations, risk assessment, remediation technologies. Private-public partnership, Government initiatives. Disposal of Hazardous Waste - Underground Storage Tanks Construction, Installation and Closure.

Managing wastes
Basics, types, working and typical conversion efficiencies of composting, anaerobic digestion, combustion, incineration, gasification, pyrolysis.

Environmental Impact Assessment
Production and assessment of impacts due to air and water pollution on the environment. Environment Impact Assessment in the land and biological environment. Environmental Effects due to Incineration.

Text Books:

1. Shah, Kanti L., Basics of Solid & Hazardous Waste Management Technology, Prentice Hall 1999.
2. Barthwal, R. R., Environmental Impact Assessment, New Age International Publishers (P) Ltd 2012 3. Parker, Colin, & Roberts, Energy from Waste - An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985

Reference Books:

1. Adaptive environmental assessment and Management Ed. C. S. Holling, John Wiley and Sons 2005
2. S.A. Abbasi and N. Abbasi, Renewable Energy Sources and Their Environmental Impact, Prentice Hall of India 2010
3. Environmental Impact Assessment L.W.Canter, McGraw Hill Book Company 1995
4. Barthwal, R. R., Environmental Impact Assessment, New Age International Publishers (P) Ltd 2012

POWER CONVERTER ANALYSIS AND DESIGN

Course Code : EE40019
Credit : 3
L-T-P : 3-0-0
Prerequisite : Power Electronics (EE30001)

COURSE OBJECTIVE

This course is intended to teach the fundamentals of power conversion and will cover the design and analysis of all types of power converters – such as, dc-dc converters, dc-ac inverters.

COURSE OUTCOMES

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

CO1: Design the power electronics converters for different applications.
CO2: Design high frequency transformers and Inductors.
CO3: Analyze the operation and application of inverters
CO4: Describe resonant converter and SMPS in various industrial applications.
CO5: Know the power quality improvement strategies using power electronic converters.
CO6: Design the gate driver circuit for different semiconductor devices.

COURSE CONTENT

AC – DC Converters
Single phase Rectifier Circuit: L-C filter design, performance parameter calculation, Heat Sink calculation.

DC to DC Converters
Non-isolated dc-dc converters: Design and operation of buck-boost, Cuk, SEPIC, Zeta in DCM and CCM.

Switch Mode Power Supply
Isolated dc-dc converters: Operation of Flyback Converter, Forward Converter andpush-pull Converters in CCM, Current Mode Control; Design of Magnetic Materials suitable for high frequency transformers.

Resonant Converters
Introduction to Soft switching, difference between hard and soft switching, basic resonant circuit concept; ZCS and ZVS resonant converters; Electronic Ballasts.

Inverters
Modulation Strategies of inverter: Bipolar and Unipolar switching scheme; Performance parameters of 3 phase Sinusoidal PWM Inverters; Harmonic reduction techniques, Multi-level inverters-configurations: Diode clamped, flying capacitor, cascaded multi-level inverters and applications.

Gate drive Circuits
Gate drive circuits for MOSFET, IGBT.

Text Book:

1. Power Electronics By M.H. Rashid Pearson Education, 3rd Edition, 2009.
2. Power Electronics, Converters, Applications and Design, by N. Mohan, Underland and Robbins, John Wiely and Sons, 3rd Edition,2011.

Reference Books

1. Power Electronics By M.D. Singh and K.B. Khanchandani, Tata McGraw - Hill publishers, 2nd edition, 2008.
2. Modern Power Electronics, by P.C Sen, Wheeler publishing Co, First Edition, 2009.
3. 3.Elements of Power Electronics, by Philip T. Krein, Oxford University Press, 25 Sept 1997

DIGITAL SYSTEM DESIGN USING FPGA

Course Code : EE40020
Credit : 3
L-T-P : 3-0-0
Prerequisites : Analog and Digital Electronics Circuits (EE20007)

COURSE OBJECTIVE

This course deals with basic digital system design, introduces essential FPGA concepts and programming. The course covers the technological background of FPGA both theoretically as well as practical implementation of digital solutions.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO1: Learn advanced design methodologies for high-performance FPGA applications.
CO2: Analyze the implementation of a complete sophisticated digital system using FPGA.
CO3: Apply translating software models of digital signal processing applications.
CO4: Comprehend sophisticated optimization techniques for streaming applications.
CO5: Understand design procedure and compare performance of FPGA based system.
CO6: Synthesize VHDL based digital system.

COURSE CONTENT

SystemLevel Design

System- level architecture design for FPGAs. TMS322F series architecture.

VHDL

Review of VHDL programming basics, Synthesizable VHDL, synchronous and asynchronous processes, finite state machines, and memory.

Programming Spartan-3E using VHDL

Practical test bench design, performance testing. Counter design using Spartan 3E.

Design Optimization using FPGA interface in NI-CRIO-9082

Design optimizations and performance comparison, FIFOs and streaming architectures, Analog signal processing using NI-CRIO FPGA interface.

Synthesis of Design Using VHDL
Design, optimize, simulate, and analyze the performance for a digital application, FPGA synthesis and iterative performance optimizations. (Xilinx software), Circuit synthesis for delay circuit design.

Text Books:
1. The Designer's Guide to VHDL, Peter J. Ashenden; HDL Chip Design, Douglas J. Smith;
2. Advanced FPGA Design Architecture, Implementation, and Optimization, Steve Kilts

Reference Books:
1. Digital System Design with FPGA, Implementation using Verilog and VHDL, Cem Unsalan, Bora Tar.1st Edition TMH publication.

BATTERY MANAGEMENT SYSTEM

Course Code : EE40021
Credit : 3
L-T-P : 3-0-0
Prerequisite :Chemistry (CH10001) and Electric Circuit Analysis (EE21001)

COURSE OBJECTIVE
This course aims to provide a comprehensive understanding of the various aspects of battery modelling and management.

COURSE OUTCOMES
After successfully completing the course, the students will be able to

CO1: Analyze the behavior of battery systems using empirical, electrochemical, and lumped parameter models.
CO2: Apply battery parameter estimation techniques to estimate internal resistance, open-circuit voltage, capacity, and state of charge of different battery chemistries
CO3: Implement strategies for the cell equalization techniques used for batteries
CO4: Implementation and understanding of battery management systems
CO5: Evaluate the performance of an existing battery design
CO6: Effective integration of battery modelling and management concepts

COURSE CONTENT

Basics of Battery and Modelling
Introduction to batteries and their classifications, understanding battery characteristics such as voltage, current, capacity, and energy, battery terminology and metrics, Basic concepts of battery modelling, battery modelling techniques: empirical, electrochemical, and lumped parameter models. usage of Simulation tools for battery modelling and design.

Estimation of Battery Parameters
Battery parameter estimation techniques, methods for estimating internal resistance, open-circuit voltage, capacity, and state of charge, battery state estimation, Battery capacity estimation, Battery health estimation, techniques for parameter estimation of different battery chemistries.

Cell Equalization and Safety
Introduction to cell equalization, different cell equalization techniques: passive, active, and hybrid, Factors affecting cell equalization such as temperature, voltage, and cell aging. Battery safety and hazards.

Battery Management System Design
Introduction to battery management systems, battery management system (BMS) design, BMS architecture and components, BMS design considerations and trade-offs, Case study of existing battery modelling and BMS applications, future trends and challenges in battery modelling and management

Text Book

1. Wang, Shunli. Battery State Estimation: Methods and Models. Institution of Engineering and Technology, 2021.
2. Tan, Xiaojun, Andrea Vezzini, Yuqian Fan, Neeta Khare, You Xu, and Liangliang Wei. Battery Management System and Its Applications. John Wiley & Sons, 2022.

Reference Books

1. Notten, P., H. Bergveld, and W. Kruijt. "Battery management systems: design by modeling." Springer, 2002.
2. Li, Junqiu. Modeling and Simulation of Lithium-ion Power Battery Thermal Management. Springer Nature, 2022.
3. Ouyang, Quan, and Jian Chen. Advanced model-based charging control for lithium-ion batteries. Springer verlag, singapor, 2023.
4. Husain, Iqbal. Electric and hybrid vehicles: design fundamentals. CRC press, 2021.

VEHICLE CHARGING TECHNOLOGY

Course Code : EE40022
Credit : 3
L-T-P : 3-0-0
Prerequisites : Electric Circuit Analysis (EE21001) and Power Electronics (EE30001)

COURSE OBJECTIVE
To develop the charging infrastructure, assessment of the location of the charging station, selection, and sizing of various components and connectors required for the EV charging as per the standards.

COURSE OUTCOMES

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

CO1: Understand the basics of Electric Vehicles and their charging
CO2: Realize the various components required in EV charging
CO3: Demonstrate the types of charging and their modes
CO4: Analyze the proper selection and sizing of charging components and connectors
CO5: Realize the necessary charging standard and process of commissioning
CO6: Design the charging station for EVs

COURSE CONTENT

Introduction
History of EV, Components of Electric Vehicle, EV classification, and their electrification levels

Types of EV Chargers
Charging Equipment, Basic charging Block Diagram of Charger, Difference between Slow charger and fast charger, Slow charger design rating, Fast charger design rating, AC charging and DC charging Inboard and off-board charger specification, Types of Mode of charger Mode -2, Mode-3 and Mode-4, Wireless Charging: static charging and dynamic charging

Selection and sizing of the fast and slow chargers (AC and DC)
AC Pile Charger, DC Pile Charger, EVSE Power Module selection and technical specification, Selection of EVSE Communication Protocol (PLC / Ethernet / Modbus/ CAN Module), Communication gateway, Specification of open charge point protocol (OCCP 1.6/2.0), Bharat DC001 & AC001 Charger specification, Communication Interface between charger and CMS (central management system)

Selection and sizing of Common types of connectors and applications
Selection of AC charger type-1 type -2 and type -3, Communication between AC charger and EV, Selection of DC charger connector GB/T, CHAdeMO CCS-1 and CSS-2, Communication methodology of DC fast chargers, IS/ IEC/ARAI/ standard of Charging topology Communication and connectors (IEC 61851-1, IEC 61851-24,62196-2), Selection sizing of Charger connector cable

Public Charging infrastructure
Basic Requirements for Charging System, Charger Architectures Preparation of EV Charger Single Line Diagram, Assessment of site Location for Public charging station, Selection and Sizing of Distribution transformer, HT Equipment (VCB, CT, PT, Metering), HT Cables and LT cables, Selection and sizing of Distribution Board/feeders, Sizing calculation of LT and HT cable, Selection and of Compact Substation (CSS for EV CS).

Text Books

1. Rim, C. T., & Mi, C. (2017). Wireless power transfer for electric vehicles and mobile devices. John Wiley & Sons.
2. Code of Practice for Electric Vehicle Charging Equipment Installation. (2018). United Kingdom: Institution of Engineering & Technology.

Reference Books

1. Chan, C. C., & Chau, K. T. (2001). Modern electric vehicle technology (Vol. 47). Oxford University Press on Demand.
2. Vahidinasab, V., &Mohammadi-Ivatloo, B. (Eds.). (2022). Electric vehicle integration via smart charging: technology, standards, implementation, and applications. Springer Nature.
3. Hayes, J. G., &Goodarzi, G. A. (2018). Electric powertrain: energy systems, power electronics, and drives for hybrid, electric, and fuel cell vehicles.
4. Husain, I. (2021). Electric and hybrid vehicles: design fundamentals. CRC press.

POWER QUALITY

Course Code : EE40023
Credit : 3
L-T-P : 3-0-0
Prerequisites : Transmission and Distribution of Electric Power (EE31001)

COURSE OBJECTIVE

This course teaches how to diagnose power quality problems and perform measurements of sags, swells, voltage transients, harmonic distortion and voltage flicker that is to explain the basic concepts of power quality issues in power systems, and its measurement techniques.

COURSE OUTCOMES

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

CO1: Understand the power quality issues in electrical distribution network.
CO2: Analyze the severity of voltage sag, voltage swell and transient in distribution network.
CO3: Calculate harmonics distortion for voltage and current signals.
CO4: Analyze the effects of harmonics in power quality.
CO5: Formulate compensation techniques during power system problems.
CO6: Analyze the basics of power quality monitoring system.

COURSE CONTENT

Introduction
Importance of Power Quality (PQ), terminology of PQ as per IEEE std. 1159 transients, short and long duration voltage variations, interruptions, Short and long voltage fluctuation, imbalance, flicker and transients, Symptoms of poor power quality.

Flicker & Transient Over voltages
RMS voltage variations in power system and voltage regulation per unit system, complex power, Principles of voltage regulation, Basic power flow and voltage drop various devices used for voltage regulation and impact of reactive power management, various causes of voltage flicker and their effects. Short term and long term flicker.

Voltage Sag, Swells and Interruption
Voltage sags versus interruptions, Economic impact of voltage sag, Areas of vulnerability, Assessment of equipment sensitivity to voltage sags, voltage swell.

Harmonics
Definitions of harmonics, causes and effect of harmonics, Triplen harmonics, characteristics and non characteristics harmonics, harmonic series and parallel resonances, Consequences of harmonic resonance, Principles for controlling harmonics, Definitions of various powers, power factor under balanced, unbalanced and non-sinusoidal conditions.

Power Quality Monitoring
Need of PQ monitoring and approaches followed in PQ monitoring, PQ monitoring objectives and requirement, Theories of load compensation.Introduction to custom power devices and their applications in power system. Power quality instrumentation, Selection of power quality monitors, Selection of monitoring location and period.

Text Books:
1. RC dugan, MF Mcgranaghan, S Santoso and H W Beaty, "Electrical Power system Quality", 2nd Edition TMH publication-2008
2. Heydt, G T, "Electric Power Quality", Stars in circle Publications, Indiana 2nd edition-1994

Reference Books:
1. Arrillaga J and Watsone RN, Chen S, "Power Quality Assessment", Wiley New York 2000
2. Bollen MHJ, "Understanding Power Quality Problems; Voltage sag and instrumentations", IEEE press NY 2000 Power Quality C Sankaran CRC press

DISTRIBUTED GENERATION AND MICROGRID

Course Code : EE40024
Credit : 3
L-T-P : 3-0-0
Prerequisites : Power Electronics (EE30001) and Transmission and Distribution of Electric Power (EE31001)

COURSE OBJECTIVE
To impart knowledge about distributed generation technologies, theirinterconnection in grid, to understand relevance of power electronics in DG, to understandconcept of microgrid.

COURSE OUTCOMES

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

CO1: Know about the different renewable energy sources.
CO2: Implement distributed generation in power system.
CO3: Analyze the impact of grid integration.
CO4: Know the concept and operation of micro grid system.
CO5: Demonstrate the communication infrastructure related to micro grid.
CO6: Analyze the power quality issues related to micro grid.

COURSE CONTENT

Introduction
Conventional power generation: advantages and disadvantages, Energy crises,
Non-conventional energy, (NCE) resources: review of Solar PV, Wind Energy systems.

Distributed Generations (DG)
Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations.

Impact of Grid Integration
Requirements for grid interconnection, limits on operational parameters, voltage, frequency, THD, response to grid abnormal operating conditions, is-landing issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

Micro grids
Concept and definition of micro grid, micro grid drivers and benefits, review of sources of micro grids, typical structure and configuration of a micro grid, AC and DC micro-grids, Power Electronics interfaces in DC and AC micro grids, communication infrastructure, modes of operation and control of micro grid: grid connected and islanded mode, Active and reactive power control, protection issues.

Power Quality Issues In Micro grids
Power quality issues in microgrids-Modelling and Stability analysis of Micro grid, regulatory standards, Micro grid economics, Introduction to smart micro grids.

Text Books :

1. Gevork B. Gharehpetian S. Mohammad Mousavi Agah 'Distributed Generation Systems' ,1st Edition, 2017.
2. Pat Wheeler ,Frede Blaabjerg,"DC Distribution Systems and Microgrids",Publisher Institution of Engineering and Technology, 2018

Reference Books :

1. M.S Mahmoud" Microgrid advanced control method and Renewable energy system integration",BH Publication, 2016.
2. Gevork B.Gharehpetian, S.Mohammad Mousavi Agah "Distributed Generation Systems",1st Edition, Elsevier Publication,2017.

STATE ESTIMATION AND SECURITY

Course Code : EE 40025
Credit : 3
L-T-P : 3-0-0
Prerequisites : Power System Operation control and Protection (EE31002)

COURSE OBJECTIVE

State estimation (SE) is a statistical monitoring tool that combines network models and field measurements to calculate the most likely operating condition of the system, filtering random measurement noise and to supply uninterrupted power to the consumers within an acceptable limit of voltage and frequency

COURSE OUTCOMES

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

CO1: Develop mathematical models for analysis of linear and non–linear State Estimation.
CO2: Identify the strategic locations to analyze the state of the system.
CO3: Demonstrate observability and bad data detection techniques from a measurement.
CO4: Apply PMU in state estimation.
CO5: Solve contingency analysis of any practical Power System.
CO6: Identify the most appropriate algorithm for security of a system.

COURSE CONTENT

State Estimation
Introduction to real time control of power system, Energy control center, security analysis and monitoring, Introduction to State Estimation (SE) in power systems: Maximum likelihood Weighted Least Square (WLS) Estimation SE. SE of AC networks. Types of measurements – linear WLS–SE theory – DC load flow based WLS–SE – linearized model of WLS–SE of non–linear AC power systems – sequential and non–sequential methods to process measurements.

Network Observability and Bad Data Detection
Network Observability and Pseudo–measurements, Observability analysis for branch variable formulation, observability by Graphical technique and Triangularisation approach, network topology processing, topological observability and its algorithm. Bad data detection in WLS method, chi square test, identification of bad data: method of normalized residual and test, application of PMU in state estimation, linear measurement model with PMU's, phasor measurements in dynamic state estimation, PMU placement to detect topology errors and bad data detection.

Power System Security
Introduction, Factors affecting power system security, Contingency analysis, Detection of network problems, Linear sensitivity analysis, AC power flow methods contingency selection, concentric relaxation, Bounding area method.

Text Books:

1. Allen J. Wood and Bruce Woolenberg: Power System Generation, Operation and Control, John Wiley and Sons, 1996.
2. Power system state estimation by Mukhtar Ahmad, Artech House, 2013.

Reference Books:

1. John J. Grainger and William D Stevenson Jr.: Power System Analysis, McGraw Hill ISE, 1994.
2. IEEE Proc. July 1974, Special Issue on Computer Control of Power Systems.

SYNCHROPHASORS APPLICATION TO POWER SYSTEM

Course Code : EE40026
Credit : 3
L-T-P : 3-0-0
Prerequisites : Transmission and distribution of Electric power (EE31001)

COURSE OBJECTIVE

This course is designed to give students the required knowledge about synchrophasors and its application to real time power system network. It also provides the information of phase angle difference, PMU placement and Power Oscillation causes and monitoring.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO1: Differentiate the complex phasor and synchrophasor quantities.
CO2: Evaluate the synchrophasor matrix in real time power system operation.
CO3: Know the importance of phase angle difference.
CO4: Evaluate the placement of PMU location in power system.
CO5: Understand the impact of switching operation of power system.
CO6: Comprehend the power oscillation, causes and monitoring of power system.

COURSE CONTENT

Synchrophasor Fundamentals
Fundamentals, Definition and Description, Synchrophasor Attributes – Essential Properties, Applying Synchrophasors – Measurement Principles and Examples, Synchrophasor Technology Infrastructure – Components and Data Flow.

Synchrophasor Metrics – Use in Real Time Operations
Introduction to Synchrophasor Metrics, Phase Angle Differences, Voltage Sensitivity, Frequency Deviations, Oscillations.

Phase Angle Differences
Definition & Importance of Phase Angle Differences for Operations, Importance of PMU Location, Use of Phase Angles in Control Rooms - Line Closing, Case Study – 8 Bus System, Use of Phase Angles in Control Rooms - Islanding & System Separation, Phasor Assisted Line Reclosing.

Grid Event Signatures – Use in Operations to Detect and Diagnose Grid Events
Introduction to Grid Event Signatures, Types of Grid Event Signatures - Generation Trip, Line Fault, Line Trip, Load Trip, Islanding, Oscillations, Identify Event Type Using System Frequency Signature, Event Diagnosis - Using Synchrophasor Metrics, Case Study – Generation Trip and Line Trip.

Power System Oscillations – Types, Causes, Monitoring
Introduction to Power System Oscillations, Identifying and Analysing Oscillations, Oscillation Monitoring, Oscillation Detection.

Text Books:

1. A.G. Phadke and J. S. Thorp, “Synchronized Phasor Measurements and their Applications”, Springer, 1st edition, 2008.

Reference Books:

1. M. Shadidehpour and Y. Wang, "Communication and Control in Electric Power System", Wiley, 1st edition, 2003.
2. IEEE Transactions, Special Issue in Proceedings of the IEEE and IET proceedings.
3. IEEE standard C37-118 and other standards. Course Outcomes: MTPE 251-POWER ELEC

RENEWABLE ENERGY RECOURSE ASSESSMENT AND FORECASTING

Course Code : EE40027
Credit : 3
L-T-P : 3-0-0
Prerequisites : Renewable Energy Resource (EE30016)

COURSE OBJECTIVE

To provide an overview of factors affecting solar radiation and wind (dynamical mechanisms, terrain effects, urban effects, vertical profiles, etc.) as well as on the tools and instruments for assessing and forecasting their availability.

COURSE OUTCOMES

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

CO1: Understand atmospheoric processes and properties that influence renewable energy resources
CO2:Gain the expertise in recognizing various atmospheoric circulation that impact renewable energy
CO3: Analyze the factors influencing solar radiation availability on the earth surfaces
CO4: Apply different approaches to forcast solar radiation for enrgy related application
CO5: Understand the wind measurement methods and its modeling techniques
CO6: Applye statistical techniques s for wind resources assessment

COURSE CONTENT

Introduction to atmospheric processes
Overview of the mean atmospheric properties (chemical composition, thermal structure), Scales of atmospheric motion, Atmospheric thermodynamics, Hydrostatic balance, Atmospheric stability, Atmospheric dynamics: synoptic-scale motion, geostrophic wind, Mesoscale circulations, coastal breezes, mountain and valley winds.

Solar radiation measurement and modelling
Factors determining the solar radiation availability at the Earth's surface, Instruments for solar radiation measurements, Models for the estimate of the solar radiation components under different meteorological conditions, and over horizontal and inclined surfaces, Overview of the databases (solar atlases) presently available for the estimate of the solar resource at a specific site, Overview of the different approaches nowadays used to forecast solar radiation for energy-related applications, Practical exercise on the assessment of the solar resource.

Wind measurement and modelling
Wind climatology: synoptic-scale winds, mesoscale circulations and local effects, Monin-Obukhov similarity theory and dependence of the vertical wind profile on atmospheric stability, Overview of the wind atlases presently available: strengths and weaknesses, Instruments for wind measurements, correct siting of anemometers and planning of field measurements, Tools and methodologies for wind resource assessment, Analysis of wind data from experimental campaigns: relevant statistics for wind power assessment

Text Books:
1. Badescu V., Modeling Solar Radiation at the Earth's Surface: Recent Advances, Springer, Berlin, 2008.
2. Emeis S., Wind Energy Meteorology, Springer, Berlin, 2013.

Reference Books:
1. Wallace J.M., Hobbs P.V., Atmospheric Science, Academic Press, New York, 2006.
2. Duffie, J.A., and Beckman, W.A. Solar Energy Thermal Process, John Wiley and Sons, NewYork, 2006.

GRID INTEGRATION AND CONTROL

Course Code : EE40028
Credit : 3
L-T-P : 3-0-0
Prerequisites : Power Electronics (EE30001)

COURSE OBJECTIVE
Objective of the course is to introduce to the challenges and the possible solutions to the integration of the renewable energy systems at the grid, and utility level.

COURSE OUTCOMES

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

CO1: Understand different power quality issues and international regulations in distributed power generation systems.
CO2: Analyse different Grid Synchronization structures and their control techniques.
CO3: Apply Clarke Transformation, Park Transformation in grid synchronization structures.
CO4: Design different passive and active filters used for grid connected converters.
CO5: Investigate symmetrical and unsymmetrical grid faults.
CO6: Develop different synchronization techniques of power converters under grid fault conditions.

COURSE CONTENT

Introduction to Grid Integration
Introduction to electric grid, active and reactive power in electric system, voltage sag, voltage swell, unbalanced voltage, notch, harmonic distortion, frequency deviations, effects of renewable energy penetration into the grid (wind energy, solar energy),control issues and challenges in distributed power generation systems, abnormal grid conditions, IEEE and IEC standards for renewable energy grid integrations.

Grid Synchronization of three phase systems
Grid Synchronization Techniques: Zero crossing detection Technique, Phase-Locked Loop, Clarke Transformation, Park Transformation, Control structures of grid connected power converters: Synchronously rotating reference frame control structure, Stationary reference frame control structure, Natural reference frame control structure, linear and nonlinear controllers for grid applications.

Grid Filter Designs
Passive tuned filters, Passive high-pass filters, three-phase shunt active filters, instantaneous power theory, series active filters, and hybrid filters, Unified Power-Quality Conditioner (UPQC), STATCOM for reactive power compensation.

Grid Synchronization of Power Converters under Grid Faults
Grid fault, symmetrical and unsymmetrical grid faults,Fault Ride-Through feature of the wind turbines, Ideal Three-Phase Grid voltage, Three-Phase Voltage Vector under Grid Faults, Synchronous Reference Frame based PLL (SRF-PLL) under Unbalanced and Distorted Grid Conditions, SOGI-PNSC based grid synchronization technique under grid fault.

Text Books :

1. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, Grid Converters for Photovoltaic and Wind Power Systems, Wiley Int. Jan 2011.
2. Ali Keyhani Mohammad Marwali and Min Dai, "Integration and Control of Renewable Energy in Electric Power System" John Wiley publishing company, 2010, 2nd Edition.
3. Hirofumi Akagi, Edson HirokazWatanable , Mauricio Aredes, Instantaneous Power Theory and Applications to Power Conditioning , Wiley- IEEE Press , Feb 2007.

Reference Books :

1. Robert W Erickson and Dragan Maksimovic , Fundamentals of Power Electronics, 2nd Ed, Springer (India) Pvt. Ltd. 2005.
2. Wind Power Plants and Project Development by Joshua Earnest, Tore Wizelius, Second Edition, PHI Publication, 2015.
3. F. Gardner, Phaselock Techniques, New York, NY, USA: Wiley, 2005.
4. M. H. J. Bollen, Understanding Power Quality Problems: Voltage Sags and Interruptions. IEEE Press, 2002.

WIND TURBINES AND AERODYNAMICS

Course Code : EE40029
Credit :3
L-T-P : 3-0-0
Prerequisites : Renewable Energy Resource (EE30016)

COURSE OBJECTIVE

The objective of this course is to provide students with a comprehensive understanding of wind turbine technology, aerodynamics principles, and their application in the design, analysis, and operation of wind turbines. The course aims to equip students with the necessary knowledge and skills to work in the field of wind energy, including wind turbine design, performance evaluation, and optimization.

COURSE OUTCOMES

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

CO1: Know about various type of wind turbine and wind mills
CO2: Able to analyse the viability of wind resources
CO3: Understand the basic terminologies and concepts in aerodynamics
CO4: Know the methodologies to analyse and design of wind turbine blade.
CO5: Develop the competency for aerodynamic design of wind turbine.
CO6: Understand the various aspect of wind turbine control.

COURSE CONTENT

Introduction: Modern Wind Energy and its Origins
Modern Wind Turbines, Modern Wind Turbine Design, Power Output Prediction, Other Wind Turbine Concepts, History of Wind Energy, A Brief History of Windmills

Wind Characteristics and Resources
Introduction, General Characteristics of the Wind Resource, Characteristics of the Atmospheric Boundary Layer, Wind Data Analysis and Resource Estimation, Wind Turbine Energy Production Estimates Using Statistical Techniques, Regional Wind Resource Assessment, Wind Prediction and Forecasting, Wind Measurement and Instrumentation.

Concepts of Aerodynamics
General Overview, 2-D Aerodynamics, 3-D Aerodynamics ,1-D Momentum Theory for an Ideal Wind Turbine and the Betz Limit, Ideal Horizontal Axis Wind Turbine with Wake Rotation, Airfoils and General Concepts of Aerodynamics.

Aerodynamics of Wind Turbines
Blade Design for Modern Wind Turbines, Momentum Theory and Blade Element Theory, Blade Shape for Ideal Rotor without Wake Rotation, General Rotor Blade Shape Performance Prediction, Blade Shape for Optimum Rotor with Wake Rotation. Generalized Rotor Design Procedure. Simplified HAWT Rotor Performance Calculation Procedure, Effect of Drag and Blade Number on Optimum Performance, Computational and Aerodynamic Issues in Aerodynamic Design, Aerodynamics of Vertical Axis Wind Turbines

Wind Turbine Control
Introduction, Electrical Aspects of Wind Turbines, Overview of Wind Turbine Control Systems, Typical Grid-connected Turbine Operation, Supervisory Control Overview and Implementation, Dynamic Control Theory and Implementation

Text Books

1. Manwell, James F., Jon G. McGowan, and L. Anthony. "AL Rogers,(2009)." WIND ENERGY EXPLAINED Theory Design and Application Second Edition. John Wiley & Sons Ltd.
2. M. Hansen, Aerodynamics of Wind Turbines, Routledge, 2015

Reference Book

1. S. Heier, Grid Integration of Wind Energy Conversion Systems, Wiley, 2014.
2. F. M. Vanek and L. D. Albright, Energy Systems Engineering – Evaluation & Implementation, McGraw Hill Professional, 2016.

ENERGY SYSTEM MODELLING AND ANALYSIS

Course Code : EE40030
Credit : 3
L-T-P : 3-0-0
Prerequisites : Renewable Energy Resource (EE30016)

COURSE OBJECTIVE

The objective of this course is to understand the energy system, system analysis and optimization, planning and designing the energy system.

COURSE OUTCOMES

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

CO1: Understand the concept of economics and statistical analysis
CO2: Analyze the energy system by using Econometric techniques and energy forecasting
CO3: Apply the regional and national energy policy
CO4: Analyze the methodology of energy demand analysis
CO5: Forecast of future energy demand consistent with macroeconomic parameters in India
CO6: Evaluate the performance indices of the energy system

COURSE CONTENT

Basic Concept of Econometrics and Statistical Analysis
The 2-variable regression model; The multiple regression model; Tests of regression coefficients and regression equation. Econometric techniques used for energy analysis and forecasting with case studies from India.

Basic Concept of Input-Output Analysis
Concept of energy multiplier and implication of energy multiplier for analysis of regional and national energy policy. Energy and environmental Input - Output analyses using I-O model.

Energy Modeling: Interdependence of Energy
Economy-environment; Modelling concept, and application, Methodology of energy demand analysis; Methodology for energy forecasting. Sectoral energy demand forecasting; Inter-fuel substitution models; SIMA model, and I-O model for energy policy analysis. Simulation and forecasting of future energy demand consistent with macroeconomic parameters in India.

Project Evaluation and Management
Financial analysis: Project cash flows, time value of money, Life cycle approach and analysis, Conception, Definition, Planning, Feasibility and Analysis; Project appraisal criteria; Risk analysis; Project planning matrix; Aims oriented project planning; Social cost benefit analysis. Project evaluation techniques; Funds planning; Project material management, Evaluation and analysis; Implementation and monitoring; Performance indices; Case studies.

Text Books:

1. Polak P, Systematic Errors in Engineering Experiments, Macmillan Press Ltd.
2. Holman Jack P, Experimental Methods for Engineers, McGraw-Hill Book Company. Doebelin Ernest O, Engineering Experimentation – Planning, Execution, Reporting, McGraw-Hill.

Reference Books:

1. David Cleland, Roland Gareis, Global Project Management Handbook: Planning, Organizing and Controlling International Projects, McGraw Hill Professional.
2. Jean Carlo Binder, Global Project Management: Communication, Collaboration and Management Across Borders, Gower Publishing, Ltd. Hampshire, UK.
3. Garth Ward, The Project Manager's Guide to Purchasing: Contracting for Goods and Services, Gower Publishing, Ltd. Hampshire, UK.
4. Denise Bower, Management of Procurement, Thomas Telford, London, UK

FUEL TECHNOLOGY

Course Code : EE40031
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

To know the various types of fuel i.e. solid, liquid and gaseous fuels and their refining process along with applications

COURSE OUTCOMES

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

CO1: Know the different types of fuel
CO2: Illustrate the preparation, combustion techniques of solid fuel
CO3: Demonstrate the refining process, products, handling and storage of liquid fuel
CO4: Analyze the different types of gaseous fuel
CO5: Describe the cleaning, purification of solid, liquid and gaseous fuel
CO6: Know the applications of all types of fuel

COURSE CONTENT

Introduction
Types of fuels, solid, liquid and gaseous fuels, History of solid liquid and gaseous fuels, production, present scenario and consumption pattern of fuels, fundamental definitions, properties and various measurements, properties of solid liquid fuels and their measurement techniques.

Solid Fuels
Coal origin, its classification, composition, and properties. Coal mining,preparation, and washing. Combustion of coal and coke making, different types of coalcombustion techniques, coal tar distillation, coal liquefaction: direct and Indirectliquefaction, coal gasification, oxidation and hydrogenation. Efficient use of solidfuels, Applications.

Liquid Fuels
Origin and classification of petroleum, refining, properties & testing ofpetroleum products, various petroleum products, petroleum refining in India, liquidfuels from other sources, storage and handling of liquid fuels, Applications.

Gaseous Fuels
Types of gaseous fuels: natural gases, methane from coal mines,manufactured gases, producer gas, water gas, biogas, refinery gas, LPG, hydrogen,acetylene, other fuel gases. Cleaning, purification and quality enhancement of gaseousfuels, Applications.

Text Book

1. Irvin Glassman, "Combustion" 2nd ed., Academic Press.
2. John Griswold, "Fuels Combustion and Furnaces" Mc-Graw Hill Book Company Inc.
3. S.P. Sharma & Chander Mohan, "Fuels and Combustion", Tata McGraw Hill Publishing Co. Ltd.

Reference Books

1. Gupta O.P, "Elements of Fuels, Furnacesand Refractories", 3rd ed., Khanna Publishers.
2. Dr. Samir Sarkar, "Fuels and Combustion", 2nd ed., Orient Longman

ENERGY AUDIT AND MANAGEMENT

Course Code : EE40033
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

To determine ways to reduce energy consumption per unit of product output or to lower operating costs and minimize waste and environmental effects without affecting production & quality .

COURSE OUTCOMES

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

CO1: Understand about energy scenario nationwide and worldwide.
CO2: Identify various energy conservation techniques for demand side and supply side management.
CO3: Analyze power, load profiles andvarious tariff system
CO4: Analyze different types of furnace technology.
CO5: Design various heating system and conduct energy performance assessment.
CO6: Perform detail energy audit analysis and prepare audit report.

COURSE CONTENT

General Energy scenario

Energy consumption – world energy reserves – prices – Types of energy sources, Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach energy policies, Energy security, Demand side Management, Supply side management, Energy cconservation and its importance, Energy strategy for the future, Energy conservation Act-2001 and its features. Energy and environment: Air pollution, Industrial safety.

Electrical system

Electricity tariff, Load management, types of power: firm power, dump power, secondary power, load curve, load distribution curve, Power factor improvement, Electrical losses and efficiency, Light source, Choice of lighting. Industrial energy use – Energy index – Cost index, Representation of energy consumption: Pie charts – Sankey diagrams – Load Profile.

Energy Utilization and conversion system

Classification of furnace, controlled atmosphere in furnace, efficiency of energy in furnace, Heat – Heat content – Rate of heat transfer – Heat transfer coefficient – Conduction – Convention and radiation. Thermal insulation & its importance – space heating – HVAC system – Heating of Buildings – District heating – Factors & affecting the choice of district heating. Energy performance assessment of compressor, HVAC system and Lighting system

Energy Management and Audit

Data collection and data analysis methodologies, understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments, Payback period, CUSUM analysis, energy audit-reporting format.

Text Book

1. Abbi, Y.P. and Jain, S., Handbook on Energy Audit and Environment Management, Teri Bookstore (2006).
2. W.R. Murphy and G. McKay, “Energy management”, Butterworth & Co Publishers, Oxford, UK, 2001.

Reference Books

1. A Workbook for Energy Management in building by: Tarik Al-Shemmeri, Wiley-Blackwell.
2. Energy audit: Thermal power, combined cycle, and co-generation plants, by: Y.PAbbi, TERI, 2011.
3. Diwan, P., Energy Conservation, Pentagon Press (2008).
4. Younger, W., Handbook of Energy Audits, CRC Press (2008)

ENERGY STORAGE TECHNOLOGY

Course Code : EE40035
Credit : 3
L-T-P : 3-0-0
Prerequisite : Chemistry (CH10001)

COURSE OBJECTIVE

This course introduces the procedure for energy storage and provides a broad understanding and scientific principles of operations and the importance of the Fuel cell for recent needs.

COURSE OUTCOMES

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

CO1: Describe application of different energy storage systems.
CO2: Compare the performance of different types of energy storage devices.
CO3: Analyse the principle of different types of fuel cells.
CO4: Contrast between different types of battery technologies.
CO5: Estimate the state of charge of batteries using different techniques.
CO6: Discuss waste heat recovery and green house heating.

COURSE CONTENT

Introduction
Energy availability, Demand and storage, Need for energy storage, Different types of energy storage; Mechanical, Chemical, Electrical, Electrochemical, Biological, Magnetic, Electromagnetic, Thermal, Comparison of energy storage technologies.

Mechanical, Thermal Energy Storage
Flywheel storage, Hydro storage, Capacitor, Principles and applications, Thermal energy storage, principles and applications, Phase change materials; Energy analysis of thermal energy storage, solar energy and thermal energy storage.

Electrochemical Energy Storage
Electrochemical energy storage: Battery fundamentals and technologies, characteristics and performance comparison of Lead-acid, Nickel-Metal hydride, Lithium Ion; Battery system model, emerging trends in batteries, Voltages and Capacities of Electro-chemical Cells, Equivalent Circuit of an Electrochemical Cell, Charging and discharging operation of batteries, State-of-charge (SOC) of batteries, battery management systems.

Fuel Cells
Hydrogen as energy carrier and storage; Hydrogen resources and production; Basic principles; Fuel cell types: AFC, PEMFC, MCFC, SOFC, Microbial Fuel cell; Fuel cell performance; Fuel cell applications for power and transportation.

Application of Energy Storage
Food preservation, Waste heat recovery, Solar energy storage: Greenhouse heating; Drying and heating for process industries.

Text Books:

1. Huggins R. A., Energy Storage: Fundamentals, Materials and Applications, second edition, Springer International Publishing, 2015.
2. Dincer I., and Rosen M. A., Thermal Energy Storage: Systems and Applications, second edition, Wiley, 2011.

Reference Books:

1. Fuel Cell Fundamentals, O'Hayre R., Cha S., Colella W., and Prinz F. B., Wiley, Second Edition, 2009.
2. Chemical and Electrochemical Energy System, Narayan R. and Viswanathan B., Universities Press, (1998).
3. Battery Systems Engineering, Rahn C. D. and Wang C., First Edition, Wiley, 2013.
4. Electrochemical Energy Storage for Renewable Sources and Grid Balancing, Moseley P. T., and Garche J., Elsevier Science, 2014.
5. Compressed Air Energy Storage, Miller F. P., Vandome A. F., and John M. B., VDM Publishing, 2010.

POWER SYSTEM PROTECTION

Course Code : EE40041
Credit : 3
L-T-P : 3-0-0
Prerequisite : Network Analysis (EE30034)

COURSE OBJECTIVE

The objective of this course is to provide students with a comprehensive understanding of power system protection principles, techniques, and practices. The course aims to equip students with the necessary knowledge and skills to design, implement, and maintain protection systems for electrical power systems.

COURSE OUTCOMES

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

CO1: Describe the need of protective devices in power system.
CO2: Distinguish in different types of Circuit Breakers.
CO3: Demonstrate the principle of operation of different relays.
CO4: Realize the different scheme of protection for alternator, transformer.
CO5: Apply different types of protection schemes for bus bar, feeder and transmission line.
CO6: Know the different protection scheme against surges.

COURSE CONTENT

Introduction

Protection system and its attributes, Philosophy of protection, requirement of ideal protective scheme, different terms in protective systems, Basic elements in protective scheme, Requirement of circuit breakers, characteristics of an electric arc, principle of AC and DC arc interruption, Recovery voltage, re-striking voltage, current chopping, resistance switching.
Circuit Breakers: Types of AC and DC circuit breakers, Arc extinction methods, oil circuit breaker, air blast circuit breaker, vacuum and SF_6 circuit breaker, Principle of miniature circuit breaker and molded case circuit breaker, determination of circuit breaker capacity, circuit breaker ratings. Protective Elements: Concept of Fuse, need, construction, principle, characteristics of H.R.C fuse. Earthing: Introduction, Methods of neutral grounding (solid earthing, resistance earthing and Peterson coil earthing and its effects on fault conditions), Construction, Principle of operations of Electromagnetic type, induction type: over current, directional, distance relays, Differential relay. Activity-Bulk and minimum oil circuit breaker, control switch operation of circuit breaker, MCB, MCCB, RCCB, Relay characteristics.

Alternator Protection

Different types of faults, differential protection with biasing, restricted earth fault protection, negative sequence protection, automatic field suppression and neutral circuit breakers. Transformer Protection: Buchholz relay, Biased differential protection, restricted earth fault protection, harmonic restraint, protection of combined alternator and transformer. Bus Bar Protection: Differential scheme for both phase and line faults, introduction to digital protective relay and microprocessor-based relays.

Feeder Protection

Time graded protection: radial, parallel and ring feeders; over current and earth fault protection, calculation of graded time setting, split core protection of feeders, carrier current protection. Pilot Wire Protection: Circulating current differential protection (Merz-Price protection), Biased or percentage differential protection scheme, opposed (balanced) voltage
differential protection system, Translay scheme; static relays. Protection against Surges: Ground wire, Surge diverters: rod gap, horn gap lighting arresters, surge absorbers.

Text Book

1. Fundamentals of Power System Protection", Y. G. Paithankar, S. R. Bhide, 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2011.
2. Power System Protection and Switchgear by B Rabindranath and M Chander , Wiley Eastern 2017, 2nd Edition.

Reference Books

1. A Course in Power Systems, J. B. Gupta, S. K. Kataria and Sons Publishers and Distributors, 2009.
2. Principles of Relaying", Van Warrington, Y. G. Paithankar. TMH, 2009.
3. Power system Switchgear and Protection N.Veerappan and S R Krishnamurthy, S Chand Publication, Revised edition 2013.
4. Power system Protection and Switchgear, Badri Ram and D N Vishwakarma Tata McGraw Hill, 2nd reprint 2012
5. Electrical Power System, C.L. Wadhwa, New Age International (P) Limited, Publishers, 2009.

ROBOTICS AND CONTROL

Course Code : EE400042
Credit :3
L-T-P : 3-0-0
Prerequisite :Network Analysis (EE30034), Linear Control System (EE20004)

COURSE OBJECTIVE

This course helps the student to basic idea of Robots. Students are introduced to the basic design consideration of robots. Concepts like trajectory planning, obstacle avoidance, kinematics and dynamics of robotic manipulators are introduced. Industrial applications of robotic manipulators are also included as part of the course to get an overall idea on robotics

COURSE OUTCOMES

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

CO1: Gain knowledge about configuration of robot.
CO2: Analyze the kinematics and dynamics of robot.
CO3: Understand the trajectory planning of robot.
CO4: Design controller for robot.
CO5: Apply robot to solve industrial issues.
CO6: Know about various sensors in robotics.

COURSE CONTENT

Introduction to Robotics
Basic Structure of Robots, Robot Anatomy, Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Basic Robot Configurations and their Relative Merits and Demerits, the Wrist & Gripper Sub-assemblies.Kinematics of Robot Manipulator: Direct Kinematics problem, Geometry Based Direct kinematics problem, Co-ordinate and vector transformation using matrices, Rotation matrix, Inverse Transformations, Problems, Composite Rotation matrix, Homogenous Transformations, Robotic Manipulator Joint Co-Ordinate System, Euler Angle & Euler Transformations, Roll-Pitch-Yaw (RPY) Transformation, D-H Representation & Displacement Matrices for Standard Configurations, Jacobian Transformation in Robotic Manipulation.

Trajectory Planning
Joint space trajectory planning- cubic polynomial, linear trajectory with parabolic blends, trajectory planning with via points; Cartesian space planning, Point to point vs continuous path planning. Obstacle avoidance methods based on classical techniques (e.g. Artificial Potential field, A* algorithms). Dynamics of Robotic Manipulators: Lagrange's formulation – Kinetic Energy expression, velocity Jacobian and Potential Energy expression, Generalized force, Euler-Lagrange equation, Dynamic model of planar and spatial serial robots up to 2 DOF. Control design for Robotic System: Control Loops of Robotic Systems, trajectory, velocity and force control, Computed Torque control, Linear and Nonlinear controller design of robot. Design of controller for robot in Matlab programming.

Industrial Applications of Robotics
Material handling, welding, Spray painting, Machining. Case studyfor a typical industrial application including robot selection considerations such as number of axes, work volume, capacity & speed, stroke &reach, Repeatability, Precision and Accuracy, Operating environment. Applications of robotics in active perception, medical robotics, autonomous vehicles, and other areas. Sensors for Robotics: Wheel/motor sensors, Heading sensors, Accelerometers, Inertial measurement unit (IMU), Ground beacons, Active ranging, Motion/speed sensors, Vision sensors. art systems.

Text Book

1. Robert. J. Schilling , "Fundamentals of robotics – Analysis and control", Prentice Hall of India,1990, (Latest reprint).
2. Introduction to Robotics- John J. Craig, Addison Wesley Publishing, 3rd edition, 2010.

Reference Books

1. R K Mittal & I. J. Nagrath, Robotics and Control, McGraw Hill Publication, 201.
2. Groover, M.P. Weiss, M. Nagel, R.N. & Odrey, N.G., Ashish Dutta, Industrial Robotics, Technology, Programming & Applications, Tata McGraw Hill Education Pvt. Ltd. New Delhi.
3. Introduction to Robotics by S K Saha, Mc Graw Hill Education

HYBRID ELECTRIC VEHICLES

Course Code : EE40044
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE
The objective of this course is to provide students with a comprehensive understanding of hybrid electric vehicle technology, systems, and design principles. The course aims to equip students with the necessary knowledge and skills to design, develop, and analyze hybrid electric vehicle systems.

COURSE OUTCOMES

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

CO1: Understand the modeling of Electric Vehicles and Hybrid Electric Vehicles.
CO2: Know the mechanism of propulsion drive system.
CO3: Control the output voltage and current of Traction Inverter.
CO4: Analyze the control of the speed and torque of various traction motors.
CO5: Explain the different energy storage systems.
CO6: Know the design of Hybrid Electric Vehicle.

COURSE CONTENT

Introduction
History of hybrid and Electric vehicles, social and environmental importance of hybrid and electric vehicles.
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.
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 Propulsion unit
Introduction to electric components used in hybrid and electric vehicles, configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, and Switch Reluctance Motor drives, drive system efficiency.
Storage and its analysis
Fuel Cell 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. concept of tariff management in charging stations.
Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text Book

1. Electric and Hybrid Vehicles: Design Fundamentals, by Iqbal Husain, CBC Press, Second Edition, 2010.
2. Vehicular Electric Power Systems by Ali Emadi, Willis Press, 2003

Reference Books

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. Electric Vehicle Technology by James and John, John Wiley & Sons, Ltd First Edition, 2004.

HYDROGEN AND FUEL CELL TECHNOLOGY FOR ELECTRIC AND HYBRID VEHICLE

Course Code : EE40045
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

To understanding the principles of hydrogen as an energy carrier and its application in fuel cell technology.

COURSE OUTCOMES

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

CO1: Know the working principle and operation of fuel Cell
CO2: Illustrate the reaction kinetics of fuel cell
CO3: Understand the characteristics of the fuel cell
CO4: Analyze the mathematical modelling of the fuel cell
CO5: Integrate the Fuel Cells in Electric Vehicles and their Performance
CO6: Analyze economic and policy aspects of hydrogen and fuel cell technology

COURSE CONTENT

Introduction to Fuel Cells
Introduction – working and types of fuel cell – low, medium and high temperature fuel cell, liquid and methanol types, proton exchange membrane fuel cell solid oxide, hydrogen fuel cells – thermodynamics and electrochemical kinetics of fuel cells.

Fuel Cells for Automotive Applications
Fuel cells for automotive applications – technology advances in fuel cell vehicle systems – onboard hydrogen storage – liquid hydrogen and compressed hydrogen – metal hydrides, fuel cell control system – alkaline fuel cell – road map to market.

Fuel Cell Components and Their Impact on Performance
Fuel cell performance characteristics – current/voltage, voltage efficiency and power density, ohmic resistance, kinetic performance, mass transfer effects – membrane electrode assembly components, fuel cell stack, bi-polar plate, humidifiers and cooling plates.

Integration of Fuel Cells in Electric Vehicles and their Performance
Hybrid electric vehicles (HEVs) and fuel cell electric vehicles (FCEVs), Integration of fuel cells with electric drive trains, Benefits and limitations of fuel cell vehicles, Performance characteristics of fuel cell vehicles, Fuel efficiency and range considerations, Maintenance and servicing of fuel cell system, Diagnostics and troubleshooting in fuel cell vehicles

Economic and Policy Aspects of Hydrogen and Fuel Cell Technology
Cost analysis of fuel cell systems and hydrogen production, Government policies and incentives promoting fuel cell vehicles, Market trends and commercialization prospects, Future developments and challenges in hydrogen and fuel cell technology

Text Book

1. Fuel Cells: From Fundamentals to Applications by Supramaniam Srinivasan
2. Fuel Cells: Principles, Design, and Analysis by Jochen Valentin and Michael W. G. Hoffmann

Reference Books

1. Fuel Cell Fundamentals by Ryan P. O'Hayre, Suk-Won Cha, Whitney G. Colella, Fritz B. Prinz
2. Introduction to Hydrogen Technology, by Roman J. Press and Raymond L. Markiewicz
3. Hydrogen and Fuel Cells: A Comprehensive Guide, by Rebecca L. Wagner
4. Hydrogen and Fuel Cells: Advances in Transportation and Power, by David A. J. Rand

IOT IN ELECTRIC VEHICLES

Course Code : EE40046
Credit : 3
L-T-P : 3-0-0
Prerequisite :Nil

COURSE OBJECTIVE

Understand the fundamentals of electric vehicles (EVs) and their integration with the Internet of Things (IoT). Explore the key components of an IoT-enabled electric vehicle system, including sensors, actuators, connectivity, and data management. Examine the benefits and challenges of implementing IoT in electric vehicles, such as improved energy efficiency, enhanced safety, and effective fleet management.

COURSE OUTCOMES

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

CO1: Categorize the components of IoT.
CO2: Analyze various protocols of internet.
CO3: Compare various IoT networking techniques.
CO4: Distinguish the Security and Privacy of IoT.
CO5: Categorize various techniques of inter connected vehicles.
CO6: Analyze IoT application in electric vehicle.

COURSE CONTENT

Introduction
Definition, Components in the internet of things, Sensing and Actuation Anywhere, Anytime, Genesis of the Internet of Things, Power Sources, Internet Principles, sensor types and properties, different transducers and actuators, Internet Communications: An Overview (IP, TCP, The IP Protocol Suite (TCP/IP), UDP), IP Addresses (DNS, Static IP Address Assignment, Dynamic IP Address Assignment, IPv6), MAC Addresses, TCP and UDP Ports.

IoT Protocols
MQTT, XMPP, CoAP, IEEE802.15.4, ZigBee, LORA, RFID, Client Server Model, HTTP, Thingspeak, AWS, Cloud MQTT.

IoT Security
Network and transport layer challenges, IoT Gateways, IoT Routing attacks, Fog computing, IoT Fog.

Vehicle with IoT
Levels of operations, vehicle to everything, V2X paradox, VANETs, Information centric networks, CCN for VANET, three layered architecture, intelligent connected vehicles.

IoT Application in EV
Charging management system (CMS), smart charging, Block-chain IoT for interconnected vehicle, transportation management system, logistic management system.

Text Book

1. Precision: Principles, Practices and Solutions for the Internet of Things, Timothy Chou, TMH.
2. Designing the Internet of Things", Adrian Mc Ewen, Hakim Classically, Wileypublication,1st Edition, November2013.
3. The Internet of Things in the Power Sector Opportunities in Asia and the Pacific, Ramamurthy, A. and Jain, P,2017.

Reference Books

1. The Internet of Things: A Survey, Journal on Networks, Luigi Atzori, Antonio Lera, Giacomo Morabit, Elsevier Publications, October,2010.
2. The Internet of Things in the Cloud: A Middle ware Perspective, Honbo Zhou, CRCPress-2012.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Springer,2011.

CYBER SECURITY

Course Code :EE40047
Credit : 3
L-T-P : 3-0-0
Prerequisite :Nil

COURSE OBJECTIVE

The objective of the "Cyber Security" course is to provide students with a comprehensive understanding of the principles, techniques, and best practices in the field of cybersecurity.

COURSE OUTCOMES

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

CO1: Understand the need of cyber security for an organization.
CO2: Know the different hacking, hijacking and security to reduce the risk of cyber exploitation.
CO3: Measure the performance and troubleshoot cyber security systems.
CO4: Analyze the management of electronic records and relevancy for cyber security
CO5: Comprehend the tools and methods in Cybercrime
CO6: Design Cloud and IoT based security measures for cyber crime

COURSE CONTENT

Introduction
Introduction of Cyber Crime, Challenges of cyber crime, Classifications of Cybercrimes: E-Mail, Spoofing, Spamming, Internet Time Theft, Salami attack/Salami Technique.

Web Jacking
Online Frauds, Software Piracy, Computer Network Intrusions, Password Sniffing, Identity Theft, cyber terrorism, Virtual Crime, Perception of cyber criminals: hackers, insurgents, and extremist group etc. Web servers were hacking, session hijacking.

Cyber Crime and Criminal Justice
Concept of Cyber Crime and the IT Act, 2000, Hacking, Teenage Web Vandals, Cyber Fraud and Cheating, Defamation, Harassment and E-mail Abuse, Other IT Act Offences, Monetary Penalties, jurisdiction and Cyber Crimes, Nature of Criminality, Strategies to tackle Cyber Crime and Trends.

Indian Evidence Act
The Indian Evidence Act of 1872 v. Information Technology Act, 2000: Status of Electronic Records as Evidence, Proof and Management of Electronic Records; Relevancy, Admissibility and Probative Value of E-Evidence, Proving Digital Signatures, Proof of Electronic Agreements, Proving Electronic Messages.

Tools and Methods in Cybercrime
Proxy Servers and Anonymizers, Password Cracking, Key loggers and Spyware, virus and worms, Trojan Horses, Backdoors, DoS and DDoS Attacks , Buffer and Overflow, Attack on Wireless Networks, Phishing : Method of Phishing, Phishing Techniques.
Cloud and IoT are the latest emerging technologies and every other organization wants to implement it. Therefore, it is understandable to learn security measures under this category.

Text Books

1. Principles of Cyber crime, Jonathan Clough Cambridge University Press
2. John R.Vacca, Computer Forensics:Computer Crime Scene Investigation, 2nd Edition, Charles River Media, 2005

Reference Books

1. Cyber Law Simplified, VivekSood, Pub: TMH.
2. Cyber Security by Nina Godbole, SunitBelapure Pub: Wiley-India
3. Information Warfare: Corporate attack and defense in digital world, William Hutchinson, Mathew Warren, Elsevier.
4. Cyber Laws and IT Protection, Harish Chander, Pub:PHI.
5. Cryptography and Network Security: Principles and Practice, Global Edition, 7/E, William Stallings, Pearson.

WIRELESS NETWORK SYSTEMS

Course Code :EE40048
Credit : 3
L-T-P : 3-0-0
Prerequisite :Nil

COURSE OBJECTIVE

The objective of the "Wireless Network Systems" course is to provide students with a comprehensive understanding of the principles, protocols, and technologies used in wireless network systems.

COURSE OUTCOMES

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

CO1: Know the fundamentals of wireless communications and advanced cellular system.
CO2: Comprehend the domains of application of Radio Propagation.
CO3: Understand the concepts of Cellular Communication.
CO4: Analyze the CDMA and FDMA communication systems.
CO5: Evaluate the utility of WANs.
CO6: Create new wireless systems for the mankind.

COURSE CONTENT

Introduction
Overview of wireless communications and systems Review of digital communications, Cellular systems from 1G to 3G Wireless 4G systems.

Radio propagation and propagation path-loss model
Free-space attenuation, Multipath channel characteristics, Signal fading statistics, Path-loss models

Fundamentals of cellular communications
Hexagonal cell geometry, Co-channel interference, Cellular system design, Sectoring using directional antennas

Multiple access techniques
Frequency division multiple access (FDMA), Time division multiple access (TDMA), Code division multiple access (CDMA), Space division multiple access (SDMA), Orthogonal frequency division multiplexing (OFDM), Multicarrier CDMA (MC-CDMA), Random access methods

Wireless Network
Wide-area wireless networks (WANs) GSM – IS-136, IS-95, UMTS, Cdma2000

Long Term Evolution Technologies (LTE)
OFDM, MIMO channels, Space Time Codes, LTE Advanced, Other Wireless systems IEEE 802.11 WLAN (WiFi), WiMAX

Text Books

1. Wireless Communications: Principles and Practice, 2nd Edition. Theodore S. Rappaport, Pearson publications

2. Mobile Wireless Communications. Mischa Schwartz. Paperback (2013) ISBN:9781107412712. Cambridge University Press.

Reference Books:

1. The evolution to 4G cellular systems: LTE-Advanced. Ian F. Akyildiz, David M. GutierrezEstevez, Elias Chavarria Reyes. Broadband Wireless Networking Laboratory, School of Electricaland Computer Engineering, Georgia Institute of Technology.
2. Vijay K. Garg, Wireless Communications and Networking, Morgan Kaufmann Publishers, 2007, ISBN 978-0-12-373580-5

IoT IN INDUSTRY

Course Code :EE40049
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

The objective of this course is to understand the concepts and principles of IoT and its applications in industrial settings as well as exploring the key components and technologies involved in building IoT systems for industry.

COURSE OUTCOMES

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

CO1: Categorize the components of IoT and Industrial IoT
CO2: Apply AI and Bigdata in Industrial IoT.
CO3: Analyze the architecture approach of Industrial IoT.
CO4: Understand the communication technique of Industrial IoT.
CO5: Design building blocks of Industrial IoT.
CO6**:** Design IoT system for various industrial cases.

COURSE CONTENT

Smart Industry

Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis.

Architecture

Industrial Processes, Industrial Sensing & Actuation, Industrial Internet Systems, Business Model and Reference Architecture, IoT Reference Architecture, Industrial IoT- Layers, Sensing, IoT Processing, IoT Communication.

Security

Security and Fog Computing, Fog Computing in IoT, IoT Application Domains Design,
Interconnected Healthcare IoT architecture design, Open source IoT design for agricultural application, Facility Management. Industrial IoT design based on Application Domains: Oil, chemical and pharmaceutical and process industry.

Text Books

1. Designing the Internet of Things, Adrian McEwen, Hakim Cassimally, Wiley publication, 1st Edition, November 2013.
2. The Internet of Things in the Power Sector Opportunities in Asia and the Pacific, Ramamurthy, A. and Jain, P, 2017.

Reference Books

1. The Internet of Things: A Survey, Journal on Networks, Luigi Atzori, Antonio Lera, Giacomo Morabito, Elsevier Publications, October, 2010.
2. The Internet of Things in the Cloud:A Middleware Perspective, Honbo Zhou, CRC Press-2012.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Springer, 2011.

SMART BIO-MEDICAL INSTRUMENTATION

Course Code :EE40050
Credit : 3
L-T-P : 3-0-0
Prerequisite :Basic Electronics(EC10001), Science of Living Systems (LS10001)

COURSE OBJECTIVE

The objective of the "Smart Bio-Medical Instrumentation" course is to provide students with a comprehensive understanding of fundamental concepts in biomedical instrumentationand its role in healthcare. Application-specific biomedical sensors and non-invasive diagnostic parameters has also been introduced in this course.

COURSE OUTCOMES

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

CO1: Demonstrate various biomedical signal sources.
CO2: Illustrate various Physiological system of the human body.
CO3: Understand cardiovascular system and related measurements.
CO4: Know working principle of measurement instrument for respiratory and nervous system.
CO5: Identify the non-invasive diagnostic parameters.
CO6: Analyze the performance characteristics of various sensors in biomedical equipment.

COURSE CONTENT

Introduction of Bio-medical Instrumentation
Sources of Bioelectric Potentials and Electrodes. Introduction to man-instrument system, components of the man-instrument system, Physiological system of the body, Problems encountered in measuring a living system. Resting and action potentials.

Cardiovascular System and Measurements
The heart and cardiovascular system, ECG, blood pressure and its measurement, respiration and pulse rate, characteristics and measurement of blood flow meter.Measurement of Heart Rate using Stethoscope, Blood pressure using Sphygmomanometer, Pulse Rate and SpO_2measurement using Pulse Oximeter

Respiratory systemand Measurements
The physiology of the respiratory system, test and instrument for the mechanics of breathing.Use of Spiro meter.

Neuro-muscular System and Measurements
Somatic nervous system,EEG,EMG ,GSR

Measurement and Recording of Noninvasive Diagnostic Instrument
Principle of ultrasonic measurement, thermography, elements of intensive care monitoring-ray, CT – Scan, MRI, Tonometer, Dialysis and Diathermy .

Biomedical Sensors
Recognize the role of sensors in biomedical instrumentation, basic mechanisms and principles of biomedical sensors.

Text Books
1. Cromwell, L. and Weibell, F.J. and Pfeiffer, E.A., Biomedical Instrumentation and Measurement, Dorling Kingsley (2006) 2nd edition.
2. Carr, J.J. and Brown, J.M., Introduction to Biomedical Equipment Technology, Prentice Hall India (PHI) (2000) 4th edition.

Reference Books
1. Geddes, L.A., and Baker, L.E., Principles of Applied Biomedical Instrumentation, Wiley InternationalScience (1989) 3rd edition.
2. Khandpur, R.S., Handbook of Biomedical Instrumentation, McGraw Hill (2003) 2nd edition.
3. Webster, J.G., Medical Instrumentation Application and Design, John Wiley (2007) 3rd edition
4. Medical Device Technologies: A Systems Based Overview Using Engineering Standards, G. Baura, Academic Press, 2011

BIO-INSPIRED ALGORITHM

Course Code : EE40051
Credit : 3
L-T-P : 3-0-0
Prerequisite :Nil

COURSE OBJECTIVE

The objectives of this course are to learn bio- inspired theorem and algorithms, to understand simulated annealing, genetic algorithm, differential evolution, swarm optimization, ant colony for feature selection.

COURSE OUTCOMES

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

CO1: Understand the basic concept of evolutionary computation.
CO2: Demonstrate swarm intelligence for existing systems
CO3: Interpret the implementation issues of evolutionary algorithms.
CO4: Calculate the appropriate parameter settings for algorithm convergence .
CO5: Evaluate new evolutionary operators, representations and fitness functions.
CO6: Identify different evolutionary algorithms for engineering applications

COURSE CONTENT

Evolutionary Computation
Biological and artificial evolution, Evolutionary computation, Different historical branches of EC, Genetic Programming: Trees as individuals, Major steps of genetic programming, e.g., functional and terminal sets, initialization, crossover, mutation, fitness evaluation, etc. Search operators on trees, automatically defined functions, Issues in genetic programming, e.g., bloat, scalability, etc. Selection schemes: Fitness proportional selection and fitness scaling, Ranking, including linear, power, exponential and other ranking methods, Tournament selection, Selection and its impact on evolutionary search, Search Operators: Recombination/Crossover for strings (e.g., binary strings), e.g., one-point, multi-point, and uniform crossover operators, Mutation for real-valued representations, e.g., Gaussian and Cauchy mutations, self-adaptive mutations, etc., Generational cycle-convergence of Genetic Algorithm.

Introduction to Swarm Optimization
Conventional Computing versus Swarm Computing; Classification of meta-heuristic techniques- single solution based and population based algorithms – exploitation and exploration in population based algorithms; Properties of Swarm intelligent Systems;
Particle Swarm Optimization: PSO Model, global best, Local best, velocity update equations, position update equations, velocity clamping, inertia weight, constriction coefficients, synchronous and asynchronous updates, Binary PSO.

Different Evolutionary Algorithms
Historical development, types of bees and their role in the optimization process, Introduction to Ant Systems, Ant Colony Optimization Technique, Pheromones and its Density as Deciding Factor. Artificial bee colony (ABC) algorithms binary ABC and continuous ABC algorithms; Bacterial foraging techniques-taxes-elimination-dispersals bacteria motility and swarming; Biological immune systems and artificial immune systems affinity measures- representations; Basic immune models and algorithms.

Text Books :

1. Genetic Algorithms in Search, Optimization & Machine Learning, D E Goldberg, Addison-Wesley, 1989
2. James Kennedy and Russel E Eberheart, ‘Swarm Intelligence’, The Morgan Kaufmann Series in Evolutionary Computation, 2001

Reference Books :

1. Eric Bonabeau, Marco Dorigo, and Guy Theraulaz, “Swarm Intelligence: From Natural to Artificial Systems”, Oxford University Press, 1999
2. Engelbrecht, A.P. Computational Intelligence: An Introduction, Second Edition, John Wiley and Sons, 2007.

3. Dorigo, M., Stutzle, T., Ant Colony Optimization, MIT Press, 2004
4. Parsopoulos, K.E., Vrahatis, M.N., Particle Swarm Optimization and Intelligence: Advances and Applications, Information Science Reference, IGI Global, 2010
5. Clerc, M., Particle Swarm Optimization, ISTE, 2006 7. Nature Inspired Metaheuristic Algorithms, Xin-She Yang, Luniver Press, 2010.
6. Handbook on Evolutionary Computation, T. Baeck, D. B. Fogel, and Z. Michalewicz (eds.), IOP Press, 1997.
7. Andries P. Engelbrecht, "Computational Swarm Intelligence", Wiley, John & Sons, 2006.

IoT SENSORS AND PROTOCOLS

Course code : EE40052
Credit : 3
L-T-P : 3-0-0
Prerequisite : NIL

COURSE OBJECTIVE

The objective of the "IoT Sensors and Protocols" course is to provide students with a comprehensive understanding of the various sensors and protocols used in Internet of Things (IoT) systems. By the end of the course, students should be able to understand the principles and working mechanisms of different types of sensors used in IoT applications. Gain practical knowledge in the deployment and integration of sensors within IoT systems. Explore the characteristics, advantages, and limitations of commonly used IoT protocols such as MQTT, CoAP, and HTTP. Understand the role of data acquisition.

COURSE OUTCOMES

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

CO1: Categorize the components of IoT sensors.
CO2: Analyze various types of actuators for IoT applications.
CO3: Access Various Protocols for IoT.
CO4: Prioritize various clouds and its application.
CO5: Distinguish an embedded development platform.
CO6: Design devices based ob enduser applications.

COURSE CONTENT

Introduction to Sensor

Sensor types and properties, different transducers and actuators, IoT sensors :Temperature sensors, Proximity sensor, Pressure sensor, Water quality sensor, Gas sensor, Smoke sensor, IR sensors, Level sensors, Image sensors, Motion detection sensors, Accelerometer sensors, Gyroscope sensors, Humidity sensors, Optical sensors.

Communications

An Overview (IP, TCP, The IP Protocol Suite (TCP/IP), UDP), IP Addresses (DNS, Static IP Address Assignment, Dynamic IP Address Assignment, IPv6), MAC Addresses, TCP and UDP Ports.

IoT Protocols
MQTT, XMPP, CoAP, IEEE802.15.4, ZigBee, LORA, RFID.

Advanced Embedded Development Platforms
System on Chip (SoC), ARM®, Raspberry Pi, Evolution of Pi and technical specification comparative study, GPIO Interfacing Cloud, Analytics & UI, Client Server Model, HTTP, Thingspeak, AWS, CloudMQTT.

IoT framework Design
Selection of sensors for use cases, IoT end node hardware design, IoT dashboard Design for end user applications.

Text Books:

1. Designing the Internet of Things, Adrian McEwen, Hakim Cassimally, Wiley publication, 1st Edition, November 2013.
2. The Internet of Things in the Power Sector Opportunities in Asia and the Pacific, Ramamurthy, A. and Jain, P, 2017.

Reference Books:

1. The Internet of Things: A Survey, Journal on Networks, Luigi Atzori, Antonio Lera, Giacomo Morabito, Elsevier Publications, October, 2010.
2. The Internet of Things in the Cloud: A Middleware Perspective, Honbo Zhou, CRC Press-2012.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Springer, 2011.

PROBABILITY AND STATISTICS

Course Code : MA21001
Credit :4
L-T-P :3-1- 0
Prerequisite :Differential Equations and Linear Algebra (MA11001)

COURSE OBJECTIVE

The objective of this course is to familiarize the students with the foundation of probability and statistics and to use it in solving the problems arises in engineering and real life applications.

COURSE OUTCOMES

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

CO1:understand basic probability and its applications
CO2: study probability distributions and can use it in real life data analysis
CO3:have a knowledge on univariate and bivariate distributions and their properties
CO4: measure the central tendency and dispersion of a data set to draw conclusion from the data and interpret the data with the appropriate pictorial representation.
CO5: have good understanding of the Central Limit Theorem and its applications
CO6: analyze the statistical inference

COURSE CONTENT

Probability and random variables

Basic concepts of sample space, events(with example), Axiom of Probability,Conditional Probability, Bayes' Theorem and its applications.Discrete random variable, probability mass function, cumulative distribution function and Moment Generating function for discrete random variable, some special distributions likeUniform distribution, Geometric distribution, Binomial distribution, Negative Binomial distribution, Poisson distribution, Hyper geometric distribution, mean and variance.Continuous random variable, density function, cumulative distribution function and Moment Generating function. Uniform distribution, normal distribution, mean, variance, percentile and critical value of normal distribution,normal approximation of the binomial distributionand exponential distribution.

Joint probability and distributions

Joint probability mass function and marginal probability mass function, joint probability density function and marginal probability density function, concept of independent random variable(joint probability), conditional probability mass function and conditional probability density function. Expected value, covariance and correlation for jointly distributed random variable(both continuous and discrete).

Descriptive Statistics

Frequency distribution,pictorial and tabular representation of data, stem and leaf display, dot plots, histogram, box plots and comparative box plots.Basic conceptson mean, median and mode, Skewness, Kurtosis, Correlation, Coefficient of Correlation, rank correlation, Regression Analysis: Least square method.

Inferential statistics

Population, sample, random sample, sampling distribution, distribution of sample mean, central limit theorem, point estimator, point estimation of parameter using method of maximum likelihood estimation, confidence interval, confidence interval for the mean of a normal population with known and unknown variance, confidence interval for the variance of a normal population, hypothesis testing, one sided and two sided alternatives, Tests for mean of the normal distribution with known variance, Tests for mean of the normal distribution with unknown variance, tests for variance of the normal distribution.

Text books:

1. Probability and Statistics for Engineers and Sciences by J. L. Devore, CENGAGE Learning, 9th Edition
2. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, 10th Edition.

Reference Books:

1. Introduction to Probability and Statistics for Engineers and Scientists by S.M. Ross, Elsevier/AP, 6th Edition.
2. Introduction to Probability and Statistics by J.S. Milton & J.C. Arnold, Mc Graw Hill, 4th Edition.
3. Introduction to Probability Theory and Statistical Inference by H.J. Larson, John Wiley & Sons Inc, 3rd Edition.
4. Fundamental of Mathematical Statistics by S.C. Gupta & V.K.Kapoor, S. Chand, 12th Edition.

VECTORS, DIFFERENTIAL EQUATIONS AND COMPLEX ANALYSIS

Course Code : MA21006
Credit :4
L-T-P :3-1-0
Prerequisite : Differential Equations and Linear Algebra (MA11001) and Transform Calculus and Numerical Analysis (MA11002)

COURSE OBJECTIVE

The objective of this course is to empower the students to design and solve branch prospective problems by the use of Vector calculus, partial differential equations, Complex variables.

COURSE OUTCOMES

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

CO1: understand the physical significance of the concepts like divergence, curl and gradient.
CO2: apply vector integration theorems like Gauss divergence, Stokes and Greens theorem in different engineering applications like work done by force, evaluation of flux etc.
CO3: know the basic analytical techniques for solving the classical wave, heat and Laplace equation
CO4: know the concepts of analytic functions, its differentiation and its series representation
CO5:understand the fundamental concepts of contour integration to evaluate complicated real integralsvia residue calculus
CO6: apply multi steps numerical methods to solve initial and boundary value problems

COURSE CONTENT

Vector Calculus
Brief concepts of vectors, gradient of a scalar field, directional derivatives, divergence and curlof a vector field. Vector line integral, surface integral, Green's theorem, Gauss divergence theorem, Stoke's theorem, engineering applications of above integral theorems like work done by force, flux integration, independence of path etc.

Partial Differential Equations(PDE)
Basic concepts of PDE like order, degree, linear, nonlinear, homogeneous and non-homogeneous PDE. Solution of PDE by Variable Separable method. Classification of PDE and their reduction to normal form. One dimensional Wave equation, D'Alembert and Fourier series solution of 1-D wave equation. Solution of 1-D heat equation by Fourier series method. Solution of 2-D Laplace equation and 2-D heat equations. (steady state) with different types of boundary conditions using Fourier series.Laplace equation in polar co-ordinate and its application to find the electrostatic potential/steady state temperature in a disk with appropriate boundary conditions. Solution of PDE by Laplace Transform.

Complex Analysis
Basic concepts of complex number. Complex functions, derivatives, analytic function, Cauchy Riemann equations, harmonic functions, harmonic conjugate, elementary functions like exponential, trigonometric, hyperbolic, logarithmic functions and general powers. Curves in complex plane and their parametric representation. Line integrals, Cauchy integral theorem, Cauchy integral formula, Derivatives of analytic function. Power series, Taylor's series, Maclaurin's series, Laurent's series, singularities, Residues, Residue Integration, Real Integralsand Cauchy's Principal Value integrals.

Numerical Solution of ODEs
Solution of Linear Difference Equations; IVP (Multi Steps Method): (Predictor-Corrector method) Adams-Bashforth Method, Adam-Moulton Method; BVP: Shooting methods.

Text books
1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, 10th Edition.
2. Numerical Methods for Scientific and Engineering Computation by Jain , Iyenger and Jain, New age International (P) Ltd.,6th Edition.

Reference books:
1. Higher Engineering Mathematics by B.S.Grewal, Khanna Publishers,36thEdition.
2. Higher Engineering Mathematics by B.V. Ramana, TMH, 2017 Edition.
3. Advanced Engineering Mathematics by H. K. Dass, S. Chand, 2007 Edition

INDUSTRY 4.0 TECHNOLOGIES

Course Code : EX20001
Credits : 2
L-T-P : 2-0-0
Pre-requisites :Nil

COURSE OBJECTIVES

The current manufacturing industries and businesses are moving from the third industrial revolution of the computers and automation the fourth where the automation becomes even smarter fueled by data analytic and artificial intelligence. This course is designed to offer learners an introduction to use of Internet and digital technology for better manufacturing and business. Learners will gain deep insights into how smartness is being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges.

COURSE OUTCOMES

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

CO1: Understand the key components and enablers of Industry 4.0Technology
CO2: Appreciate the smartness in Smart Factories,smart products and smart Services.
CO3: Outline Smart Factory technologies and their role in an Industry 4.0 world
CO4: Outline IoT technology and scope of implementing IoT in Industries and businesses.
CO5: Comprehend distributed cyber-physical and digital manufacturing system
CO6: Demonstrate the opportunities, challenges brought about by Industry 4.0 and how organizations and individuals should prepare to reap the benefits

COURSE CONTENT

Introduction
The Fourth Industrial Revolution, Difference between conventional automation and Industry 4.0, Case Studies: Health, Agriculture, Manufacturing

Industry 4.0 and its components
Internet of Things(IoT) and Industrial Internet of Things(IoT), Internet of Services, Value chains in manufacturing companies, Digital Twins

Digital Manufacturing and Design:
Cyber Physical Systemsand Next Generation sensors, Collaborative Platform and Product Life-cycle Management, Robotics and Automation

IndustrialIoT
Cloud Computing, Big-Data Analytic, AI&ML, Virtual and Augmented Reality, Block-chain

Challenges & Opportunities inIndustry4.0
A Digital Strategy alongside Resource Scarcity, Standards and Data security, Financing conditions, availability of skilled workers, Comprehensive broad-band infra-structure, Legal framework, protection of corporate data, liability, handling personal data.

Text books:

1. D. Pyo, J. Hwang, and Y.Yoon, Tech Trends of the 4th Industrial Revolution, Mercury Learning &Information publisher, 2021.
2. BrunoS. Sergi, Elena G. Popkova, Aleksei V.Bogoviz, and Tatiana N.Litvinova Understanding Industry4.0: AI, theInternet of Things, and the Future of Work, Pub: Emerald Publishing Limited, 2019

Reference Books:

1. S.Misra,A. Mukherjee,and A.RoyIntroduction toIoT. CambridgeUniversity Press, 1st edn. 2021
2. Dac-Nhuong Le, Chung Van Le, Jolanda G. Tromp , Gia Nhu Nguyen, Emerging Technologies for Health and Medicine: Virtual Reality, Augmented Reality, Artificial Intelligence, Internet of Things, Robotics, Industry 4.0, John Wiley publisher, 2018
3. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress Berkeley publisher, CA 1st

SCIENTIFIC AND TECHNICAL WRITING

Course Code : EX20003
Credit :2
L-T-P :2-0-0
Prerequisite : Nil

COURSE OBJECTIVE

Technical documents take many forms depending on their purpose and the audience. A technical document can be a project proposal, minutes of a meeting, an advertisement in a newspaper, or even a research paper. A scientific document is a form of technical document where both the author and the audience are experts. The writing styles and the document density of technical documents depend on the nature of the document. The objective of this subject is to train the students in the art and science of writing a range of scientific and technical documents.

COURSE OUTCOMES

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

CO1 :Realize the need to articulate the purpose of the document, identify its audience, and decide the density of information to be included in scientific and technical documents.
CO2 :Internalize the art and science of scientific and technical writing.
CO4 :Make appropriate use of crisp language, illustrations, and symbols.
CO4 :Distinguish between bad and good writing. (Analyze and Evaluate).
CO5 :Prepare a variety of scientific and technical documents, including laboratory and project reports;
CO6 :Write these documents in an accurate, clear, concise, coherent, appropriate, and readable manner.

COURSE CONTENT

Introduction

Forms and features of creative, technical, scientific, and science writing; Audience types (general and specific experts, technicians, managers, laypersons, and mixed audience); Examples of documents for technical, professional, and scientific communications; Characteristics of effective technical writing: Accuracy, clarity, conciseness, coherence, appropriateness, and readability.

Language Issues

Revisiting English grammar; Punctuation (period, comma, colon, semicolon, question mark, exclamatory mark, apostrophe, quotation marks, hyphen, dash, parentheses, and brackets); Mechanics (capitalization, italics, abbreviations, acronyms); Latin terms used popularly in English texts; Informal and colloquial English; Dangling modifiers, Faulty parallelism, Judicious use of common words and phrases; Active and passive voice; Nominalization; Common English errors; Pitfalls in writing; Adapting texts to issues of gender, race, and ethnicity; and Guarding against Plagiarism.Paragraphing: Unity of idea, topic sentence, logical and verbal bridges through use of signposts, transitions, and link words; Patterns of development of an idea; and Lists.

Structure of Scientific Documents

Prefatory Materials:Title, Copyright Notice, Declaration and Certificates, Abstract, Keywords, Acknowledgements and Conflict of Interest Statement, Symbols and Abbreviations, and Table of Contents.

Body of Scientific Documents

Introductory Materials—Context, problem and current response, research questions, hypotheses, and objectives and scope; Literature Review—Presentation styles, citations and referencing systems, quoting, paraphrasing, and summarizing; Materials and Methods—Mathematical Materials: Methodology, methods, tools, and techniques; Quantitative, qualitative, experimental, and mixed methods; Numbers and numerals, engineering and scientific notations of numbers, mathematical operators, equations, flowcharts, algorithms, SI units, significant digits and order of magnitude, figures, tables, and photographs; Experimental apparatus, materials, specifications, measuring instruments, procedure, data analysis; Concluding Materials—Conclusions, implications, generalization, limitations, scope for further work, and contributions of the work.

End Matters

References, Appendixes, and Supplementary materials.

Structure of Selected Technical Documents

PowerPoint presentation, Abstract of a paper, Laboratory reports, Progress report, Project proposal, Minutes of a meeting, Brochure, and News items.

Test Book:

1. Lecture notes on Scientific and Technical Writing
2. Alred, G. J., C. T. Brusaw, and W. E. Oliu (2008), Handbook of Technical Writing, St. Martin's Press, New York, Ninth Edition.
3. Angelika H. Hofmann (2014), Scientific Writing and Communication, Papers, Proposals, and Presentations, Oxford: Oxford University Press.
4. Duke Graduate School Scientific Writing Resource(https://sites.duke.edu/scientificwriting/).

Reference Books

1. Gerald. J. Alred, Charles. T. Brusaw, and Walter. E. Oliu (2008), Handbook of Technical Writing, St. Martin's Press, New York, Ninth Edition.
2. OWL, The Purdue Online Writing Laboratory, https://owl.english.purdue.edu/owl/.
3. Perelman, L. C., J. Paradis, and E. Barrett (1998), The Mayfield Handbook of Technical and Scientific Writing, Mayfield Publishing (ed.), Available free at http://www.mhhe.com/mayfieldpub/tsw/toc.htm, Mayfield Publishing Company, Inc.,1280 Villa Street, Mountain View, CA 94041, 415.960.3222, <http://www.mayfieldpub.com>, <mailto:hypertext@mayfieldpub.com>
4. Rubens, P. (2001), Science and Technical Writing: A Manual of Style, 2nd Edition, Routledge, New York.

RESEARCH METHODS AND ETHICS

Course code : EX40001
Credit : 3
L-T-P : 3-0-0
Prerequisite : NIL

COURSE OBJECTIVE

The objective of this course is to introduce to the undergraduate students the various elements and methods of ethically conducting a piece of scientific research.

COURSE OUTCOMES

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

CO1 : Select research topics and formulate research questions,
CO2 : Conduct a literature search and make a review of literature,
CO3 : Get acquainted with a range of qualitative, quantitative, experimental, and theoretical methods of Research,
CO4 : Become familiar with the techniques of data collection, analysis, and interpretation,
CO5 : Understand the importance of research ethics and the implications of the broader impact of research, and
CO6: Conduct research with honesty and integrity.

COURSE CONTENT

Introduction to research
Structure of research: Scientific method and Engineering design cycle, Defining and scoping Research problems, Formulating research objectives and research questions.

Literature Review
Searching for literature; Narrative and systematic literature review; Summarizing, paraphrasing, and quoting; and Referencing styles.

Design of Experiments

Basic Principles of randomization, replication, and Blocking; Factors and Responses; Analysis of variance, Experiments with blocking factors, and Factorial designs.

Data Analytics

Data pre-processing; Data visualization; Tests of hypothesis; Decision trees; and Artificial neural networks.

Theoretical Models

Typology of models; Optimization models, forecasting models, and control models; Monte Carlo simulation; Genetic Algorithm; Model verification and validation; and Measurement and uncertainty analysis.

Drawing Inferences

Drawing inferences, Generalizing, Finding potential applications, Imagining future scope, and Highlighting novelty of research.

Research Ethics

Ethics and morality; Utilitarian and deontological theories of ethics; Fabrication, falsification, plagiarism, and questionable research practices; Issues related to privacy and confidentiality; and Ethical issues related to publications

Text Books:

1. Dunn, P. K. (2021), Scientific Research and Methodology: Tutorials, An Introduction to Quantitative Research and Statistics in Science, Engineering, and Health: Tutorials, Available free at https://bookdown.org/pkaldunn/SRM-tutorials/.

2. Dunn, P. K. (2021), Scientific Research and Methodology: Software, An Introduction to Quantitative Research and Statistics in Science, Engineering, and Health: Using Software, Available free at https://bookdown.org/pkaldunn/SRM-software/. (Uses Jamovi and SPSS Software, Jamovi is a freely downable software)
3. Lectures note on Research Methods and Ethics provide by Concerned faculty members

ENGINEERING PROFESSIONAL PRACTICE

Course Code :EX40003
Credit : 2
L-T-P : 2-0-0
Prerequisite :Nil

COURSE OBJECTIVE

Engineers are expected to perform their tasks responsibly and ethically, following professional standards and guidelines. This subject allows the students to understand the roles and responsibilities of engineers in society, learn professional standards, codes of ethics, issues concerning employment contracts and other legal matters, and skills of working in teams, and to effectively communicate. The subject will be offered jointly by the faculty members of various schools of technology and will be coordinated by the School of Mechanical Engineering.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO1: Know (a) the features of engineering as a profession, (b) the roles and responsibilities of engineers in society, and (c) the skills for working in teams,
CO2: Realize the use of professional standards, codes of ethics, legal provisions surrounding engineering functions,
CO3: Apply the above-stated standards, codes, legal provisions, and group communication skills in their decision-making situations,
CO4: Break down a complex problem into smaller manageable tasks,
CO5: Compare among alternatives in situations of uncertainty, risk, and ambiguity,and
CO6: Design engineering solutions to industrial environmental and social problems.

COURSE CONTENT

Engineering and Engineer: Engineering as a discipline and a profession; Attributes and functions of a practicing engineer; and Engineer as a problem solver, designer, and change agent.
Selected Functions of Engineering: Designing for safety and reliability; Quality and productivity management; Dealing with problem complexity, uncertainty, risk, and ambiguity; Project management; and Managerial functions such as planning, organizing, motivating, and controlling; Costing and accounting.
Professional Aspects of Engineering: Accreditation, certification, and licensing; Ethical issues: Ethics and morality, ethical dilemmas, codes of ethics, professional conduct, nature and role of professional societies, engineering standards; Legal issues—Legal forms of business organizations, employment contracts, trademarks, patents, copyrights, trade secrets, professional liability, contractual agreements, environment and information technology laws, and international legal framework such as WTO.
Group Dynamics: Individual cognition; Dynamics of working in teams/groups; Interacting with stakeholders; Dealing with multicultural environments; Team and group communication; and Negotiation and conflict resolution.

Text Book

1. Shrestha, R. K. and Shrestha, S. K. (2020), Text Book of Engineering Professional Practice, 3rd Edition, Heritage Publishers and Distributors Pvt. Ltd.

Reference Books

1. Habash, R. (2019), Professional Practice in Engineering and Computing: Preparing for Future Careers, 1st Edition, Boca Raton: CRC Press.
2. Walesh, S. G. (2012), Engineering Your Future: The Professional Practice of Engineering, 3rd Edition, Wiley.
3. Subramaniam, R. (2017), Professional Ethics, 2nd Edition, Oxford University Press
4. Lectures note on Engineering Professional Practice provide by Concerned faculty members.

ECONOMICS OF DEVELOPMENT

Course Code : HS20120
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

The objective of this course is to provide students with the essential tools and concepts of development economics, to prepare them to understand what makes underdevelopment persist and what helps development succeed.Students will explore diverse dimension and measures of development, as well as the application of micro-economic analysis to issues of development in poor countries, including the study of household decisions and the analysis of institutions and norms influencing development.And To enhance students understanding of the SDGs to create a better- informed citizenry, which will lead to a more sustainable action by all and for all.

COURSE CONTENT

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

CO1: Understandkey factors and issues in the process of economic development,
CO2: Enhance their ability in applying economic models to study development Problems,
CO3: Learning the role of the three basic components of ecosystems and environment and underlying causes of their degradation,
CO4: Understand the policy scenario and the existing environmental conventions/ regulations/ laws,
CO5: Development of sustainable planning for sustainable development of environment, economy and firms
CO6: select and apply appropriate economic techniques to solve environmental problems and measure the value of environmental goods.

COURSE CONTENT

Economic Growth and Development

Meaning of development and Economic growth, Characteristics of less developed countries.
Factors in Economic development, Measuring development and development gap — per capitalincome, inequality of income and wealth, Gini coefficient, Human Development Index , PhysicalQuality of Life Index, and other indices of development.

Theories of Economic Growth and Development

Theories of Economic Development: Classical (Smith, Ricardo, Malthus), Marxian – Theory ofSocial change, immutable laws, Crisis in capitalism, Schumpeter and capitalist development,Rostow's stages of growth. Partial theories of growth and development: Vicious circle ofPoverty, Big push, balanced growth, unbalanced growth,

International aspects of Economic Development

International trade as an engine of growth; Static and dynamic gains from trade; Prebisch,Singer and Myrdal theses vs. free trade; Export-led growth; Tariffs and effective protection;WTO and developing countries. External resources; FDI; Aid vs. trade;

Development and Environment
Economy linkage; Environment as a necessity and luxury; Population environment linkage.Allocation problem; Market failure for environmental goods; environment as a public good.

Sustainable Development
Concept and indicators of sustainable development.Common Property Resources, Propertyright approach to environmental problem-property rights approach, property rights andenvironmental problems,Externalities and Pigovian tax, Coase theorem, Coase theorem and transaction cost. Prevention,control and abatement of pollution.

Text Books

1. S.Ghatak, An Introduction to Development Economics, Allen andUnwin, London,2003
2. Kindleberger, C. P. Economic Development, McGraw Hill, New York, 1958
3. Todaro, M. P. Economic Development, Longman, London.

References Books

1. Thirwal, A. P. Growth and Development, Macmillan, U. K,2017
2. Adelman, I. Theories of Economic Growth and Development. StanfordUniversity Press, Stanford, 1966.
3. Chenery, H. and T.N. Srinivasan (Eds) Handbook of DevelopmentEconomics, Vols 1 & amp; 2 Elsevier, Amsterdam, 2002
4. Myint, H. Economic Theory and Underdeveloped Countries, Oxford University Press, NewYork,1971

INTERNATIONAL ECONOMIC COOPERATION

Course Code :HS20122
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

This course's overarching objective is to equip students with knowledge of both the thoretical concepts and the actual procedures involved in international trade. The specific purpose is to increase the knowledge of importing and exporting essentials and to offer the with the skills for understanding the international trading process.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO1 : Learn theories of international trade,
CO2 : Understand free trade, protection, and BOP,
CO3 : Analyse the role of international organisations,
CO4 : Understand the working of foreign exchange,
CO5 : Study the EXIM policies,and
CO6 : Analyse secondary data relating to international trade.

COURSE CONTENT

Theories of International Trade
Classical Theories of International Trade- Mercantilism, Absolute Advantage,Comparative advantage Theory, Gains from international trade; Terms of trade; Theory of Reciprocal Demand; Modern Theories of International Trade-Heckscher-Ohlin theory

Free Trade,Protection and Balance of Payment
Free trade and protection in developing countries; Forms, methods and effects of protection; Introduction of BoP; Structure of BoP; Disequilibrium in BoP; Measures to overcome disequilibrium in BoP., Tariff; Trade creation vs Trade diversion.

International Organizations
International Monetary Fund; World Trade Organasation; Regional Trade Agreements; Trade Blocs.

Foreign Exchange
Foreign Exchange Market; Theories of foreign exchange; Factors affecting exchange rate; Fixed and flexible exchange rate; FERA and FEMA.

EXIM Policies
Recent budgetary policies and programs relating to inequality; Analysis of Economic Survey data.

Text Books

1. R. R Paul, Money Banking and International Trade, Kalyani Publishers; 12th edition,2015,ISBN-10 : 932725774X ISBN-13 : 978-9327257748
2. Bo Södersten and Geoffrey Reed, Palgrave Macmillan, International Economics. 1994, ISBN-10 : 0333612167 ISBN-13 : 978-0333612163

Reference Books

1. Dominick Salvatore,International Economics: Trade and Finance, Wiley; Eleventh edition,2017, ISBN-10 : 8126552344ISBN-13 : 978-8126552344
2. Paul R. Krugman, Maurice Obstfeld, Marc Melitz,International Trade: Theory and Policy, 2017, ISBN-10 : 9789332585768 ISBN-13 : 978-9332585768

ORGANIZATIONAL BEHAVIOUR

Course code : HS20220
Credit :3
L T P :3 0 0
Prerequisite : NIL

COURSE OBJECTIVE

This course shall guide the students to learn the basic concepts of Organizational Behaviour and its applications in contemporary organizations. Further, it help them to describe how people behave under different conditions and understand why people behave as they do. The students would be in a position to synthesize related information and evaluate options for the most logical and optimal solution such that they would be able to predict and control human behaviour and improve results. Lastly, this course would help the students to understand how individual, groups and structure have impacts on the organizational effectiveness and efficiency.

COURSE OUTCOMES

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

CO1 : Know about organization, organizational behaviour, it's nature, scope and significance,
CO2 : Develop their personality as per industry requirement,
CO3 : Apply motivational techniques to make the employees work with confidence and satisfaction,
CO4 : Develop different leadership styles to adjust themselves in different organizational situations,
CO5 : Improve the knowledge of group behaviour and techniques of group decision making,and
CO6 : Apply the concepts for managing changes in organization as well as the development of an organization's human resources.

COURSE CONTENT

Introduction to Organizational Behaviour
Organizational Behaviour- nature and scope; Need for studying OB; contributing disciplines to OB; evolution of OB; OB approaches and models; OB opportunities and disruptions

Individual Perspective
Introduction to Individual behaviour; Personality- concept, determinants, types and theories/models; Personality and OB; Perception- meaning, perceptual process, factors affecting perception; perception and its application in OB; Attitude- nature, components, formation and types; Values- concepts, types and formation; attitude, values and behaviour

Individual Perspective
Learning- meaning, determinants, theories and principles; learning and behaviour; Motivation- nature, importance, process and theories; managerial implication of motivation- job design, quality of work life and employee engagement; organizational citizenship behaviour- meaning, theoretical perspective, determinants and predictors

Group Perspective

Foundation of group behaviour; meaning and characteristics of group; why do people form and join groups; types and groups; stages of group development; group decision making; Team building- meaning and types of team; team building process; Meaning, sources and types of conflict; conflict management and negotiation strategies; Leadership- meaning and importance; differentiating between leader and manager; leadership styles; leadership theories

Organizational Perspective

Organizational structure- meaning and elements; Organizational culture- meaning, types and functions of culture; creating, sustaining and changing a culture; Organizational change- meaning and need; ; managing resistance to change; Organizational development- meaning, objectives, models and interventions

Text Books

1. Dr. S..S. Khanka,Organizational behaviour texts and cases Sultan Chand, OB text and cases S.S. Khanka, S chand, 2022
2. Stephen P. Robbins, Timothy A. Judg, Neharika Vohra Organizational Behaviour, Pearson, 18th edition, 2018

Reference Books

1. Fiona M. Wilson,Organizational Behaviour and Work Oxford University Press,2014
2. K. Aswathappa ,Organizational Behaviour, , Himalaya Publishing House, 2013

HUMAN RESOURCE MANAGEMENT

Course code : HS20222
Credit : 3
L T P :3 0 0
Prerequisite : NIL

COURSE OBJECTIVE

This course aims at providing conceptual knowledge on human resource management that will be useful for a manager of an organization. It also understands employer and employee relationship in order to achieve organizational objectives effectively. It starts with hiring and continues till retention. It also focuses on enabling the students to integrate the understanding of various HR concepts along with the domain concept in order to take correct business decisions.

COURSE OUTCOMES

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

CO1: Learn the various functions of management, personal and professional qualities of a manager in order to manage human resource of an organization effectively,
CO2: Understand the process of acquiring human resource through effective planning, recruitment and selection process,
CO3: Apply different training and development methods for organizational effectiveness,
CO4: Analyse the importance of performance appraisal and equitable pay for the growth of both individual and organization,
CO5: Inculcate the sense of inter personal relation required in professional front in handling employer-employee relation effectively for achievement of organizational objectives,and
CO6: Know the technique of managing and being managed by the organization.

COURSE CONTENT

Introduction to HRM
Introduction, scope, objectives; Managerial and operational functions of Management; HRM as a source of competitive advantage; Qualities and role of HR managers

Planning and Acquiring Manpower
Human resource planning- Introduction, objectives, need, importance; Factors, Process and barriers of HRP; Job analysis- concept, objective and Process; Meaning, process and sources of recruitment; Factors of effective recruitment; Meaning and process of selection; Competency mapping for selection decision; Induction and socialization; recent trends in recruitment and selection

Developing Manpower
Training- nature, need, objectives, importance; areas of training; training process- identifying training need, designing a training program; methods and techniques of training; evaluating training effectiveness; Role specific and competency based training; career planning and development- meaning, objective and process

Managing Performance and Compensation
Performance appraisal- concept, objectives and importance of performance appraisal; Process of performance appraisal; Methods of performance appraisal; Problems in performance appraisal; Potential Appraisal; Components of compensation; objectives and factors affective Wage and salary administration; methods of wage payment; process of wage determination; Pay band compensation system

Maintaining and Retaining Human Resources
Industrial Relation- concept, objective and approaches: Reasons for poor industrial relation; Measures for improving industrial relation; Industrial Dispute- nature, causes, prevention and settlement; meaning, objectives, importance and conditions for successful collective bargaining; Workers Participation in management- concept, objectives, forms and measures; Discipline and Grievance- Statutory provisions concerning discipline; causes and machinery for redressal of grievances

Text Books

1. P. Jyoti & D. N. Venkatesh ,Human Resource Management, Oxford Publication.
2. Gary Dessler and Biju Varkkey ,Human Resource Management, , Pearson Education, 2020

Reference Books

1. S S Khanka Human Resource Management Text and Cases by, S.Chand and company Limited, 2022
2. K. Aswathappa,Human Resource Management. Mc Graw Hill Education, 2013
3. P. Subba Rao Personnel and Human Resource Management., Himalaya Publishing House, 2022

ENGINEERING ECONOMICS

Course Code : HS30101
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

The objective of Engineering Economics is to aid in decision-making by focusing on the economic implications of technical analysis. It is committed to making operational level decisions and solving problems.

COURSE OUTCOMES

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

CO1 : Comprehend the significance of different components of Engineering Economics
CO2 : Analyze the basic economic concepts required for engineers and managers
CO3 : Develop the problem solving aptitude in the students through practical and case problems
CO4 : Decide the feasibility of a particular project by the application of different project evaluation techniques
CO5 : Use the economic tools in the decision making process
CO6 : Survey the current macroeconomic situations in the economy

COURSE CONTENT

Introduction to Economics and Engineering Economics

Basic concepts of Engineering Economics: Demand Analysis, Supply Analysis, Market Equilibrium. Revenue Analysis. Demand Forecasting- Quantitative Methods, Consumer's Equilibrium.

Production and Cost Analysis

Short Run and Long Run Production Functions, Producer's Equilibrium condition.Cobb-Douglas Production Function.
Cost Concepts: Short Run and Long Run Cost analyses. Break-Even Analysis.
Market: Concepts and Types;Perfect Competition, Monopoly

Time Value of Money
Interest Formulae and their applications with cash flow diagram. Evaluation of Investment Proposals - Present Worth, Future worth and Annual Equivalent Method of comparison

Economic Appraisal Techniques
Net Present Value (NPV), Internal Rate of Return(IRR) ,Cost Benefit analysis.Depreciation calculation; Meaning and Definition, Methods.

Macroeconomic policies
Functions of commercial banks and central bank, Fundamentals of Business cycle, Macroeconomic policies for stabilization.

Text Books

1. Dominick Salvatore,Siddartha K.Rastogi,Managerial Economics: Principles and Worldwide Applications, Oxford University Press, ISBN 9780199467068 ,
   9th Edition,2020
2. D N Dwivedi, H L Bhatia, & S N Maheswari,Engineering Economics:, Vikas Publishing House, Noida, ISBN:978-93-5674-625-1, 2nd Edition 2023.
3. James Riggs, David D.Bedworth and Sabah U.Randhawa ,Engineering Economics–, 4th Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2016.

Reference Book

1. William A. McEachern and Simrit Kaur Micro ECON-A South-Asian Perspective-, Cengage Learning, 2013.
2. Yogesh Maheshwari,Managerial Economics- 3rdEdition, PHI Learning Private Limited,2014.
3. A. Khan, Arshad Noor Siddiquee, Brajesh Kumar,Engineering Economy-Zahid Pearson Publication, 2012.
4. R.Panneerselvam Engineering Economics –, Pub: PHI Learning Private Limited, New Delhi, 9thEdition, 2008.
5. G.S Gupta Managerial Economics, , Tata McGraw Hill Education Private Limited, 2nd Edition, 2011.
6. D.M.Mithani, Managerial Economics – Theory and Applications –Himalaya Publication, New Delhi, 6th Edition, 2009.
7. S.B.Gupta, R7. Monetary Economics-Institutions, Theory and Policy- Publication: S.Chand, 1995.
8. R.D. Gupta R8. Macro – Economics –, Publication: Kalyani Publication, 1994.

MARKET STRUCTURE AND PRICING POLICIES

Course Code : HS30125
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

Develop the ability for getting conceptual clarity about the various types of markets along with their functions and understand the pricing policy operations in the different markets.

COURSE OUTCOMES

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

CO1: Comprehend the significance of different components of market,
CO2: Analyze the basic economic concepts required for various types of market and theirpolicies
CO3: Develop the problem solving aptitude through practical and case study problems faced by the economy
CO4: Able to use the economic tools in the decision making process of fixing prices and quantities in different Market,
CO5: Differentiate between different markets and the policy measures to regulate it
CO6: Survey and map the impact of the current micro and macro-economic situations in the economy.

COURSE CONTENT

Cost and Revenue Analysis
Concepts of cost (economic cost, production cost, real cost, opportunity cost, private & social cost), cost function, Output maximisation and cost minimisation, Derivation of cost function, traditional and modern theories of costs.
Concepts of revenue (total, average, marginal revenue), relationship between TR, AR and MR.

Market Structures and Perfect Competition
Meaning of market, characteristics of market, and types of market.
Perfectly competitive market and features, equilibrium of the firm and industry under perfect competition (short run and long run).

Monopoly Market
Meaning, concepts and characteristics of monopoly market.
Equilibrium price and output determination under monopoly market in short and long run. Monopoly price discrimination. Degree of monopoly power and its measure.
Control and regulation of monopoly power.

Duopoly and Oligopoly Market
Non-collusive oligopoly: Cournot's duopoly and Kinked-Demand Model. Collusive oligopoly: Cartel; Cartels aiming at joint profit maximization and market sharing cartels.
Price leadership; low-cost price leadership, dominant firm price leadership and barometric price leadership.

Monopolistic Competition
Meaning, price determination of a firm under monopolistic competition; Chamberlin's group equilibrium; theory of excess capacity; selling costs; difference between perfect competition and monopolistic competition; difference between monopoly and monopolistic competition.

Text Books:

1. Koutsoyiannis, Modern Microeconomics, St. Martin's Press, New York,2nd Edition 1979, ISBN 978-0-333-25349-6
2. G. S. Maddala , Ellen M. Miller ,Microeconomics: Theory and Applications, , McGraw-Hill Inc.,US-Publisher, 1989, 0070394156-ISBN
3. H L Ahuja, Modern Microeconomics: Theory & Applications, S Chand Publishing,2022, ISBN : 9789355011015,

Reference Books:

1. Robert Pindyck, Daniel Rubinfeld, Microeconomics ,Eighth Edition, 2017, 9789332585096-ISBN,
2. Pearson Education Publication
3. G. Fransico Stigler, Theory of Price, Prentice Hall of India, New Delhi, 4th Edition 1996.
4. H. Gravelle and R. Rees, Microeconomics, Person Education U.K. 3rd Edition 2007, 2007ISBN: 9788131716557, 8131716554
5. H. R. Varian , Micro Economic Analysis, W W Norton & Company; New York, 3rd edition 2019, ISBN-13 : 978-8130908632

PRAGMATIC INQUIRY

Course Code : HS30127
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

As a foundation for lifelong inquiry, this course introduces students to research techniques and how they are used in both liberal arts, technical and professional courses.

COURSE OUTCOMES

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

CO1 :Understand the meaning and importance of research in behavioral science
CO2 :Describe in detail different types of research methodologies
CO3 :Identify the strengths and weaknesses of the different study designs
CO4 :Assess whether research studies are using the most appropriate study design
CO5 :Discuss why various approaches may be appropriate/ inappropriate for their work-based research Question
CO6 :Apply the concepts in research related activity.

COURSE CONTENT

Pragmatic Inquiry
Meaning, characteristics, need, type, and approaches.

Research Problem
Meaning, definition, selection, and framing of problem statement.

Research Design
Meaning, characteristics, need, type, approaches, and problems of research design.

Sampling Design
Meaning, characteristics, need, type, approaches, and problems.

Data Collection Method and Analysis
Types of data, Source of data, Methods of data collection, data analysis.

Text Book

1. Deepak Chawla & Neena Sodhi, Research Methodology: Concepts and Cases, Vikas Publishing House,2018, ISBN-10: 9325982390, ISBN-13: 978-9325982390.

Reference Books

1. C R Kothari and Gaurav Garg, Research Methodology, New Age International
2. Publishers,2019,ISBN-10 9386649225, ISBN-13- 978-9386649225
3. S.K. Mangal, Research Methodology in Behavioural Sciences, Prentice Hall India Learning Private Limited, 2013, ISBN-10 : 9788120348080, ISBN-13 : 978-8120348080
4. Sameer S. Phanse, Research Methodology-Logic, Methods, and Cases,OUP, Sameer S. Phanse,2016 ISBN: 9780199453788

ECONOMIC ANALYSIS OF DECISION RULES

Course Code : HS30129
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

Analyze and understand investment decisions under the conditions of risk and uncertainty.Particular economic models are not the ends, but the means for illustrating the method of applying mathematical techniques to economic theory in general.

COURSE OUTCOMES

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

CO1: Analyze and understand investment decisions under the conditions of risk and uncertainty,
CO2: Explainhow game theory brings out the strategy used by the oligopoly firms to determine the best possible action to maximize profit-maximizing objective,
CO3: Understand functional formulation of the problem and application of linear programming,
CO4: Describes different concepts used in analysing the national income and the different methods applied to measure the national income,
CO5: Describe and explain the main channels of the monetary transmission mechanism through monetary and fiscal policy
CO6: Describe managerial decisions through the application of some economic concepts, theories and principles.

COURSE CONTENT

Investment Decisions under Risk and Uncertainty
Concepts of Risk and Uncertainty; Investment Decisions under Risk: The Pay-Off Matrix Method, Risk-Adjusted Discount Rate Method, Certainty-Equivalent Approach, Probability Theory Approach, Decision Tree Method, Simulation, Sensitivity Analysis.

Game Theory and Strategic behaviour of Firms
Basics of Game Theory, Prisoners' Dilemma: The Problem of Oligopoly Firms; Application of Game Theory to Oligopolistic Strategy; Nash Equilibrium: Pure and Mixed Strategy

Optimization: Constrained & Extrema
Free and constrained optimization, extrema of a function of two variables: graphical analysis, Lagrange method. Utility maximization & Cost minimization.

Linear and Non-Linear Programming for Business Decisions

Conditions for Application of Linear Programming; Concept of Feasible Solution; Assumptions of Linear Programming Application of Linear Programming Technique: Profit Maximization Problem, Formulation of Profit Maximization Problem in Linear Programming Mode; Graphical Method of Solving Linear Programming Problems; Simplex Method: Algebraic Solution, Simplex Tableau Method. Introduction to Non-Linear Programming

Input-Output Analysis
Input-output model, its structure and its derivation. The use of input output model in Economics.

Text Book

1. D. N. Dwivedi, H L Bhatia, S N Maheshwari, VIKAS® PUBLISHING HOUSE PRIVATE LIMITED, 2022.

Reference Books

1. C. Chiang and K. Wainwright, *Fundamental Methods of Mathematical Economics*, McGraw Hill International Edition, 2017
2. K. Sydsaeter and P. J. Hammond:, *Mathematics for Economic Analysis*, Pearson Educational Asia, 2002

ECONOMICS OF HEALTH AND EDUCATION

Course Code : HS 30131
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

The United Nations member states' adoption of the Millennium Development Goals, which include among other objectives achieving universal primary education, reducing child mortality, enhancing maternal health, and combating diseases, reflects the significance of education and health in enhancing wellbeing. This course offers a microeconomic framework to examine, among other things, individual preference in the demand for health and education, governmental involvement, and elements of inequality and discrimination in both sectors. An outline of India's health and education system is also provided.

COURSE OUTCOMES

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

CO1: Understanding role of health and education in human development,
CO2: Analysing microeconomic foundations of health economics,
CO3: Assessing the growth of health sector in India,
CO4: Appraising the benefits of investment in human capital,
CO5: Assessing the growth of education health sector in India
CO6: Examining the underling discrepancies in both sectors.

COURSE CONTENT

Role of Health and Education in Human Development
Importance of health and education outcomes and their relationship with macroeconomic performance.

Health Economics Market
Demand for health; uncertainty and health insurance market; alternative insurance mechanisms; market failure and rationale for public intervention; equity and inequality.

Education: Investment in Human Capital
Rate of return to education: private and social; quality of education; signaling or human capital; theories of discrimination; gender and caste discrimination in India.

Health and Education Sectors in India: An Overview
Health outcomes; health systems; health financing. Cost effectiveness and cost-benefit analysis; burden of disease. Literacy rates, school participation, school quality measures.

Trend in Health and Education Sector in India
Secondary data analysis pertaining to health and education sector. Trend analysis and forecasting using time series data. Simple growth rate calculations.

Text Book

1. S. K. Mishra, and V. K. Puri, *Indian Economy*, Himalaya Publishing House,2022, ISBN: 978-93-5596-423-6

Reference Books

1. William, Jack, *Principles of Health Economics for Developing Countries*, World Bank Institute Development Studies, 1999.
2. World Development Report, *Investing in Health*, The World Bank, 1993.
3. G.Ronald, Ehrenberg and S.Robert, Smith, *Modern Labor Economics: Theory and Public Policy*, Addison Wesley, 2005.

BUSINESS ETHICS AND CORPORATE GOVERNANCE

Course Code : HS30223
Credit : 3
L-T-P : 3-0-0
Prerequisite : NIL

COURSE OBJECTIVE

This course focuses upon the fundamental principles and standards that should govern the business organizations. The objective of this paper is to make the students aware about the importance of ethics, corporate governance and role of CSR & sustainable development goals in the business to encourage moral practices and sensitivity towards the ethical dimension of managerial problems.

COURSE OUTCOMES

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

CO1: Familiarize the learners with the concept and relevance of Business Ethics in the modern era
CO2: Understand the value of business ethics which will guide them in maintaining firmmoral values while taking managerial decision
CO3: Apply the ability to make moral judgments in dilemmatic situations across the work domains
CO4: Analyse the application of management practices by adhering to corporate law and ethics
CO5: Evaluate the scope, opportunity and complexity of Corporate Social responsibility in the global and Indian context
CO6: Create an opportunity to understand the sustainable development goals in maintaining a balance between the economic, environmental and social needs.

COURSE CONTENT

Business Ethics: Concept, Principles and Theories
Meaning, objective and types of Ethics; Business ethics- concept, need, scope, objectives and importance; factors influencing business ethics; Principles of Business ethics; Relationship between ethics and business ethics; theories of business ethics; Ethical dilemma and ethical decision making

Ethics in Practice across the domain
Ethics in marketing- introduction, ethical dilemma in marketing, unethical marketing practices, measures to stop unethical practices in marketing; Ethics in Finance- introduction, code of ethics in finance, unethical practices in finance or frauds, measures to stop unethical practices in finance; Ethics in HRM- introduction, ethical issues in HRM (job discrimination, sexual harassment, employee privacy, whistle blowing, affirmative action); importance of workplace ethics and employee code of conduct

Corporate Governance
Corporate Governance- concept, objective and need. Role of law in corporate governance; important issues in corporate governance; Corporate governance in India-past, present and Future; Importance and principles of Corporate Governance

Introduction to Corporate Social Responsibility
CSR- Concept, evolution and development; Why CSR; Apprehensions against CSR; Forms and dimensions of CSR; making business corporations socially responsible; CSR in India

Sustainable Development
Introduction, meaning, history, features, objectives of sustainable development; The pillars and principles of sustainable development; SDG and its relevance in business

Text Books

1. Dr. K. Nirmala, Dr. B.A. Karunakara Reddy & N. Aruna Rani, Business Ethics and Corporate Governance, Himalaya Publication House
2. C.S.V. Murthy, Business Ethics and Corporate Governance, Himalaya Publishing, 2022

Reference Books

1. Prabhakaran Paleri,Corporate Social Responsibility (concept, cases and trends Cengage Learning India Pvt. Limited, 2020
2. Dr. S.S. Khanka,Business Ethics and Corporate Governance, Sultan Chand, 2019
3. C.U. Saraf, Corporate Social Responsibility (CSR), Corporate Governance, Sustainable Development and Corporate Ethics/Business Ethics Himalaya Publishing House 2017

LEADERSHIP AND TEAM EFFECTIVENESS

Course Code : HS30225
Credit : 3
L-T-P : 3-0-0
Prerequisite : NIL

COURSE OBJECTIVE

An effective leader understands the team dynamics, stimulates the morale of the followers and always aims at creating a participative workforce by enhancing team work. This course mainly focuses on individual, group and organization factors associated with leadership.There is a strong connection between emotional intelligence and leadership because the technical skills and knowledge will definitely help the students to fulfil the entry level requirements. Similarly, understanding employee empowerment would assist the students in acquiring the desirable professional skills.

COURSE OUTCOMES

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

CO1: Learn the characteristics and need of an effective leader
CO2: Understand the effectiveness of different leadership styles in different contextsfrom an instrumental, political and ethical perspective
CO3: Apply leadership theories to the real business scenario
CO4: Analyse group dynamics and importance of team work
CO5:Evaluate the ways to handle emotions and stress and manage work-life flexibility
CO6:Create organizational environment that is psychologically safe and make the employees feel empowered.

COURSE CONTENT

Leadership: concepts and practices
Meaning, Definition and understanding of leadership; the role and functions of a leader; Differentiation between leadership and management; ; what makes a leader effective; characteristics of an effective leader; leadership in Indian organization

Leadership Perspectives
Trait perspective of leadership (Great man theory and trait theory); Behavioural perspective of leadership (mangerial grid and likert system - four management); Studies on leadership (Hawthorne, IOWA, Michigan and Ohio); Contingency perspective of leadership (fiedler's contency theory, path goal, hersey blanchard situational theory); contemporary perspective to leadership (transformational, transactional, charasmatic,servant and Nurturant-task leadership style)

Team effectiveness and Leadership
Characteristics and types of teams; types and functions of group; Group vs team; understanding an effective team; who is a team leader; tuckman's team development stages; team development and team building; team meetings and leadership; team effectiveness leadership model; high-performance teams and leadership;team cohesiveness; common threats to groups

Emotional Intelligence and Leadership
What are emotions; Meaning, type and source of emotions; Concept and competencies of emotional intelligence; Elements of emotional intelligence; importance of EI; EI at workplace; Emotional intelligence and leadership; Significance of EI for leaders; strategies to enhance EQ in our jobs; EQ vs. IQ; developing EQ; obstacles to the development of EQ

Leadership and empowerment
Employee empowerment- concept, need and importance; approaches to empowerment; advantages and disadvantages of empowerment; empowerment skills of a leader; empowering vs. Dis-empowering; leader as a coach (coaching skill); delegation (advantages and levels of delegation, steps and principles of effective delegation); empowering interpersonal skills

Text Book

1. Ranjana Mittal,Leadership Personal effectiveness and Team Building, Vikas Publishing House Pvt Ltd, 2015

Reference Book

1. S. Bhargava and Gourav Bhargava,Team Building and Leadership Neelam Himalaya Publishing House, 2015

UNIVERSAL HUMAN VALUES

Course Code : HS30401
Credits : 3
L-T-P : 3-0-0
Pre-requisites : Nil

COURSE OBJECTIVE

The objective of the course is to develop a holistic perspective based on self-exploration, understand the harmony in the human being, strengthen self-reflection, and develop commitment and courage to act.

COURSE OUTCOMES

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

CO1: Understand the concept of value education and its need,
CO2: Apply their knowledge on value education for apt self-assessment,
CO3: Comprehend human-human relationship,
CO4: Build holistic perception of harmony at all levels of existence,
CO5: Develop the sense of natural acceptance of human values,
CO6: Create people friendly and eco-friendly environment.

COURSE CONTENT

Need, Basic Guidelines, Content and Process for Value Education
Purpose and motivation for the course, recapitulation from Universal Human Values-I. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Understanding Harmony in the Human Being - Harmony in Myself!
Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

Understanding Harmony in the Family and Society- Harmony in HumanHuman Relationship
Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship . Understanding the meaning of Trust; Difference between intention and competence . Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order-from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence
Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of naturerecyclability and selfregulation in nature. Understanding Existence as Co-existence of mutually interacting units in all pervasive space. Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Implications of the above Holistic Understanding of Harmony on Professional Ethics
Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a) Ability to utilize the professional competence for augmenting universal human order b) Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c) Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations . Sum up. Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathi, Human ValuesNew Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).

GENDER STUDIES

Course Code : HS30421
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

The objective of this course is to make student understand the concepts of masculinity and femininity as analytical categories via analysing the role of communalism, patriarchy, violence as major hurdles to women's rights globally. Further, this course will enhance their understanding over the current health and education status of women to analyze impact of government health policy on women. Additionally, it will bring greater understanding over the integration of gender concerns and perspectives in policies and programmes for sustenance of environment at international, national, regional levels.

COURSE OUTCOME

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

CO 1: Familiarise the students with the concepts of sex, gender and sexuality commonly used in gender studies,
CO 2: Identifying major human rights violations faced by women worldwide,
CO 3: Learn about women's health movements and government health policies,
CO 4: Develop an insight into policy perspective issues, and concerns of girl's education in India,
CO 5: Delineate the characteristics and the issues of environment and the involvement of women in balancing ecosystem,
CO 6: Understand on sustainable development, millennium development goal, and other global level development initiatives taken for uplifting women status in society.

COURSE CONTENT

Understanding Basic Concepts in Gender Studies
Concepts: Sex, Gender, Sexuality, Femininities, Masculinities and other sexualities, Patriarchy; WID: Women in Development; WAD: Women and Development; GAD: Gender and Development
Gender and Human Rights Discourse
Women's Rights as Human Rights (FGM, FF, Rape, Honour Killing, IVP, Witch Hunting, Virginity Test, Communalism, Trafficking, Immigration); National Commission for Women and other State Commissions, Ministry and Department of Women and Child.

Gender and Health
Sexual and reproductive health (ICPD, B.P.A. Family planning and Abortion); Impact of violence on women's health; Women's health movement: National and International; National health and population policy; National Family Health Survey (NFHS)

Gender and Education
Women's Education in Free India: Gender Disparity in Enrolment; Constraints of Women's Education: Social, Economic, Cultural, Geographical, other Factors; Important Committees and Commissions on Women's Education: Radhakrishnan Commission (1948), Mudaliar commission (1952), Kothari Commission (1964-1966), Ramamurthy Commission (1991).
Gender and Environment
Role of women in environment conservation; Role of Women in Waste Management; Women's Resistance to Environmental Destruction: Joint Forest Management – CHIPKO Movement – Narmada Bachao Aandolan

Reading Materials

1. Gerda Lerner, Creation of Patriarchy, Oxford University Press,1985
2. Menon, Nivedita. ed. 2007. Sexualities. Women Unlimited. New Delhi.
3. Gnew, Sneja, A Reader in Feminist Knowledge, Routledge, New York,1991
4. Marjorie Agosin (ed.), Women, Gender and Human Rights: A Global Perspective, Rawat Publications, 2000
5. Monica Chawla, Gender Justice: women and law in India, Deep and Deep pub., New Delhi, 2006, 2013
6. P D Kaushik, Women's rights; access to justice, Bookwell Publications, New Delhi, 2007
7. Paola Monzini, Sex Traffic, Prostitution, Crime and Exploitation, Zed Pub., 2005
8. Chloe E. Bird, Patricia P. Rieker, Gender and Health, Cambridge University Press, 2008.
9. Jasmine Gideon, Ed., Handbook on Gender and Health (International Handbooks on Gender series), Development Studies, Birkbeck, University of London, UK, 2016.
10. Nelson E, Zimmerman C. Household survey on domestic violence in Cambodia. Ministry of Women's Affairs, Project Against Domestic Violence, Cambodia,1996.
11. Parker B, McFarlane J, Soeken K. Abuse during pregnancy: effects on maternal complications and birth weight in adult and teenage women. Obstetrics and gynaecology, 1994, 84(3):323-328.
12. Madeleine Arnot and Mairtin Mac, An Ghaill, (2006) "Gender and Education" Routledge, New York
13. Aruna Goel, (2004) "Education and Socio-Economic Perspective of Women Development and Empowerment" Deep and Deep Publications, New Delhi
14. Eileen M. Byrne, (1978) "Women and Education" Tevi Stock Publications, Michigan
15. Payal Mago and Isha Gunwal, (2019). Role of Women in Environment Conservation.
16. M.S Swaminathan. (1998). "Gender Dimensions in Biodiversity management". Konark Publisher's Pvt. Ltd, New Delhi.
17. P.K.Rao. (2000). "Sustainable Development – Economics and Policy". Blackwell, New Delhi.

18. Swarup, Hemlata and Rajput, Pam. (2000). "Gender Dimensions of Environmental and Development Debate: The Indian Experience" in Stuart S. Nagel, (ed.) "India's Development and Public Policy". Ashgate, Burlington.

TRIBAL RESOURCE MANAGEMENT

Course Code : HS30423
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

The course intends to impart a comprehensive knowledge about the reality, pertaining to economic alleviation of the poor and downtrodden. It is inter-disciplinary and based on utilization of natural resources employing traditional means of approach, conducive for societal growth and development. This shall hone socioeconomic environmental development for uplifting the condition of tribal population for igniting new ideas in the new economy.

COURSE OUTCOME

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

CO 1: Identify the concept of sustainable natural resource management,
CO 2: Recognize agribusiness management, its opportunities and risks,
CO 3: Discuss adequate skills to prepare and implement integrated development plan & projects for the optimal use of tribal renewable resources for the sustainable development of the environment,
CO 4: Illustrate the nuances of environmental policies and Laws in India and understand the core competencies required for resource mobilization and policy formulation based on the research insight,
CO 5: Prioritize the role of health and education for the development of tribal community, considering tribal people as resources,
CO 6: Develop trainees or volunteers as competent change agent in the field of tribal resource management.

COURSE CONTENT

Natural Resource Management
Introduction to Natural Resources and their management: Natural Resource Management (NRM): Concept, Issue and Approaches; Need for developing extension strategies for NRM; Issues in management of NRM; Problems encountered while advocating strategies for NRM; Monitoring and auditing in Natural Resource Management (NRM); Triple Bottom Line (TBL) and concept of Sustainable Natural Resource Management; NRM of Water, land and forests: Water resources and their management, Overview of irrigation management, Integrated Watershed management and rainwater harvesting, River Basin management; Scope of market mechanism in NRM

Agribusiness Management
Agricultural value chains and their relevance; Managerial Insights: Identifying agribusiness opportunities; Assessing feasibility – technical, commercial and financial and thereby identify feasible opportunities for projects; Analyzing influences of external environment factors and associated risks; Discussions on illustrative agribusiness projects; select models and opportunities of agribusiness opportunities and ventures.

Environmental Resource Management of Tribals
Environment and Development-Theories of optimal use of exhaustible and renewable resources; Sustainable Development - The concept of sustainable development; strong and weak sustainability; Mechanism for environment regulation in India; environmental laws and their implementation; Environmental Policy in India-Policy instruments for controlling water and air pollution and forestry policy; Institution for forest Management- The institutions of joint forest management , social foresty-rationale and benefits

Tribal Health and Education Management
Role of Health and Education in Tribal Development: Importance in poverty alleviation; health and education outcomes and their relationship with macroeconomic performance; Tribal Health in India: An Overview Health outcomes; health systems; health; Evaluation of Health Programs for tribals: Costing, cost-effectiveness and cost benefit analysis; burden of disease; Tribal Education in India: An Overview Literacy rates, school participation, school quality measures

Agro forestry Management
Multiplicity of Agroforestry products and services- ecological and economic and cultural considerations-gender equality- preservation of indigenous knowledge. Socioeconomic benefits of agroforestry; Smallholder livelihood and the role of agroforestry- Food and nutritional security Fulfillment of food, fodder, fuelwood and shelter based needs- income generation vs. subsistence production; Adoption of AF- Determinants of adoption: feasibility, profitability, and acceptability; . Self-efficacy in farmer decision-making - policy aspects.

Text Books

1. Madhusudan Bandi ,Tribals and Community Forest Management , Rawat Publication, 2013
2. Jumyir Basar,Indigenous Knowledge and Resource Management Shipra Publications, 2014
3. Laishram Herojit, Rethinking Resource Management: Sustainability and Indigenous Peoples, A.K. Publications, 2012.

Reference Book

1. G.K. Bera, Tribal India’s Traditional Wisdom and Indigenous Resource Management by, Abhjeet Publishers.

INDIAN KNOWLEDGE SYSTEM

Course Code : HS30425
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

The objective of the course is to promote interdisciplinary study on all aspects of the Indian Knowledge System (IKS), preserve and disseminate IKS for further study and societal applications. It will actively help students to engage in spreading the rich heritage of our country and traditional knowledge in the field of Liberal Arts, Literature, Basic Sciences, Engineering and Technology, Economics, mental and physical well being etc.

COURSE OUTCOME

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

CO 1: Understand the concept of Indian traditional knowledge and its importance,
CO 2: Know the need and importance of protecting traditional knowledge,
CO 3: Develop an appreciation among the students for ancient scriptures,
CO 4: Contrast and compare characteristics and important kinds of traditional knowledge,
CO 5: Evaluate social change on traditional knowledge
CO 6: Create innovative ways of bringing forward ancient knowledge to the forefront.

COURSE CONTENT

Meaning of Traditional Knowledge System
Overview of the Vedas, the Upanishads, the Puranas, and the Itihasas. Main Schools of Darshana/ Philosophy: Astika (Vedanta, Nyaya, Vaisheshika, Sankhya, Mimamsa, Yoga) and Nastika (Buddhist, Jainist, Lokayata). Types of Shastra (Vyakarana, Kavya, Alamkara, Shilpa, Vastu, Natya and Sangita). Types of Kavya (Drishya, Shravya, Chitra). Theory of Rasa: Natyashastra by Bharata (Chapter 6). Applied Traditional Knowledge: Myths, Rituals, Taboos and Superstitions, Folktales, Proverbs. Fundamental Concept of Dharma and Its Role in Various Streams of Indian Knowledge System

Yoga and Spiritualism
Definition and Origin of Yoga. Significance of spirituality in Yoga, Historical development of Yoga; Yogic philosophy: The eight limbs of yoga according to Patanjali, Mind, body & spirit connection in yoga; Relevance of Asana, Pranayama & Dhyana in Yoga: Physical posture for physical, mental and spiritual development, Breathing techniques for energy restoration & consciousness, Meditation for inner stillness and mindfulness, Meditation for spiritual growth & self-discovery; Ethics & Moral Values in Yoga: Exploring the ethical principles Yama and Niyama, Application of yogic principles to daily life for spiritual growth; Yoga & Spirituality in modern life.

Fun with mathematics without calculator

Arithmetic- Quick calculation with 11 and 12, Multiplication with 99999 in seconds, multiplication with numbers near the bases, vertical and cross multiplication, Magic squares and square roots, cubes, fractions, divisions, HCF and LMC in ancient style. Algebra- Factorising quadratic expressions, One variable linear equation, Simultaneous linear equations. Implementation of Vedic mathematics tools during competitive examinations.

Ancient Indian Science and Technology

Technological development in India: Agriculture (Origin and development, ancient crops, Traditional practices), Water management (Overview, Harappan water management, other case studies, Medieval Water structures), Pottery (Overview, Technical aspects), Silpasastra (Architecture and Construction· An introduction to Silpasastra, Construction Technology), Metallurgy (Copper/Bronze/Zinc, Iron and Steel Technology in India).

Trade and Commerce in Ancient India

Internal, External, Trade routes Indo-Roman contacts and Maritime Trade of South India; Silk and Cotton Textiles, the Principal Maritime Trade Commodities of Ancient India; Trade routes in Ancient India: Silk Route and Spice Route.

Reading Materials

1. Dasgupta, Surendranath. A History of Sanskrit Literature, Motilal Banarsidass
2. Banerji, Suresh Chandra. A Companion to Sanskrit Literature, Motilal Banrasidass
3. Chatterjee, Satischandra. An Introduction to Indian Philosophy, Motilal Banarsidass
4. Sharma, Chandradhar. A Critical Survey of Indian Philosophy, Motilal Banarsidass
5. A Text Book on Yoga and Health by Dr. Sajib Kumar Bhowmik, Sports Publication, 2020.
6. Light on the Yoga Sutras of Patanjali, B.K.S Iyengar, Element, 2005.
7. The Complete Book of Yoga: Karma Yoga, Bhakti Yoga, Raja Yoga, Jnana Yoga by Swami Vivekananda, Fingerprint Publishing, 2019.
8. Singhal, Aditi. How to Become A Human Calculator. ISBN : 9789352836543. S Chand Publishing
9. M. Tyra and K Kundan. Magical Book on Quicker Maths . ASIN : B07X93W2FC. BSC Publishing Co Pvt Ltd.
10. Singh, Balram. Science and Technology in Ancient texts. DK Print World ltd, 2012. ISSN 9788124606322.
11. Chandra Moti, Trade and Trade Routes in Ancient India. New Delhi: Abhinav Publications, 1977
12. Textiles in Ancient India: From Indus Valley Civilization to Maurya Period. Vishwavidyalaya Prakashan, 1994.
13. Duraiswamy, D. Silk and Cotton Textiles, the Principal Maritime Trade Commodities of Ancient India. ACTA VIA SERICA, Vol. 6, No. 2, Dec. 2021: 91-116, 6(2), 91–116.

K-Xplore
(Practice Oriented Open Elective – I)

The B. Tech. curriculum provides for a 1-Credit practice-oriented Open Elective K-Xplore in Semester V to make our undergraduate engineering programme holistic, multidisciplinary, skill-based, and balanced. This course allows the students to explore the opportunity that the KIIT University offers to them to sharpen their skills in areas which excite them the most.

Offered in a self-learning mode, this subject allows the students to hone their skills in areas they are passionate about which they select from a wide spectrum of subjects in art, literature, technology, community engagement and service, health, and environment and sustainability. In addition, the students develop soft skills that are important for them in their professional life. This course, thus, allows students to explore and grow in areas outside of core academics and provides a channel for complementing the lessons learned in the classroom, offering them the opportunity to apply academic skills in a real-world context and providing a truly well-rounded education.

This course is designed on the basis of the guiding philosophy of student-centered learning where the students define problems, evaluate alternatives, design solutions, and self-learn by performing certain assigned activities with limited guidance from faculty facilitators.

Each student selects an area of his (or her) choice from a specified list of areas. All the students with choice in a particular area are assigned to one or more faculty facilitators. Faculty facilitators assign the activities and tasks necessary for the course to the students and decide the desired mode of skills training. They may decide to make small groups of students of varying group sizes to carry out the assigned activities and tasks. They also make the required facilities available to the students to enable them to carry out the assigned activities and tasks.

The timetable will earmark specific hours for the subject. But the students are expected to use their spare time (including holidays and after-lecture hours on working days) to learn the required skills and use these skills to accomplish the assigned activities and tasks. The students, however, have to meet the faculty supervisors on the specified hours every week to appraise them of their progress, clear their doubts, if any, and chart their future plan.

The Head of KIIT Student Activity Centre (KSAC) will coordinate offering of the course.

COURSE OUTCOMES

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

CO1 : Develop the needed technical skills in their chosen fields of interest,
CO2 : Develop higher levels of self-confidence and soft skills such as communication, writing, discussion and debate, time-management, and leadership skills,
CO3 : Apply the learned skills to give shape to their passionate ideas,
CO4 : Develop Innovation and entrepreneurial mindset,
CO5 : Analyze and judge a problem situation for deploying the learnt knowledge and skills and develop problem solving strategies,
CO6 : Build new products and services using the learned knowledge and skills.

ROBOTICS

Course Code : SA38001
Credit : 1
L-T-P : 0-0 -2
Prerequisite :Nil

COURSE OBJECTIVE
To assist students develop the knowledge of robotics and circuitry, build circuits, bots and robots, and participate in different Robotics events such as Robo Wars.

WEB DESIGNING

Subject Code : SA38003
Credit : 1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To help a student learn and develop front-end and back-end web development skills and create websites.

CIVIL-TECH

Subject Code : SA38005
Credit : 1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To make a student ready to plan and design selected aspects of real life construction projects with relation to environment, transport & connectivity, water resource engineering & soil exploration and gain pre-, present-, and post- construction experience.

CIRCUIT DESIGN & CONTROL

Course Code : SA38007
Credit: :1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To let the students learn the required skills to design and develop electrical circuits and implement controllers for use in robotics, automation, voice recognition, gesture recognition, etc.

INDIAN CLASSICAL, FOLK & BOLLYWOOD DANCE

Course Code : SA38009
Credit : 1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To encourage and boost the confidence of the students to choreograph and perform in classical, semi classical / folk and bollywood dance forms.

INDIAN CLASSICAL & WESTERN MUSIC

Course Code : SA38011
Credit : 1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To give confidence to the students to participate and perform as a vocalist and/or instrumentalist in different forms of Indian classical and western music.

GRAPHIC DESIGNING & EDITING

Course Code : SA38013
Credit : 1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To nurture the students' skills in creative designing, photo and video editing activities, and digital sketching and painting, using Designing & Editing software such as Photoshop, Illustrator and video editing software.

ART & CRAFT

Course Code : SA38015
Credit : 1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To endow the students with the skills to do various types of painting such as portrait painting, landscape painting, abstract painting, pencil sketching, and doodling and craft, using various Painting and Sketching tools.

THEATRE & STREET PLAY

Course Code : SA38017
Credit : 1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To give students the confidence to perform in Theatres, Nukkad, Mono Acts and skits based on written scripts.

FILM MAKING

Course Code : SA38019
Credit : 1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To impart skills for film making in areas such as cinematography, script writing, audio recording, and editing.

DEBATING, PUBLIC SPEAKING & ANCHORING

Course Code : SA38021
Credit : 1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To develop the students' skills for performing oratory activities such as extempore speech, debate, poetry reading, open topic speech, public speaking, interviewing, open dialogue, anchoring, and presentation.

CREATIVE WRITING

Course Code : SA38023
Credit : 1
L-T-P : 0-0-2
Prerequisite :Nil
COURSE OBJECTIVE
To develop the students' skills in creative writing, content writing, article writing, and poem composition.

PHOTOGRAPHY & VIDEOGRAPHY

Course Code : SA38025
Credit : 1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To provide the technical knowledge required to create photos and videos that tell a story or capture a real-world occurrence.

FASHION STYLING

Course Code : SA38027
Credit : 1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To impart the basic skills of costume design, styling, grooming, and presentation relevant to a specified theme.

CULINARY ARTS

Course Code : SA38029
Credit : 1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To help the students learn the skills of cooking, knowing ingredients, and preparing cuisines of Pan India and 65 countries

QUIZ ACTIVITY

Course Code : SA38031
Credit : 1
L-T –P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To give the students the confidence to participate in, and conduct, various forms of quiz, such as Technical Quiz and Business Quiz.

SOCIAL OUTREACH

Course Code : SA38033
Credit : 1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To sensitize the students on the social issues and giving them an opportunity to connect with the community and the environment through outreach activities, community projects, and volunteering.

HEALTH & EMERGENCY CARE

Course Code : SA38035
Credit : 1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
To let the students learn about health issues, basic Life-saving skills and participate in health awareness and sensitization programs.

VOCATIONAL ELECTIVES

Vocational Courses Offered by School of Civil Engineering

BUILDING DRAWING, ESTIMATION & COSTING

Course Code :CE28001
Credi : 1
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
This subject is designed to enrich the basic knowledge of engineering students to develop building drawings. The subject will also give students exposure about quantity estimation and costing of the building.

COURSE OUTCOMES

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

CO1: Prepare the layout plan, elevation of building
CO2: Understand the building drawings and details
CO3: Learn the basic concept of estimation and its application in real construction projects.
CO4: Analyze the rates of individual items for the preparation of the estimates.
CO5: Prepare schedule of quantities required to be attached with the tender documents.
CO6: Develop critical thinking ability to optimize the building construction cost.

COURSE CONTENT
Building Drawing:
Construction Standards and drawing techniques in projects. Introduction to basic principles of Computer-Aided Design (CAD), Orthographic projection including sectional views of buildings and parts of buildings and building details, e.g. foundations, walls (including openings), jambs, sills, lintels and arches, floors and roofs, doors and windows, simple stairs. Preparation of simple working drawings and details from free-hand sketches.
Estimation:
Estimation, units, item work, different kinds of estimates, different methods of estimation, estimation of materials in building, with different sections of walls, foundation. Bar Bending Schedule, Estimation of finishing works.
Specification of Works:
Necessity of specification types of specification, general specification, specification of bricks, cement, sand, reinforcement, detailed specification for earthwork, cement, concrete, brickwork, flooring, D.P.C, R.C.C, cement plastering, white and colour washing, distempering, painting.
Rate analysis:
Procedure of rate analysis for items - Earth work, concrete works, R.C.C works, reinforced brick work, plastering.

Text Book(s):

1. B. N. Dutta, Estimating and Costing in Civil Engineering – Theory & Practice, CBS Publishers & Distributors Pvt Ltd, 28th Edition, 2020.
2. M. Chakraborty, Estimating & Costing, Specification and Valuation in Civil Engineering, Chakraborty, 29th Edition, 2006, ISBN-10: 818530436X.

Reference Book(s):

1. B. S. Patil, Civil Engineering Contracts and Estimates, Universities Press, 3rd Edition 2006, ISBN-10: 8173715599.

GIS & GPS APPLICATIONS

Course Code :CE28003
Credit :1
L T P : 0 0 2
Prerequisite :Nil

COURSE OBJECTIVE

The objective of the course is to understand the GIS principles, applications, preparation of study maps, creation of interpolation maps, delineation of watershed, explain the functions of GPS and operation of GPS.

COURSE OUTCOMES

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

CO1: explain the fundamentals of GIS
CO2: understand the operations of ArcGIS tools and prepare the layout of study area
CO3: create interpolation maps
CO4: delineate watershed using ArcGIS
CO5: describe the principles and functions of GPS
CO6: operate GPS in the field for navigation

COURSE CONTENT

- Overview of Geographic Information System (GIS)
- Familiarization to ArcGIS Interface
- Layout of study area
- Preparation of interpolation map
- Watershed delineation
- Remote sensing satellites
- Basics of Global position system
- Basic operations of GPS Handset
- GPS field surveying and data processing

Reference Books

1. Principles of geographical information systems by P.A. Burrough and R. A. McDonnell, Oxford University Press, UK.
2. Geographic information systems and science by M.F. Goodchild, P.A. Longley, D.J. Maguire and D.W. Rhind, John Wiley & Sons Ltd., England.
3. Global Positioning system: Principles and Applications by SatheeshGopi, McGraw Hill Education.

Vocational Courses Offered by School of Computer Science Engineering

WEB DESIGN

Course code :CS28001
Credit : 1
L-T-P :0-0-2
Prerequisite : Nil

COURSE OBJECTIVE

Web design and programming is a large field, with different types of technologies implemented by different tools. HTML, CSS, and JavaScript are known to be the three pillars of client-side web programming. After finishing this course, a student should be prepared to write nicely formatted, interactive web pages, with no dependencies on server-side technologies.

COURSE OUTCOMES

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

CO1: Understand the basics of web page design.
CO2: Use formatting instructions of HTML.
CO3: Apply the style formats using CSS.
CO4: Write basic scripts using JavaScript.
CO5: Apply DOM in web pages.
CO6: Create dynamic web pages using HTML and JavaScript.

COURSE CONTENT

HTML Fundamentals

HTML: Structure of a program, various tags and their roles in HTML programs, Lists: ordered, unordered, definition, Table

More with HTML

Form design,Frames, link and it's types, Images

CSS Essentials

Style sheets: Inline, Internal, External

JavaScript Basics

Introduction, characteristics, Variables, Data types, Type casting and conversion Functions. Primitives, operators, Control statements, Array, Function, Function – Parameter Passing and dynamic argument and return statement

More with JavaScript

DOM - browser, window, document, image and form object, Properties and Methods of different objects, Predefined Java Script Object - Array, String and Date Object and their methods, Event handling – Link, Body, Image and events associated with different HTML tags

Text Book:

1. MASTERING HTML, CSS & Java Script Web Publishing, Laura Lemay, Rafe Colburn and Jennifer Kyrnin, BPB Publications.

Reference Books:

1. HTML, CSS and JavaScript All in One, Sams Teach Yourself, Julie C. Meloni and Jennifer Kyrnin, Pearson Education.
2. HTML 5 Black Book, DT Editorial Services, Dreamtech Press.

Vocational Courses Offered by School of Electrical Engineering

INDUSTRIAL WIRING AND CONTROL PANEL DESIGN

Course Code	**:**	**EE28011**
Credit	**:**	**1**
L-T-P		**:0-0-2**
Pre-requisites	**:**	**NIL**

COURSE OBJECTIVE

This vocational course will provide an overview of electrical occupations, including the training and the employment options available in electrical industry. It is also designed to provide related training in the electrical trade that will give students the proper coursework in installation and designing of control panel.

COURSE OUTCOMES

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

CO1 : Realize the purpose and general principles of control components and circuits

CO2: Install Industrial wiring circuits according to given specification and plan.

CO3: Analyze circuit operations on basic motors.(3ø induction Motor)

CO4: Interpret and install circuits according to rules and regulations of the National Electrical Codebook.

CO5: Connect motor controllers for specific applications with emphasis on safety practices and in accordance with National Electrical Code (NEC) requirements.

CO6: Select and size contactors, relays and timing relays and overload relays both physically and schematically and describe their operating principles.

COURSE CONTENT

Hands on Practice:

1. Design multiwire circuit for a direct motor starter (DoL) with one operating (forward) direction using QElectrotech software.
2. Design multiwire circuit for a direct motor starter (DoL) with two operating (forward &reverse) direction using QElectrotech software.
3. Design multiwire circuit for a Star – Delta motor stator with one operating (forward) direction using QElectrotech software.
4. Design multiwire circuit for a Star – Delta motor stator with two operating (forward &reverse) direction using QElectrotech software.
5. Design &connect for a direct motor starter (DoL) with one operating (forward) direction in modular set up .
6. Design &connect for a direct motor starter (DoL) with two operating (forward & reverse) direction in modular set up .
7. Design &connect for a Star – Delta motor stator with one operating (forward) direction in modular set up.
8. Design &connect for a Star – Delta motor stator with two operating (forward& reverse) direction in modular set up.
9. Install & wire for a direct motor starter (DoL) with one operating (forward) direction in Industrial Control Panel.
10. Install & wire for a direct motor starter (DoL) with two operating (forward & reverse) direction in Industrial Control Panel.
11. Install & wire for a Star – Delta motor stator with one operating (forward) direction in Industrial

Control Panel.

12. Install & wire for a Star – Delta motor stator with two operating (forward &reverse) direction in Industrial Control Panel.

Reference Book:

1. Installation, commissioning and maintenance of electrical equipment by Tarlok Singh.
2. Industrial Electrical Systems by B. P. PATIL and M. A. CHAUDHARI

INSTALLATION, OPERATION AND MAINTENANCE OF SOLAR POWER SYSTEM

Course Code	**:**	**EE28013**
Credits	**:**	**1**
L-T-P	**:**	**0- 0- 2**
Pre-requisites	**:**	**NIL**

COURSE OBJECTIVE

To impart job-oriented training to students and make them well convergent on Installation, operation & maintenance of solar PV system. This vocational course is based on study of solar photovoltaic (PV) cells, modules, and system components; electrical circuits; PV system design and sizing for use on homes, commercial building etc., understanding energy conversion from sunlight to electricity, and working with solar conversion equipment. This Course will give students the book knowledge and hands on experience needed to become entrepreneur / self-employed.

COURSE OUTCOMES

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

CO1: Demonstrate and apply the knowledge of solar electric systems terms and concepts
CO2: Size and design a photo voltaic system.
CO3: Mount, ground, position, install, wire and connect a photo voltaic system.
CO4: Test voltage generated by photo voltaic system.
CO5: To learn different types of solar PV modules and batteries used in solar PV plant
CO6: Design of solar PV plant based on estimated loads.

COURSE CONTENT

Designing of solar panel and installation

1. Homer
2. PVSYST
3. Helioscope

Hands on Practice:

1. Demonstrate the I-V and P-V Characteristics of PV module with varying radiation and temperature level.
2. Demonstrate the I-V and P-V characteristics of series and parallel combination of PV modules.
3. Show the effect of variation in tilt angle on PV module power.
4. Demonstrate the effect of shading on module output power.
5. Demonstrate the working of diode as bypass diode and blocking diode.
6. Draw the charging and discharging characteristics of battery.

7. Observe the output waveform of the inverter in auto mode.
8. Workout power flow calculations of standalone PV system of AC load with battery.
9. Workout power flow calculations of standalone PV system of DC load with battery.
10. Find the MPP manually by varying the resistive load across the PV panel.

Reference Book:

1. Solar Photo Voltaic Technology and Systems by Chetan Singh Solanki
2. Non-Conventional Energy Resources by B.H.Khan.
3. Solar Energy - Principles of Thermal Collection and Storage by P.Sukhatme.
4. Solar Energy: Fundamentals, Design, Modelling and Applications by G.N.Tiwari.

DOMESTIC WIRING AND HOME AUTOMATION

Course Code	**:**	**EE28015**
Credit	**:**	**1**
L-T-P	**:**	**0- 0-2**
Pre-requisites	**:**	**NIL**

COURSE OBJECTIVE

This vocational course will provide an overview of electrical occupations, including the training and the employment options available in electrical consultancy. It is also designed to provide related training in the electrical wing that will give students the proper coursework in installation and designing of domestic wiring and home automation.

To develop electrical wiring skills in students through systematic training that would enable the students to construct and test various electrical circuits using appropriate electrician tools, wires, protective devices and wiring accessories as per IS standards.

COURSE OUTCOMES

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

CO1:Use appropriate electrician tools, wires, protective devices and wiring accessories

CO2:Rig up wiring diagrams using conduit system of wiring.

CO3:Apply IS standards for electrical wiring

CO4:Prepare different types of wiring joints.

CO5:Well convergent in drawing electrical wiring circuit.

CO6. Enhancement of knowledge regarding specification and application of different electrical devices.

Domestic wiring and Home Automation, QElectrotech software.

COURSE CONTENT

Hands on Practice:

1. Perform the assembly, wiring and implementation of a single switch (SPST Switch) in circuit.
2. Perform the assembly, wiring and implementation of a Double switch (SPST Switch) in circuit.
3. Perform the assembly, wiring and implementation of a power socket in circuit.
4. Perform the assembly, wiring and implementation of a controlled power socket circuit in housing.
5. Perform the assembly, wiringand implementation of a two ways switches (SPDT Switch) in circuit.
6. Perform the assembly, wiring and implementation of a impulse relay in circuit.
7. Perform the assembly, wiring and implementation of a time switch in circuit
8. Perform the assembly, the wiring and the implementation of a timer lighting in circuit.

9. Perform the assembly, the wiring and the implementation of a twilight switch in circuit in house or in a shop.
10. .Perform the assembly, wiring and implementation of a controlled lighting in circuit (time switch, timer, twilight switch).
11. Perform the assembly, the wiring and the implementation of a water heater in circuit.
12. Perform the assembly, wiring and implementation of a central impulse relay in circuit.
13. Study and implementation of Light sensitive switch.
14. Perform the assembly, wiring and implementation of a fan in circuit.
15. Perform the assembly, wiring and implementation of a distribution panel.
16. Home automation using KNX technology.
17. Application of Load shedding contactor and programmable time switch.

Reference Book:

1. Home Automation - A Smart Home Guide: The Beginner's Manual Including Google Home, Echo Dot and Amazon Alexa. Easy Instructions, Directions and Commands ... and Home Automation Guide Series Book 1) Kindle Edition
2. Home Automation and Wiring by James Gerhart

CYBER PHYSICS APPLICATION IN INDUSTRIAL IOT

Course Code	**:**	**EE28017**
Credits	**:**	**1**
L-T-P	**:**	**0-0-2**
Pre-requisites	**:**	**NIL**

COURSE OBJECTIVE

The students will utilize the principles of Cyber-Physical Systems (CPS) and Internet of Things (IoT) to develop applications, implement IoT applications by selecting appropriate hardware and software platform and also Develop IoT applications using open-source platforms.

COURSE OUTCOMES

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

CO1 : Basics of cyber physics components
CO2: Understanding of sensors and actuators
CO3: Layout diagram of open source microcontroller board
CO4: Understanding of analog and digital I/O for cyber-physics
CO5: Understanding of different protocols for IoT connectivity
CO6: Basic architecture for IoT enabled Cyber Physics

COURSE CONTENT

Cyber Physical System
CPS Real-world,Design and Validation of CPS,Smart city application CPS,CPS Hardware Platforms (Process, Sensors and Actuators)

Industry 4.0.

IOT Fundamentals and protocols including layers, Sensor and Interfacing.

Hands on Practice:

1. Architecture and pin diagram of Arduino UNO/MEGA and ESP8266
2. IDE installation for open source C++ or Python
3. Analog and Digital voltage sensing and processing through Firmware
4. Analog and Digital voltage based actuator through Firmware
5. Display OLED/Seven segment integration through IDE PCB Design Concept and implementation with Uc
6. Implementation of UI/UX through Rest API based Thing speak
7. DATA logging and Generating CSV through RestAPI
8. Writing a Firmware for ESP-8266 or NODEMCU(programming based knowledge)
9.IoT based transformer / condition monitoring system

Reference Book:

1.Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally
2.Asoke K Talukder and Roopa R Yavagal,"Mobile Computing," Tata McGraw Hill, 2010.
3.Computer Networks; By:Tanenbaum, Andrew S; Pearson Education Pte. Ltd., Delhi, 4th Edition
4.Data and Computer Communications; By:Stallings, William; Pearson Education Pte. Ltd., Delhi, 6th Edition
5.F. Adelstein and S.K.S. Gupta, "Fundamentals of Mobile and Pervasive Computing," McGraw Hill, 2009.

INDUSTRIAL CONTROL AND REMOTE MONITORING

Course Code	**:**	**EE28019**
Credits	**:**	**1**
L-T-P	**:**	**0-0-2**
Pre-requisites	**:**	**NIL**

COURSE OBJECTIVE

To provide hands on experience in developing Industrial Control and remote monitoring by using PLC (Programmable logic Controller), thus by utilizing it in Process control applications

COURSE OUTCOMES

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

CO1: Know about typical components of a Programmable Logic Controller
CO2: Know the concept of Electrical ladder logic and its relationship to PLC instructions
CO3: Understand the concept of digital electronics and data acquisition
CO4: Program PLC logical switching circuits for industrial applications
CO5: Choose and utilize Timer, Counter, and other intermediate programming functions
CO6: Design and program automated industrial production line

COURSE CONTENT

Programmable Logic Controller System:
Introduction to Industrial Automation, Introduction to PLC programmable logic controller
PLCs & related software and its major Components:
Relay logic Hardware Platforms (Switches, Sensors and Actuators), Study of Contactors, Timers, Counter and Comparator

Human Machine interface:
Introduction to HMI Communication with PLC, HMI tags and Assignments, Project on Industrial load sequential feedback control Using PLC HMI

Hands on Practice:
1. Introduction of PLC SOFTWARE as TIA Portal
2. Ladder Programming for Basic gates logics by using SPST Contacts
3. Ladder Programming on SPDT
4. Latching Concept and related Latching program
5. Study of program memory and Programming on Memory Bits
6. Study of TIMER BLOCKs and its Programming
7. Introduction to COMPARATOR BLOCK and its Programming
8. Introduction to COUNTER BLOCK and its Types with Programming
9. Project on Industrial Load OFF/ON control Using PLC and HMI
10. Introduction to analog Logic in PLC and its Programming

Reference Book:

1. Programmable logic Controller by Vijay R. Jadhav KHANNA PUBLISHERS Second Edition 2012
2. Industrial Automation Using PLC,SCADA and DCS by R.G Jamkar Laxmi Publications Private Limited;
3. PLC and SCADA by Prof Rajesh Mehra and Er. Vikrant Vij Published by University Science Press, 1st
4. Programmable logic Controller: Programming methods and Applications By John R Hackworth and Frederick D. Hackworth Jr. PEARSON Edition: 1st Edition, 2006.

Vocational Courses Offered by School of Electronics Engineering

COMPUTATIONAL PHOTOGRAPHY

Course code :EC28001
Credit : 1
L-T-P :0-0-2
Prerequisite : MA11001

COURSE OBJECTIVE

Computational photography (CP) is the fusion of computer graphics, computer vision, optics and imaging. The role of CP is to overcome the limitations of traditional cameras by combining imaging and computing to enable new and improved ways to capture, represent and interact with the physical world. The course provides and overview of elements photography, which includes digital image capturing mechanisms, lighting controls, effect of focal length and aperture and various lossy and lossless image storage mechanisms. Objective is to briefly explain computational methods used to enhance photographs.

COURSE OUTCOMES

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

CO 1: Appreciate concept of photography, and digital camera technology
CO 2: Understand types of cameras and their mechanisms
CO 3: Demonstrate computational image processing
CO 4: Apply computational photography methods for photo composition and panoramic
CO 5: Apply computational image processing for photography quality enhancement
CO 6: Explain various image filtering techniques

COURSE CONTENT

Introduction to Computational Photography:
History of Photography and Computational Photography, Digital Representation of Images, Cameras, Difference between Full frame, APSC and Medium format sensors, scaling, crop sensor advantages/disadvantages

Digital photography:
Principle of Operation of DSLR camera, Aperture, ISO, Shutterspeed and Angle Control, Camera Calibration and Tethering, Computational Cameras, Image Storage formats: Compressed vs uncompressed formats, Basics of Lenses: Wide angle, Telephoto, Prime lenses, Macro lenses. Difference in angle, Depth of field control

Computational Techniques:
Concept of Color, color models, noise, its types, image histogram, Image Processing software: Licensed and Open Source

Training on Computational Photography:
Shooting with wide angle lenses, Shooting with Telephoto lens, zooming, changes in angle, Shooting with Prime lenses and constant aperture lenses, Shooting with Macro lenses, microscopic photography

Training on Digital Imaging-I:
Photography Genres, Scene Composition, Dynamic Range improvement, Portraits, Photographing scenes, crowd and people, Shooting Portraits, group photos and events

Training on Digital Imaging-II:
Long exposure, Brenizer's Method, Sports High Shutter speed, Burst, fisheye, architecture photography, Macro, Basics of Long exposures, using polarizing filters Shooting panorama, Brenizer's method and other photographing techniques Shooting sports, high shutter speed

Training on Digital Imaging-III:
Use of lights, soft box and flashes, guide number etc. , product photography, computational photography,E-commerce photography, Use of Lights, Flash, wireless flash, Basics of product photography, photography for e-commerce and computational photography

Training on Post Processing-I:
RAW image processing, Basic adjustments and correction, Lens Distortion and color correction using Adobe Photoshop, Monochrome image processing, color image processing batch processing using Light-room

Training on Post Processing-II:
Image enhancement operations, noise removal, Artistic filtering, cosmetic filtering, and other post processing methods. Post Processing III: Background removal, artificial coloring.

Training on Post Processing-III:
Open Source and free software for image post processing and computational photography, their usage and capabilities.

Photography Ethics:
Photography ethics: empathy, consent, integrity, ethical decision making, privacy

Text Book:

1. Computer Vision: Algorithms and Applications, 2nd ed by by Richard Szeliski

Reference Books:

1. Computational Imaging Book, by AyushBansai, AchutaKadambi, and Ramesh Raskar.
2. Multiple View Geometry in Computer Vision, by Richard Hartley and Andrew Zisserman.
3. Computer Vision: A Modern Approach, by David Forsyth and Jean Ponce.
4. Foundations of 3D Computer Graphics, by Steven Gortler.
5. Digital Image Processing, by Rafael Gonzalez and Richard Woods.
6. Photography, by Barbara London and John Upton

SOUND ENGINEERING

Course code :EC28003
Credit :1
L-T-P :0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
It elaborately covers in various aspects of sound (physical and mechanical behavior), equipment used for recording/ reproducing and basic idea for the preparation of final sound track in film or television production.

COURSE OUTCOMES

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

CO1: Recognize, define, and explain the principles of sound engineering related to signal flow, microphones, recording, mixing, production, and mastering.
CO2: Demonstrate practical, imaginative understanding and fluency on sound engineering technologies and procedures.
CO3: Solve problems independently, imaginatively, and creatively in the field of sound engineering will be demonstrated by students.
CO4: Learn how to conduct research and have a critical comprehension of sound engineering and its related fields.
CO5: Understand the basic techniques of sound recording.
CO6: Understand the working of different types microphone and loudspeakers and their applications in industry.

COURSE CONTENT

- Introduction to technology of sound
- Analysis of prerecorded speech, music and effects
- Observation of the installation of PA System in a large auditorium
- Study and analysis of different microphones
- Study the feature of 2 channel digital sound recorder
- Study about the effect of loudness in relation with the distance from source to the listener
- Sound recording and reproduction practice by using recorder in PA system chain
- Study of sound in different environmental situation
- Study and analysis on Modulated Radio wave AM and FM in Live streaming radio stations
- Study the effect of Bass and Treble (Concept of Equalization)

Text Book:

1. Sound Recording and Reproduction – Glyn Alkin

Reference Book:

1. Sound Assistance – Michael Talbot Smith

SENSORS FOR AUTOMATION

Course code :EC28005
Credit : 1
L-T-P :0-0 -2
Prerequisite : Nil

COURSE OBJECTIVE

Sensors and automation are revolutionizing the technology in the areas like consumer electronics, automotive industry, healthcare, and in other settings. The course will provide an opportunity for students to learn different sensors and its application in real world problems. It will empower the students to develop their knowledge regarding operation, application and integration of sensors to enable the design and realization a complete systems.

COURSE OUTCOMES

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

CO1: Learn about the microcontroller, its hardware interfacing and programming
CO2: Understand the working principle and characteristics of different types of sensor
CO3: Interface various sensor interfacing with microcontroller and display devices
CO4: Understand the basic principles of analog to digital conversion and its application with different sensors
CO5: Gain knowledge about various types of automation system
CO6: Develop and implement sensor for final products in real time applications

COURSE CONTENT

1. Introduction to microcontroller, platform of operations with basic programming techniques
2. Interfacing of serial and parallel device with microcontroller
3. Interfacing of microcontroller with display devices
4. Use of ADC to interface various analog sensors with microcontroller
5. Introduction to sensor, measurement of physical parameters like temperature and humidity
6. Application of ultrasonic and proximity sensor
7. Application of gas and pressure sensor
8. Application of IR sensor and RFID
9. Interfacing actuators to drive DC motor (application of touch switch as actuators)
10. Implement sensor in final products for real time solution

Text Book:

1. T. Karvinen, and K. Karvinen, Getting started with sensors, Shroff Publishers, Kindle, Edition, 2014.

Reference Books:

1. J. S. Katre, Sensors in Automation, TechKnowledge Publications, 1st Edition, 2023
2. D. Patranabis, Sensors and Transducers, PHI Learning, 2nd Edition, 2003.

PCB DESIGN

Course code :EC28007
Credit : 1
L-T-P :0-0-2
Prerequisite : Basic Electronics EC10001

COURSE OBJECTIVE

Over the years, printed circuit board manufacturing has continued to grow in order to keep up with the increasing demands of newer, faster, and more complex electronic circuitry. This course will familiarize students to design, simulate electronics circuit and fabricate PCB for prototyping using CAD tool. This program is designed to provide a balanced foundation of theoretical knowledge and practical skills in printed circuit board design.

COURSE OUTCOMES

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

CO1: Understand and evaluate different electronics components.
CO2: Create schematic and simulate the circuit using OrCAD or any other CAD tools.
CO3: Understand single- and double-layer PCB.
CO4: Create and fabricate PCB and analyze the PCB using screen printing method.
CO5: Understand assembly of electronics component by soldering.
CO6: Analyze and test the circuit for any error.

COURSE CONTENT

Description of different Electronics Component and their Identification:
Passive and active components, component identification, Color code for resistor and disc capacitors, Inductor and their types, simple air core and iron core inductor design.

Circuit Design and Simulation using CAD tool (OrCAD): Design of a simple electronics circuit using data sheet and circuit schematic and simulation.

Schematic to PCB transfer and routing:
Schematic to PCB transfer (assigning foot prints to various components, transfer to PCB), routing, DRC, ERC, EMC

Screen Printing Procedure:
Preparation of screen, mask transfer

PCB preparation and Checking of Routing:
transfer of layout to PCB using screen printing methods, etching, cleaning, error checking of routing, component mounting, soldering

Testing and Verification:
Testing the circuit with the help of multi-meter and CRO

Text Books:

1. Chris Robertson, Printed Circuit Board, PHI, 2003
2. Elaine Rhodes, Developing Printed Circuit Assemblies: From Specifications to Mass Production, 2008, ISBN: 978-1435718760.

Reference Books:

1. Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, PHI, 2003.
2. Kraig Mitzner, Complete PCB Design Using OrCAD Capture and PCB Editor, Newnes, 2009
Open source EDA Tool KiCad Tutorial : http://kicad-pcb.org/help/tutorials/

Vocational Courses Offered by School of Mechanical Engineering

ADDITIVE MANUFACTURING (3D PRINTING)

Course Code : ME28011
Credit : 2
L-T-P : 0-0-2
Prerequisite :Nil

COURSE OBJECTIVE
Additive Manufacturing (AM) is a modern manufacturing technology also known as 3D printing process, will provide a clear understanding about the process, acceptability and usability in various field. AM technologies classified on the basis material types will be focused with its real life applications with advantages and disadvantages. Different types of errors associated with AM and CAD technology will be discussed with suitable error minimization processes. Various reverse engineering process will be discussed and practically implemented with its real life applications.

COURSE OUTCOMES

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

CO1: Understand the concept of additive manufacturing, its benefits and applications in various field.
CO2: Know the various liquid, powder and solid material based technologies in Rapid Prototyping and Rapid Tooling process.
CO3: Know the application of AM process in the field of Biomedical.
CO4: Design solid models and converting it to 3D printing readable file format required for part fabrication.
CO5: Focus on the various types errors in the RP parts and errors during CAD file conversion.
CO6*:* Apply reverse engineering process to generate data for fabrication RP part.

COURSE CONTENT

Introduction to Additive Manufacturing Technologies:
Need and Development of AM systems, AM process chain, Impact of AM and Tooling on Product Development, Benefits, Applications, Digital prototyping, Virtual prototyping.

Model Preparation using Solid Modelling Software.

Classification of Additive Manufacturing Technologies:
Classification of AM technologies on the basis of Materials types. Discussion on various AM processes based solid, liquid and semi solid type of materials along with its application, advantages and disadvantages.

Hands on practice for model creation and saving on particular file format.

Data Processing for AM Technologies:
Process planning for AM, CAD model preparation, data requirements & geometric modelling techniques: Wire frame, surface and solid modelling data formats.

Hands on practice for the fabrication of Single components and Assembly components.

Rapid Tooling:
Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect, Fabrication processes, Applications, Rapid tooling techniques such as laminated metallic tooling, direct metal laser sintering, vacuum casting.
Hands on practice for the fabrication of pattern and mould preparation.

Reverse Engineering Processes:
Introduction to reverse engineering, Integration of reverse engineering with AM technology.
Hands on practice to generate model data in revere engineering process integrated with AM process

Reference Books:

1. Rapid Prototyping: Principle and Applications, Rafiq I Noorani, Wiley & Sons, 2006.
2. Rapid prototyping: Principles and applications, Chua C.K., Leong K.F., and Lim C.S., Yes Dee Publishing Pvt. Ltd, Third edition, 2010.
3. Rapid Prototyping and Engineering Applications, Frank W. Liou, CRC Press, Special Indian Edition, 2007.
4. Additive manufacturing, R.B. Choudhary, Khanna Publication, 2022

DIE DEVELOPMENT BY CNC MILLING

Course code : ME28013
Credit :1
L-P-T : 0-0-2
Prerequisite : Workshop (ME18001)

COURSE OBJECTIVE

The objective of the course is to provide basic knowledge on various tools and precision instruments used during CNC milling operation. It helps in understanding the usage of various machining cycles to reduce the manufacturing lead time. Moreover, it explains the usage of various standards and programming methods to be followed during CNC machining operation. Finally, the students can develop/generate the programs used to produce the geometries with complex contours using CNC milling machine.

COURSE OUTCOMES

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

CO1: Understandthe usage of different tools and precautions to be followed during machining.
CO2: Know the principle and operation of precision instruments.
CO3: Understand the technological advancements in NC and aimed to achieve JH pillar.
CO4: Understanding the programming methods and programming in simulators
CO5: Planning for optimized CNC programming by estimating suitable process parameters
CO6: Programming of die contours and executing on CNC milling machine.

COURSE CONTENT

Tools and Safety: List of tools used on Milling Machine to perform various operations.
Safety: Introduction to safety equipment and their uses.

Measuring instruments
Vernier caliper, Micrometer, Bevel protractor, Coordinate measuring machine (CMM): Construction, principle graduation and reading, least count.

Introduction to CNC
Introduction to CNC technology, Conventional Vs. CNC machine tool, CNC clamping system. Implementation of JH for CNC.

CNC programming
Introduction to CNC programming, Introduction and demonstration of line programs milling machine using ISO codes into the CNC simulator. Part programming methods, Cutting process parameter selection, Process planning issues and path planning, G & M Codes, Interpolations, Tool compensations.

CNC Programming-Milling
Calculations of parameters like speed feed, depth of cut etc. and set a references for the various operations. Prepare & set CNC Milling operations and dry run on themachine. Execute program and inspect simple geometrical forms / standard parts.

Reference Books:

1. Computer Control of Manufacturing Systems, Mc Graw Hill Publication, By YoramKoren.
2. CAD/CAM ByMikell P. Groover
3. A text book of Manufacturing Technology-II By P C Sharma
4. Engineering Metrology, Khanna Publishers, By R K Jain

CONCEPT CAR MANUFACTURING

Course code : ME28015
Credit :1
L-P-T : 0- 0-2
Prerequisite : Workshop (ME18001)

COURSE OBJECTIVE

Objective of the course is to give the students hands on experience on building a racing car. Students find it very interesting to develop important parts of a racing car and then assemble and take part in various national and international events. In this process they meet the requirement set by the authorities. Therefore the students learn here how to propose a new car body and prove the feasibility by computational analyisis of the body and other important parts.

COURSE OUTCOMES

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

CO1: Remember the fundamentals of concept car characteristics.
CO2: Understand the aerodynamic requirements in racing vehicles.
CO3: Use the concepts of chassis behaviour of concept car
CO4: Illustrate the suspension characteristics of the concept car.
CO5: Understand the problems faced in drives and braking systems in motorsports.
CO6: Build a concept car body

COURSE CONTENT

Car Development
Constraints And Specifications – Performance, Handling, Structure; Driver Accommodation and Safety

Tyres: Adjustable Features, Preliminary Design And Analysis; Driver-Vehicle Relationship. Desirable Vehicle Characteristics, Fundamentals of Track and Lap

Racing Car Aerodynamics
Aerodynamic Force and Moment, Race Car Drag; Spoilers, Dams, Wings - Effectiveness Of Wings In SteadyState Cornering

Chassis Design
Conditions For Traversing a 90° Corner, Effects Of High Speed Braking, Cornering, Combined Braking Cornering; Steady State Cornering, Throttle Behaviour, Steering Wheel Force And Kick Back; Moving CG Position, Roll Centre Position Changing

Suspension System
Front Suspension- General Design Issues, Camber Effects; SLA Suspension, McPherson Struts; Independent Rear Suspension- Trailing Arm Types, Instant Axis Concept; Suspension Springs- Torsion Springs, Coil Springs.

Text Book

1. Advanced Race Car Chassis Technology HP1562: Winning Chassis Design and Setup for Circle Track and Road Race Cars Bob Bolles, HP Books; Revised, Updated ed. edition 2010

Reference Books

1. Race car vehicle dynamics, William F. Milliken and Douglas L. Milliken, 11th edition, SAE, 1995.
2. Formula 1Technology, Peter Wright, Sae Intl; 1st edition 2001.

DEVELOPMENT OF AUTONOMOUS WHEELED ROBOTS

Course code : ME28017
Credit : 2
L-T-P : 0-0-2
Prerequisite : Basic Electronics EC10001

COURSE OBJECTIVE

Nowadays, robotics is playing a vital role in industry 4.0, and autonomous wheeled robots are being applied to minimize human efforts and to improve the production rate. This course gives fundamental knowledge about wheeled robotics and its different hardware and software components. Moreover, the subject discusses kinematics equations, which will be implemented to control the motion of wheeled robots through the actuators. Further, the present course also describes the integration of various sensors and their programming, which will be used to make an autonomous control system for a robot.

COURSE OUTCOMES

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

CO1: Understand the fundamentals of wheeled robotics and its different components.
CO2: Apply locomotion constraint features to travel the wheeled robots in different surface conditions.
CO3: Apply various sensors integration on wheeled robots for autonomous navigation.
CO4: Analyze the kinematics of wheeled robots.
CO5: Create a robot programming to make an autonomous sensor-actuator control system.
CO6: Design of automation solutions using wheeled robots.

COURSE CONTENT

About Locomotion for Wheeled Robot:
Key issues for locomotion, wheeled mobile robot's locomotion, Legged wheeled robots.

Wheeled Robots Kinematics:
Kinematic models and constraints, Representing robot position, Forward kinematic models, Wheel kinematic constraints, Degree of freedom.

Sensors forAutonomous Wheeled Robots:
Various sensors for wheeled robots, Sensor classification, Ultrasonic sensor, Infrared sensor, Vision sensor, Inertial measurement unit (IMU).

Actuators forAutonomous Wheeled Robots:
Various actuators for wheeled robots, DC motor, Servo motor, Stepper motor, Motor controller.

Wheeled Robots Programming:
Robot programming language features, Computer control and robot software (monitor mode, run mode and editor mode), Arduino microcontroller programming, Raspberry Pi programming, Complete design of an autonomous wheeled robot.

Reference Books:

1. R. Siegwart, I.R. Nourbakhsh, D. Scaramuzza, Introduction to Autonomous Mobile Robots, MIT Press, 2011.

2. S.G. Tzafestas, Introduction to Mobile Robot Control, Elsevier Science, 2013.
3. G. Dudek, M. Jenkin, Computational Principles of Mobile Robotics, Cambridge University Press, 2010.
4. T. Bräunl, Embedded Robotics Mobile Robot Design and Applications with Embedded Systems, Springer Berlin Heidelberg, 2013.
5. U. Nehmzow, Mobile Robotics A Practical Introduction, Springer London, 2012.

MODELLING OF MICRO-WIND TURBINE BY 3D CAD DESIGN

Course code : ME28019
Credit : 2
L-T-P : 0-0-2
Prerequisite: Mathematics (MA11001), Fluid Mechanics (ME2021)

COURSE OBJECTIVE
Introduce computer-based solid, parametric, and assembly modeling as a tool for engineering design; enhance critical thinking and design skills. This course introduces the technology and economics of converting wind energy to electricity and other kinds of energy. Both utility scale horizontal axis wind turbines and small-scale horizontalare addressed, as well as the economical and environmental issues associated with wind energy.

COURSE OUTCOMES

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

CO1: Learn about the basic concepts of wind energy conversion system.
CO2: Understand the engineering design process and the implementation of different design phases.
CO3: Create a 3D solid model with high degree of confidence.
CO4: Develop the ability to extract 2D orthographic views from the 3D model for fabrication.
CO5: Learn the basics of assembly and associative constraints.
CO6: Understand the importance of standalone, grid-connected, and hybrid operation in renewable energy systems.

COURSE CONTENT

Introduction to Wind Energy, Wind Power, State of the art technology:
Introduction to renewable sources, Wind energy, Types of wind turbines, State of the art technology in wind energy.

Design and development of small wind turbines:
Small wind technology, blade element momentum theory, design of tail fin, Wind turbine tower structure design stiffness and strength consideration, Aerodynamics of wind turbine rotor blade design, angle of attack, profile.

3D modelling of wind turbine using CAD tools (SOLIDOWRKS):
Introduction to 3D modeling, Parametric modeling, feature-based modeling, Design Intent; Solid modeling commands: Sketching, Extrusion, Revolve, fillet, pattern.; Solid Modeling: reference geometry, Sweeps and Lofts;

Assembling of the 3D model of the Wind turbine:
Assembly modeling; Top-down and bottom-up, Mates in assembly, exploded view,

Creation of 2D drawings for production/manufacturing processes.
Extract 2D orthographic views from the 3D model for fabrication by specifying the proper dimensions, according to industry standards, for parts to be fabricated and to extract section and auxiliary views, Dimensioning standards and conventions. 3D assembly drawing of the wind turbine, exploded view of the tower, 3D drawings of all 3D printed parts.

Simulation of wind turbine using SOLIDWORKS using CAD tools (SOLIDOWRKS and ANSYS):
Engineering analysis with SolidWorks, Stress and deflection of the wind turbine tower, Simulation of wind turbine using SolidWorks

Reference Books:

1. Wind Energy Explained: Theory, Design, and Application, By James F. Manwell, Jon G. McGowan, and Anthony L. Rogers, Wiley (2010).
2. Wind Power Plants: Fundamentals, Design, Construction and Operation, Gasch, Robert, Twele, Jochen (Eds.) Springer-Verlag Berlin Heidelberg; 2nd edition (2012).
3. Open source SOLIDWORKS Tutorial : https://my.solidworks.com/training/video/40d7a678-3293-4d7b-ba18-2113ff114b2a

LABORATORY AND SESSIONAL SUBJECTS

ELECTRICAL SYSTEM MODELING USING MATLAB

Course Code : EE28002
Credit :1
L-T-P :0-0-2
Prerequisite(s):Nil

COURSE OBJECTIVE
This course is proposed as a Sessional to UG students with the aim of imparting basic understanding of Modeling and Simulation so that the students will find it easy to use this knowledge in profession for applying to various engineering systems and design.

COURSE OUTCOMES

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

CO1: Know the characteristic of half wave and full wave uncontrolled rectifier .
CO2: Understand the characteristic of half wave and full wave controlled rectifier .
CO3: Apply modeling techniques to Simulate the R-L and R-C circuit.
CO4: Analyse the methods of plotting of single phase and 3 phase sine wave.
CO5: Evaluate the simulated design of the PID controller.
CO6: Design a circuit to Plot I-V & P-V Characteristic of a PV cell.

COURSE CONTENT
Topics:
- Simulation of single phase half wave uncontrolled rectifier with R & R-L load.
- Simulation of single phase full wave uncontrolled rectifier with R & R-L load.
- Simulation of Single Phase Half Wave Controlled Rectifier with R &R-L Load
- Simulation of Single Phase Full Wave Controlled Rectifier with R &R-L Load
- DC transient analysis of R-L and R-C series circuit in Matlab-Simulink.
- Simulation of PID Controller
- Matlab Programming plot a 1-ph and 3-ph sine wave in MATLAB.
- Modelling and simulation of DC shunt motor.
- I-V Characteristic of PV system
- P-V Characteristic of PV system.

Textbook(s):
1. Getting started with MATLAB by Rudra Pratap.

Reference Book(s):
1. Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers by Rudra Pratap.
2. MATLAB: An Introduction with Applications by Amos Gilat.

ELECTRIC CIRCUIT LABORATORY

Course Code :EE 29001
Credit :1
L-T- P :0-0-2
Prerequisite(s): Nil

COURSE OBJECTIVE

The main objective of the Electric Circuit Laboratory is to design and verify different electrical circuits. It helps in measurement of current flowing through and voltage across different elements. It allows the students to verify different characteristics of electrical circuits. It enhances the ability of students to verify Sperposition theorem , measure neutral current and power of 3-phase circuit, determine parameter of RL RLC circuit, verification of Thevenin's theorem, Maximum power transfer theorem, Two port network, series and parallel resonance circuit and filter design.

COURSE OUTCOMES

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

CO 1: Remember the ways to measure neutral current in 3-phase circuit.
CO 2: Understand the superposition theorem and its application in different circuit.
CO 3: Apply Maximum power transfer and Thevenin's theorem to different circuit
CO 4: Analyse RL, RLC circuit and two-port network to find network parameters
CO 5: Assess the resonance condition and bandwidth in series and parallel circuit
CO 6: Design a filter circuit through passive parameter .

COURSE CONTENT

Topics:

- Verification of superposition theorem
- Measure the neutral current in a 3-phase star connected circuit
- Single phase power measurement by three ammeter and three volt meter method.
- Measure the power of 3-phase star connected circuit using two wattmeter method.
- Determine the parameter of R-L, RLC circuit
- Verification of Maximum power transfer & Thevenin's theorem.
- Verification of Two-port network & RLC resonance circuit.
- Design a passive filter for a specified cutoff frequency.

Textbook(s):

1. Circuit Theory, Analysis and Synthesis, by A. Chakrabarti, Dhanpat Rai Publishing Company (P) Limited, 5th Edition, 2008.

Reference Book(s):

1. Network Analysis 3rd Edition, by M.E. Van Valkenburg, Pearson Education, 2006.
2. Basic Circuit Analysis (Second Edition) John O'Malley, Schaum's Outlines, Tata McGraw-Hill, 2010 (Reprint)

ELECTRICAL MACHINES LABORATORY

Course Code :EE 29002
Credit :1
L-T-P :0-0-2
Prerequisite(s) : Electric circuit Laboratory

COURSE OBJECTIVE

The main objective of the Electrical machines laboratory is to provide the practical exposure to the student regarding operation of various electrical machines like DC generators, DC Motors, Alternators, Synchronous motors, Induction Motors, Special Motors and Transformers. Students are allowed to conduct various experiments for the validation of performance characteristics of all the machines. From this laboratory courses student will gain the skill to select correct machine for a specific application.

COURSE OUTCOMES

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

CO 1: Memorize the working principle and applications of different electrical machines.
CO 2: Understand the challenges in industrial applications of electric motors.
CO 3: Utilize different electrical machines.
CO 4: Analyse different electrical machine according to the requirement in the industrial applications.
CO 5: Assess the safety precautions to be taken while using electrical equipment.
CO 6: Design the equivalent circuit of the transformer and construct the circle diagram of an induction motor.

COURSE CONTENT

Topics:

- No Load and Load Characteristics of a (i) D.C Shunt Generator and (ii) Separately Excited Generator.
- Design of the equivalent circuit by using the open circuit and short circuit test on a single phase Transformer.
- Determination of the voltage regulation of a three phase alternator using the Open circuit and short circuit test.
- Design of the circle diagram using the No load and Block rotor test on three phase induction motor.
- Speed control of D C Motor by using the different Methods.
- Connection of three single Phase transformers in star-star, star-delta, delta-star, delta-delta and open delta.
- Testing of a D C motor to find the different parameters and to draw the performance characteristics.
- Draw the V curve and inverted V curve of a three phase synchronous motor.
- Draw the performance characteristics of a single phase induction motor by using the different tests.

Textbook(s)

1. Electrical Machinery, P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.
2. Electrical Machines, by P. K. Mukherjee and S. Chakravorti, Dhanpat rai Publication, 18th reprint 2013

Reference Book(s)

1. Electrical Machines, Ashfaq Hussain, Dhanpat Rai, Delhi, 2nd Edition, 2008.
2. Electrical Technology, Volume -II. B. L. Theraja, S .Chand Publications. 2010.
3. Electric Machines, C. I. Hubert, Pearson Education, 2003.
4. Electric Machines ,by Kothari. D P and I J Nagrath, 3rd Edn, Tata McGraw-Hill, New Delhi. 2004.

MEASUREMENT AND SENSOR LABORATORY

Course Code :EE 29003
Credit :1
L-T-P :0-0-2
Prerequisite(s): Nil

COURSE OBJECTIVE

The main objective of the Measurement and sensor laboratory is to provide the practical exposure to the student regarding operation of various electrical measuring instruments like ammeters, voltmeters, wattmeter, energy meters, transducers, bridge circuits, CROs, etc. Students are allowed to conduct various experiments for the understanding and knowing about measuring different electrical parameters. From this laboratory courses student will gain the skill to select correct measuring instrument for a specific application.

COURSE OUTCOMES

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

CO 1: Remember the utilities of various Electrical Measuring instruments.
CO 2: Comprehend working principle, applications and characteristics of different electrical and electronic instruments for measurement.
CO 3: Apply the measuring techniques in displacement, temperature transducers.
CO 4: Analyse errors of electrical Measurements System.
CO 5: Evaluate the choice of appropriate instruments for various electrical measurands.
CO 6: Elaborate about the safety precautions while using electrical equipment.

COURSE CONTENT

Topics:

- Measurement of Resistance by Wheatstone Bridge.
- Measurement of Capacitance by Schering Bridge.
- Measurement of Self-Inductance by Anderson's Bridge
- Active and reactive power measurement using two and single wattmeter method respectively.
- To study and measure displacement using LVDT.

- To be familiarized with phantom loading used for calibration of a wattmeter.
- Measurement of phase angle and power factor for different category of loads using CRO.

Textbook(s):

1. Electronic Instrumentation and Measurement Techniques, By William David Cooper, PHI, 2010.
2. Electrical Measurements and Measuring Instruments, By Edward William Golding, F. C. Widdis, 5th Edition, Pitman, reprint 2012.

Reference Book(s):

1. Electronics Instruments and Measurements – David A. Bell – PHI, 2012.
2. A Course in Electrical and Electronics Measurement and Instrumentation by A. K. Sawhney, 10th edition, Dhanpat Rai, 1994.
3. Electrical Measurement and Measuring Instruments by Arthur Harris, Intelliz press, ISBN: 978-1-6825/-382-8/2018.

CONTROL SYSTEM LABORATORY

Course Code :EE29004
Credit :1
L-T-P :0-0-2
Prerequisite(s) : Electric circuit laboratory

COURSE OBJECTIVE

The main objective of the Control Systems laboratory is primarily used for teaching Control system basics and Design of controllers for different systems. The Control Systems Laboratory is equipped with different modules for DC position control, AC position Control, DC Motor Speed Control, Frequency Response Analysis, Time Response Analysis, Tunning of PID controller, Temperature Controller, Pressure Controller, Flow Rate Controller etc. From this laboratory courses student will gain the skill to evaluate the performance of PID controller with respect to changes in control parameters, study the effect of controllers on different electrical and mechnical systems, analyse the stability of designed controller & develop computer software programs for analysis of controllers.

COURSE OUTCOMES

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

CO 1: Remembers the modern software tools for feedback controllers.
CO 2: Understand the iterative nature of a successful controller design.
CO 3: Apply the theoretical concepts and computational tools while designing controllers.
CO 4: Analuse the characteristics obtained by by varying the input parameters in a SIMULINK environment
CO 5: Evaluate the electrical and mechanical parameters of a given system and to find the transfer function.
CO 6: Create new programs in MATLAB environment.

COURSE CONTENT

Topics:

- Time response analysis of linear system
- Tuning of PID controller or a First Order Process with Time Delay (FOPTD) Simulated System by Process Reaction Curve Method.
- Lead Compensator design
- Stability analysis using bode plot
- Stability analysis using root locus plot
- Design of Speed Controller for Armature controlled DC motor

Textbook(s):

1. Modern Control Engineering- By D. Roy Choudhury, PHI Publication, 5th Edition, 2009.
2. Control Systems- By Smarajit Ghosh, Pearson, Second Impression, 2013.

Reference Book(s):

1. Automatic Control System- By Hasan Saeed, Sixth Revised Edition, 2008
2. Modern Control Engineering- By K. Ogata, PHI publication, 5th edition 2010
3. Automatic Control Engineering- By B. C. Kuo , Prentice Hall, 7th edition 2009
4. Control System Engineering- By I. J. Nagrath and M. Gopal, New Age International Publication
5. Automatic control systems- By Prof. B.S. Manke & S.N.Verma ,Khanna publication, 2012.

ANALOG AND DIGITAL CIRCUIT DESIGN LABORATORY

Course Code :EE 29005
Credit :1
L-T-P :0-0-2
Prerequisite(s): Nil

COURSE OBJECTIVE

The main objective of the Analog and Digital electronics Laboratory is to learn and understand the basic concepts to design Schmitt trigger circuit, Active high pass & low pass filter with the help of variac, oscilloscope, function generator, DSO, multimeter etc. understand the concepts of digital electronics. Students will be able to design basic logic circuits using different gates (AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR); combinational circuits like adder, subtractor, decoder, multiplexer, demultiplexer; sequential circuits like synchronous counters, asynchronous counters, shift registers. From this laboratory course students will be able to analyze & design digital circuits for a specific application.

COURSE OUTCOMES

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

CO 1: Explain the digital circuits using Boolean algebra and K-maps.
CO 2: Execute different combinational circuits and Differentiating multiplexer and demultiplexer using logic gates.
CO3: Analyse line regulation and load regulation in a voltage regulator circuit using zener diode.
CO 4: Assess the conditions of oscillations in a RC phase shift oscillator and to design Schmitt trigger circuit.
CO 5: Checking the operation of synchronous & asynchronous counters using different flip-flops.
CO 6: Design different types of shift registers.

COURSE CONTENT
Topics:

- Determination of line & load regulation using Zener diode.
- Study of an RC phase shift oscillator and find its frequency of oscillation.
- Design of Schmitt trigger circuit, Active Low Pass & High Pass Filter using op-amp.
- Verification & implementation of different gates using universal gates.
- Realization of adder & subtractor circuits.
- Implementation of MUX & DEMUX using logic gates.
- Design of synchronous & asynchronous counters using flip-flops.
- Design of shift registers.

Textbook(s)

1. Fundamentals of Digital Circuits by A.Anand Kumar - PHI, 4th Edition, 2017.
2. Fundamentals of Electric Circuits 4th Edition, by Charles K. Alexander, Matthew N.O. Sadiku, Mcgraw-Hill, 2009.
3. Digital Logic and Computer Design by M. Morris Mano - PHI, 2011.

Reference Book(s)

1. Digital Fundamentals by T.L. Floyd & Jain -Pearson Education, 10th Edition, 2011.
2. Digital Principles and Applications by Malvino & Leach -TMH, 7th Edition, 2011.

INDUSTRIAL AUTOMATION USING PLC

Course Code :EE38001
Credit : 1
L-T-P : 0-0-2
Prerequisite(s):Nil

COURSE OBJECTIVE

PLC Laboratory is to aware the students about the Industrial Automation Techniques. The students will be familiar with different switches, sensors, actuators and measuring instruments which are most frequently used in process control industries. The students will be enabling with the upgraded relevant advanced software based controller utilized in modern industry. PLC laboratory gives the effort for making them efficient to design and construct the hardware part related to desired process control. Students can be able to know the technique and logical programme behind the Industrial process Control.

COURSE OUTCOMES

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

CO 1: Spell typical components of a Programmable Logic Controller.
CO 2: Explain the concept of electrical ladder logic and its relationship to programmed PLC instruction.
CO 3: Apply the concept of basic digital electronics and data manipulation.
CO 4: Analyse the timers and counters using intermediate programming functions.
CO 5: Evaluate the PLC circuits for entry-level PLC applications.
CO 6: Design and program automated industrial production line.

COURSE CONTENT

Topics:

- Introduction to PLC programmable logic controller
- Details of programming language as LAD
- LADDER Programming using NO ,NC
- Programming on SPST and SPDT Logic
- Introduction to TIMER and COMPARATOR BLOCK
- Introduction to COUNTER BLOCK

Textbook(s)

1. Programmable logic Controller by Vijay R. Jadhav KHANNA PUBLISHERS Second Edition 2012
2. Industrial Automation Using PLC,SCADA and DCS by R.G Jamkar Laxmi Publications Private Limited; First edition 2017

Reference Book(s)

1. PLC and SCADA by Prof Rajesh Mehra and Er. Vikrant Vij Published by University Science Press, 1st edition
2. Programmable logic Controller: Programming methods and Applications By John R Hackworth and Frederick D. Hackworth Jr. PEARSONEdition: 1st Edition, 2006

DATA STRUCTURE AND PROGRAMMING PARADIGM

Course code : EE38003
Credit : 1
L-T-P : 0-0-2
Prerequisite(s): Programming Laboratory

COURSE OBJECTIVE

The data structure lab is to develop skills for the design, analysis and implementation of operations like search, insertion, deletion, traversal, and other specified problem definition on various linear and nonlinear data structures. It improves the ability to define, apply the appropriate data structure for the real world problem and various techniques for representation of the data in the real world. In addition, it helps them to gain knowledge of data structure applications related to industry.

COURSE OUTCOMES

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

CO1: understand the importance of structure, unions and abstract data type, and their basic usability in different applications through C programming language
CO2: analyze, differentiate and implement different algorithms based on their time and space complexity
CO3: understand and implement the linked implementation, and its uses both in linear and non-linear data structure
CO4: understand and implement various data structures such as stacks, queues, trees, graphs, etc. to solve various computing problems
CO5: understand and implement various kinds of searching and sorting techniques, and know when to choose which technique
CO6: decide and implement the suitable data structure and algorithm to solve a real world problem

COURSE CONTENT

Topics:

- Array, pointer with Dynamic Memory Allocation
- Structure, Single Linked List
- Doubly Linked List, Circular Linked List
- Polynomial Representation, Addition & Multiplication, Sparse Matrix Représentation, Addition &Multiplication
- Stack
- More on Stack & Applications of Stack
- Queue
- Tree
- Graph
- Searching & Sorting

Text book's

1. Data Structures:A pseudocode Approach with C, 2nd Edition, Richard F.Gilberg, Behrouz A. Forouzan, Cengage

Reference Book's

1. Data Structures and Algorithm Analysis in C, Mark Allen Weiss, Pearson Education 2nd Edition.

2. Data Structures Using C,2nd Edition, Reema Thereja, Oxford University Press.
3. Data Structures, Schaum's OutLines, Seymour Lipschutz, TATA McGraw Hill.

SYSTEM DESIGN USING IoT

Course Code :EE38005
Credit :1
L-T-P : 0-0-2
Prerequisite(s) :Nil

COURSE OBJECTIVE

This Internet of Things (IoT)-lab is the network of physical objects or 'things' embedded with electronics, software, sensors, and connectivity to enable objects to exchange data. IoT allows direct integration between the physical world and computer-based systems, helping to connect people, processes and devices.This course focused on learning methodical and logical idealization of various protocols which is highly essential for solving a network. The course intends to make the students familiar with various parts of sensors and cloud storage and analytic of storage data.

COURSE OUTCOMES

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

CO 1: Realize the importance of sensors and its parameters.
CO 2: Adopt team working skills as a member of group with common objective.
CO 3: Identify the different protocols and its applications.
CO 4: Identify the different types of cloud storage of things data.
CO 5: Present and Analyze the experimental results through IoT analytic.
CO 6: Design Internet of Things architecture.

COURSE CONTENT

Topics:

- Familiarisation of ESP32/Raspberry Pi and perform necessary software installation.
- To interface analog voltage input to ESP32/Raspberry Pi.
- To interface DHT11/DHT22, pressure, voltage and current sensor date input to ESP32/Raspberry Pi.
- To interface motor using relay with ESP32/Raspberry Pi.
- To interface OLED with ESP32/Raspberry Pi and write a program to print temperature and humidity.
- Write a program on ESP32/Raspberry Pi to retrieve tempurature and humidity data from DHT11/DHT22 to Thingspeak Cloud.
- Write a program to generate Thingspeak SNS alert service.
- Write a program on ESP32/Raspberry Pi to publish DHT11 data through MQTT protocol.
- To install MySQL data on ESP32/Raspberry Pi and perform SQL queries.
- Write a program to create TCP server on ESP32/Raspberry Pi and transfer data from TCP client.

Text Books:

1. Designing the Internet of Things, Adrian McEwen, Hakim Cassimally, Wiley publication, 1st Edition, November 2013.
2. The Internet of Things in the Power Sector Opportunities in Asia and the Pacific, Ramamurthy, A. and Jain, P, 2017.

Reference Books:

1. The Internet of Things: A Survey, Journal on Networks, Luigi Atzori, Antonio Lera, Giacomo Morabito, Elsevier Publications, October, 2010.
2. The Internet of Things in the Cloud:A Middleware Perspective, Honbo Zhou, CRC Press-2012.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Springer, 2011.

POWER ELECTRONICS LABORATORY

Course Code :EE 39001
Credit :1
L-T-P :0-0-2
Prerequisite(s) : Electric circuit laboratory

COURSE OBJECTIVE

Utilities of Power Electronic Converters are introduced. The AC-DC converters are examined in details with R and RL loads. Analysis of DC-DC converters are done so that experimental verification can be facilitated. The principle of chopper is applied in the Fly-Back Converters for SMPS. The waveforms and the output voltage equation of SMPS are experimentally verified.

COURSE OUTCOMES

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

CO 1: Choose an appropriate converter for variety of needs..
CO 2: Comprehend the principles of operation of various converters.
CO 3: Apply AC-DC converters for rectification..
CO 4: Analyze the parameters and the waveforms of the output of the converters.
CO 5: Assess the efficacy of a converter.
CO 6: Discuss about the merits and demerits of the converters.

COURSE CONTENT
Topics:

- Study of output voltage waveforms and parameters of three phase uncontrolled rectifier.
- Study of single phase fully controlled AC-DC converter with R and RL laod.
- Verify the performance of DC-DC Buck-Boost converters.
- Verify the performance of Fly-Back Converters for SMPS.

Textbook(s):

1. Power Electronics by M. H. Rashid, Pearson Education, 3rd Edition, 2009.
2. Elements of Power Electronics, by Philip T. Krein, Oxford University Press, 25 Sept 1997.
3. Power Electronics, by P S Bhimbra, Khanna Publishers, 5th Edition, 2011.

Reference Book(s):

1. Power Electronics, Converters, Applications and Design, by N. Mohan, Undeland and Robbins, John Wiley and Sons , 3rd Edition ,2009.
2. Modern Power Electronics by P. C Sen, S Chand Publisher- 2013.
3. Power Electronics, by K.R.Varmah and Chikku Abraham, Cengage Publications- 2014.
4. Power Electronics, by M. D. Singh and K.B. Khanchandani, Tata McGraw - Hill publishers, 2nd edition, 2008.

POWER SYSTEMS LABORATORY

Course Code :EE39002
Credit :1
L-T-P : 0-0-2
Prerequisite(s) : Electric circuit laboratory

COURSE OBJECTIVE

The main objective of the Power Systems laboratory is primarily used for teaching power system basic and advance modelling of transformers, transmission lines, fault analysis, protective relays characteristics and its schematics. The Power Systems Laboratory is equipped with different Protection Scheme of Alternator, over Current Relay, over voltage relay, Percentage biased Differential Relay, Microcontroller based negative sequence relay, Transmission line simulator kit. From this laboratory courses student will gain the skill to analyse the performance of power system networks, study different power system protective relays and develop computer software programs for analysis of power systems.

COURSE OUTCOMES

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

CO 1: Spell the characteristics of a transmission line.
CO 2: Comprehend the uses of different relays in power systems.
CO 3: Apply suitable techniques to locate the fault of an underground cable.
CO 4: Analyze the results of short circuit analysis for symmetrical and unsymmetrical faults.
CO 5: Assess the characteristics of a solar PV module.
CO 6: Discuss the procedural steps needed to implement for interpreting the results of the power system software.

COURSE CONTENT

Topics:

- Determine the ABCD parameters of a transmission lines.
- Study of electromechanical type over current relay & over voltage relay
- Fault location of Under Ground Cable by Varley Loop Test
- Develop software programs for analysis of power systems

Textbook(s):

1. Modern Power System Analysis, I. J. Nagrath, D. P. Kothari, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 4th Edition 2013.
2. Electrical Power System, C.L. Wadhwa, New Age International (P) Limited, Publishers, 2010.

Reference Book(s):

1. Power system analysis by Hadi Sadat Tata McGraw Hill.
2. Power System Protection and Switchgear by B Rabindranath and M Chander, Wiley Eastern (1977)
3. Fundamentals of Power System Protection", Y. G. Paithankar, S. R. Bhide, 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2011
4. A Text Book on Power System Engineering, A. Chakrabarti, M.L. Soni, P.V. Gupta and U.S. Bhatnagar, Dhanpat Rai and Co., Reprint 2012

ELECTRIC DRIVES LABORATORY

Course Code :EE39004
Credit :1
L-T-P : 0-0-2
Prerequisite(s): Power Electronics Laboratory

COURSE OBJECTIVE

This course will impart knowledge on performance of the fundamental control practices associated with AC and DC machines (starting, reversing, braking, plugging, etc.) using power electronics. Students will perform experiments related to topics studied in electric drives like various DC and AC motor drives and their control. Students will be encouraged to focus on industry oriented learning. They will be engaged to evaluate the performance of electrical drives with the use of computer-based analysis tools.

COURSE OUTCOMES

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

CO 1: Learn the importance of safety practices to be adopted in the laboratory.
CO 2: Understand about the triggering circuit, control circuit and power circuit of a power electronic device.
CO 3: Implement the industrial and domestic applications of various DC and AC motor drives.
CO 4 Analyse the schemes of speed control of various DC and AC drives.
CO 5: Evaluate the electrical and mechanical parameters of a given motor and to find its transfer function.
CO6: Design different electric drive circuits in Simulink environment and compare the result with experimentations.

COURSE CONTENT

Topics:

- Determination of parameters of separately excited DC motor and to draw the block diagram to find the transfer function.
- Speed control of separately excited DC motor by armature voltage control method using single phase fully controlled AC to DC converter with and without load.
- Speed control of 3 phase squirrel cage induction motor using V/F control method.
- Speed control of single phase induction motor by stator voltage control using single phase AC to AC converter.
- Speed control of PMDC Motor using four quadrants DC chopper.

Textbook(s):

1. G.K. Dubey, Fundamentals of Electric Drives, Second Edition, Narosa Publishers, 2007.
2. S. K. Pillai: A First Course On Electrical Drives, New Age International Publishers, 2nd Edition, 2007.

Reference Book(s):

1. Bimal K. Bose, Power Electronics and Motor Drives: Advances and Trends, Academic Press, Har/Cdr edition (13 September 2006).
2. N. K. De, P. K. Sen: Electric Drives, PHI Learning Pvt. Ltd., 7th Edition, 2004.
3. Modern Power Electronics and AC Drives by Bimal. K. Bose, PHI Publisher, 1st Edition, 2013.
4. S.A. Nasar, Boldea , Electrical Drives, CRC Press, Second Edition, 2006
5. M. A. El-Sharkawi , Fundamentals of Electrical Drives , Thomson Learning, 1st Edition, 2000.
6. R. Krishnan, Electrical Motor Drives, PHI, 2003

MICROPROCESSOR LABORATORY

Course Code :EE 39006
Credit :1
L-T-P :0-0-2
Prerequisite(s) : Analog and Digital Circuit Design Laboratory

COURSE OBJECTIVE

This laboratory focuses on the assembly language programming on 8085, 8086 and 8051 processors. It covers the basic programming such as addition, subtraction, multiplication and division programs on microprocessor and microcontroller kits. The course also covers the complex programming based on arrays. Along with hands-on practice, the course also provides the different simulating platforms for program verification to the students. Further, interfacing programs on 8085 and 8051 processors are provided. Finally, the laboratory offers the basic learning on NodeMCU and Arduino embedded systems to the students.

COURSE OUTCOMES

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

CO 1: Remember the concept of microprocessors, microcontrollers and interfacing.
CO 2:Understand the mnemonics in microprocessor 8085, 8086 and microcontroller 8051.
CO 3: Apply the concept of the program logic to different applications.
CO 4: Analyse electrical projects through programming in microprocessor and microcontroller
CO 5: Evaluate the different microprocessor and microcontroller programing
CO 6: Create own programs for different problems.

COURSE CONTENT

Topics:

- Basic Programming of 8085 microprocessor.
- Array Programming of 8085 microprocessor.
- Basic Programming of 8086 microprocessor.
- Array Programming of 8086 microprocessor.
- Basic Programming of 8051 microcontroller.
- Array Programming of 8051 microcontroller.
- Interfacing programming using 8085 microprocessor and 8051 microcontroller.
- Basic Programming on NodeMCU and Arduino Board
- PWM signals generation using Arduino Board

Textbook(s):

1. Microprocessor architecture, programming and application with the 8085 by R. S. Goankar, Penram International Publications, 6th edition
2. Microprocessors and Interfacing, Programming and Hardware by D. V. Hall, TMH, 3rd edition, 2012.
3. Microcontroller theory and applications by Deshmukh, TMH, 2005
4. Arduinouno (Atmega328) on line manual.

Reference Book(s):

1. Introduction to Microprocessors, by A. P. Mathur, eTMH, 3rd edition, 2011.
2. Microprocessor and microcomputer based system design, by Md. Rafiquzzaman, 2nd edition
3. Advanced microprocessors and microcontrollers, by Prof. S. K. V. Rama, Lashmi Publication, 1st edition
4. 8051 Microcontroller-Hardware, software and applications, by V. Udayashankara and Mallikarjunaswamy, TMH, 1st edition
5. The 8051 microcontroller and embedded systems, by M. A. Mazidi, Pearson Pub., 2nd edition, 2011.

PROGRAMMABLE LOGIC CONTROL LABORATORY

Course Code :EE 39007
Credit :1
L-T-P :0-0-2
Prerequisite(s):Nil

COURSE OBJECTIVE

PLC Laboratory is to aware the students about the Industrial Automation Techniques. The students will be familiar with different switches, sensors, actuators and measuring instruments which are most frequently used in process control industries. The students will be enabling with the upgraded relevant advanced software based controller utilized in modern industry. PLC laboratory gives the effort for making them efficient to design and construct the hardware part related to desired process control. Students can be able to know the technique and logical programme behind the Industrial process Control.

COURSE OUTCOMES

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

CO 1: Spell typical components of a Programmable Logic Controller.
CO 2: Explain the concept of electrical ladder logic and its relationship to programmed PLC instruction.
CO 3: Apply the concept of basic digital electronics and data manipulation.
CO 4: Analyse the timers and counters using intermediate programming functions.
CO 5: Evaluate the PLC circuits for entry-level PLC applications.
CO 6: Design and program automated industrial production line.

COURSE CONTENT

Topics:

- Introduction to PLC programmable logic controller
- Details of programming language as LAD
- LADDER Programming using NO ,NC
- Programming on SPST and SPDT Logic
- Introduction to TIMER and COMPARATOR BLOCK
- Introduction to COUNTER BLOCK

Textbook(s):

1. Programmable logic Controller by Vijay R. Jadhav KHANNA PUBLISHERS Second Edition 2012
2. Industrial Automation Using PLC,SCADA and DCS by R.G Jamkar Laxmi Publications Private Limited; First edition 2017

Reference Book(s):

1. PLC and SCADA by Prof Rajesh Mehra and Er. Vikrant Vij Published by University Science Press, 1st edition
2. Programmable logic Controller: Programming methods and Applications By John R Hackworth and Frederick D. Hackworth Jr. PEARSONEdition: 1st Edition, 2006

POWER SYSTEMS PROTECTION LABORATORY

Course Code :EE49001
Credit :1
L-T-P :0-0-2
Prerequisite(s) : Nil

COURSE OBJECTIVE

The main objective of the Power Systems protection laboratory is primarily used for teaching power system protection basic and advance modelling of transformers, transmission lines, fault analysis, protective relays characteristics and its schematics. The Power Systems protection Laboratory is equipped with different Protection Scheme of Alternator, over Current Relay, over voltage relay, Percentage biased Differential Relay, Microcontroller based negative sequence relay, Transmission line simulator kit etc.. From this laboratory courses student will gain the skill to analyse the performance of power system networks, study different power system protective relays & develop computer software programs for analysis of power systems.

COURSE OUTCOMES

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

CO 1: Spell the characteristics of a transmission line.
CO 2: Comprehend the uses of different relays in power systems.
CO 3: Apply suitable techniques to locate the fault of an underground cable.
CO 4: Analyze the results of short circuit analysis for symmetrical and unsymmetrical faults.
CO 5: Assess the characteristics of a solar PV module.
CO 6: Discuss the procedural steps needed to implement for interpreting the results of the power system software.

COURSE CONTENT

Topics:

- Determine the ABCD parameters of a transmission lines.
- Study of electromechanical type over current relay & over voltage relay
- Fault location of Under Ground Cable by Varley Loop Test
- Develop software programs for analysis of power systems

Textbook(s):

1. Modern Power System Analysis, I. J. Nagrath, D. P. Kothari, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 4th Edition 2013.
2. Electrical Power System, C.L. Wadhwa, New Age International (P) Limited, Publishers, 2010.

Reference Book(s):

1. Power system analysis by Hadi Sadat Tata McGraw Hill.
2. Fundamentals of Power System Protection", Y. G. Paithankar, S. R. Bhide, 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2011
3. A Text Book on Power System Engineering, A. Chakrabarti, M.L. Soni, P.V. Gupta and U.S. Bhatnagar, Dhanpat Rai and Co., Reprint 2012

SENSOR AND CONTROL LABORATORY

Course Code : EE49002
Credit :1
L-T-P :0-0-2
Prerequisite(s) :Nil

COURSE OBJECTIVE

The course of Sensor and Control Laboratory comprises of various key technologies used in sensing and control of electric vehicles, like speed, displacement, temperature, etc. It is a specialized practical oriented course which intends to develop and understand various principles of sensors and transducers and also the use in control application. The course focused on learning methodical and logical idealization of various schemes of EV which is highly essential. The course intends to develop the ability of problem solving by analyzing control strategies. This lab helps the students to understand the principle of control operation of various essential parameters.

COURSE OUTCOMES

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

CO 1: Measure the linear displacement using LVDT and temperature using RTD.
CO 2: Know and realize the impact of stress by measuring the same.
CO 3: Control the speed of PMDC Motor using encoder as feedback sensor.
CO 4: Identify and monitoring of position control of DC Motor using PID Control.
CO 5: Know controlling a stepper motor using microcontroller.
CO 6: Know and familiarize with the application of embedded MCUs.

COURSE CONTENT

Topics:

- To study and measure linear displacement using LVDT
- Measure temperature using RTD
- Strain measurement using Strain Gauge
- Speed Measurement using Encoder and control the speed of a PMDC Motor
- Position Control of DC Motor using PID control
- Control of Stepper Motor using Microcontroller
- Familiarization and application of embedded MCUs

Textbook(s):
1. Ian R Sinclair, Sensors and transducers, Third Edition, Newness Publishers, 2001.
2. Doebelin E O, Measurement Systems, Application and Design, McGraw Hill, Fifth Edition, 2004.

Reference Book(s):
1. Jack P Holman, Experimental Methods for Engineers, Seventh Edition, McGraw Hill, USA, 2001.

IOT LABORATORY

Course Code :EE 49003
Credit :1
L-T-P :0-0-2
Prerequisite(s):Nil

COURSE OBJECTIVE
This Internet of Things (IoT)-lab is the network of physical objects or 'things' embedded with electronics, software, sensors, and connectivity to enable objects to exchange data. IoT allows direct integration between the physical world and computer-based systems, helping to connect people, processes and devices.This course focused on learning methodical and logical idealization of various protocols which is highly essential for solving a network. The course intends to make the students familiar with various parts of sensors and cloud storage and analytic of storage data.

COURSE OUTCOMES
After successfully completing the course, the students will be able to

CO 1: Realize the importance of sensors and its parameters.
CO 2: Adopt team working skills as a member of group with common objective.
CO 3: Identify the different protocols and its applications.
CO 4: Identify the different types of cloud storage of things data.
CO 5: Present and Analyze the experimental results through IoT analytic.
CO 6: Design Internet of Things architecture.

COURSE CONTENT

Topics:

- Familiarisation of ESP32/Raspberry Pi and perform necessary software installation.
- To interface analog voltage input to ESP32/Raspberry Pi.
- To interface DHT11/DHT22, pressure, voltage and current sensor date input to ESP32/Raspberry Pi.
- To interface motor using relay with ESP32/Raspberry Pi.
- To interface OLED with ESP32/Raspberry Pi and write a program to print temperature and humidity.
- Write a program on ESP32/Raspberry Pi to retrieve tempurature and humidity data from DHT11/DHT22 to Thingspeak Cloud.
- Write a program to generate Thingspeak SNS alert service.
- Write a program on ESP32/Raspberry Pi to publish DHT11 data through MQTT protocol.
- To install MySQL data on ESP32/Raspberry Pi and perform SQL queries.
- Write a program to create TCP server on ESP32/Raspberry Pi and transfer data from TCP client.

Text Books:

1. Designing the Internet of Things, Adrian McEwen, Hakim Cassimally, Wiley publication, 1st Edition, November 2013.
2. The Internet of Things in the Power Sector Opportunities in Asia and the Pacific, Ramamurthy, A. and Jain, P, 2017.

Reference Books:

1. The Internet of Things: A Survey, Journal on Networks, Luigi Atzori, Antonio Lera, Giacomo Morabito, Elsevier Publications, October, 2010.
2. The Internet of Things in the Cloud:A Middleware Perspective, Honbo Zhou, CRC Press-2012.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Springer, 2011

ELECTRIC VEHICLES LABORATORY

Course Code :EE 49005
Credit :1
L-T-P :0-0-2
Prerequisite(s): Nil

COURSE OBJECTIVE

This course provides a comprehensive study of Electric Vehicles (EVs), focusing on their various components, configurations, and power train characteristics. Students will analyze battery charging and discharging profiles, investigate the requirements of battery electric vehicles for different drive cycles, and determine the performance characteristics of Permanent Magnet Synchronous Motor (PMSM) drive. Additionally, the course covers the examination of inductive wireless power for EV charging and the design characteristics of 2-wheelers, 3-wheelers, and 4-wheelers.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO 1: To be able understand and explore various configurations of Electric Vehicles.
CO 2: Basic Design and analysis of Power train configuration of the vehicle.
CO 3: To analyze the battery charging and discharging profile.
CO 4: To Realize and understand the solar powered electric vehicle.
CO 5: To Study the simulation of PMSM drive.
CO 6: To understand the concept of inductive power transfer for the charging of electric vehicles.

COURSE CONTENT

Topics:

- To Know the various components of the Electric Vehicle (EV) and Study the different types of EV configurations
- Analysis and design of EV power train Characteristics
- Study and Analysis of the battery charging and discharging profile.
- Investigation on various requirements of Battery electric vehicle for various drive cycle simulations
- Determination of performance characteristics of PMSM drive
- Examination and basic study of Inductive wireless power for EV charging
- Study and Analysis of design characteristics for 2W.
- Study and Analysis of design characteristics for 3W.
- Study and Analysis of design characteristics for 4W.

Textbook(s):

1. Husain, I. (2021). Electric and hybrid vehicles: design fundamentals. CRC press.
2. Zhang, Y., & Mi, C. (2018). Automotive power transmission systems. John Wiley & Sons.

Reference Book(s):

1. Larminie, J., & Lowry, J. (2012). Electric vehicle technology explained. John Wiley & Sons.
2. Rim, C. T., & Mi, C. (2017). Wireless power transfer for electric vehicles and mobile devices. John Wiley & Sons.

MINOR PROJECT

Course Code: EE 37002
Credit: 2
L-T-P :0-0-4
Prerequisite(s):[Electrical Circuits Analysis, Linear control system, Electrical Machine, Power Electronics , Power system operation control and protection]

COURSE OBJECTIVE

The minor project for Electrical engineering students is projected to acquire practical knowledge in Electrical engineering . The students are directed to do a project related to Electrical engineering . The objective of the minor project is to provide an opportunity for students to undertake short research training outside the classroom to solve real-world issues. That mainly involves the application of Electrical engineering as a part of its solution, through a short project.

COURSE OUTCOMES

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

CO 1: Recall various technologies for project management.
CO 2: comprehend the practice of literature review for defining novel objectives.
CO 3: Apply the literature search techniques to identify and formulate the engineering problem.
CO 4: Analyse the environmental friendly solutions to engineering problems.
CO 5: Evaluate the prescribed standards/ safety norms through implementation.
CO 6: Create an independent study to identify the mathematical, engineering and managerial concepts to solve engineering problem

PROJECT-I

Course Code :EE 47001
Credit :5
L-T-P :0-0-10
Prerequisite(s) :[Electrical Circuits Analysis, Linear control system, Electrical Machine, Power Electronics, Power system operation control and protection]

COURSE OBJECTIVE

A fully engaged student shall be able to get exposure to undertake a short research project. Also, able to communicate and demonstrate the learning through structured thesis and oral presentation. Student's conduct research under the mentorship of the research supervisor/s in an organization on a topic mutually agreeable to them. The minor project coordinator oversees the process and mentor students whenever required.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO 1: Remembers the objectives of short research project.
CO 2: Understand the tenets of literature review
CO 3: Apply the engineering concepts and tools to arrive at design solution(s) for various problems
CO 4: Analyze the results of experiments conducted to arrive at valid conclusions.
CO 5: Evaluate an exhaustive list of available engineering tools used for solving problems.
CO 6: Create a structured thesis report and presentation to disseminate the learning.

PROJECT-II

Course Code :EE 47002
Credit :9
L-T-P :0-0-18
Prerequisite(s):[Electrical Circuits Analysis, Linear control system, Electrical Machine, Power Electronics , Power system operation control and protection]

COURSE OBJECTIVE

A fully engaged student shall be able to get exposure to undertake a short research project. Also, able to communicate and demonstrate the learning through structured thesis and oral presentation. Student's conduct research under the mentorship of the research supervisor/s in an organization on a topic mutually agreeable to them. The minor project coordinator oversees the process and mentor students whenever required.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO 1: Know the practices of budget analysis by the utilization of resources (finance, power, area, bandwidth, weight, size, any other).
CO 2: Understand the IEEE paper format for project report writing.
CO 3: Utilise the communication skill in reporting in IEEE paper format.
CO 4: Analyse the project reports from the point of view of adherence to professional ethics.
CO 5: Evaluate the individual contributions in a team work.
CO 6: Create an effective audio visual presentation to disseminate the inferences of a project work

INTERNSHIP

Course Code :EE 48001
Credit :2
Prerequisite(s):[Electrical Circuits Analysis, Linear control system, Electrical Machine, Power Electronics , Power system operation control and protection]

COURSE OBJECTIVE

A student will undergo the intership training to know the engineering application in real life. They come across the day to day application of his/her leering and how theory is different from the practical applications. Apart from this how the theoretical knowledge is important to understand each and every concepts or engineering in real application. If the industry permits then they will do some hands on in their interest to learn and feel the importance of engineering.

COURSE OUTCOMES

After successfully completing the course, the students will be able to
CO 1: Know the importance of safety practices to be adopted in the industry.
CO 2: Comprehend the industrial operations during the training.
CO 3: Utilize the industrial safety paramenter to ensure the smooth operation.
CO 4: Analyse the various operational procedures of an industry to identify imminent problems.
CO 5: Evaluate the policies of human resource managements adopted for optimizing benefits.
CO 6: Create a report reflecting all the findings during the tenures of the training.

ELECTRICAL SUBJECT OFFERS TO EEE BRANCH

NETWORK THEORY

Subject Code : EE20001
Credit :3
L-T-P : 3-0-0
Prerequisites : NIL

COURSE OBJECTIVE

To familiarize the concepts of network theorems, explain the concept of coupling in electric circuits and analyze the transient response of circuits with dc and ac inputs. Understand the concept of two port network, network topology and able to design filters.

COURSE OUTCOMES

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

CO1: Analyze different electrical circuits using network theorems.
CO2: Understand the magnetic couple circuits.
CO3: Apply the transients in DC/AC circuits.
CO4: Evaluate different parameters and functions of one port and two port networks
CO5: Know the concept of network topology
CO6: Design different passive filters

COURSE CONTENT

Network Theorems (for DC and AC Circuit)
Superposition theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem.

Magnetic coupled circuits
Self and Mutual Inductance, Dot convention for coupled circuits and coefficient of coupling.

Transient Response
Duality of circuits, Transient response for R-L, R-C and R-L-C circuits with both DC and AC excitation in time domain and Laplace transformation method.

Two-Port Networks
Network Configurations, Open Circuit, Short circuit, transmission and hybrid parameters, Condition of symmetry and reciprocity in two port network, Interconnection of two port networks (Series, Parallel &Cascade).Inter-relationship between parameters of two port network.

Network Function
Concept of complex frequency, driving point and transfer functions of one port and two port network.

Network Topology

Concepts of Network graph, Tree, Co-Tree, Links and Twigs, Formation of incidence matrix [A] and loop matrix [B] Formation of Fundamental Cut-Set Matrix [QF], Tie-Set Matrix. Relation between branch voltage and current, loop current network topology analysis.

Filter Design

Passive filters, Design of low pass, high pass, band pass, and band elimination filter.

Text Books:

1. Network Analysisby M. E. Van Valkenburg, Pearson Education, 3rd Edition, 2006.
2. Fundamentals of Electric Circuits, Charles K. Alexander, Matthew N.O. Sadiku, McGraw Hill Education; 5 edition (1 July 2013).

Reference Books:

1. Circuits and Networks Analysis and Synthesis (Second Edition) A Sudhakar ShyammohanS Palli, Tata McGraw-Hill, 2011.
2. Basic Circuit Analysis(Second Edition), John O'Malley, Schaum'sOutlines, Tata McGraw-Hill, 2010(Reprint).
3. Network Theory Analysis and Synthesis by Ravish R Singh, S. Chand Publication 1st edition 2023.
4. Engineering circuit analysis by William Hart Hayt Jack E Kemmerly Steven M Durbin
5. Networks and systems by D.Roy Choudhury, New Age Publication, 2nd Edition, June 2013.

ELECTRICAL MACHINES

Course Code : EE20010
Credit : 3
L-T-P : 3-0-0
Prerequisite : Network Theory

COURSE OBJECTIVE

To understand construction, working principles, testing and control of different electrical machines and their industrial and domestic applications.

COURSE OUTCOMES

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

CO1: Know the Construction, principle, efficiency and control of DC machines.
CO2: Understand the principle, Phasor diagram, losses, efficiency and regulation of transformers.
CO3: Analyze the three phase transformers through vector grouping.
CO4: Comprehend the operation and characteristics of Synchronous machines.
CO5: Investigate the operation and characteristics of Induction Motor.
CO6: Study the construction, principle of operation and application of single phase induction motors.

COURSE CONTENT

DC Machine:
Principle of Operation, emf equation of DC machine, Types and its characteristics. Concepts of back emf, armature and shaft torque, Speed control of DC shunt motor, efficiency, Necessity of starter, 3-point starter.

Transformer:
Single phase transformer, Construction , Principle of operation, emf equation, equivalent circuit and phasor diagram, open circuit and short circuit test, regulation, losses and efficiency. Three phase transformer with different vector group.

Three-phase Synchronous Machine:
Construction, Principle of operation, Pitch factor, distribution factor, winding Factor, winding diagram, EMF equation, armature reaction, equivalent circuit V-curves, method of starting and application, voltage regulation of three phase alternator (synchronous impedance and mmf method), power stage and efficiency.

Three-Phase Induction Motor:
Construction, squirrel cage and slip ring type, principle of operation, equivalent circuit and phasor diagram, Torque slip characteristics, starting torque and maximum torque, losses and efficiency, method of starting, speed control and application.

Single-phase Induction Motor
Construction, Staring method and application

Text Books

1. Electrical Machinery, P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.
2. Electrical Technology, Volume -II. B. L. Theraja, S .Chand Publications. 2010.
3. Electrical Machines, Ashfaq Hussain, Dhanpat Rai, Delhi, 2nd Edition, 2008.

Reference Books

1. Electric Machines, C. I. Hubert, , Pearson Education, 2003.
2. Electric Machines, by Kothari. D P and I J Nagrath, , 3rd Edn, Tata McGraw-Hill, New Delhi. 2004

POWER ELECTRONICS AND DRIVES

Course Code : EE30005
Credit : 3
L-T-P : 3-0-0
Prerequisite : Basic Electronics

COURSE OBJECTIVE

It aims to familiarize readers with switching devices, power converters, and their uses in different industrial drive systems.

COURSE OUTCOMES

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

CO1. :Understand the working principles of different power electronics devices.
CO2. :Analyze the concepts of single phase and three phase controlled rectifiers.
CO3. :Compare different topologies of DC to DC converters.
CO4. :Analyze the control of single phase and three phase Inverters
CO5. :Explainthe operation of power factor correction circuit and MLI
CO6. :Discuss the different industrial drive system.

COURSE CONTENT

Introduction to Power Electronics
Comparison of power devices operating in the switch mode to those operating in the active region.
Power Electronic Devices: Thyristor characteristics, Turn ON methods, Dynamic Characteristics of thyristors, Two Transistor Model of thyristor, Characteristics and construction of Power MOSFETS, Characteristics and construction of IGBT, SiC based power devices and applications.

AC to DC Converters
Single Phase Converters – Half Wave with R, RL, RLE load and effect of free Wheeling diode, Single Phase half and full controlled full Wave converters with R and RLE Load, 3 Phase half and fully controlled rectifiers, Power factor correction circuit.

DC to DC Converters
Step up and Step Down choppers, basic concepts of bi-directional converter. Forward and Flyback converters.

Inverters
Single Phase Half Bridge and Full Bridge Inverters, 3 Phase Inverters, 180° and 120^0 conduction, Voltage Control of inverters, Sinusoidal Pulse Width Modulation, Concept of multi level inverters.

Electric Drives
Different loading and operating points of speed torque characteristics, Selection of motors, Steady state stability, load Equalization, D.C. Motor Speed control, 4 quadrant choppers for control of DC motor, A.C. Drives: variable frequency drives.

Text Books:

1. Power Electronics, Devices, Circuits & Applications by M. H. Rashid, Pearson Education, 4^{th}Edition, 2017.
2. Power Electronics, by P S Bhimbra, Khanna Publishers, 7^{th}Edition, 2022.

3. Electrical Drives, by G K Dubey, NAROSA PUBLISHING HOUSE PVT LTD; Second Edition 2010.

Reference Books:

1. Power Electronics by M. D. Singh and K. B. Khanchandani, Tata McGraw-Hill publishers, Second Edition, 2007.
2. Power Electronics, Converters, Applications and Design N. Mohan, Undeland& Robbins, John Wiley and Sons, Third Edition, 2009.
3. Electric Motor Drives: Modeling, Analysis and Control, by R Krishnan, Pearson Education India, 1st Edition, 2015.

POWER SYSTEM OPERATION AND CONTROL

Course Code : EE30006
Credit : 3
L-T-P : 3-0-0
Prerequisite : Power Transmission and Distribution

COURSE OBJECTIVE

This subject provides the basic knowledge of analyzing a power system by different studies and suggests appropriate control action for smooth operation of a power system.

COURSE OUTCOMES

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

CO1: Compute the bus admittance matrices
CO2: Solve the load flow problems.
CO3: Find economic operation of power generation.
CO4: Classify different Power system faults.
CO5: Apply the stability concept to power system.
CO6: Analyze the concepts of generation control

COURSE CONTENT

Load Flow Studies:
Bus classification, Nodal Admittance matrix, Formulation of load flow problem, Approximate load flow solution by Gauss-Siedel Method with and without PV bus, acceleration of convergence, Newton-Raphson Method, Decoupled and Fast decoupled method.

Economic Operation of Power System:
Introduction, Optimal operation of generators, Distribution of load on various generating units, Penalty factor and Transmission loss as a function of plant generation.

Symmetrical and Unsymmetrical Fault Analysis:
Introduction, Transients in transmission line, Symmetrical components, Sequence analysis of power system, Symmetrical Fault analysis, Unsymmetrical Fault analysis.

Stability Analysis:
Introduction to stability, Dynamics of synchronous machines, Swing equation, Power angle curve and its equation, Steady state stability, Equal area criterion, Effect of clearing time on stability.

Automatic Generation and Voltage Control:
Introduction, Load frequency control, Turbine speed governing system, Modeling of speed governing system, Turbine model, Generator load model, Integrated representation of various models, Proportional plus integral control, Automatic voltage regulator .

Text Books:

1. Modern Power System Analysis, I. J. Nagrath, D. P. Kothari, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 3rd Edition, 2003.
2. Power System Analysis- By John. J. Grainger & W. D. Stevenson, Jr., TMH, 2003 Edition, (15th Reprint).

Reference Books:

1. Power System Analysis by T K Nagsarkar and M S Sukhija, 1st Edition, Eighth impression 2012, Oxford University Press.
2. Power System Analysis Operation and Control, Abhijit Chakrabarti, Sunita Halder, Third Edition, 2010, PHI Learning Private Limited.

POWER TRANSMISSION AND DISTRIBUTION

Course Code : EE30007
Credit : 3
L-T-P : 3-0-0
Prerequisite : Nil

COURSE OBJECTIVE

To give the students requisite basic knowledge about the key parameters of transmission and distribution of modern power supply system, analyze the performance of transmission lines, cables, distribution systems and mechanically design the components of a power system.

COURSE OUTCOMES

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

CO1: Describe different powers in power system.
CO2: Evaluate the line constants in different configuration of overhead lines.
CO3: Analyze the performance of transmission lines and underground cables.
CO4: Describe different phenomenon of transmission line.
CO5: Calculate the corona loss in transmission lines.
CO6: Determine the current and voltage distribution in different distribution modules.

COURSE CONTENT

Introduction:
Single and 3-phase transmission, Concept of complex power, Per Unit system, Power System layout. Supply System: Comparison of AC and DC transmission, Advantage of high voltage transmission, Advantages and Disadvantages of EHV (AC) and HVDC Transmission.

Line constants:
Resistance, Inductance of Single phase and three phase line with symmetrical and unsymmetrical spacing, GMD and GMR calculation, Transposition of power line, Capacitance of Single-phase line, Effect of earth on line capacitance, Charging current due to capacitance effect, Bundle conductors, Skin and Proximity effect.

Performance of Transmission line:
Analysis of short, medium and long Transmission Line, ABCD constants and its calculation for Short, Medium and Long Transmission Line, Ferranti effect, Surge Impedance and Surge Impedance Loading, Line compensators.

Corona: Critical disruptive voltage, Visual critical voltage, Corona Power losses, Factors affecting corona, Advantages and Disadvantages of Corona, Problem Discussion, Radio Interference between power and communication line.

Mechanical Design of overhead transmission lines
Types of conductors and insulator, Insulating materials, Potential distribution over a string of suspension Insulators, String Efficiency, Methods of equalization of the potentials, Sag and Stress calculation, Effect of ice and wind loading, Vibration dampers.

Underground Cable
Overhead line verses underground cables, Type and construction, Grading of cables, Insulation resistance of cable, Capacitance of three core cable, dielectric losses.

Distribution Systems
Classification of distribution system, Types of AC and DC distributors, Feeder, Voltage drop and load calculation for concentrated and distributed loads, Radial and ring main system, Economic choice of conductor, Kelvin's law.

Text Book

1. Electrical Power System, C.L. Wadhwa, New Age International (P) Limited, Publishers, 2009.
2. A Text Book on Power System Engineering, A. Chakrabarti, M.L. Soni, P.V. Gupta and U.S. Bhatnagar, Dhanpat Rai and Co., Reprint 2012.

Reference Books

1. A Course in Power System, J. B. Gupta, S K Kataria and Sons Publishers and Distributors, 2011.
2. Power System Analysis and Design- By B. R. Gupta, S. Chand Publications, 3rd Edition, Reprint, 2003.
3. Principle of Power System by V.K.Mehta, S.Chand Publishers, 2012.

SWITCH GEAR AND PROTECTING DEVICES

Course Code : EE30045
Credit :3
L-T-P :3-0-0
Prerequisite : Power Transmission and Distribution (EE30007)

COURSE OBJECTIVE

To know the construction and working principles of Circuit breakers and relays for protection of Generators, Transformers and feeder bus bar and understand the need of protection of electric equipment and their protection schemes.

COURSE OUTCOMES

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

CO1: Describe the need of protective devices in power system.
CO2: Distinguish in different types of Circuit Breakers.
CO3: Demonstrate the principle of operation of different relays.
CO4: Realize the different scheme of protection for alternator, transformer.
CO5: Understand the protection schemes of bus bar, feeder and transmission line.
CO6: Know the protection against surges.

COURSE CONTENT

Introduction
Protection system and its attributes, Philosophy of protection, requirement of ideal protective scheme, different terms in protective systems, Basic elements in protective scheme, Requirement of circuit breakers, characteristics of an electric arc, principle of AC and DC arc interruption, Recovery voltage, re-striking voltage, current chopping, resistance switching.

Circuit Breakers
Types of AC and DC circuit breakers, Arc extinction methods, oil circuit breaker, air blast circuit breaker, vacuum and SF_6 circuit breaker, Principle of miniature circuit breaker and moulded case circuit breaker, determination of circuit breaker capacity, circuit breaker ratings.

Protective Elements
Concept of Fuse, need, construction, principle, characteristics of H.R.C fuse.

Earthing
Introduction, Methods of neutral grounding (solid earthing, resistance earthing and Peterson coil earthing and its effects on fault conditions), Construction, Principle of operations of Electromagnetic type, induction type: over current, directional, distance relays, Differential relay.

Alternator Protection
Different types of faults, differential protection with biasing, restricted earth fault protection, negative sequence protection, automatic field suppression and neutral circuit breakers.

Transformer Protection
Buchholz relay, Biased differential protection, restricted earth fault protection, harmonic restraint, protection of combined alternator and transformer.

Bus Bar Protection
Differential scheme for both phase and line faults, introduction to digital protective relay and microprocessor based relays.

Feeder protection:
Time graded protection: radial, parallel and ring feeders; over current and earth fault protection, calculation of graded time setting, split core protection of feeders, carrier current protection.

Pilot Wire Protection
Circulating current differential protection (Merz-Price protection), Biased or percentage differential protection scheme, opposed (balanced) voltage differential protection system, Translay scheme; static relays.

Protection against Surges
Ground wire, Surge diverters: rod gap, horn gap lighting arresters, surge absorbers.

Text Books:

1. Fundamentals of Power System Protection, Y. G. Paithankar, S. R. Bhide, 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2011.
2. Power System Protection and Switchgear by B Rabindranath and M Chander , Wiley Eastern 2017, 2nd Edition.

Reference Books:

1. A Course in Power Systems, J. B. Gupta, S. K. Kataria and Sons Publishers and Distributors, 2009.
2. Principles of Relaying, Van Warrington, Y. G. Paithankar. TMH, 2009.
3. Power system Switchgear and Protection N.Veerappan and S R Krishnamurthy, S Chand Publication, Revised edition 2013.
4. Power system Protection and Switchgear, Badri Ram and D N Vishwakarma Tata McGraw Hill, 2nd reprint 2012
5. Electrical Power System, C.L. Wadhwa, New Age International (P) Limited, Publishers, 2009.

ELECTRICAL SUBJECT OFFERS TO MECHATRONICS BRANCH

DC AC AND SPECIAL ELECTRICAL MACHINES

Course Code : EE20009
Credit : 3
L-T-P : 3-0-0
Prerequisite :Nil

COURSE OBJECTIVE
To understand construction, working principles, testing and control of different electrical machines and their industrial and domestic applications.

COURSE OUTCOMES

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

CO1: Analyse the construction, basic principle ,types ,characteristics and applications of DC Machines.
CO2: Estimate the performance of Transformer.
CO3: Measure the emf generated,voltage regulation of an alternator
CO4: Outline the construction, principle of operation, types, speed control,starting and applications of three phase induction motor
CO5: Discuss the principle,types and application of single-phase Induction Motor.
CO6: Prioritize the performance of various special electrical machines with their Industrial applications.

COURSE CONTENT

DC Machines
DC Generator: rinciple of Operation,Different Parts,Emf equation,Different Types and their characteristics,Applications.
DC Motor: Principle,Concepts of back emf, Voltage and Power equation,Types and their characteristics,Armature and shaft torque, Different methods of Speed control of DC shunt motor, Applications.Necessity of starter, 3-point starter.
Losses and Efficiency of DC Machines

Transformer
Single phase transformer: Principle of operation, Types, Emf equation, Ideal and Practical Transformer,Transformer without and with load, Exact equivalent circuit and phasor diagram, Open circuit and Short crcuit Test, losses, Efficiency and Regulation, Applications.
Three phase transformer: Principle,Connections,Applications.

Three-phase Synchronous Machine: Alternator:Principles,Construction, Types,EMF equation of Alternator, Voltage regulation by Synchronous impedance method.
Synchronous Motor: Construction, Principle of operation, Applications.

Three-Phase Induction Motor: Principle of operation, Construction, Types,Torque Equation, Torque slip characteristics, starting torque and maximum torque, losses and efficiency, Different methods of speed control and method of starting, Applications.

Single-Phase Induction Motors and Special Motors
Single-Phase Induction Motors: Operating Principle,Types and Applications

Special Motors: Principle, operation and applications of Stepper motor, Shaded pole motor, Repulsion motor, Universal Motor, Reluctance Motor and Hysteresis Motor,

Text Books :

1. Electrical Machines, by P. K. Mukherjee and S. Chakravorti, Dhanpat rai Publication, 18th reprint 2013
2. Electrical Technology, Volume -II. B. L. Theraja, S .Chand Publications. 2010.

Reference Books :

1. Electrical Machines, Ashfaq Hussain, Dhanpat Rai, Delhi, 2nd Edition, 2008.
2. Electrical Machinery, P. S Bimbhra, 7th Edition, Khanna Publishers, 2008.
3. Electric Machines, C. I. Hubert, Pearson Education, 2003.
4. Electric Machines ,by Kothari. D P and I J Nagrath, 3rd Edn, Tata McGraw-Hill, New Delhi. 2004.

Kalinga Institute of Industrial Technology (KIIT)

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