Academic Rules and Regulations

2020 (Revision 1.0)

(Applicable for the students admitted during 2021 – 2022 and 2022 – 2023 only from the upcoming semester from the date of approval)

Undergraduate Programs

Choice Based Credit System (CBCS)

Nadimpalli Satyanarayana Raju Institute of Technology (NSRIT)
Sontyam, Andhra Pradesh 531173
(An Autonomous Institute, Affiliated to JNTU - Gurajada, Vizianagaram, AP)
Accredited by NAAC with 'A' Grade

Contents

Revision	1.0
Year of introduction	2023
Approved	VI Academic Council
Date of approval	

Sign and Seal of the Chairman (ACM)

The Vision

To promote societal empowerment and become an institution of excellence in the field of engineering education and research

The Mission

- To develop the students into outstanding professionals through innovative Teaching - Learning process
- To uphold research through long term Academia - Industry interaction
- To inculcate ethical standards and moral values

Academic Regulations for B. Tech. (Regular, Honors and Minor with Specialization) Program

(For all the candidates admitted from the Academic Year 2020 – 2021 onwards)

B. Tech. (Regular: 160 Credits | Lateral Entry: 121) | B. Tech. (Honors/Minor - Regular: 180 Credits | Lateral Entry: 141)

1. Preliminary Definitions and Nomenclature

In this regulation, unless the context otherwise requires:

a. **Degree**:The academic award conferred upon a student on successful completion of a programme designed to achieve the defined attributes. It is referred to as Under-Graduate (UG) Degree, that is B.Tech. degree

b. **Program**: The cohesive arrangement of courses, co-curricular and extracurricular activities to accomplish predetermined objectives leading to the awarding of a degree. It also means specialization or discipline of B.Tech.

c. **Course**:Theory, Practical or Theory-cum-Practical subject studied in a semester, like Engineering Mathematics, Physics, etc.

d. "**University**" means Jawaharla Nehru Technological University – Gurajada, Vizianagaram (JNTU – GV)

e. "**Institute**" means Nadimpalli Satyanarayana Raju Insitutute of Technology (NSRIT)

2. Eligibility for Admission

2.1. Admission to the B. Tech. (Regular, Honors and Minor with Specialization) shall be made subject to the eligibility and qualifications as prescribed by Andhra Pradesh State Council for Higher Education (APSCHE), Government of Andhra Pradesh. The total number of seats as per the approved annual intake is categorized into two categories viz. Convenor Quota (Cat. – A) and Management Quota (Cat. – B) with a ratio of 70:30 (G. O. No. 52). The admission under Cat. – A shall be done based on the merit score secured through state-wise common state commone entrance test i.e., AP Engineering Agricultural, Pharmacy Common Entrance Test (AP – EAPCET). The allotment pertaining to Cat. – B admission, the merit list based on 10+2 shall be taken as a benchmark in compliance with the norms issued by APSCHE

2.2. With regard to the students admitted through Lateral Entry Scheme, the students shall be admitted directly into semester III of the second year of B. Tech. programs. Under this scheme 10% seats of the sanctioned intake will be available in each program of study as supernumerary seats. Admissions to this 3 year B. Tech. lateral entry Programme will be through Andhra Pradesh Engineering Common Eligibility Test (ECET). The maximum period to complete B. Tech. under lateral entry scheme is 6 consecutive academic years from the date of joining

3. Duration and Medium of Instruction of the Program

The program duration for the award of degree in B. Tech. (Regular, Honors and Minor with specialization) will be of 4 academic years and each academic year will have two semesters. In case, if the student is unable to complete the program in the above said stipulated duration, he/she shall be permitted to complete the program of study within 8 consecutive academic years from the year of admission into B. Tech. program. For the students admitted through lateral entry scheme the duration of the program is 3 years and 6 years if the student fails to complete the program of study in the

stiupulated duration of 3 years. The student who fails to meet the requirements for the award of B. Tech. program during the above said extended duration shall forfeit the degree in B. Tech. program of study. The medium of instruction during the program of study is English.

Academic Calendar: As already mentioned, each academic year will have two semesters. Each academic year, an academic calendar will be issued by the Office of the Controller of Examinations (CoE) indicating the duration of instruction period, mid-term tests, semester-end examinations, practical examinations and eventually evaluation. Normally each semester will have fifteen weeks of instruction, one week of practical examinations and two to three weeks for descriptive examinations. In total, each semester will span for a maximum duration of 15 – 19 weeks.

4. Programs of Study

NSRIT offers seven programs of four year duration leading to Bachelor's Degree in Engineering and Technology (B. Tech.) as follows

i. Civil Engineering
ii. Computer Science and Engineering (CSE)
iii. Computer Science and Engineering (Artificial Intelligence and Machine Learning)
iv. Computer Science and Engineering (Data Science)
v. Electronics and Communication Engineering (ECE)
vi. Electrical and Electronics Engineering (EEE)
vii. Mechanical Engineering

5. Structure of Programs

5.1. Categorization of Courses

Each program shall have a common curriculum framework with well defined educational objectives, program outcomes and courses outcomes as per the philosophy of Outcome Based Education (OBE) in line with the Vision and Mission of the department offering the program and in turn in accordance with the Vision and Mission of the Institute. The program structure comprise of theoretical courses, practical courses, theory-cum-practical courses, MOOCs, summer and full semester internship, skill oriented courses, project work, seminars and other relevant courses meeting industry requirements. As the curriculum is framed with Choice Based Credit System (CBCS), the students have the flexibility in opting the courses of their choice under the category of electives. The courses of a particular program are categorized as follows

a. Foundation Courses
    i. Humanities and Social Science including Management (HS)
    ii. Basic Science (BS)
    iii. Engineering Science (ES)
b. Professional Core Courses relevant to the chosen program of study
c. Electives
    i. Professional Electives (PE) relevant to the chosen program of study
    ii. Open Electives (OE) relevant to other programs of study
d. Project, Seminar and Internship
e. Skill Oriented Courses (SOC) and Industry Connect Courses (ICC)
f. Mandatory Courses (MC) as prescribed by AICTE / UGC

5.2. **Nomenclature of Credit Distribution**

No.	Nature of Course	Credit	Nomenclarture
1	Theory Course / Elective Course (per Hour)	1.0	1 hour / credit
2	Practical / Drawing Course (per Hour)	0.5	0.5 hour / credit
3	Summer Internship (2nd Year | 3rd Year)	1.5 | 3.0	-
4	Full Semester Internship	6.0	-
5	Capstone Project	6.0	-
6	Moocs (Per Hour)	1.0	1 hour / credit
7	Skill Advanced / Soft Skill Course (per Hour)	2.0	0.5 hour / credit
8	Mandatory Course	-	-
9	Counseling/Mentoring	-	-
10	Sports/Hobby Clubs/Activities	-	-

5.3. **Structure of Curriculum**

Sem	No. of Theory Courses	No. of Lab Courses, Internship, Term Paper, Project	Total Credits
I	5 Theory	3 + Sports/Hobby Clubs/Activities	19.5
II	6 (5 Theory + 1 MC)	3 + Sports/Hobby Clubs/Activities	19.5
III	7 (5 Theory + 1 SOC + 1 MC)	3 + Sports/Hobby Clubs/Activities	21.5
IV	6 (5 Theory + 1 SOC)	3 + Sports/Hobby Clubs/Activities	21.5
V	7 (3 Theory + 1 PE + 1 OE + 1 SOC + 1 MC)	2 + Sports/Hobby Clubs/Activities + Summer Internship #1	21.5
VI	7 (3 Theory + 1 PE +1 OE + 1 SOC + 1 MC)	3 + Sports/Hobby Clubs/Activities	21.5
VII	7 (3 PE + 2 OE (MOOCs) + 1 Elective (HS) + 1 SOC)	Summer Internship #2	23
VIII	Project	Full Semester Internship	12
		Total Credits	**160**

5.4. **Credit Distribution for each Category**

No.	Category	Credits	
		Regular	Lateral
1	**Foundation Courses**	**55.5**	**13.5**
	Humanities and Social Science including Management (HS)	10.5	06.0
	Basic Science (BS)	21.0[1]	06.0[1]
	Engineering Science (ES)	24.0[1]	04.5[1]
2	**Professional Core Courses**	**51.0[1]**	**51.0[1]**
3	**Electives**	**27.0**	**27.0**
	Professional Electives	15.0	15.0
	Open Electives	12.0	12.0
4	**Project, Seminar and Internship**	**16.5**	**16.5**
5	**Skill Oriented Courses**	**10.0**	**10.0**
6	**Mandatory Courses**as prescribed by AICTE and UGC (Not to be accounted for CGPA)	-	-
7	**Audit Course**	-	-
Minimum credits to be earned for the award of the B. Tech. (Regular) degree		**160**	**121**

[1]The total number of credits may have marginal variation from one program to other program based on the requirement to accomadate few eseential courses related to the program of study

5.5. Assessment Pattern for the Courses

With the true spirit of implementing Outcome Based Education (OBE), each course is designed with customized assessment pattern addressing the various cognitive levels of Revised Bloom's Taxonomy (RBT) with appropriate proportion covering the breadth and depth of the courses. The Assessment Instrument or QPs shall be designed with a combination of question responses with short answer, long answer, higher order thinking skills through critical thinking and creativityand MCQ that fits best to the assessment of the intended learning outcomes. The course instructor can also take the liberty of setting their own customized question papers along with the distribution of marks leveraging the status of autonomous promoting higher order thinking skills and creativity through case studies or questions related to problems solving skills through open book examinations other than that of the one prescribed in the academic regulation 2023. This shall be deployed by taking necessary approval from the respective Chairman, Board of Studies and the Head of the Institution as well before the commencement of the course while preparing the course plan along with the rubircs indicating the criteria and scale/metirc for assessment. With regard to the assessment pattern for the skill oriented courses, appropriate assessment instrument shall be developed by the respective course facilitator that suits to assess the skills that are expected from the courses by taking approval from the respective Chairman, Board of Studies and the Head of the Institution as well before deploying for assessment. Incase of video based grading, suitable rubrics shall be developed for mearing the course outcomes or intended learning outcomes. In all the cases other than the assessment pattern being prescribed in the academic regulation 2023, the pattern of customized assessment pattern shall be submitted to the office of the Controller of Examinations before the commencement of the course.

5.6. Internship / Community Service Projects (CSP)

As per the guidelines specified in these regulations, each student is expected to undergo community service projects (CSP),internship in the form of summer and full semester internship (FSI) during the program of study and it is mandate for all the students. The curriculum offers two summer internships i.e., one at the end of second year and the other one is at the end of third year of study; each one spans for a duration of four to eights weeks. The CSP shall be taken at the level of second year as an alternate option to summer internship (Phase I) as per the standard operating procedure prescribed by the institution and the allotment is purely at the discretion of the Industry – Institute Engagement cell based on the requirement and availability of internship offers. With regard to the FSI, the curriculum provides flexibility at two different slots during VII and VIII semesters with a span of 12 weeks – 16 weeks. The students who are opting FSI either during semester VII or VIII shall register for the course during the semester V through the Head of the department and the same shall be forwarded to the Office of Controller of Examination (CoE) and Internship Cell. To ensure effective implementation of FSI, the Institute shall depute ~50% of the interns during semester VII and the rest during semester VIII. Accordingly, the courses pertaining to the semesters shall be inter-changed. The students who are opting for FSI in semester VIII shall be permitted to take up the capstone projectat the industries along with the FSI in the same industry,if he/she is interested and submit a separate report along with internship/training report.

Students will be evaluated by a panel of internal and external subject matter experts (SMEs) nominated by the Office of the CoE. It is mandate for all the learners going either for internship / CSPs to capture a video demonstrating the self reflection on the learning outcomes for grading by the course supervisor/guide.

5.7. **Project Work**

Each student is expected to carryout one capstone project relevant to his/her program of study or interdisciplinary of nature leading to design, development of solutions, and fabrication of system component or a product. On successful completion of the project work, the students are expected to submit a detailed project report along with the working models, if any for evaluation. The office of the CoE shall nominate a team of experts to assess the quality and evaluate the project as per the evaluation guidelines prescribed in the academic regulation. Incase, if any student is interested in doing industry oriented project (Individual) atthe industries or research organization, he/she shall take up the project duly approved by the Head of the Department, CoE and the Head of the Institution well before the commencement of the course. In such cases, the students should inform the respective department well in advance, preferably during semester VII. The students who opted FSI in the semester VII shall take up the courses as prescirbed in the curriculum during semester VIII along with the capstone project.

5.8. **Statutory Mandatory Courses and Audit Courses**

Mandatory courses are those courses which are designed inline with the requirement of AICTE. These courses do not carry any credits and are not accounted for the calculation of CGPA.The students shall register for the courses in the respective semester as specified in the curriculum. All the students (regular and lateral entry students) shall complete the mandatory course by taking two assessment in the form of multiple choice questions during the continuous assessment. A minimum of 40% of marks (average of two continuous assessment) is required to complete the course and the status of completion will be indicated in the grade memo and an online certification is also mandatory for a duration of 30 hours in the relevant area as specified in the curriculum. In addition to the above, the curriculum provides flexibility to nurture employability skills through audit courses and it is mandatory for all students to complete the audit courses for the award of the degree and it will not be counted for the calculation of CGPA. The academic regulation permits autonomous learning with mandatory courses promoting self learning ability among the learners.

5.9. **MOOCs and Autonomous Learning**

The curriculum provides adequate flexibility for the students to take up MOOCs through self-study mode enabling them to learn the courses on independent/autonomous mode with minimal guidance of faculty mentor to earn necessary credits for the award of the degree B. Tech. (Regular) and B. Tech. (Honors & Minor with Specialization) and the attendance is not mandatory. The courses shall be opted from MOOCs platform viz. NPTEL, SWAYAM or any other platforms as approved by the respective Chairman, Board of Studies (BoS). Incase of MOOCs through NPTEL, SWAYAM, the credits shall be directly transferred without conducting any further examination from the institution. For all other platforms, the assessment pattern for such courses which are part of the curriculum for the B. Tech. (Regular) degree shall be carried out as similar to

other regular theory and skill-oriented courses. And for B. Tech. (Honors) and B. Tech. (Minor with Specialization) shall be inline with the agencies or the platforms offering these courses. Further, if the grade is not specified by the particular agency or platform, the office of CoE shall follow the institutional SOP for the award of the grade and take necessary approval from the Academic Council through circulation. MOOCs shall be identified by the respective department taking necessary approval from the BoS/Chairman (BoS) and shall be intimated well in advance to the students. Futher, in case, if the student is preferred to undergo Semester Away Programme as per Clause 5.11 during semester VII, the credits earned through self-study courses shall be compensated for the calculation of CGPA. The curriculum provides flexibility to the students to select the semester VII on self-study mode to facilitate the Semester Away Program. Incase of notification of On-Job Training (OJT) by the institute industry-institute engagement cell during semester VI through VIII, the academic regulations 2023 provides flexibility enabling the students to opt self learning in the respective semester and can appear for continuous assessment and semester end examinations as per the examinations schedule and fulfill the credit requirement for the award of the B. Tech. program. In such cases, the attendance at the industries/research organization shall be taken for promotion from one semester to subsequent higher semesters for a duration of 15 weeks.

5.10. **Industry Supported Courses**

a. Students can opt for one-credit courses, offered by experts from industry/research organizations which are approved by academic council. Students can register such coursesfrom his/her second year of study as and when these courses are conducted by various departments. A student is also permitted to register for the courses of other departments, provided the student has fulfilled the necessary pre-requisites of the course being offered andsubject to the approval of both the Heads of Departments. There is no limit to the number of 1-credit or 2-credit courses a student can register during the programme of study. However, a student can register for only one course in a semester. These courses are evaluated by the respective course coordinator of the programme. The maximum number of credits that can be earned from industry supported courses is limited to four
b. If a student does not successfully complete the registered industry supported 1-credit or 2-credit courses in a semester, the registration of that course will be considered as cancelled. Further, it will not be treated as arrear and no supplementary examination will be conducted; alternatively, if he/she wishes, he/she can re-register for the same course in the ensuing semesters and successfully complete it as and when it is offered subsequently
c. The credits earned through these courses will be treated over and above the credit requirement for the award of the B. Tech. (Regular, Honours and Minor with specialization) programs

5.11. **Semester Away Programme (SAP) to Promote Multi-disciplinary Skills (Choice Based Semester System):** The interested students can have the option of undergoing Semester Away Programme leveraging Choice Based Semester System during semester VII with Higher Learning Institutions at Foreign Countries or Institutions of National Repute or Research Organizations in India, by earning necessary equivalent credits in the semester VII through course study, projects or whatever terms and conditions as prescribed by the respective organization.In addition to the above, the students can opt a combination of 1-, 2-, 3-, 4-credit

courses to compensate the credits required for semester VII on self study mode in case of shortage of credits.The students who are interested to opt for SAP shall register to the office of CoE during the beginning of semester III and initiate self-study mode for futuristic compensation of credits. The registration for this SAP is valid as long as the students maintain 8.0 CGPA in all semesters with no history of arrears. Incase, if the student fails to register during the above said period, he/she may register for the same by taking prior permission from the respective Head of the Department. Further, the students are encouraged to opt inter-disciplinary courses of their interest (need not be in the area of the program of study). The Controller of Examinations shall ensure that necessary approvals are taken from the Academic Council well before the time period of their SAP. In case of any uncertain circumstances, if the student fails to complete SAP, the registration will be cancelled automatically and he/she can earn the credits required for that particular semester through self-study mode.

5.12. **Procedure for Awarding Marks for Continuous Assessment**

Theory(Internal: 30 Marks | External 70 Marks)

Continuous Internal Assessment #1 (First two and half units with a duration of 90 Minutes)

Descriptive Examination	: 20 Marks
Assignment	: 05 Marks

Continuous Internal Assessment #2 (Next two and half units with a duration of 90 Minutes)

Descriptive Examination	: 20 Marks
Assignment	: 05 Marks

Comprehensive Quiz (50 Multiple Choice Questions each carries 01 mark and scaled down to 05 Marks)

The final internal marks will be awarded by considering equal proportion for both the CIA which shall be scaled down to 25 marks and 05 marks from comprehensive quiz.

Laboratory Courses (Internal: 30 Marks | External: 70)

Total Internal Marks	**: 30 Marks**
Distribution for Continuous Evaluation	
Continuous Assessment	: 10 Marks
Record	: 10 Marks
Internal Test	: 10 Marks
Total External Marks	**: 70 Marks**
Experiment & Viva - Voce	: 50 Marks
Video assessment (Learning outcome)	: 20 Marks (One video shall be uploaded by the student demonstrating the self reflection on that particular laboratory course for grading)

Drawing and Design Related Courses(Internal: 30 Marks | External: 70 Marks)

Total Internal Marks	: 30 Marks
Distribution for Continuous Evaluation	
Continuous Assement	: 15 Marks
Internal Test	: 15 Marks
Total External Marks	: 70 Marks

There shall be two internal tests in a semester for 15 marks each and final marks will be calculated by considering equal proportion for both the CIA.

Mandatory Courses

Assessment :As prescribed in the Academic Regulation

Online certification course :01 course (in the relevant area of the pursuing mandatory course with a minimum duration of 30 hours and the students need to submit the certification of completion and assessment compliance issued by the respective online learning platforms)

Technical Paper Writing

Internal Review #1	: 10 Marks
Internal Review #2	: 10 Marks
Final Review and Presentation	: 30 Marks

Paper Publications: Students are requested to publish their review articles to either peer-reviewed journals or any one of the reputed conferences and submit the published paper. It is mandatory for the award of the degree. Academic regulation suggest to publish the articles either in UGC – CARE or journals indexed by SCOPUS.

Summer Internship (Internal: 50 Marks)

Interim Assessment and Report Writing	: 20 Marks
Final Presentation	: 30 Marks

Full Summer Internship (Internal: 100 Marks | External: 100 Marks)

Interim Review #1 (Industry Supervisor)	: 20 Marks (Rubrics based)
Interim Review #2 (Industry Supervisor)	: 30 Marks (Rubrics based)
Terminal Presentation	: 15 Marks (Presentation)
Report	: 25 Marks
Video based assessment	: 10 Marks

In all the continuous assessment pertaining to internship, the major focus of the assessment will be predominently on skills and application of knowledge viz. Communication Skills, Team-Work, Organization Skills, Interpersonal Skills, Analytical and Problem Solving Skills, Leadership Skills, Work Ethics and any specific intiatives by the interns.

Skill Oriented Courses (Internal: 50 Marks)

Interim Assessment and Report Writing :15 Marks

Outcomes	: 20 Marks
Final Presentation	:10 Marks
Video based assessment	: 05 Marks

The outcomes shall be in the form of design, development of working model of a system component or a product and these 20 marks shall be awarded based on Rubrics that addresses Critical Thinking, Creativity, Collaboration and Communication.

Project (Internal: 100 Marks | External: 100 Marks)

Distribution of Marks (Continuous Internal Assessment)

Innovativeness of the Project	: 10 Marks
Literature Survey	: 05 Marks
Experimentation/ Simulation	: 15 Marks
Presentation, Interpretation& Analysis of Results	: 15 Marks
Interim Review #1(Presentation)	: 05 Marks
Interim Review #2 (Presentation)	: 05 Marks
Product Development	: 15 Marks
Terminal Presentation	: 10 Marks
Report	: 05 Marks
Publication in Conference / Journal (CARE)	: 05 Marks
Video based assessment	: 05 Marks (Mandatory)
Online Certification	: 05 Marks (Mandatory)

The online certification shall be from MOOCs platform with a minimum duration of 30 – 45 hours and the student need to earn the certification and for which there will not be any further assessment from the institution or program of study.

A student shall earn the following percentage of minimum percentage of marks in each theory, practical, design and drawing course in B. Tech. program.

- A minimum of 35% (24 and above out of 70 marks) of marks for each course Semester End Examinations (SEE) and
- A minimum of 40% marks for each course considering both CIA and SEE taken together

6. Attendance Finalization and Result Declaration

6.1. Procedure

The attendance shall be calculated as per this autonomous regulation 2020 for the students to appear for the end semester examinations as per clause 6.2. The Institute shall formulate a committee “Joint Board” constituting of Principal (Chairman), Chairpersons of all Boards of Studies, Controller of Examinations (Member Secretary) and two senior members of faculty. The tenure for the senior members of faculty shall be of 2 years. The member secretary shall place the attendance of all the students before the Joint Board for approval before the finalization and declaration of attendance. The same procedure shall be adopted for declaring the end semester examination results.

6.2. **Attendance Requirements and Result Declaration Procedure**

a. A student shall be eligible to appear for the end semester examinations if he/she acquires a minimum of 75% of attendance in aggregate of all the courses in a semester and shortage of attendance below 65% shall in no case be condoned and such cases will not be permitted to appear for the end semester examinations
b. Condonation for shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester shall be permittedbased on medical leave (hospitalization / accident / specific illness) and on-duty leave for participation in College / University / State / National / International Sports events with prior approval from the competent authority. After taking necessary approval from the Head of the Institution or Competent Authority, the student shall be permitted to appear for the end-semester examination by paying the condonation fee as prescribed by the Office of CoE. However, the student who have represented the college in outside world activities shall be exempted in paying the condonation fee
c. A student who has secured less than 40% of attendance in a particular course shall not be permitted to appear for the end semester examination though he/she maintains more than 75% of attendance in aggregate of all courses in that particular semester. In such cases, the student need to reappear physically as and when the courses are being offered by the respective department and accordingly the time-table shall be optimized to avoid overlapping
d. Students, who do not meet the minimum required attendance in a semester, shall be detained in that particular semester and they will not be promoted to the next semester. In such cases, the student need to rejoin in that particular semester in the subsequent academic year
e. Academic regulations applicable to the semester in which re-admission is sought shall be applicable to the re-admitted student
f. In case if there are any professional electives and/or open electives, the same may also be re-registered if offered by the respective program of study. However, if those electives are not offered in the later semesters, alternatively, the students may opt other electives from the same set of elective courses offered under that category in that particular semester

7. Promotion Policies

During the four year (Regular) or three year (Lateral) program of study, it is mandatory for all students to maintain a minimum of 40% of the credits pertaining to the current year of study to get promoted to subsequent year of study, say 2nd year to 3rd year and so on. In case if the student fails to earn the necessary percentage of credits required for promoting to subsequent year of the program of study, he/she will be detained and he/she need to earn the required credits and take re-admission in the subsequent years of the academic year to complete the B. Tech. degree program.

8. Eligibility for the Award of the Degree

A student shall be declared to eligible for the award of the degree in B. Tech. (Regular) program if he/she has fulfilled the following requirements

a. The student should earn the minimum requirement of credits (160 for regular admission and 121
credits for lateral entry) and cleared all the mandatory courses as prescribed in the curriculum within the maximum duration of 8 consecutive academic years (Regular) and 6 consecutive academic years (Lateral) from date of admission
b. The student should maintain more than 5 CGPA at any point of time
c. The student shall not have any pending disciplnary issues

The student shall forfeit his/her Degree and his/her admission stands cancelled if he/she fails to meet the above compliance.

9. Award of Grades

Range of Marks	Letter Grade	Grade Point
>= 90	'O'	10
>= 80 < 90	'A+'	09
>= 70 < 80	'A'	08
>= 60 < 70	'B+'	07
>= 50 < 60	'B'	06
>= 40 < 50	'C'	05
< 40	'F'	0
Absent	'AA'	0
Non completion of a semester (Repeat)	'I'	0
Withdrawal from end semester examination	'W'	0

After completion of the programme, the Cumulative Grade Point Average (CGPA) from the I Semester to VIII Semester (from III to VIII semester for lateral entry) is calculated using the formula:

$$CGPA = \frac{\sum_{i=1}^{n-1}(c_i \times g_i)}{\sum_{i=1}^{n-1} c_i}$$

where 'n' is the number of courses registered for, 'c_i' is the credits allotted to the given course and 'g_i' is the grade point secured in the corresponding course

10. Classification of the Degree Awarded

a. **B. Tech. (Honors):** In addition to the requirement as cited in (10.c), if the student secures 20 additional credits in accordance with the clause (14), he/she shall be declared with B. Tech. (Honors)

b. **B. Tech. (Minor with Specialization):** In addition to the requirement as cited in (10.c), if the student secures 20 additional credits in accordance with the clause (15), he/she shall be declared with B. Tech. (Minor with Specialization)

c. **B. Tech. (Regular) - First Class with Distintion:** The student who qualifies for the award of the B. Tech. degree in the chosen program of study with 160 credits (Regular) and 121 credits (Lateral) within 5 consecutive academic years (Considering the formal approval for the break of study from the competent authority) from the date of admission at his/her first attempt maintaining 7.5 CGPA and above shall be declared to have passed in first class with distintion and should not have been prevented from appearing end semester examinations for the want of attendance requirements

d. **B. Tech. (Regular) - First Class:** The student who qualifies for the award of the B. Tech. degree in the chosen program of study with 160 credits (Regular) and 121 credits (Lateral) within 4 consecutive academic years from the date of admission maintaining 6.75 CGPA and above shall be declared to have passed in first class and should not have been prevented from appearing end semester examinations for the want of attendance requirements

e. **B. Tech. (Regular) - Second Class:** The student who qualifies for the award of the B. Tech. degree in the chosen program of study with 160 credits (Regular) and 121 credits (Lateral) within 8 consecutive academic years from the date of admission maintaining 5.75 CGPA and above and less than 6.75 CGPA shall be declared to have passed in second class
f. **B. Tech. (Regular) - Pass:** All other students who have not covered and qualifies for the award of the degree maintaining 5.00 CGPA and above and less than 5.75 CGPA shall be declared to get Pass with minimum credit requirement for the award of the degree in B. Tech. program

11. Flexibility to Add or Drop Self Study Courses (SSC)

a. It is mandatory that all the students need to earn the minimum number of the credits for the award of B. Tech. degree in their respective program of study. However, a student can earn more number of credits if he/she opt, by registering additional courses, from the list of courses available in the curriculum of all disciplines, over and above to the existing courses from semester IV – VI. The student shall be permitted to drop any SSC at any point of time and registration for such courses gets cancelled and will not be reflected in Cumulative Grade Memo (CGM)
b. All the courses registered and cleared by a student in this mode will be mentioned in the CGM as additional acquired. However, the CGPA is calculated as per the minimum requirement of the credits for the award of the B. Tech. degree

12. Withdrawal from the Examination

a. A candidate may, for valid reasons, be granted permission by the Principal to withdraw from appearing for the examination in any course or courses of only one semester examination during the entire duration of the Degree Programme. Also, only ONE application for withdrawal is permitted for that semester examination in which withdrawal is sought
b. Withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination and if it is made prior to the commencement of the examination in that course or courses and also recommended by the Head of the Department
c. Such withdrawal from the examination shall be treated as absent for the 1st attempt to the respective examination and will lose the eligibility for First Class with Distinction
d. If any student is intended to drop FSI subsequent to his/her registration followed by allotment, he/she needs to re-register the course

13.Transitory Regulations: To enable the students to take admission or entry into NSRIT from other Institution either by Transfer, Re-admission, Admission, or Transfer from other engineering Institution affiliated to JNTUK/Academic regulation within the Institute, the following regulations shall be followed based on the nature of case as cited above.

- Transfer of candiate from Autonomous / Non-Autonomous Institution affiliated to JNTUK
- Within the Institution from one regulation to other academic regulation

a. Transfer of a candidate from Autonomous / Non-Autonomous Institution affiliated to JNTUK

Any canddate who is interested to take admission in NSRIT from a non-autonomous engineering institution affiliated to the parent university either in the semester III or thereafter, shall acquire the

credits required for graduation as per the Institute autonomous regulations and the candidature shall be treated under following category

Students from non-autonomous institution seeking admission into semester III shall be treated in par with the students taking admission for 3 year program of study (i.e. lateral entry students) and should have cleared all the courses in the semester I and II as per university regulation. The same shall be calculated as per NSRIT regulations if the student is seeking admission into NSRIT from an autonomous institution. The credits earned during semester I and II shared be calculated as per the Institute autonomous regulations and in case if the earned credits during first two semestersare not adequate to take admission in the semester III, the student shall take additional courses approved by the respective Board of Studies and Academic council during semester III at NSRIT on self study mode and the same procedure shall be followed for taking admission into higher semesters

b. **Within the Institution from one regulation to other academic regulation**

A student taking admission under one regulation, say Academic Regulation 2020 in the first year, shall continue with the same regulation and should earn the necessary credits as metioned in the academic regulation at the time of joining. However, In case of readmission into a subsequent new regulation, and if the readmission is into any of the semesters from semester I through IV, the student shall follow the current regulations to which he/she taking admission and continue with the same regulation till graduation. In case of any credit shortage, the necessary credits shall be earned on self study mode to compensate the required number of credits. In case of excess credits, it will be treated as over and above.

In both the cases (a) and (b), the details shall be forwarded to the parent university along with the proceedings of the Academic Council.

14. **B.Tech. (Honors):** The curriculum provides flexibility to enable the students to register for B.Tech. (Honors) program by earning additional 20 credits which is over and above the requirement for the award of B.Tech.(Regular) degree. He/She shall register in the office of the CoE during semester III provided he/she secures ≥8 CGPA without backlogs in earlier semesters. If he/she wishes to withdraw from B.Tech. (Honors) program at any point of time, the credits obtained will not be compensated for the award of the degree and considered as over and above. The maximum enrollment B. Tech. (Honors) shall be restricted to 10% of the total intake in a particular batch of students.

The additional 20 credits shall be earned by opting four 4-credit courses offered by the respective program of study which are categorized in the curriculum and these courses shall be offered with a combination of guided learning or taught courses or self study mode depending on the total number of students registered for that particular course and the Chairperson of the Board of Studies reserves the right to decide the mode of delivery. Apart from this, he/she shall choose two 2-credit MOOCs of 30 hours or 6 weeks duration. Above all, if any student fails to maintain the 8 SGPA in the subsequent semesters after semester III, the registration for the B. Tech. (Honors) program stands cancelled without any notification. In case of students admitted through lateral entry, the CGPA compliance will be considered from semester III onwards as already mentioned.

15. **B.Tech. (Minor with Specialization):** The curriculum provides flexibility to enable the students to register for B. Tech. (Minor with Specialization) program by earning additional 20 credits which is over and above the requirement for the award of B. Tech. (Regular) degree. He/She shall register in the office of the CoE during the semester III provided he/she secures ≥8 CGPA without backlogs in earlier semesters. If he/she wishes to withdraw from B. Tech. (Minor with Specialization) program at any point of time, the credits obtained will not be compensated for the award of the degree and considered as over and above. In case of students admitted through lateral entry, the CGPA compliance will be considered from semester III onwards.

    The student shall opt three inter-disciplinary courses each of 3-credit as listed in the curriculum offered by other programs and one 3-credit MOOCs of 30 hours or 6 weeks duration in addition to a project of 8-credit leading to design, process development, system component design & fabrication and application development relevant to the chosen field of interest prescribed in the curriculum.

16. **Academic Bank of Credits:** This academic regulation 2023 provides complete scope of academic flexibility in accordance with The Gazette of India, the notification issued by UGC pertaining to the Academic Bank of Credits (ABC) vide File No. 14-31/2018 (CPP – II) dated 28th July, 2021, New Delhi. The ABC provides a full length academic flexibility while removing rigid curriculum boundaries and creating new possibilities of life-long learning.

    Incase with students registering under ABC, it is very much mandate and recommended to complete the courses pertaining to professional core and the courses at the lower semesters, especially, the courses pertaining to Mathematics, Physics, Chemistry and few related to Engineering Sciences. Further, the students opting for industry connect courses can be accumulated, transferred and redeemed for the award of B. Tech (Regular) degree alone and courses in the curriculum other than the category of Basic Sciences, Engineering Sciences and Professional Core can be compensated.

17. **Temporary Break of Study from the Program**: The curriculum provides flexibility for the students having ≥9 CGPA to take a break of one year at any time after the end of I/II/III year of study to pursue entrepreneurship on full time. This period of gap shall be counted for the maximum time of graduation. A committee approved by the Academic Council shall be constituted to evaluate the proposal submitted by the student and the committee shall decide on permitting the student for availing the break of study.

18. **Revision of the Academic Regulations and Curriculum**

    The Joint Board Committee and the Academic Council of the institute reserve the right to revise, change or amend the regulations, the scheme of examinations, the curriculum and the syllabi from time to time if found necessary.

19. **Representation of Special Cases**

    In case of any clarification in the interpretation of the above rules and regulations, they shall be referred to the Joint Board Committee through the Head of the Institution. The Joint Board Committee will offer suitable interpretations/ clarifications /amendments required for special case on such references and get them ratified in the next meeting of the Academic Council. The decision of the Academic Council is final.

20. Curriculum and Syllabi of various Programs of Study (Scan to view the Program Curriculum and Syllabi)

Electrical and Electronics Engineering Program

Preamble: The curriculum of B. Tech. (Electrical and Electronics Engineering) program offered by the Department of Electrical and Electronics Engineering under Academic Regulation 2020 is prepared in accordance with the curriculum framework of AICTE, UGC and Andhra Pradesh State Council of Higher Education (APSCHE). Further this Outcome Based Curriculum (OBC) is designed with Choice Based Credit and Semester System (CBCSS) enabling the learners to gain professional competency with multi-disciplinary approach catering the minimum requirement (Program Specific Criteria) of Lead Societies like IEEE and other Professional Bodies as per the Engineering Accreditation Commission (EAC) of ABET and NBA. In addition, the curriculum and syllabi are designed in a structured approach by deploying Feedback Mechanism on Curriculum from various stakeholders viz. Industry, Potential Employers, Alumni, Academia, Professional Bodies, Research Organizations and Parents to capture their voice of the respective stakeholders.

The Curriculum design, delivery, and assessment, the three major pillars of academic system is completely aligned in line with Outcome Based Education (OBE) to assess and evaluate the learning outcomes facilitating the learners to achieve their Professional and Career Accomplishments.

The Vision

To be a hub for imparting knowledge, skills and behaviour for exemplary contributions in the field of Electrical & Electronics Engineering

The Mission

- To impart technical education through the state of the art infrastructural facilities, laboratories and instruction
- To inculcate industry oriented learning through industrial visits, internships, projects at industries, MOUs, to make students technically skilled oriented
- Creating conductive environment for higher education, employment and entrepreneurship through quality education, professional skills and research
- To promote societal commitment among students by inculcating moral and ethical values

Program Educational Objectives (PEOs)

The PEOs are the educational goals that reflect Professional and Career Accomplishments that a graduate should attain after 4 – 5 years of his/her graduation.

The graduates of Electrical and Electronics Engineering of NSRIT will

1. Demonstrate the real-world engineering problem solving skills by applying the fundamental and conceptual engineering knowledge as a practicing Electrical and Electronics engineer or as a member/lead in a multidisciplinary project setting that utilize 21st century skills

2. Provide research-based engineering solutions addressing the triple bottom line of environment and sustainability maintaining the professional standards, ethics and integrity

3. Foster self-directed learning through their professional experience, technology advancements in their relevant field of interest and desiring graduates pursue advanced higher education leading to research

Program Outcomes (POs)

The POs are the transactional statements of graduate attributes (GAs) that each graduating engineer should possess in terms of knowledge, skill and behaviour with a minimum target performance level at the time of graduation as fixed by the program of study seeking continuous improvement year on year.

The graduates of Electrical and Electronics Engineering of NSRIT will be able to demonstrate the following outcomes in terms knowledge, skill and behavioural competencies at the time of graduation with the expected target performance level

1. Apply the knowledge of basic sciences and fundamental engineering concepts in solving engineering problems (Engineering Knowledge)
2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences (Problem Analysis)
3. 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 (Design/Development of Solutions)
4. Perform investigations, design and conduct experiments, analyse and interpret the results to provide valid conclusions (Investigation of Complex Problems)
5. Select/develop and apply appropriate techniques and IT tools for the design & analysis of the systems (Modern Tool Usage)
6. Give reasoning and assess societal, health, legal and cultural issues with competency in professional engineering practices (The Engineer and Society)
7. Demonstrate professional skills and contextual reasoning to assess environmental/societal issues for sustainable development (The Environment and Sustainability)
8. Demonstrate Knowledge of professional and ethical practices (Ethics)
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary situations (Individual and Team Work)
10. Communicate effectively among engineering community, being able to comprehend and write effectively reports, presentation and give / receive clears instructions (Communication)

11. Demonstrate and apply engineering & management principles in their own / team projects in multidisciplinary environment (Project Finance and Management)
12. Recognize the need for, and have the ability to engage in independent and lifelong learning (Life Long Learning)

Program Specific Outcomes (PSOs)

1. Analyze, design and simulate diverse problems associated in the field of electrical, electronics and computer based systems by providing sustainable solutions adopting ethical practices
2. Apply appropriate methods and modern components to aid design, analysis and synthesis of solutions

Category-wise Credit Distribution of Courses

Category		AICTE	APSCHE	NSRIT (A)
HS	Humanities and Social Science	12.0	10.5	10.5
BS	Basic Science	25.0	18.0	21.0
ES	Engineering Science	24.0	22.5	22.5
PC	Professional Core	48.0	55.5	52.5
PE	Professional Elective	18.0	15.0	15.0
OE	Open Elective	18.0	12.0	12.0
IN	Internship (s), Project & Seminars	15.0	16.5	16.5
SC	Skill Oriented Courses	-	10.0	10.0
MC	Mandatory Courses	-	-	-
AC	Audit Course	-	-	-
Total no. of credits		160	160	160

Electrical and Electronics Engineering

Credit requirement for the award of the degree under academic Regulation 2020 – 2021 for the candidates admitted from the academic year 2021 onwards		
	Four Years	Three Years
B. Tech. (Regular Degree)	160	121
B. Tech. (Honors Degree)	180	141
B. Tech. (With Minor specialization other than Chosen Branch of Engg. & Tech.)	180	141

No.	Code	Course	POs	Contact Hours				
				L	T[1]	P	C	
Semester I								
01	20HSX01	Communicative English	10	3	0	0	3.0	HS
02	20BSX11	Linear Algebra and Differential Equations	1, 12[2]	3	1	0	3.0	BS
03	20BSX33	Applied Physics	1	3	1	0	3.0	BS
04	20ESX03	Basic Electrical Engineering	1	3	0	0	3.0	ES
05	20ESX02	Programming for Problem Solving Using 'C'	1	3	0	0	3.0	ES
06	20HSX02	Communicative English Lab	10	0	0	3	1.5	HS
07	20BSX34	Applied Physics Lab	1, 4	0	0	3	1.5	BS
08	20ESX07	Programming for Problem Solving Using 'C' Lab	1, 4	0	0	3	1.5	ES
			Sub-total	15	02	09	19.5	
Semester II								
01	20BSX12	Partial Differential Equations and Vector Calculus	1	3	1	0	3.0	BS
02	20BSX23	Applied Chemistry	1	3	1	0	3.0	BS
03	20CS403	Python Programming	1	3	1	0	3.0	ES
04	20ESX04	Engineering Mechanics	1	3	1	0	3.0	ES
05	20ESX01	Engineering Drawing	1, 5, 10	1	0	4	3.0	ES
06	20BSX24	Applied Chemistry Lab	1, 4	0	0	3	1.5	BS
07	20CS407	Python Programming Lab	1	0	0	3	1.5	ES
08	20ESX06	Engineering Workshop	4	0	0	3	1.5	ES
09	20MCX01	Environmental Science	1	2	0	0	-	MC
			Sub-total	15	04	13	19.5	
Semester III								
01	20BSX13	Numerical Methods and Transforms	1	3	1	0	3.0	BS
02	20EC302	Electronic Devices and Circuits	1, 3, 10	3	0	0	3.0	PC
03	20EE303	Electrical Circuit Analysis	1, 3, 10, PSO	3	1	0	3.0	PC
04	20EE304	DC Machines and Transformers	2,3, PSO 1	3	0	0	3.0	PC
05	20EE305	Power Generation and Transmission	2, 7, 10, PSO	3	0	0	3.0	PC
06	20EC306	Electronic Devices and Circuits Lab	4, PSO 1	0	0	3	1.5	PC
07	20EE307	DC Machines and Transformers Lab	4, PSO 1	0	0	3	1.5	PC
08	20EE308	Electrical Circuit Analysis Lab	4, PSO 1	0	0	3	1.5	PC
09	20EES01	Short-term Skill Oriented Elective	5	1	0	2	2.0	SC
10	20MCX02	Constitution of India[3]	-	2	0	0	-	MC
			Sub-total	18	02	11	21.5	

[1] Suggested tutorial hours will not carry any credits

[2] By default, all courses are mapped to PO 12 as they are Weakly contributing

[3] It is mandate for all students to pursue an online certification course for minimum duration of 30 hours covering the areas of Sustainability, Climate changes, Environmental Impact Assessment in line with Sustainable Development Goals (SDG)

No.	Code	Course	POs	Contact Hours				
				L	T	P	C	
Semester IV								
01	20HSX03	Managerial Economics and Financial Analysis	11	3	0	0	3.0	HS
02	20BSX15	Probability and Statistics	1	3	1	0	3.0	BS
03	20EE403	Control Systems	3, PSO 1	3	0	0	3.0	PC
04	20EE404	Induction Motors and Synchronous Machines	2, 3, PSO 1	3	1	0	3.0	PC
05	20EE405	Electro Magnetic Field Theory	3, PSO 1	3	0	0	3.0	ES
06	20EE406	Induction Motors and Synchronous Machines Lab	4	0	0	3	1.5	PC
07	20EE407	Industrial Automation for Electrical & Electronics Engg.	4	0	0	3	1.5	PC
08	20EE408	Control Systems Lab	4, PSO 1	0	0	3	1.5	PC
09	20EES02	Short-term Skill Oriented Elective	3, 4	1	0	2	2.0	SC
			Sub-total	16	02	11	21.5	
Semester V								
01	20EC303	Signals and Systems	1,2	3	0	0	3.0	PC
02	20EE502	Power Electronics	2, 3, PSO 1	3	1	0	3.0	PC
03	20EC305	Digital System Design	1, 3	3	0	0	3.0	PC
04	-	Professional Elective I	-	3	0	0	3.0	PE
05	-	Open Elective I	-	3	0	0	3.0	OE
06	20EC308	Digital System Design Lab	4	0	0	3	1.5	PC
07	20EE507	Power Electronics Lab	4, PSO 1	0	0	3	1.5	PC
08	20EES03	Technical Paper Writing[4]	-	0	0	4	2.0	SC
09	20MCX03	Intellectual Property Rights and Patents[5]	-	2	0	0	-	MC
10	-	Summer Internship #1/ CSP[6]	5, 8, 9, 10, PSO 1	0	0	0	1.5	IN
			Sub-total	17	01	08	21.5	
Semester VI								
01	20EC603	Micro Processors and Micro Controllers	3	3	0	0	3.0	PC
02	20EE602	Electrical Measurements and Instrumentation	2, PSO 1	3	0	0	3.0	PC
03	20EE603	Power System Analysis	2, 3, 6, PSO 1	3	1	0	3.0	PC
04	-	Professional Elective II	-	3	0	0	3.0	PE
05	-	Open Elective II	-	3	0	0	3.0	OE
06	20EC606	Micro Processors and Micro Controllers Lab	4, 9	0	0	3	1.5	PC
07	20EE607	Electrical Measurements and Instrumentation Lab	4, PSO1	0	0	3	1.5	PC
08	20EE608	Power Systems and Simulation Lab	4, PSO1	0	0	3	1.5	PC
09	20EES04	Short-term Skill Oriented Elective	5	1	0	2	2.0	SC
10	20MCX04	Indian Traditional Knowledge[7]	-	2	0	0	-	MC
			Sub-total	18	01	11	21.5	
Semester VII								

[4] The students are expected to identify one research area in the recent trends, collect recent research articles, prepare a technical research review paper and publish in renowned annual conferences/ journals, preferably indexed in Scopus or UGC care

[5] The students are expected to identify one research area in the recent trends, collect recent research articles, prepare a technical research review paper and publish in renowned annual conferences/ journals, preferably indexed in Scopus or UGC care

[6] The work pertaining to summer Internship #1 and #2 shall be completed at the end of the semesters IV & VI respectively. The assessment shall be carried out during the semesters V and VII
It is mandate for all the students to undergo 4-6 weeks of industrial training and appear for assessment during Semester V with report. With regard to Community Service Project (CSP), based on the availability the students can opt CSP as an alternate option for summer internship #1 for a duration of 08 weeks

[7] It is mandate for all the students to pursue an online certification course for minimum duration of 30 hours covering the application of ITK in Science Engineering & Technology

01	-	Professional Elective III	-	3	0	0	3.0	PE
02	-	Professional Elective IV	-	3	0	0	3.0	PE
03	-	Professional Elective V	-	3	0	0	3.0	PE
04	-	Open Elective III	-	3	0	0	3.0	OE
05	-	Open Elective IV	-	3	0	0	3.0	OE
06	20HSX04	Professional Ethics	8	3	0	0	3.0	HS
07	20EES05	Short-term Skill Oriented Elective	9, PSO #1	1	0	2	2.0	SC
08	-	Summer Internship #2[8]	5, 8, 9, 10, PSO 1	0	0	0	3.0	IN
			Sub-total	19	0	02	23.0	
Semester VIII								
01	-	Full Semester Internship[9]	5-10, PSO 1, PSO	0	0	0	06	IN
02	-	Capstone Project[3]	5-10, PSO 1, PSO	0	0	0	06	IN
			Sub-total	0	0	0	12.0	
			Total Credits	-	-	-	160	

[8] It is mandate for all the students to undergo 6-8 weeks of industrial training and appear for assessment during Semester VII with report and those opted FSI during Semester VII shall appear through online for reviews

[9] Students opting for FSI in VII semester have to take up courses of VII semester in VIII semester. The students are expected to do a capstone project parallelly demonstrating their POs & PSOs and submit a separate report

List of Electives

Professional Elective #1								
1	20EE001	Advanced Power Electronics	-	3	0	0	3.0	PE
2	20EE002	Digital Control Systems	-	3	0	0	3.0	PE
3	20EE003	Utilization of Electrical Energy	-	3	0	0	3.0	PE
4	20EE004	Machine Modelling and Analysis	-	3	0	0	3.0	PE
5	20EE005	Sensors and Transducers	-	3	0	0	3.0	PE
Professional Elective #2								
6	20EE006	Solid State Electric Drives	-	3	0	0	3.0	PE
7	20EE007	Advanced Control Systems	-	3	0	0	3.0	PE
8	20EE008	Reactive Power Compensation and Management	-	3	0	0	3.0	PE
9	20EE009	Basic Industrial Automation	-	3	0	0	3.0	PE
10	20EE010	Process Instrumentation	-	3	0	0	3.0	PE
Professional Elective #3								
11	20EE011	Switchgear Protection	-	3	0	0	3.0	PE
12	20EE012	Digital Signal Processing	-	3	0	0	3.0	PE
13	20EE013	HVDC and FACTS	-	3	0	0	3.0	PE
14	20EE014	Programmable Control Devices and Applications	-	3	0	0	3.0	PE
15	20EE015	Virtual Instrumentation	-	3	0	0	3.0	PE
Professional Elective #4								
16	20EE016	Analysis of Power Converters	-	3	0	0	3.0	PE
17	20EE017	Multivariable Control System	-	3	0	0	3.0	PE
18	20EE018	Power System Operation and Control	-	3	0	0	3.0	PE
19	20EE019	Automotive Electrical Engineering	-	3	0	0	3.0	PE
20	20EE020	Wireless Sensors and Instrument Networks	-	3	0	0	3.0	PE
Professional Elective #5								
The curriculum provides academic flexibility to choose any of the domain specific courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self- study mode. The course shall be of 45 – 60 hours duration (4-credits) and the assessment shall be as per the academic regulation 2020.								PE
Open Elective #1								
21	20CEO01	Urban Environmental Service	-	3	0	0	3.0	OE
22	20CSO01	Data Structures and Algorithms	-	3	0	0	3.0	OE
23	20AIO01	Machine Learning for Engineers	-	3	0	0	3.0	OE
24	20DSO01	Introduction to Database Management Systems	-	3	0	0	3.0	OE
25	20ECO01	Architectures and Algorithms of IoT	-	3	0	0	3.0	OE
26	20EEO01	Introduction to Renewable Energy Sources	-	3	0	0	3.0	OE
27	20MEO01	Nano Technology	-	3	0	0	3.0	OE
28	20SHO01	Women and Society	-	3	0	0	3.0	OE
Open Elective #2								
29	20CEO02	Ecology, Environment and Resources Management	-	3	0	0	3.0	OE
30	20CSO02	Designing the Internet of Things	-	3	0	0	3.0	OE
31	20AIO02	Fundamentals of Deep Learning	-	3	0	0	3.0	OE
32	20DSO02	Introduction to Data Science	-	3	0	0	3.0	OE
33	20ECO02	IoT for Smart Grids	-	3	0	0	3.0	OE
34	20EEO02	Electrical Safety and Management	-	3	0	0	3.0	OE
35	20MEO02	Fundamentals of Automobile Engineering	-	3	0	0	3.0	OE
Open Elective #3								
36	20CEO03	Disaster, Risk Mitigation and Management	-	3	0	0	3.0	OE
37	20CS404	Operating Systems	-	3	0	0	3.0	OE
38	20AIO03	Fundamentals of AI	-	3	0	0	3.0	OE
39	20DSO03	Introduction to Big Data	-	3	0	0	3.0	OE
40	20ECO03	Privacy and Security in IoT	-	3	0	0	3.0	OE
41	20EEO03	Low-cost Automation	-	3	0	0	3.0	OE
42	20MEO03	Industrial Automation	-	3	0	0	3.0	OE
43	20SHO02	Design Thinking	-	3	0	0	3.0	OE
Open Elective #4								

The curriculum provides academic flexibility to choose any of the inter-disciplinary courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration and the assessment shall be as per the academic regulation 2020.								OE
B. Tech. (Honors)								
Category I								
1	20EEH01	Smart Grid	-	4	0	0	4.0	HO
2	20EEH02	Advanced Smart Power Grids	-	4	0	0	4.0	HO
3	20EEH03	Electric Power Quality	-	4	0	0	4.0	HO
Category II								
4	20EEH04	Electric Vehicle Technologies	-	4	0	0	4.0	HO
5	20EEH05	Energy Audit Conversation and Management	-	4	0	0	4.0	HO
6	20EEH06	Electrical Load Estimation	-	4	0	0	4.0	HO
Category III								
7	20EEH07	Challenges and Impact of Electric Vehicle on Smart Grids	-	4	0	0	4.0	HO
8	20EEH08	Optimization Techniques	-	4	0	0	4.0	HO
9	20EEH09	Illumination Engineering	-	4	0	0	4.0	HO
Category IV								
10	20EEH10	Design and Testing of Battery Management System for Electric Vehicle	-	4	0	0	4.0	HO
11	20EEH11	Advanced Power System Protection	-	4	0	0	4.0	HO
12	20EEH12	Power System Stability	-	4	0	0	4.0	HO
B. Tech. (Minor with Specialization)								
Category I								
1	20CEM01	Air Pollution	-	3	0	0	3.0	MI
2	20CSM01	E-Commerce	-	3	0	0	3.0	MI
3	20MEM01	Biomaterials	-	3	0	0	3.0	MI
4	20EEM01	Basic Control Systems	-	3	0	0	3.0	MI
5	20ECM01	Semi-Conductor Devices and Circuits	-	3	0	0	3.0	MI
6	20AIM01	Fundamentals of Neural Networks	-	3	0	0	3.0	MI
7	20DSO03	Introduction to R Programming	-	3	0	0	3.0	MI
8	20SHM01	Psychology	-	3	0	0	3.0	MI
9	20SHM02	Statistical Methods	-	3	0	0	3.0	MI
10	20MBM01	General Management	-	3	0	0	3.0	MI
11	20MBM02	Human Resource Planning	-	3	0	0	3.0	MI
Category II								
12	20CEM02	Climate Change Mitigation and Adaptation	-	3	0	0	3.0	MI
13	20CSM02	Knowledge Discovery and Databases	-	3	0	0	3.0	MI
14	20MEM02	Micro Electromechanical Systems	-	3	0	0	3.0	MI
15	20EEM02	Basics of Electrical Machines and Drives	-	3	0	0	3.0	MI
16	20ECM02	Digital Electronics	-	3	0	0	3.0	MI
17	20AIM02	Machine Learning with Python	-	3	0	0	3.0	MI
18	20DSM02	Data Management and Analysis	-	3	0	0	3.0	MI
19	20SHM03	English for Media	-	3	0	0	3.0	MI
20	20SHM04	Statistical Inference	-	3	0	0	3.0	MI
21	20MBM03	Organization Behaviour	-	3	0	0	3.0	MI
22	20MBM04	Compensation Management & Employee Welfare Laws	-	3	0	0	3.0	MI
Category III								
23	20CEM03	Sustainability and Pollution Prevention Practices	-	3	0	0	3.0	MI
24	20CSM03	Database Security	-	3	0	0	3.0	MI
25	20MEM03	Surface Engineering	-	3	0	0	3.0	MI
26	20EEM03	Electrical Engineering Material Science	-	3	0	0	3.0	MI
27	20ECM03	Analog Electronic Circuits	-	3	0	0	3.0	MI
28	20AIM03	Interpretable Machine Learning	-	3	0	0	3.0	MI
29	20DSM03	Data Governance	-	3	0	0	3.0	MI
30	20SHM05	Journalism	-	3	0	0	3.0	MI
31	20SHM06	Statistical Quality Control	-	3	0	0	3.0	MI
32	20MBM05	Entrepreneurship & Business Venture Planning	-	3	0	0	3.0	MI
33	20MBM06	Performance Management & Talent Management	-	3	0	0	3.0	MI

Short Term Skill Oriented Electives								
34	20EES01	MATLAB		0	0	4	2.0	SC
35	20EES02	PLC		0	0	4	2.0	SC
36	20EES04	P-SPICE		0	0	4	2.0	SC
37	20EES05	ECAD		0	0	4	2.0	SC
Industry Connect Courses (Skill Oriented Courses)[10]								
38	20ICC01	Competitive Programming	-	2	0	8	6.0	ICC
39	20ICC02	Web Technologies – Theory to Practice	-	2	0	8	6.0	ICC
40	20ICC03	Java and Springboard	-	2	0	8	6.0	ICC
41	20ICC04	Robotics Process Automation (RPA)	-	2	0	8	6.0	ICC
42	20ICC05	Information Security and Forensics	-	2	0	8	6.0	ICC
43	20ICC06	Battery System Design Engineering	-	2	0	8	6.0	ICC
44	20ICC07	Blockchain Technology	-	2	0	8	6.0	ICC
45	20ICC08	Network Administration	-	2	0	8	6.0	ICC
46	20ICC09	Product Engineering	-	2	0	14	9.0	ICC
47	20ICC10	Machine Learning Engineer	-	2	0	8	6.0	ICC
48	20ICC11	Data Scientist	-	2	0	8	6.0	ICC
49	20ICC12	Industrial IoT	-	2	0	8	6.0	ICC

[10] The credits earned through Industry Connect Courses (Skill Oriented Course) can be tradeoff with any other 3-Credit course other than Professional Core

BS 20BSX13 Numerical Methods and Transforms 3 1 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO1	PO12	DoK
20BSX13.1	Calculate the approximate roots of the algebraic equations & Transcendental equations by different techniques	3	1	L1, L2, L3
20BSX13.2	Make use of the concepts of interpolation to estimate the unknown functional values	3	1	L1, L2, L3
20BSX13.3	Find approximate values of finite integrals using different numerical techniques and use different algorithms for approximating solutions of ordinary differential equation to its analytical computations.	3	1	L1, L2, L3
20BSX13.4	Apply the Laplace transform to solve ordinary differential equations with initial conditions.	3	1	L1, L2, L3
20BSX13.5	Solve engineering problems using Fourier Transforms	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Solutions of Algebraic and Transcendental Equations **11+1 Hours**

Introduction – Bisection method – Secant method – Method of false position – Iteration method – Newton-Raphson method– Jacobi and Gauss-Seidel methods solving system of equations

Convergence of – Bisection method, Secant method, Method of false position Newton - Raphson Method

Unit II: Interpolation. **11+1 Hours**

Introduction — Finite differences – Forward differences – Backward differences – Central differences – Relations between operators – Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula – Newton's divide difference formula.

Errors in Polynomial Interpolation – Error Propagation in a Difference Table- Numerical differentiations

Unit III: Numerical integration and solution of ordinary differential equations. **11+1 Hours**

Numerical integration: Trapezoidal rule – Simpson's 1/3rd and 3/8th rule

Solution of ordinary differential equations by Taylor's series – Picard's method of successive approximations – Euler's method – Runge-Kutta method.

Runge-Kutta method (second order)

Unit IV: Laplace Transforms **11+1 Hours**

Laplace Transforms of Standard Functions - Shifting Theorems –Transforms of Derivatives and Integrals – Multiplication by t^n – *Division by* t –Unit Step Function -Unit Impulse function-Laplace Transforms of Periodic Functions- Inverse Laplace Transforms - Convolution Theorem (Without Proof).

Applications: Solving Ordinary Differential Equation (Initial Value Problems) using Laplace Transforms.

Unit Step Function -Unit Impulse function

Unit V: Fourier Transforms **11+1 Hours**

Fourier Transforms: Fourier Integrals - Fourier Cosine and Sine Integrals - Fourier Transform- Sine and Cosine Transform – Properties-Inverse Fourier Transforms.

Finite Fourier Sine Transforms, Finite Fourier Cosine Transforms, Inverse Finite Fourier Transforms.

Textbooks:

1. Grewal. B. S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2018

Head of the Department

2. Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Education, 2018

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2015
2. Bali. N. P., "Engineering Mathematics", 22th Edition, Lakshmi Publications, 2018.
3. Peter O' Neil," Advanced Engineering Mathematics",8th Edition, Cengage, 2017.
4. Iyenger.T.K.V,Prasad.M.V.S.S.N, Ranganatham.S, KrishnaGandhi.B "Engineering Mathematics II& III ",S. Chand publications, 2nd Edition ,2019.

Web References:

1. https://nptel.ac.in/courses/122/102/122102009/
2. https://nptel.ac.in/courses/111/106/111106139/
3. https://nptel.ac.in/courses/111/102/111102129/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	50	40
L3	30	40
Total (%)	100	100

L1: Remember

1. Identify the root lies between which values for $x^3 - 5x + 1 = 0$
2. Prove that $(1+\Delta)(1-\nabla)=1$
3. Find the First difference of the polynomial $x^4-12x^3+42x^2-30x+9$ with interval of Differencing h=2.
4. Define unit step function
5. State Convolution theorem

L2: Understand

1. Find a real root of xtanx+1=0 using false position method.
2. Find a real root of the equation $xe^x-cosx=0$ using Newtons-Raphson method.
3. Use Gauss backward interpolation formula to find f(32) given that f(25)=0.2707 f(30)=0.3027 ,f(35)=0.3386, f(40)=0.3794
4. Using Lagrange's formula find the value of f(1) given that

x	-2	-1	2	7
y	-1	0	4	11

5. Find $\int_0^1 \frac{1}{1+x}$ dx by (i) Trapezoidal rule (ii) Simpsons $\frac{1}{3}$rd rule (iii) Simpsons $\frac{3}{8}$th rule.

L3: Apply

1. Using Newton Raphson method compute $\sqrt[3]{37}$ correct to 4 decimal places
2. Find $\sqrt{12}$ & $\frac{1}{\sqrt{12}}$ by the fixed point iteration method
3. The population of a nation in the decimal census was given below .Estimate the population in the year 1925 using appropriate interpolation formula

Year x	1891	1901	1911	1921	1931
Population y	46	66	81	93	101

4. Given that $Sin45^0$ =0.7077, $Sin50^0$ = 0.766, $Sin55^0$ =0.8192, $Sin60^0$ =0.866 find $Sin40^0$ using Newton's forward difference formula.
5. Solve $y'=y-x^2$,y(0)=1 using picard's method up to fourth approximation.

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PC 20EC302 Electronic Devices and Circuits

3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO3	PO10	
20EC302.1	Explain the operation and characteristics of PN junction diode and special diodes.	2	-	1	L1,L2
20EC302.2	Classify, Analyze and design different types of rectifiers.	1	3	2	L2,L3,L4
20EC302.3	Compute the flow of current in different configurations of the transistor.	1	-	2	L1,L2
20EC302.4	Demonstrate the concept of DC biasing and transistor stabilization leading to the design of amplifiers.	1	3	2	L2,L3,L4
20EC302.5	Design small signal low frequency transistor amplifiers.	1	3	2	L2,L3,L4

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Junction Diode Characteristics **12 Hours**

Open circuited PN junction, Biased PN junction, current components in PN junction Diode, diode current equation, V-I Characteristics, temperature dependence on V-I characteristics, Diode resistance, Diode capacitance, energy band diagram of PN junction Diode, Quantitative theory of PN junction diode.

Diode switching times, PN diode clipping circuits.

Unit II: Special Semiconductor Diodes and Rectifiers **12 Hours**

Zener Diode, Breakdown mechanisms, Zener diode applications, Construction, operation and characteristics of LED, Photo diode, Tunnel Diode, SCR, UJT. Operation, Derivations of parameters of rectifiers, Input and output waveforms of half wave rectifier, Full wave rectifier and bridge rectifier, Filters: Inductor filter, Capacitor filter, π filter, Comparison of various filter circuits in terms of ripple factors.

Liquid crystal display (LCD), Pin diode, LC filter.

Unit III: Transistor Characteristics **12 Hours**

BJT: Junction transistor, Transistor current components, Transistor equation, Transistor configurations, Transistor as an amplifier and characteristics of transistor in CB, CE and CC configurations, Ebers-Moll model of a transistor, Punch through/reach through, Photo transistor, Typical transistor junction voltage values.

FET: JFET- types, Construction, Operation, Characteristics and parameters, MOSFET-types, Construction, Operation and characteristics, Comparison between JFET and MOSFET.

Transistor switching times, FET working as voltage variable resistor.

Unit IV: Transistor Biasing and Thermal Stabilization **12 Hours**

Need for biasing, operating point, Load line analysis, BJT biasing methods, basic stability, fixed bias, collector to base bias, self bias, Stabilization against variations in VBE, Ic, and β, Stability factors, (S, S', S''), Thermistor and Sensistor bias compensation techniques, Thermal runaway, Thermal stability, JFET Biasing methods and stabilization.

Diode compensation technique, transistor compensation technique.

Unit V: Small Signal Low Frequency Transistor Amplifier Models **12 Hours**

BJT: Two port network, Transistor hybrid model, Determination of h-parameters, Conversion of h-parameters, Generalized analysis of transistor amplifier model using h-parameters, Exact and approximate analysis of CB, CE and CC amplifiers, Comparison of transistor amplifiers.

FET: Generalized analysis of small signal model, Analysis of CG, CS and CD amplifiers, Comparison of FET amplifiers.

Effects of emitter bypass capacitor (C_e) on low frequency response.

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Text Books

1. Lal Kishore K, "Electronic Devices and Circuits", 4th Edition, Bright Sky Publications, 2016.
2. Millman J, Christos C. Halkias, "Electronic Devices and Circuits", 4th Edition, Tata Mc-Graw Hill, 2010.
3. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 5th Edition, 2009.
4. Boylestad R.L. and Louis Nashelsky, "Electronic Devices and Circuits", 10th Edition, Pearson Publications, 2009.

Reference Books

1. Salivahanan S, Suresh Kumar N, Vallavaraj A, "Electronic Devices and Circuits", 2nd Edition, Tata Mc-Graw Hill, 2012.
2. Donald .A. Neamen, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill, 2010.
3. J. Millman, C. Halkias, "Integrated Electronics", 2nd Edition, Tata Mc-Graw Hill, 2009.
4. B. P. Singh, Rekha, Electronic Devices and Integrated Circuits, Pearson publications, 3rd Edition, 2009.
5. Mittal G.K., "Electronic Devices and Circuits", 3rd Edition, Khannan Publishers, 2008.

Web Resources

1. www.elprocus.com/p-n-junction-diode-theory-and-working/
2. http://fourier.eng.hmc.edu/e84/lectures/ch4/node3.html
3. http://nptel.ac.in/courses/117103063/11

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	20	20
L3	30	30
L4	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define cut-in Voltage
2. What is diffusion capacitance?
3. What is break down voltage?
4. List any three applications of SCR
5. Define pinch off voltage
6. What is rectifier?
7. Define ripple factor
8. Give any two applications of full wave rectifier
9. Give the classification of filters
10. Write any two disadvantages of half wave rectifier

L2: Understand

1. Draw and explain V-I characteristics of PN junction diode
2. Describe the construction and operation of tunnel diode
3. With neat circuit diagram describe the operation of bridge rectifier
4. Explain why Zener diode is used in reverse bias with the help of characteristics
5. Draw and explain the input and output Characteristics of Common base configuration
6. With neat sketches explain the V-I characteristics of NPN transistor in common emitter configuration
7. Write a short note on (i) Thermal Runaway (ii) Thermal stability
8. Explain the Drain and transfer characteristics of n-Channel JFET
9. With the help of diagram explain self bias method of JFET
10. Explain thermister compensation technique

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L3: Apply

1. Show that the efficiency of half wave rectifier is 40.6%
2. Show that the efficiency of full wave rectifier is 81.2%
3. Obtain an expression of stability factor for fixed bias
4. With suitable expressions explain self bias of BJT
5. Obtain the expression for voltage divider bias method of JFET
6. With the help of circuit diagram explain voltage divider bias method of JFET
7. Give the comparison of BJT, JFET and MOSFET
8. Obtain the expressions for voltage gain and current gain of small signal low frequency common emitter amplifier
9. Obtain the expressions for voltage gain and current gain of small signal low frequency common source amplifier

L4: Analyze

1. Derive the equation for ripple factor for half wave rectifier with capacitor filter
2. Determine the peak load voltage, peak current and power dissipation in a 495Ω load resistor connected to a bridge rectifier circuit that has a 26 V ac input. The rectifier diodes are germanium
3. Derive the equation for ripple factor of half wave rectifier with LC filter
4. Derive the expression for stability factor for voltage divider bias of BJT
5. Derive the expression for stability factor for self bias of JFET
6. For the fixed bias circuit R_B = 150 kΩ and R_B = 100 kΩ. Calculate I_B, I_C and V_{CE} if V_{CC} = 12 V, R_C = 1.1 kΩ and β = 100 and also state the region of operation
7. Analyse the h-parameters from transistor characteristics
8. Discuss the analysis for small signal model of JFET
9. Analyse the h-parameters of common base amplifier
10. Investigate the h-parameters of common drain amplifier

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PC 20EE303 Electrical Circuit Analysis

3 1 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO3	PO10	PSO 1	
20EE303.1	Demonstrate R-L-C circuits using different techniques.	3	3	2	1	L1,L2,L3
20EE303.2	Examine R-L-C circuits using Sinusoidal excitation and 3-Phase circuits with Balanced and Un-Balanced loads.	3	3	2	1	L1,L2,L3
20EE303.3	Illustrate the network theorems on electrical circuits.	3	3	2	1	L1,L2,L3
20EE303.4	Solve Two Port Networks and obtain different parameters for a given Two port Network.	3	3	2	1	L1,L2,L3
20EE303.5	Estimate the Transient behavior of electrical circuits using different approaches.	3	3	2	1	L1,L2,L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction to Electrical Circuits: **11+1 Hour**

Network elements classification, Electric charge and current, Electric energy and potential, Resistance parameter series and parallel combination, Inductance parameter series and parallel combination, Capacitance parameter series and parallel combination. Energy sources: Ideal, Non-ideal, Independent and dependent sources, Source transformation, Kirchhoff's Laws, Mesh Analysis and Nodal analysis, Principal of Duality with examples.

Basic Concepts of passive elements of R, L, C and their V-I relations.

Unit II: Single Phase AC Circuits and Three – Phase AC Circuits: **11+1 Hour**

R.M.S, Average Values and Form Factor for Different Periodic Waveforms: Sinusoidal Alternating Quantities. Phase and Phase Difference, Complex and Polar Forms Of Representations, j-Notation, Steady State Analysis of R, L and C (In Series, Parallel and Series Parallel Combinations) With Sinusoidal Excitation, Concept of Power Factor, Concept of Reactance, Impedance, Susceptance and Admittance-Real and Reactive Power and Complex Power.
Relation between Line and Phase Voltages and Currents, Measurement of Active and Reactive Power in Balanced and Unbalanced Three Phase Systems, Mutual coupled circuits.

Addition and subtraction of phasor, mathematical representation of sinusoidal quantities

Unit III: Network Theorems (DC & AC Excitation): **11+1 Hour**

Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Superposition Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem, Milliman's Theorem and Compensation Theorem for circuits with independent and dependent sources, Applications and Limitations of theorems

Tellegens Theorem

Unit IV: Two Port Networks **11+1 Hour**

Relationship of two port networks, Z-parameters, Y-parameters, Transmission line parameters, h-parameters, Inverse h-parameters, Inverse Transmission line parameters, Relationship between parameter sets, Parallel connection of two port networks, Cascading of two port networks, series connection of two port networks, problem solving including dependent sources also.

Concept of Duality and Dual Networks

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Unit V: Transient Analysis in DC and AC circuits **11+1 Hours**

Transient response of R-L, R-C, R-L-C circuits using AC & DC excitations, solution using differential equations and Laplace transforms.

Solutions using Laplace transform method.

Textbooks

1. Alexander K and Mathew N.O.Sadiku, "Fundamentals of Electrical Circuits", 6th Edition, McGraw Hill Publications 2019
2. ME Van Valkenburg, "Network Analysis", 3rd Edition, Prentice Hall of India, 2000

Reference Books

1. Abhijit Chakrabarti, "Circuit Theory Analysis and Sythesis", 6th edition, Dhanpat Rai & Co., 2014
2. William Hayt and Jack E. Kemmerley, "Engineering Circuit Analysis", 6th edition, McGraw Hill Company, 2015
3. Sudhakar and Shyammohan S Palli, "Circuits & Networks", 5th Edition, Tata McGraw – hill Higher Education, , 2015

Web References:

1. https://nptel.ac.in/courses/108/106/108106172/
2. https://nptel.ac.in/courses/108/104/108104139/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	30	30
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

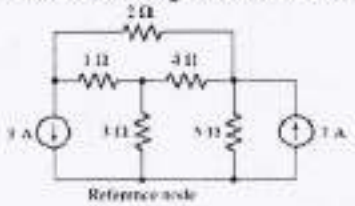
1. Classify the Network elements
2. Define Source Transformation with an example
3. State Principle of Duality
4. State Maximum Power transfer theorem and Compensation Theorem
5. Define Time constant of RL circuit

L2: Understand

1. Explain the Transient response of RC circuit for AC excitation
2. Explain the concept of Impedance and Power Factor
3. Explain the Types of Energy Sources
4. Discuss the Principle of Duality
5. Explain the Cascading of Two port networks

L3: Apply

1. For the circuit shown in figure, determine the voltage across each current source



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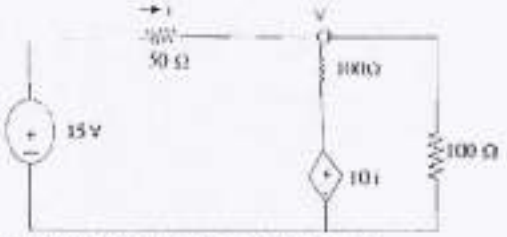
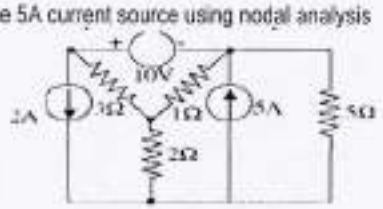
2. Using source transformation, find the voltage V in the circuit shown in figure



3. Find the power delivered by the 5A current source using nodal analysis



4. A resistance of 12 Ω and an inductance of 0.025 H are connected in series across a 50 Hz supply. What values of resistance and inductance when connected in parallel will have the same resultant impedance and pf? Find the current in each case when the supply voltage is 230 V?
5. Two inductively coupled coils have self inductances L1= 50mH and L2= 200mH. If the coefficient of coupling is 0.5 i) find the value of mutual inductance between the coils and ii) what is the maximum possible mutual inductance?

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PC **20EE304 DC Machines and Transformers** 3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping of PO's			DoK
		PO2	PO3	PSO 1	
20EE304.1	Understand the principle of electromagnetic energy conversion	-	-	3	L1, L2
20EE304.2	Evaluate the performance characteristics of various DC generators based on excitation	3	1	1	L1,L2,L3,L4
20EE304.3	Evaluate the performance characteristics of various DC Motors based on excitation	3	1	1	L1,L2,L3,L4
20EE304.4	Brief the construction of transformers, its Losses and regulation	1	1	1	L1, L2
20EE304.5	Design of three phase transformers to achieve phase conversion	2	3	1	L1,L2,L3,L4

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Po s

L1: Remember | L2: Understand | L3: Apply | L4: Analyse | L5: Evaluate | L6: Create, DoK : Depth of Knowledge

Unit I: Principles of Electromechanical Energy Conversion **11+1 Hour**

Energy in magnetic system, field energy and mechanical force, multiply-excited magnetic field systems, forces/torques in systems with permanent magnets, energy conversion via electric field, dynamical equations of electro mechanical systems

permanent magnets, and applications of permanent magnet materials.

Unit II: DC Generator **11+1 Hour**

Constructional details Principle of operation, Armature winding Lap & Wave, Emf equation, Methods of excitation, Armature Reaction

Characteristics of D.C. Generators: O.C.C, internal-external characteristics, losses-power flow, efficiency calculation

Purpose Equalizer rings, Different methods of commutation

Unit III: DC Motors: **11+1 Hour**

Principle of operation of DC motors, Back EMF, Torque equation, Types of DC motors, Speed-Torque characteristics of DC motors

Speed Control & Testing of DC Machines:

Starting of DC motors: 3-point starter, 4-point starter, Losses and efficiency, Condition for maximum efficiency, Speed control methods, Brake test, Swinburne's test, Retardation test, Hopkinson's test, fields test, application of DC motors to industries

Separation of iron and frictional losses

Unit IV: Transformers I **11+1 Hour**

Constructional features, Principle of operation, , EMF equation, Transformer on No load and Load Phasor diagram, equivalent circuit, Regulation, losses and efficiency, transformer cooling-natural cooling and forced cooling.All day efficiency.

polarity test, back-to-back test

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Unit V: Transformers II **11+1 Hour**

Open circuit and short circuit test, Sumpner's test, parallel operation, separation of core losses test, auto transformers, 3-Ø transformer connections, Scott connection

applications and comparison with two winding transformers, phase conversion topics

Text Books

1. Bhimbra P.S. "Electrical Machines", 4th Edition, Khanna Publishers, 2015
2. Theraja B.L., Theraja A.K., "A Textbook Of Electrical Technology: AC And DC Machines", volume 2, S Chand, 1999
3. A.E.Fitzgerald, Charles kingsley, Stephen D.Umans "Electric Machinery", 6th Edition, Tata McGraw- Hill 2013

Reference Books

4. Kothari D. P., Nagarth I .J., "Electrical Machines", 4th edition, Mc Graw Hill Publications, 2010
5. Rajput R.K. "Electrical Machines", 5th edition, Lakshmi publications, 2016
6. Mulukutla S.Sarma & Mukesh k.Pathak "Electric Machines", 4th Edition, CENGAGE Learning, 2012
7. Guptha J.B., "Theory & Performance of Electrical Machines", 6th Edition, S.K.Kataria & Sons, 2008

Web References

1. https://nptel.ac.in/courses/108/105/108105017/
2. https://www.youtube.com/watch?v=AECBgmkWvo0&list=PLbMVogVj5Nqbg9353J1uq5Fnq4m1Ygxl

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	30
L3	30	40
L4	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is a back e.m.f? Why the e.m.f generated in the armature of a DC motors is called back emf
2. Discuss briefly the principle of energy conversion
3. List any three advantages of three – phase transformer over three single – phase transformers
4. Define voltage regulation of a transformer
5. Why OC test is performed on LV side of a single phase transformer?
6. Define all day efficiency of a single phase transformer?
7. Write the applications of series, shunt and compound DC motors
8. Why is armature control superior to field control scheme in case of a DC shunt motor
9. Why the main flux in a transformer is remains practically constant from no load to full load

L2: Understand

1. A 6-pole lap wound DC generator has 720 conductors; a flux of 80 mWb/poleis driven at 1000 rpm. Find the generated e.m.f.
2. Explain what would happen if the DC Motor is directly switched on to the supply without any starter

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3. Distinguish between core type and shell type transformers
4. Explain the concept of Scott connection (three phase to two phase) conversion with a neat circuit diagram
5. Explain the effects of third harmonic component in a three phase transformer
6. Explain with relevant diagrams, the different methods of excitation of DC machines
7. Explain the speed torque characteristics of DC shunt, series and cumulative compound motors
8. Derive the emf equation of a transformer
9. Explain the significance of swinburne's test on dc machine?
10. Explain the necessity of commutating poles and compensating windings in a dc machine?
11. Explain the significance of interpoles in DC machines?

L3: Apply

1. Calculate (i) the total torque developed (ii) the useful torque of a 250 V, 4 pole series motor with 782 wave connected conductors developing 8 kW and taking 40 A with a flux per pole of 25 mWb. The armature resistance of the motor is 0.75 ohms
2. In a retardation test on a D.C motor, with its field normally excited, the speed fell from 1525 to 1475 in 25 seconds. With an average load of 1 kW supplied by the armature, the same speed drop occurred in 20 seconds. Find the moment of inertia of the rotating parts in kg.m2?
3. In a 400 V, 50 Hz transformer, the total iron loss is 2300 W. When the supply voltage and the frequency reduced to 200 V and 25 Hz respectively the corresponding loss is 800 W. Calculate the eddy current loss at normal voltage and frequency
4. A 2-winding 10 kVA, 440/110 V transformer is reconnected as a step-down 550/440 V autotransformer. Compare volt-ampere rating of the autotransformer with that of original 2-winding transformer. Calculate power transferred to the load: (i) inductively (ii) conductively
5. A balanced 3-phase, 100 kW load at 400V and 0.8 p.f. lag is to be obtained from a balanced 2-phase, 1100V lines. Determine the kVA rating of each unit of the Scott-connected transformer
6. A 20 kW, 250 V, 6 pole lap connected dc generator runs at 1250 rpm. Armature has 550 conductors. For full load armature – ohmic loss of 250 W, find the useful flux per pole. Take 2 V as the brush drop at full load
7. A DC series motor, with unsaturated magnetic circuit and negligible resistance, when running at a certain speed on a given load, takes 60 A at 600 V. If the load torque varies as the cube of the speed, find the resistance to be inserted to reduce the speed by 50 %.
8. A 4.5 kVA, 400/210 V,50 Hz single phase transformer has the following test data
   O.C. test (l.v.side) 210V, 1A,70 W
   S.C. test (h.v.side) 15 V, 10.8A, 100 W
   Calculate (i) Equivalent circuit referred to l.v side and
   (ii) Secondary load voltage on full load at 0.8 power factor lagging
   (iii) Efficiency of transformer at ¾ th load and 0.7 power factor (lag).
9. A balanced 3-phase, 250 kW load at 415 V and 0.86 power factor lagging is to be supplied from a two – phase 1100 V supply. Determine voltage and current rating of each winding of scott connected transformers and kVA rating of each unit.
10. A 8 kW, 220 V, 4 – pole wave connected dc motor has 450 armature conductors. At full load, the useful flux per pole is 0.023 Wb and rotational losses are 110 W. Find the full load speed

L4: Analyse

1. In a DC generator, if the load increases the flux per pole decreases. Justify the statement
   How can determine the direction of rotation of a DC motor? And also explain how to change the direction of rotation?
2. Analyse the condition for maximum efficiency of any DC machine?
3. Draw and Analyse the load characteristics of a separately-excited dc generator
4. Analyse the purpose of using equalizing bars in parallel operation
5. Indirect test is superior to the direct test justify this statement with proof
6. A 22.38 kw, 440 V, 4-pole wave wound D.C. shunt motor has 840 armature conductors and 140 commutator segments. Its full-load efficiency is 88% and the shunt field current is 1.8 A. If brushes are shifted backwards through 1.5 segments from the geometrical neutral axis, find the demagnetizing and distorting amp-turns/pole
7. A 500 kw, 500 V, 10 pole d.c. generator has a lap wound armature with 800 conductors. Calculate the number of pole face conductors in each pole of a compensating winding if the pole face covers 75 percent of pole pitch
8. Two shunt generators A and B operate in parallel and their load characteristics may be taken as straight lines. The voltage of A falls from 240 V at no-load to 220 V at 200 A, while that of B falls from 245 V at no-load to 220

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V at 150 A. determine the current which each machine supplies to a common load of 300 A and the bus bar voltage at this load

9. In d.c. machine the total iron losses is 8 kw at its rated speed and excitation. If excitation remains the same, but speed is reduced by 25%, the total iron loss is found to be 5 kw. Calculate the hysteresis and eddy current losses at (i) full speed (ii) half the rated speed

10. Two generators each having no load voltage of 500 V, are connected in parallel to a constant resistance load consuming 400 kw. The terminal p.d. of one machine falls linearly to 470 V as the load is increased to 850 A while that of the falls linearly to 460 V when the load is 600 A. find the load current and voltage of each generator. If the induced e.m.f. of one machine is increased to share load equally find the new current and voltage

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PC 20EE305 Power Generation and Transmission 3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO2	PO7	PO10	PSO1	
20EE305.1	Identify the different components of thermal, Hydro, and nuclear power plants	-	1	1	1	L1
20EE305.2	Explain different types of load curves and tariffs applicable to consumers	-	-	-	3	L1 - L3
20EE305.3	Design the transmission line parameters for three phase, single and double circuit lines	3	3	2	1	L1 - L3
20EE305.4	Analyse the transmission lines and represent them by suitable equivalent circuits	2	1	1	1	L1 - L3
20EE305.5	Demonstrate sag/tension of transmission lines and performance of line	3	3	2	1	L1 - L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Conventional Power Generating Systems 12 Hours

Thermal Power: Block Diagram of Thermal Power Station (TPS), Brief Description of TPS Components. Hydro Power: Selection of Site, Classification, Layout, Description of Main Components. Nuclear Power: Nuclear Fission and Chain Reaction-Principle of Operation of Nuclear Reactor - Description of Main Components.

Fundamentals of electromechanical energy conversion, Combined cycle power plants

Unit II: Economic Aspects of Power Generation & Tariff 12 Hours

Economic aspects - Load curve, load duration and integrated load duration curves, discussion on economic aspects: connected load, maximum demand, demand factor, load factor, diversity factor, power capacity factor and plant use factor, Base and peak load plants. Tariff methods - Costs of generation and their division into fixed, semi-fixed and running costs, desirable characteristics of a Tariff method. Tariff methods: simple rate, flat rate, block-rate, two-part, three–part, and power factor tariff methods.

Basic concepts of power and energy

Unit III: Transmission Line Parameters 12 Hours

Types of conductors, calculation of resistance for solid conductors, Gauss law, Ampers Law, calculation of inductance for single phase and three phase, concept of GMR & GMD, symmetrical and asymmetrical conductor configuration with and without transposition, calculation of capacitance for 2-wire and 3-wire systems, effect of ground on capacitance, capacitance calculations for symmetrical and asymmetrical-single and three phase circuits, numerical problems.

R, L, C parameters and their definitions, Ferranti, Skin and proximity effects

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Unit IV: Modelling of Transmission Lines **12 Hours**

Classification of transmission lines, models and their representations, nominal-T, nominal- π and A, B, C, D constants, mathematical solutions to estimate regulation and efficiency of all types of lines, long transmission line-rigorous solution, evaluation of A, B, C, D constants, interpretation of the long line equations, surge impedance and surge impedance loading (SIL), skin effect, Ferranti effect, proximity effect charging current, numerical problems.

Fundamentals of voltage regulation and efficiency, ABCD parameter calculations

Unit V: Sag and Tension Calculations and Overhead Line Insulators **12 Hours**

Sag and Tension calculations with equal and unequal heights of towers–Effect of wind and ice on weight of conductor–Numerical problems–Stringing chart and sag template and its applications–Types of insulators–String efficiency and methods for improvement-Numerical problems – Calculation of string efficiency

Properties of insulators, Grading of Insulators

Text Books

1. Soni M.L., Gupta P.V., Bhatnagar U.S. and Chakrabarti A, "A Text Book on Power System Engineering", 4th Edition, Dhanpat Rai & Co. Pvt. Ltd., 2016
2. Wadhawa C.L., "Generation, Distribution and Utilization of Electric Energy", 3rd Edition, New age International Pvt. Ltd.,2015
3. Nagarath I.J. and Kothari D.P., "Modern Power System Analysis", 2nd Edition, Tata McGraw Hill, , 2003

Reference Books

1. Kamaraju V, "Electrical Power Distribution Systems",8th Edition, Tata McGraw Hill, New Delhi, 2009
2. Deshpande M.V., "Elements of Electrical Power Station Design" 8th Edition, Prentice Hall India, New Delhi 2009
3. John J Grainger and William D Stevenson, "Power System Analysis", 4th Edition, Tata McGraw Hill, 2014
4. Gupta B.R., "Power System Analysis and Design", 4th Edition, Wheeler Publishing, 2005
5. Murthy P.S.R, "Electrical Power Systems", 3rd Edition, B. S. Publications, 2019

Web References

1. https://nptel.ac.in/courses/108/102/108102047/
2. https://www.digimat.in/nptel/courses/video/108102047/L01.html
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-061-introduction-toelectric-power-systems-spring-2011/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	30
L3	20	30
L4	-	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is the meaning of travelling surges?
2. What is the importance of surge impedance?
3. What is the wavelength and velocity of propagation?
4. What is meant by Skin and Proximity effects?
5. What is meant by the Ferranti effect?

L2: Understand

1. Give the reasons why the lightning is a severe power system transient

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2. Explain the concept of attenuation of travelling waves
3. Explain the various properties of corona and derive the expression for power loss due to corona
4. On which parameters the variation of conductor tension depends?
5. Explain string efficiency. Why is it necessary to have high string efficiency?

L3: Apply

1. A three phase, 220 kV, 50 Hz transmission line consists of a 1.2 cm radius of conductor spaced 2 m apart as an equilateral triangle configuration. Calculate disruptive critical voltage between the lines. Irregularity factor = 0.96, temperature= 25°, barometric pressure = 72.2 cm of Hg. Dielectric strength of air = 21.1 KV (rms)/cm. Also calculate corona power loss
2. A 3 phase 220 kV, 50 Hz transmission line consists of a 30 mm diameter conductor 2.51m apart in the form of an equilateral triangle. If the temperature is 38°C and atmospheric pressure is 76 cm. Find the corona loss per km of the line? The irregularity factor is 0.83 and the stress is 21.21kV/cm
3. Calculate the inductance of a conductor per phase of a three phase, three-wire system. When the conductors are arranged at the corners of an equilateral triangle of 3.5 m sides and the diameter of each conductor is 2 cm
4. A single phase line has two pairs of conductors each pair comprises two 1.25 cm diameter conductors in parallel spaced vertically and 75 cm apart. But two parallel parts are spaced laterally by a distance of 1.5 m. Calculate the inductance of the line per km. Assuming current to be equal distributed
5. A single phase transmission line delivers 1 MVA at a power factor of 0.71 lagging, 22 kv, 50 Hz. The loop resistance is 15 ohms and inductance is 0.2H and capacitance is 0.5 microfarad. Find a) the voltage (b) the current (c) the power factor at sending end using nominal pi method

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PC 20EC306 Electronic Devices and Circuits Lab 0 0 3 1.5

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO4
20EC306.1	Identify and Demonstrate different semiconductor devices and measuring instruments.	3
20EC306.2	Experiment with the semiconductor devices and observe the characteristics.	3
20EC306.3	Design and analyse different types of rectifier circuits using PN Junction Diodes and interpret the results.	3
20EC306.4	Summarize the characteristics of BJT and FET.	3
20EC306.5	Design different amplifiers and evaluate their frequency responses.	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

List of Experiments

1. Identification, Specifications and Testing of active devices, passive devices (Diodes, BJTs, JFETs, LEDs, LCDs, SCR, UJT).
2. Study the operation of Ammeters, Voltmeters, Transformers, Analog and Digital Multimeter, Function Generator, Regulated Power Supply and CRO.
3. P-N Junction Diode V-I Characteristics (Forward bias & Reverse bias).
4. Zener Diode as voltage regulator.
5. Half-wave Rectifiers (without and with c-filter).
6. Full-wave Rectifiers (without and with c-filter).
7. BJT Input & Output Characteristics (CE Configuration & CB Configuration).
8. FET Drain & Transfer Characteristics (Common Source Configuration).
9. SCR Characteristics.
10. UJT Characteristics.
11. BJT CE Amplifier.
12. Emitter Follower - CC Amplifier.
13. FET Amplifier (Common Source Configuration).

References

1. Lab Manual for Electronic Devices and Circuits Lab of Electronics and Communication Engineering, NSRIT

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PC 20EE307 DC Machines & Transformers Lab **0 0 3 1.5**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO4
20EE307.1	Determine the Characteristic of DC motor and generator	3
20EE307.2	Estimate various losses in DC machines and transformers	3
20EE307.3	Differentiate between various control methods for DC motors	3
20EE307.4	Identify and compute safe operating limits for machines	3
20EE307.5	Obtain three phase to two phase transformation	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Po's

List of Experiments

1. Magnetization characteristics of DC shunt generator.
2. Brake test on DC shunt motor.
3. Speed control of DC shunt motor by Field and Armature Control.
4. OC & SC test on single phase transformer.
5. Sumpner's test on single phase transformer.
6. Parallel operation of Single-phase Transformers
7. Separation of core losses of a single-phase transformer
8. Hopkinson's test on DC shunt machines.
9. Swinburne's test and Predetermination of efficiencies as Generator and Motor.
10. Separation of losses in DC shunt motor.
11. Scott connection of transformers
12. Load test on DC series generator
13. Load test on DC compound generator

References

1. Lab Manual for DC Machines & Transformers, Department of Electrical and Electronics Engineering, NSRIT
2. Fitzgerald A.E., Charles Kingsley, Stephen.D.Umans, 'Electric Machinery', 6th Edition, Tata McGraw Hill Publishing company Ltd, 2008.
3. Gupta J.B.,, 'Theory and performance of Electrical Machines', 6th Edition, S.K.Kataria and sons, 2008

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PC 20EE308 Electrical Circuit Analysis Lab

0 0 3 1.5

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO4
20EE308.1	Apply various theorems for simplifying both AC and DC circuits	3
20EE308.2	Assess the time response of series RL and RC circuits	3
20EE308.3	Determine the coefficient of coupling for given single-Phase transformer	3
20EE308.4	Evaluate various two port network parameters of an electric circuit	3
20EE308.5	Assess the Reactive and Active Power for the given star/delta connected loads.	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective PO's

List of Experiments

1. Verification of Thevenin's and Norton's Theorems.
2. Verification of superposition theorem and maximum power transfer theorem
3. Verification of compensation theorem
4. Verification of reciprocity, Millmann's Theorems
5. Determination of time constants of R-L, R-C, R-L-C networks.
6. Series and parallel resonance
7. Determination of self, mutual inductances and coefficient of coupling
8. Determine Z and Y Parameters
9. Determine the Transmission and hybrid parameters
10. Measurement of Reactive Power for Star and Delta connected Un-Balanced Loads.
11. Measurement of 3-phase Average power by two Wattmeter method for unbalanced loads

References

1. Lab Manual for Electrical Circuit Analysis Lab, Department of Electrical and Electronics Engineering, NSRIT
2. Subhransu Sekhar Dash & Vijayakumar, "Electrical Engineering Practice Lab Manual", 1st Edition, Vijay Nicole Imprints Pvt. Ltd., 2013.
3. Jeyapovan.T, Saravanapandian.M and Pranitha.S, "Engineering Practices Lab Manual", 5th Edition, Vikas Publishing House Pvt. Ltd., 2009.

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SC 20EES01 MATLAB

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO5
20EES01.1	Learn the basic MATLAB commands	3
20EES01.2	Apply basic knowledge of on matrices, vectors	3
20EES01.3	Develop user- defined functions Loops ,Branches and other control Statements	3
20EES01.4	Solve mathematical problems using MATLAB programming	3
20EES01.5	Analyse electric networks using MATLAB	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

List of Experiments

Part-I: Introduction and theory

1. Introduction to MATLAB
2. MATLAB environment (command window, command history, workspace etc.)
3. Using the help system in MATLAB

Part-II: Practical experiments

4. MATLAB basics (operation, arrays, vectors, matrices)
5. Introduction to Linear algebra and different operations on vectors and matrices
6. Creation of M-files, scripts and user-defined functions
7. Plotting using MATLAB
8. Flow control and loops in MATLAB
9. Basic Math functions (trigonometry functions, complex numbers etc.)
10. Introduction to MATLAB Simulink.
11. Analyse performance of electric networks to determine parameters.
12. Application of network theorems using MATLAB/Simulink
13. Solving numerical methods using MATLAB programming.

Text Books

1. Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma, "MATLAB and its Applications in Engineering",2nd Edition ,Pearson Education,2012
2. Steven C Chapra, "Applied Numerical Methods with MATLAB for Engineers and Scientists", 3rd edition, Mc Graw Hill,2016

Reference Books:

1. Andrew Knight, "Basics of MATLAB and Beyond", Chapman & Hall/CRC

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2. Rudra Pratap, "Getting Started with MATLAB : A Quick Introduction for Engineers and Scientists", 7th Edition ,Oxford University Press .

3. Stephen J Chapman, "MATLAB Programming for Engineers", 6th Edition, Cengage India Learning Pvt. Ltd

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20MCX02 Constitution of India

2 0 0 0.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO2	PO12	
20MCX02.1	Summerizing the basic features and modalities about Indian Constitution	3	3	1	L1
20MCX02.2	Identify the Indian Federalism and Panchayath Raj systems in Indian Constitution	3	3	1	L1
20MCX02.3	Identify the Legislature and Judiciary systems in Indian Constitution	3	3	1	L2
20MCX02.4	Interpreting the political system that exists in India	3	3	1	L1, L2
20MCX02.5	Categorising the contemporary issues in global politics and Election commission in India	3	3	1	L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Indian Constitution — 10 Hours

Meaning of the Indian Constitution, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947, Indian Constitution and its Salient Features, The role of B. R. Ambedkar in the making of the Indian Constitution,The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional,The Historical Perspectives of the Constitutional Amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency and Local Self Government – Constitutional Scheme in India.

Unit II: Indian Federalism — 10 Hours

Meaning and Definition of Federalism, Structure and Features of Indian Federalism, Difference between Indian and Federation of other States, Difference between Federal and Unitary Features, Critical Evaluation of the Indian Federal System, Decentralisation of Powers, Centre-State Relations, 73rd Amendment, Panchayath Raj Institutions.

Unit III: Union Government — 10 Hours

Powers of Indian Parliament, Functions of Rajya Sabha and Lok Sabha, Powers and Functions of the President, Powers and Functions of the Prime Minister. Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Lok Pal and Lok Ayukta, The Lokpal and Lokayuktas Act 2013.

Unit IV: Challenges to Indian Political System — 10 Hours

Caste: A General Overview of the Indian Scenario,The Caste Issues in the Pre Independence Period, Gandhi Ambedkar Debate and the Poona Pact.The Politics of Caste in the Post Independence Period, Mandal Commission Reservation Policy in Government Jobs.The History of Communalism in India, The Concept of Terrorism and its Emergence in the Global Phenomenon since the End of Cold War.

Unit V: India's External Relations and Election Commission — 10 Hours

Cold War and Post Cold War Era, Foreign Policy, Indian and its Neighbours, India's Extended Neighbourhood in West Asia and South East Asia. India's Relations with the United States and Russia, India and the World Organisations, India in the 21st Century. Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission, Functions of Commissions for the welfare of SC/ST/OBC and women.

Text Books

1. Austin G., "Working of a Democratic Constitution of India", Oxford University Press, New Delhi, 2004
2. Basu D. D., "An Introduction to the Constitution of India", Prentice Hall, New Delhi, 2005
3. Chandhoke N. and Priyadarshini, "Contemporary India: Economy, Society, Politics", Oxford University Press, New Delhi, 2009
4. Jayal N. G. and Maheta P. B., Oxford Companion to Indian Politics", Oxford University Press, New Delhi, 2010
5. Vanaik A. and Bhargava R. "Understanding Contemporary India: Critical Perspectives", Orient Blackswan, New Delhi, 2010

Reference Books

1. Noorani A. G., "Constitution Questions in India: The President, Parliament and the States", Oxford University Press, New Delhi, 2000
2. Chakravarthy B. and Pandey K. P., "Indian Government and Politics", Sage Publications, New Delhi, 2006
3. Bajpai. Kanti and Pant V. Harsh, "India's Foreign Policy: A Reader", Oxford University Press, New Delhi, 2013
4. Laxmikanth M., "Indian Polity for Civil Services Examinations", Tata McGraw Hill, New Delhi, 2016
5. Singh M. P. and Saxena R., "Indian Politics: Contemporary Issues and Concerns", PHI Learning, New Delhi, 2008

Web References

1. https://en.wikipedia.org/wiki/Federalism.in.India
2. https://legislative.gov.in/constitution-of-india
3. https://en.wikipedia.org/wiki/Foreign_relations_of_India
4. https://en.wikipedia.org/wiki/Government_of_India

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HS 20HSX03 Managerial Economics and Financial Analysis 3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO11	PO12	DoK
20HSX03.1	Understand the theoretical concepts of managerial economics to make decisions for business problems	3	1	L1, L2
20HSX03.2	Gain adequate theoretical knowledge on microeconomics concepts to perform successful business operations	3	1	L1, L2
20HSX03.3	Understand the basic accounting principles and capital formation and planning	3	1	L1, L2
20HSX03.4	Apply accounting concepts to analyze financial strength of business	3	1	L3, L4
20HSX03.5	Gain theoretical knowledge on the entrepreneurship management and types of firms	3	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Managerial Economics and Demand Analysis 9 Hours

Definition of Managerial Economics – Scope of Managerial Economics and its Relationship with other Subjects – Concept of Demand, Types of Demand, Determinants of Demand- Demand Schedule, Demand Curve, Law of Demand and its Limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement - Demand Forecasting and Methods of Forecasting.

Role of Managerial Economist, Law of Supply

Unit II: Production and Cost Analysis 9 Hours

Theory of Production: Meaning and Factors of Production, Production Function with One Variable Input (Law of Variable Proportion), With Two Variable Inputs (Law of Returns to Scale) Theory of Cost: Different Cost Concepts and Different Relations between Cost and Output in Short Run and Long Run. Managerial uses of Revenue and Cost Concepts Break-Even Point). Pricing Strategies.

Economies of Scale and Diseconomies of Scale

Unit III: Introduction to Accounting and Financial Planning 9 Hours

Financial Accounting - Concepts and Conventions – Double Entry System – Preparation of Journal, Ledger and Trial Balance – Preparation of Final Accounts: Trading, Profit and Loss Account and Balance Sheet.
Capital and Capital Budgeting: Capital Budgeting: Meaning of Capita l - Capitalization - Meaning of Capital Budgeting - Time Value of Money - Methods of Appraising Project Profitability - Traditional Methods and Modern Methods.

Branches of Accounting, Concept of Working Capital

Unit IV: Financial Analysis through ratios 9 Hours

Computation, Analysis and Interpretation of Liquidity Ratios (Current Ratio and Quick Ratio), Activity Ratios (Inventory Turnover Ratio and Debtor Turnover Ratio), Capital Structure Ratios (Debt - Equity Ratio, Interest Coverage Ratio) and Profitability Ratios (Gross Profit Ratio, Net Profit Ratio,Operating Ratio, P/E Ratio and EPS).

Cash Flow Statement and Funds Flow Statement (Theory Only)

Unit V: Introduction of Entreprenuership and New Economic Environment 9 Hours

Definition of Entrepreneur and Entreprenuership, Internal and External Factors; Types of Entrepreneurs; Classification of Entrepreneurship.
Characteristic Features of Business, Features and Evaluation of Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises, Changing Business Environment in Post - Liberalizations Scenario.

Industrial Policy 1991

Text Books

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1. Appa Rao N., Vijay Kumar P., "Managerial Economics and Financial Analysis", Cengage Publications, New Delhi, 2011
2. Siddiqui S. A. and Siddiqui A. S., "Managerial Economics and Financial Analysis", New Age International Publishers, 2012
3. Kuberudu B. and Ramana T. V., "Managerial Economics and Financial Analysis", Himalaya Publishing House, 2014
4. Aryasri A. R., "Managerial Economics and Financial Analysis", Tata Mcgraw Hill, 2011

Reference Books

1. Maheswari V., "Managerial Economics", Sultan Chand, 2014
2. Suma Damodaran, " Managerial Economics", Oxford, 2011
3. Varitha Agarwal, " Managerial Economics", Pearson Publications, 2011
4. Sanjay Dhameja, "Financial Accounting for Managers", Pearson Publications, 2011
5. Maheswari V., "Financial Accounting", Vikas Publications, 2012
6. Dominick Salvatore, "Managerial Economics: Principles and World Wide Application", 7th Edition, Oxford University Press, 2012

Web References

1. https://btechgeeks.com/mefa-notes/#google_vignette
2. https://www.smartzworld.com/notes/managerial-economics-and-financial-analysis-pdf-notes-mefa
3. https://www.scribd.com/document/259129127/Mefa-course-plan
4. https://www.coursera.org/browse/business/entrepreneurship

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	20	20
L3	20	20
L4	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Managerial Economics?
2. What is meant by Elasticity of demand? How do you measure it?
3. Define different product curves
4. Define Accounting
5. Define Partnership

L2: Understand

1. Explain the role of a Managerial Economist in a Business firm
2. Explain the concept cross elasticity of demand. Illustrate your answer with suitable examples
3. Explain the formation of a Joint Stock Company
4. Distinguish between a partnership and a joint stock company
5. Explain accounting principles

L3: Apply

1. Journalise the following transactions
   2013 Jan 1st ABC Firm commenced business with Rs.40000
   Jan 2nd Deposited into bank Rs.30000
   Jan 3rd Bought goods worth Rs.48000 from Kamala
   Jan 4th Sold goods worth Rs.60000
2. Calculate Net Profit Ration from the following data
   Sales returns Rs.100000 Administration expences Rs.10000

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Gross Profit Rs.40000 Selling experces Rs.10000
Income from investment Rs.5000 Loss on account of fire Rs.3000

3. From the following particulars findout
   Selling price Rs.200 per unit
   Variable cost Rs.100 per unit
   Total fixed cost Rs.96000
   i) Break even units and values
   ii) Sales to earn a profit Rs.20000
4. The following are the Ratios related to XYZ Limited company.
   Inventory holding period 2 months
   Gross profit ration 25 %
   Gross profit for the current year announced Rs.200000
   Closing stock is excess of Rs 40000 over opening stock. Findout
   A) Sales
   B) Cost of goods sold
   C) Closing stock
   D) Opening stock

L4: Analyze

1. A Project cost is Rs.144000. The average annual cash inflows are likely to be Rs.45000 for a period of 5 Years calucalte IRR for the project
2. The cost of project is Rs.50000 The annual cash iunflows for the next 4 years are Rs.25000 what is the PBP for the project
3. A firm is considering two different investment options A & B detailes of both the options are given below (Rs. in Lakhs)

	Investment cost	Inflow 1	Inflow 2	Inflow 3
Option A	(25)	10	10	12
Option B	(40)	15	20	24

4. ARR method (ARR on original investment)
   Inintial investment Rs.1200000

Year	Cashinflows (Rs)	
	Project A	Project B
1	600000	500000
2	500000	300000
3	200000	200000
4	-	300000

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BS 20BSX15 Probability and Statistics 3 1 0 3.0

At the end of the course, students will be able to

	Course Outcomes	Mapping with POs PO1	PO12	DoK
20BSX15.1	Classify the concepts of Statistics and its importance and Interpret Measures of Central Tendency and Dispersion of Data	3	1	L1, L2, L3
20BSX15.2	Identify the suitable discrete and continuous probability distributions to solve various engineering problems	3	1	L1, L2, L3
20BSX15.3	Identify the estimation errors in sampling distributions	3	1	L1, L2, L3
20BSX15.4	Apply the proper test statistics to test the hypothetical data by Tests of Hypothesis	3	1	L1, L2, L3
20BSX15.5	Apply the method of least squares, correlation and regression analysis to fit the curves	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Descriptive statistics methods. **11+1 Hours**

Introduction to Statistics- Population vs Sample -Collection of data primary and secondary data- Data visualization, Measures of Central tendency, Measures of Variability (spread or variance)- Skewness-Kurtosis.

Measures of Dispersion – Range – Quartile Deviation

Unit II: Probability and Probability Distributions. **11+1 Hours**

Review of probability- Conditional probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution function – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

Moment generating function

Unit III: Sampling Theory. **11+1 Hours**

Introduction – Population and samples – Sampling distribution of Means and variances(Definitions only) – Central limit theorem (without proof) -Introduction to Student's t- Distribution, Chi-square Distribution and F- Distribution Point and Interval Estimations Maximum error of estimate.

Introduction to Sampling, parameters, statistics.

Unit IV: Tests of Hypothesis. **11+1 Hours**

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Large samples: Tests concerning one mean and two means - Small samples:
Student t-distribution (test for single mean, two means and paired t-test) - Chi-square test for Single variance- Chi-square - Test for goodness of fit

Test for single proportion, difference of proportions (large samples)

Unit V: Curve fitting, Correlation and Regression **11+1 Hours**

Curve fitting: Method of least squares – Straight line – Parabola – Exponential – Power curves.
Correlation: Correlation – correlation coefficient – rank correlation – regression coefficients and properties – regression lines.

Power curves by the method of least squares

Textbooks:

1. Miller and Freund J. E, "Probability & Statistics for Engineers", 9th Edition, Prentice Hall of India, 2011.
2. Iyenger.T.K.V, Prasad.M.V.S.S.N, Ranganatham.S, KrishnaGandhi.B "Probability & Statistics", 2nd Edition, S. Chand publications, 2019.

Reference Books:

1. Arnold O. Allen, "Probability & Statistics", Academic Press, 2nd Edition, 2005.
2. Shahnaz Bathul, "A text book of Probability & Statistics", 2nd Edition, V. G. S. Book Links, 2nd Edition, 2007.
3. Murugesan and Gurusamy, "A text book of Probability & Statistics", 2nd Edition Anuradha Publications, 2011.

Web References:

1. https://nptel.ac.in/courses/111106112/
2. https://nptel.ac.in/courses/111105090/
3. https://nptel.ac.in/courses/111101004/
4. https://nptel.ac.in/courses/111102111/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	10
L2	50	50
L3	30	40
Total (%)	100	100

L1: Remember

1. Define conditional probability
2. Define Population and Sample
3. Write about Skewness and Kurtosis.
4. State Correlation and Regression
5. State Mean and Variance in Sampling Distribution

L2: Understand

1. State and prove Bayes theorem.
2. Write the differences of collection of primary and secondary data type of variable.
3. Find out the Kurtosis of the data

Class Interval	0 - 10	10 - 20	20 – 30	30 - 40
Frequency	1	3	4	2

4. The mean height of students in a college is 155cms and S.D. is 15. What is the probability that mean height of 36 students is less than 157 cms
5. The number of auto mobile accidents per week in a certain community are as follows: 12, 8, 20, 2, 14, 10, 15, 6, 9, 4. Are these frequencies in agreement with the belief that accident conditions were the same during this 10 weeks period

L3: Apply

1. Calculate the regression equation Yon X from the data given below taking deviations from the actual means of X and Y

Price(Rs)	10	12	13	12	16	15
Amount Demanded	40	38	43	45	37	43

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2. The coefficient of Rank Correlation between marks in Statistics and Mathematics obtained by a certain group of students is 0.8. If the sum of the squares of the difference in ranks to be 33. Find the number of students in the group
3. A normal population has a mean of 0.1 and S.D. of 2.1 then find the probability that mean of a sample of size 900 will be negative.

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PC 20EE403 Control Systems 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO3	PSO 1	DoK
20EE403.1	Find the transfer function of physical systems using block diagram algebra and signal flow graphs.	-	3	L1-L3
20EE403.2	Examine the time responses of various systems for various input standard signals.	-	3	L1-L4
20EE403.3	Demonstrate the stability of a system using Time Domain Techniques.	2	1	L1-L4
20EE403.4	Illustrate the Stability of a system using Frequency Domain Techniques.	3	1	L1-L4
20EE403.5	Apply the state space modelling for solving problems related to real world Physical Systems	3	3	L1-L4

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Mathematical Modeling of Control Systems **12 Hours**
Classification of control systems, open loop and closed loop control systems and their differences, Feedback characteristics, transfer function of linear system, differential equations ofelectrical networks, translational and rotational mechanical systems, transfer of DC servo motor - AC servo motor - Reduction using Mason's Gain formula

Effect of feedback on disturbance and Noise

Unit II: Time Response Analysis **12 Hours**
Standard test signals - time response of first and second order systems - step response of 2nd order system - time domain specifications, steady state errors, P, PI, and PID controllers. AC servo motor - synchro, transmitter and receiver - block diagram algebra - representation by signal flow graph – Reduction using Mason's Gain formula

Ramp response of 2nd order system

Unit III: Stability and Root Locus Technique **12 Hours**
The concept of stability – characteristic equation - location of roots in s-plane for stability - Routh's Stability Criterion – limitations of Routh's stability, Root locus concept - construction of root loci (simple problems) Effect of addition of poles and zeros root locus, MATLAB programming for root locus.

Effect of addition of poles and zeroes on root locus

Unit IV: Frequency Response Analysis **12 Hours**
Introduction to frequency domain specifications - Bode diagrams - transfer function from the Bode diagram - phase margin and gain margin stability analysis from Bode plots Polar plots, Nyquist stability criterion. Lag, lead, lag-lead compensators, MATLAB programming for BODE PLOT

M & N circles, Nicholas Charts

Unit V: State Space Analysis of LTI Systems: **12 Hours**
Concepts of state, state variables and state model, state space representation of transfer function, derivation of state models from block diagrams, diagonalization, solving the time invariant state equations, State Transition Matrix and its Properties, concepts of controllability and observability.

Eigen Vectors and Diagonalization

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Textbooks:

1. Nagarath I.J. and Gopal M, "Control Systems Engineering", 2nd Edition, New age International Publications, ,2018.
2. Benjamin C.Kuo, "Automatic control systems", 8th Edition, John Wiley and sons, , 2014.

Reference Books:

1. Norman S Nise, "Control Systems Engineering", 3rd Edition, John Wiley and sons, 2018.
2. Katsuhiko Ogata, "Modern Control Engineering", 3rd Edition, Prentice Hall of India Pvt. Ltd., , 2015.
3. Nagoorkani A, "Control Systems", 3rd Edition, RBA publications, 2017.
4. Alice Mary K and Ramana P, "Control Systems", 1st Edition, Universities Press, 2016.

Web References:

1. https://nptel.ac.in/courses/107/106/107106081/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	10
L2	30	30
L3	40	30
L4	-	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the various standard test signals?
2. Define electrical zero position of synchro transmitter.
3. Define concept of observability
4. What is compensation? What are the different types of compensators?
5. What is state transition matrix? Write its properties.

L2: Understand

1. Explain how Routh Hurwitz criterion can be used to determine the absolute stability of a system
2. Compare different characteristics of A.C servo motor and D.C servo motor
3. Explain procedure of Bode plot and determination of gain margin and phase margin from Bode plot
4. Procedure for design of lead compensator using Bode plot
5. Explain about feedback characteristics?

L3: Apply

1. The characteristic polynomial of a system is $s^6+2s^5+3s^4+s^3+5s^2+2s^2+s+7=0$. Determine the location of roots on the S-plane and hence the stability of the system
2. Construct Nyquist plot for a feedback control system whose open loop transfer function is given by G(s) H(s) = s/s(s-1), comment on stability of open loop and closed loop system
3. Determine range of K for stability of unit feedback system whose open loop transfer function is G(s) = K/s(s+1)(s+2)
4. Calculate the angle of asymptotes and the centroid for the system having G(s) H(s) = K(s+3)/s(s+4)(s+2)(s+5)
5. For a system having G(s) = 25/s(s+10) and units negative feedback, find its time response specifications

L4: Analyze

1. State the necessary and sufficient conditions for stability for first and second order control systems. Explain why these conditions are necessary but not sufficient for stability of higher order systems
2. Differentiate the advantage and disadvantages of root locus and Bode Plot

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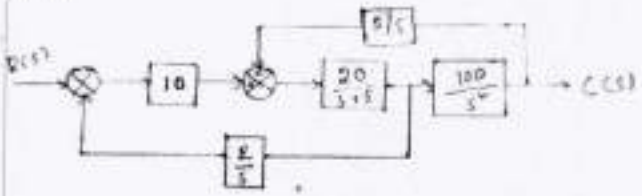
3. Justify whether the stat space model is controllable are not
4. Outline the state space model in different canonical forms
5. For the block diagram of the system shown, determine the transfer function using the block diagram reduction technique



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PC 20EE404 Induction Motors and Synchronous Machines

3 1 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's			DoK
		PO2	PO3	PSO 1	
20EE404.1	Demonstrate performance of three phase induction motors and their characteristics	-	-	3	L1,L2,L3
20EE404.2	List the different techniques related to speed control and starting of 3-phase induction motor.	-	-	3	L1,L2
20EE404.3	Discuss the operation and design different types of single phase induction motor	-	3	1	L1,L2
20EE404.4	List the different types of alternators and design alternators based on their performance characteristics	1	3	1	L1,L2,L3
20EE404.5	Interpret the performance of synchronous motors based on their applications	1	-	2	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Three Phase Induction Machines. **11+1 Hour**

Constructional features, salient pole, non-salient pole, Rotating magnetic field, Principle of operation, Torque and power equations, Torque- slip characteristics, Equivalent circuit, Power flow analysis, losses in the machine – No load and blocked rotor tests Circle diagram, Cogging phenomenon and remedies, Crawling phenomenon and remedies

Production of RMF

Unit II: Starting methods & Speed control of Three Phase Induction Machines **11+1 Hour**

Problems in starting of induction motor, Starting of squirrel cage induction motors-I, Starting of squirrel cage induction motors-II, Starting of wound rotor/slip ring induction motors. Speed control of induction motor from stator end – through stator voltage - Pole changer - Frequency control - Speed control of induction motor from rotor end – through rotor resistance control and Cascade connection, Slip power recovery scheme

Losses of three phase induction motor

Unit III: Single Phase Induction Machine **11+1 Hour**

Construction of single phase induction motor, Working – Double revolving field theory, Torque-slip characteristics , equivalent circuit, Power flow analysis, No load and blocked rotor tests, determination of equivalent circuit parameters, Split phase motors – Resistance start motors, Capacitor start motors, Capacitor start and capacitor run motors, Permanent split capacitor / single value capacitor motors, Shaded pole motors

BLDC motor and Universal motor

Unit IV: Synchronous Machine I **11+1 Hour**

Constructional features of 3 phase alternators, Armature winding, EMF Equation, Winding Coefficients, Equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage regulation using Synchronous Impedance method, MMF method, Potier's Triangle method, Parallel operation of synchronous generators, Two reaction theory, Applications

Synchronizing power and torque, applications of synchronous generator

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Unit V: Synchronous Machine II **11+1 Hour**

Construction of Synchronous motor, Principle of operation , Starting methods, Effect of varying field current at different loads, V and Λ curves, Synchronous condenser, Applications.

Excitation circle and power circle, comparison of synchronous and induction motors

Textbooks

1. Bhimbra P. S., "Electrical Machinery", 7th edition, Khanna Publishers, colour reprint 2014
2. Nagarth I. J. & Kothari D. P, "Electrical Machines", 5th edition, Tata McGraw Hill Publications, 2017

Reference Books

1. Kothari D. P., Nagarth I .J ., "Electrical Machines", 4th edition McGraw Hill Publications, 2017
2. Rajput R.K., "Electrical Machines", 5th Edition, Lakshmi publications, 2016
3. Abijith Chakrabarthi and Sudhipta Debnath," Electrical Machinery", 2nd Edition, McGraw Hill education, 2015
4. Stephen J Chapman "Electrical Machinery Fundamentals", 1st Edition, McGraw Hill education, 2010

Web References

1. https://nptel.ac.in/courses/108/104/108104087/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	40	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. State the principle of three phase induction motor
2. Mention the types of speed control methods of three phase induction motor
3. State why the single phase induction motor is not self-starting
4. State the need of parallel operation of synchronous generators
5. Define synchronous condenser

L2: Understand

1. Explain the construction of three phase induction motor
2. Describe the operation of single phase induction motor
3. Explain about double cage rotor in three phase induction motor
4. Explain the starting methods of synchronous motor

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L3: Apply

1. Construct the circle diagram of three phase induction motor
2. Calculate equivalent circuit parameters of single phase induction motors
3. Derive the EMF equation for three phase alternators

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ES 20EE405 Electro Magnetic Field Theory 3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's PO3	PSO 1	DoK
20EE405.1	Define electrostatic laws and apply them to electrostatic fields	2	1	L1, L2
20EE405.2	Demonstrate the properties of conductors and dielectrics at different configurations	2	1	L1, L2
20EE405.3	Define Biot-Savart's law and Ampere circuit law and apply them to magnetic field	2	1	L1, L2
20EE405.4	Explain the magnetic force experienced by charged particles and determine types of inductances	2	1	L1, L2
20EE405.5	Describe time varying fields using Faraday's law and Maxwell's equations	2	1	L1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction Of Fields and Electrostatics 12 Hours

Scalar and vector fields, overview of coordinate system, calculus of scalar and vector fields in Cartesian coordinates; Coulomb's Law – Electric Field Intensity (EFI) – EFI due to a line and a surface charge, work done in moving a point charge in an electrostatic field, Electric flux density, electric potential – properties of potential function – potential gradient, Maxwell's first and second equation, Gauss's law –Laplace's and Poison's equations.

Relation between cylindrical and cartersian co-ordinates

Unit II: Conductors – Dielectrics and Capacitance 12 Hours

Electric dipole – dipole moment – potential and EFI due to an electric dipole, Behavior of conductors in an electric field-Conductor- Dielectric and Dielectric – Dielectric Boundary Conditions, Polarization, Capacitance of parallel plates, spherical and coaxial cable, energy stored and energy density in a static electric field, Ohm's law in point form, equation of continuity, properties of materials in electric field.

Conduction and convention current density, Di-electric constants

Unit III: Magneto Statics 12 Hours

Biot-Savart's law, Oesterd's Experiment, Magnetic Field Intensity (MFI) – MFI due to a straight current carrying filament, MFI due to circular, square and solenoid; relation between magnetic flux, magnetic flux density and MFI, Ampere's circuital law, point form of Ampere's circuital law – applications, Maxwells Third Equation MFI due to an infinite sheet of current and a long filament carrying conductor, Point form of Ampere's Circuital Law – Maxwell's Equation Curl(H) = J.

Magnetic Field Intensity at middle of equilateral triangle

Unit IV: Magnetic Force and Inductance 12 Hours

Magnetic force, moving charges in a magnetic field – Lorentz force equation, force on a current element in a magnetic field, force on a straight and a long current carrying conductor in a magnetic field, force between two straight long and parallel current carrying conductors, magnetic dipole and dipole moment, Torque on a current loop placed in a magnetic field, properties of materials in magnetic field

Scalar and Vector magnetic potential – properties and limitations; Self and Mutual Inductances – Mutual inductance between a straight long wire and square loop wire in the same plane; energy stored and density in a magnetic field.

Self inductance of toroid, Co-axial cable

Unit V: Time varying Fields 12 Hours

Time varying fields: Faraday's laws of electromagnetic induction – its integral and point forms, Maxwell's fourth equation, Curl (E)=-∂B/∂t, statically and dynamically induced EMF.

Modified maxwell equation

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Text Books

1. Sadiku, "Principles of Electro Magnetics", 4th Edition, Oxford Publications, 2016
2. William H. Hayt and John. A. Buck, "Engineering Electromagnetics", 9th Edition, McGraw Hill Companies, 2020
3. S.Salivahanan and S.Karthie., "Electromagnetic Fields and Waves", 2nd Edition, McGraw Hill Companies, 2018

Reference Books

1. Griffiths D. J., "Introduction to Electro Dynamics", 4th Edition, Prentice Hall of India Pvt. Ltd., 2020
2. Sunil Bhooshan, "Fundamentals of Engineering Electromagnetics", Oxford University Press, Oxford Higher Education, 2012

Web References

1. https://nptel.ac.in/courses/108/104/108104087/
2. https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/syllabus/
3. https://www.edx.org/course/electricity-and-magnetism-maxwells-equations

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	60
L2	50	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Divergence, Gradient and Curl
2. Define dot and cross product
3. What is vector field and vector potential?
4. State gauss law
5. Define Laplace equation

L2: Understand

1. Derive the expression for electric field intensity due to infinite surface charge
2. Explain the behaviour of conductors in electric field
3. Determine self and mutual inductance
4. Given $V = 5x3y2z$ and $e = 2.25\epsilon_0$, find (i) **E** at point P(-3, 1, 2) (ii) ρ_v at P
5. Illustrate a expression for capacitance of a parallel plate capacitor

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PC **20EE406 Induction Motors & Synchronous Machines Lab** **0 0 3 1.5**

At the end of the course, students will be able

Code	Course Outcomes	Mapping with POs PO4
20EE406.1	To understand the performance of single phase and three phase induction motors	3
20EE406.2	To control the speed of three phase induction motors	3
20EE406.3	To analyse the characteristics of V and inverted V curves of synchronous motors	3
20EE406.4	To determine the efficiency of three phase alternator	3
20EE406.5	To determine the regulation of alternator by various methods	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective PO's

List of Experiments

1. Brake test on three phase induction motor
2. No-Load and Blocked rotor test of three phase induction motor
3. Power factor improvement of single-phase induction motor by using capacitors and load test on single phase induction motor
4. Equivalent circuit of single-phase induction motor
5. Speed control of induction motor by V/F method
6. Brake test on single phase induction motor
7. V and inverted V curves of three phase synchronous motor
8. Determination of Xd and Xq of salient pole synchronous machine
9. Regulation of three phase alternator by synchronous impedance and MMF method
10. Regulation of three phase alternator by Potier trangle method
11. Parallel operation of three phase alternator
12. Determination of efficiency of three phase alternator by loading with three phase induction motor

References

1. Lab Manual for "Induction Motors and Synchronous Machines Lab", Department of Electrical and Electronics Engineering, NSRIT
2. Bimbhra P.S.,, "Electrical Machines" 7th Edition, Khanna publishers, 2006

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PC 20EE407 Industrial Automation for Electrical & Electronics Engg 0 0 3 1.5

Code	Course Outcomes	Mapping with POs
		PO4
20EE408.1	Draw the ladder logic diagram for Boolean logic and monitor with SCADA	3
20EE408.2	Draw the ladder logic and ladder latching logic diagrams for timers, counters, combinations and monitor with SCADA	3
20EE408.3	Draw the ladder latching logic diagram for counters and timers	3
20EE408.4	Develop ladder logic for traffic signal Control and flash a light once in every one second and monitor with SCADA	3
20EE408.5	Development of ladder logic for various practical applications	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective P s

List of experiments

1. Switch on light/off light for logic gates *AND, NOR, NAND, NOR, NOT, XOR, HALF, ADDER, FULL ADDER) by using Ladder Logic and SCADA monitoring
2. Develop the ladder logic for the below Boolean logic function before and after simplification

$$Y = \overline{(AB\bar{C}D + AB\bar{C}\bar{D} + \bar{A}BCD + \bar{A}\bar{B}CD)} + D$$

3. Switch on light/off light with timers (on Delay and Off Delay), counters (up & down) and their combination by using Ladder logic and SCADA monitoring.
4. Switch on light/off with timers and switch on light/off light with counter by using Ladder latching logic and SCADA monitoring.
5. Write small ladder logic programs for traffic signal control and controlled by SCADA.
6. Develop a ladder logic program that will flash a light once every one second and controlled by SCADA
7. Develop a ladder logic for the motor which is controlled by two switches. The start switch will start the motor and the Stop switch will stop it. If the Stop switch was used to stop the motor, the start switch must be thrown twice to start the motor (The Stop switch will be wired as normally closed). And monitoring by SCADA.
8. Develop a ladder logic for the motor which is controlled by two switches. The start switch will start the motor after 10 seconds delay and the Stop switch will stop the motor after 10s delay. If the Stop switch was used to stop the motor, the start switch must be thrown twice to start the motor. When the motor is active a light should be turned on. And monitoring by SCADA
9. Develop a ladder logic for oven started with a Start button that seals in the Auto mode. This can be stopped if the Stop button is pushed. (Remember: Stop buttons are normally closed.) When the Auto goes on initially the TON timer is used to sound the horn for the first 5 seconds to warn that the oven will start, and after that the horn stops and the heating coils start. When the oven is turned off the fan continues to blow for 300s or 10 sec after. And monitoring by SCADA
10. Develop ladder logic for conveyor run by switching on or off a motor. We are positioning parts on the conveyor with an optical detector. When the optical sensor goes on, we want to wait 1.5 seconds, and then stop the conveyor. After a delay of 2 seconds the conveyor will start again. We need to use a start and stop button - a light should be on when the system is active. And monitoring by SCADA
11. To study the variable frequency drive based 3phase induction motor operation by key pad

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References

1. Lab Manual for Industrial Automation for Electrical & Electronics Engg Lab, Department of Electrical and Electronics Engineering, NSRIT
2. Frankpetruzella D , " programmable logic controllers", 3rd Edition Tata MC Graw Hill, 2010

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Board of Studies (EEE)

PC 20EE408 Control Systems Lab

0 0 3 1.5

Code	Course Outcomes	Mapping with POs	
		PO4	PSO1
20EE408.1	Analyze the performance and working Magnetic amplifier, D.C and A.C. servo motors and synchronous motors.	3	3
20EE408.2	Design P,PI,PD and PID controller, design lag, lead and lag–lead compensators	3	3
20EE408.3	Determine the transfer function of D.C.motor	3	3
20EE408.4	Control the temperature using PID controller	3	3
20EE408.5	Control the position of D.C servo motor performance	3	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

List of experiments

1. Time response of Second order system
2. Characteristics of Synchro
3. Effect of P, PD, PI, PID Controller on a second order systems
4. Design of Lag and lead compensation – Magnitude and phase plot
5. Transfer function of DC motor using MATLAB
6. Characteristics of magnetic amplifier
7. Characteristics of AC servo motor
8. Characteristics of DC servo motor
9. Root locus and Bode plot from MATLAB
10. DC position control system
11. Controllability and observability test using MATLAB
12. Temperature controller using PID

References

1. Lab Manual for Control Systems Lab, Department of Electrical and Electronics Engineering, NSRIT
2. Nagarath I.J. and Gopal M, "Control Systems Engineering", 2nd Edition New age International Publications, , 2018
3. Norman S Nise, "Control Systems Engineering", 3rd Edition John Wiley and sons, , 2018

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SC **20EES02 PLC** 1 0 2 2.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	
		PO3	PO4
20EES01.1	Determine Automation & System Overview, Engineering Software TIA Portal	3	3
20EES01.2	Distinguish b/w logic Gates, Circuit diagrams, Timers, Counters, FC's, OB's, DB's and PLC Tags	3	3
20EES01.3	Write Ladder program for varicus applications	3	3
20EES01.4	Communicate between PLC's	3	3
20EES01.5	Understand Control Strategies	3	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Po's

List of Experiments

MODULE 1: Automation Overview, System Overview.

MODULE 2: Digital Fundamentals, Engineering Software TIA Portal, STEP 7 Range of Products

MODULE 3: Devices & Networks, PLC Tags, Program Blocks and Program Editor.

MODULE 4: Binary Operations, Digital Operations, Data Blocks.

MODULE 5: Functions and Function Blocks, Organization Blocks, Troubleshooting

Text Books

1. Madhuchhanda Mitra, Samarjit Sengupta, "Programmable Logic Controllers and Industrial Automation: An Introduction", 2nd Edition, Penram International Publishing (India) Pvt.Ltd., 2017
2. Hackworth, "Programmable Logic Controllers Programming Methods And Applications", 1st Edition, PEARSON INDIA, 2011

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PC 20EC303 Signals and Systems 3 1 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with Pos			DoK
		PO1	PO2	PO4	
20EC303.1	Define the mathematical model of continuous /discrete time signals and systems	2	3	2	L1, L2
20EC303.2	Determine and Analyze the output response of LTI systems	2	3	2	L1 - L3
20EC303.3	Derive the frequency domain representation of signals and systems	2	3	2	L2 - L4
20EC303.4	Analyse the characteristics of linear time invariant systems	2	3	2	L2 - L4
20EC303.5	Determine the output response of continuous time/ discrete time LTI systems	2	3	2	L2 - L4

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction **9+3 Hours**

Continuous-time and Discrete-time signals, Basic operations on signals, Signal models: The unit step, The unit impulse, The sinusoid, The complex exponential, Sinc, Rect, Even and odd functions. Continuous-time and Discrete-time systems, System properties: Linearity, Time invariance, Causality, Stability, Response of LTI system: Impulse response, Unit step response.

Orthogonality in complex functions

Unit II: Fourier Series and Fourier Transform **9+3 Hours**

Analogy between Vectors and Signals, Orthogonality, Representation of Continuous time periodic signals using Fourier series, Dirichlet's conditions. Trigonometric fourier series and exponential Fourier series, Properties of the fourier series. Fourier transform from fourier series, Dirichlet's conditions, Fourier transform of standard and arbitrary signals, Fourier transform of periodic signals, Properties of the Fourier Transforms. Inverse Fourier Transforms.

Derivation of Fourier Transform from Fourier Series

Unit III: Convolution and Correlation **9+3 Hours**

Convolution, Graphical representation of convolution, Convolution properties, Cross correlation and Auto correlation of functions, Properties of correlation function, Energy density spectrum, Power density spectrum, Parseval's theorem, Relation between auto correlation function and energy/power spectral density function, Comparison between ESD and PSD.

Detection of periodic signals in the presence of noise by correlation

Unit IV: Analysis of Linear Systems **9+3 Hours**

Continuous time and discrete time Linear shift-invariant (LSI) systems: system impulse response and step response, Transfer function of a LTI system, Properties of LTI system, Causality, Filter characteristics of linear systems - Ideal LPF, HPF and BPF characteristics. Distortionless transmission through a system, Signal bandwidth, System bandwidth, Relationship between bandwidth and rise time, Sampling Theorem. Types of Sampling Techniques.

Reconstruction of signal from its samples, effect of under sampling – Aliasing

Unit V: Laplace Transform and Z-Transforms **9+3 Hours**

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The Laplace Transform: the region of convergence (roc) for Laplace transforms. The inverse laplace transform, Properties of the laplace transform, Causality and stability.
Introduction, Z- Transform, Distinction between Laplace, Fourier and Z transforms, Region of convergence, Constraints on ROC for various classes of signals, Properties of the z-transforms, Inverse Z Transform.

Distinction between Laplace, Fourier and Z transforms

Textbooks

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and Systems", 2nd Edition, Prentice Hall of India, 1997
2. Bhagawandas P. Lathi, "Linear Signals and Systems", 3rd Edition, Oxford University Press, 2009
3. Simon Haykin and Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley Student Edition, 2002

Reference Books

1. Anand Kumar, "Signals & Systems", Prentice Hall of India, 2nd Edition, 2012
2. Govind Sharma and Michael J. Robert, "Fundamentals of Signals and Systems", 2nd Edition, Tata McGraw-Hill Education Pvt. Ltd., 2010
3. K. Raja Rajeswari and B Visweswara Rao, "Signals and Systems", 1st Edition, Prentice Hall of India, 2009
4. Charles L. Phillips, John M. Parr and Eve A. Riskin, "Signals, Systems, and Transforms", 4th Edition, Pearson Publications, 2007

Web Resources

1. https://www.tutorialspoint.com/dip/signals_and_system_introduction
2. https://web.stanford.edu/~boyd/ee102/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-003-signals-and-systems-fall-2011/lecture- notes/
4. https://nptel.ac.in/courses/117101055/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	30	30
L3	20	20
L4	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define and sketch sinusoidal signal
2. Define Signal and System
3. What are orthogonal functions?
4. Define Hilbert transform of a signal x (t)
5. Recall Direchlet's conditions
6. State differentiation in time domain property of Fourier transforms
7. List any three properties of convolution Integral
8. When is a function x(t) said to be Laplace transformable?

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L2: Understand

1. Explain, how Impulse Response and Transfer Function of a LTI system are related?
2. Compare Laplace, Fourier and z- transforms
3. Summarize the properties of ROC of Laplace Transform
4. Relate rise time and Bandwidth
5. Organise the continuous time version of a sinusoidal signal and bring out the relation between sinusoidal and complex exponential signals
6. List the advantages and Limitations of Laplace transform
7. Obtain the Fourier transform of the unit step function
8. Obtain the Laplace transform of the signal $x(t) = e^{-at}u(t) + e^{bt}u(-t)$
9. Interpret the scaling and time shifting properties of Laplace transform

L3: Apply

1. Build the relation between unit step and signum functions
2. Develop Square wave from time shifting property of unit step signal
3. Develop relation between Rise time and Bandwidth
4. Compare one-sided and two sided z-transforms and its region of convergence
5. Solve the Laplace transform and ROC of $x(t) = e^{-5t}[u(t) - u(t-5)]$
6. Make use of Convolution property, develop discrete signals from continuous time signals
7. Develop Fourier transform from Fourier Series
8. Express complex exponential Fourier coefficients in terms of trigonometric Fourier coefficient

L4: Analyze

1. Explain briefly the extraction of a signal from noise by filtering
2. Compare impulse sampling, natural sampling and flat top sampling with relevant diagrams
3. Outline differentiation property of Fourier transform
4. Obtain the Fourier transform of the impulse function $\delta(t)$
5. Explain the aliasing effect using relevant diagrams and suggest remedies to avoid aliasing
6. Analyse the autocorrelation function and energy spectral density function of $x(t) = e^{-at}u(t)$
7. Examine the relationship between autocorrelation function and energy spectral density of an energy signal

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PC 20EE502 Power Electronics 3 1 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's			DoK
		PO 2	PO3	PSO1	
20EE502.1	explain the characteristics of various power semiconductor devices	2	2	2	L2
20EE502.2	explain the operation of single phase full–wave converters and analyze harmonics in theinput current	2	2	2	L2
20EE502.3	explain the operation of three phase full–wave converters	3	2	2	L3
20EE502.4	analyze the operation of different types of DC-DC converters	2	2	2	L2
20EE502.5	explain the operation of inverters and application of PWM techniques for voltage controland harmonic mitigation	3	2	2	L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos					
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge					

Unit I: Power Electronic Devices **12 Hours**

Basic Theory of Operation - Static Characteristics-Two Transistors analogy -Turn on and Turn off Methods - Methods of SCR Triggering - Dynamic & Gate Characteristics of SCR – SeriesandParallel Operation – Snubber circuit - Characteristics of Power MOSFET.

Characteristics of IGBT

Unit II: Single Phase AC-DC Converters **12 Hours**

Single Phase half wave controlled rectifiers - R load and RL load with and without freewheelingdiode - Single Phase fully controlled bridge converter with R load, RL load - Continuous and Discontinuous conduction - Effect of source inductance in 1-phase fullycontrolled bridge rectifier with continuous conduction – Expression for output voltages – Single Phase semi Converter with R load, RL load and RLE load – Continuous and Discontinuous conduction - Numerical Problems, applications of single phase AC-DC converters to industries.

Single Phase fully controlled bridge converter with RLE load

Unit III: Three Phase AC-DC Converters & AC – AC Converters **12 Hours**

Three Phase half wave Rectifier with R and RL load -Three Phase fully controlled rectifier with R and RL load - Three Phase semi converter with R load - Expression for Output Voltage - - Three Phase Dual Converters - Numerical Problems. AC-AC power control by phase control with R and RL loads - Three Harmonic Analysis phase AC voltage regulator with R load –Numerical Problems, applications of AC-AC converters to industries.

Three Phase semi converter with RL load

Unit IV: DC–DC Converters **12 Hours**

Operation of Basic Chopper - Classification - Control Techniques - Analysis of Buck, Boost and Buck-Boost converters in Continuous Conduction Mode (CCM) and Discontinuous ConductionModes (DCM) - Output voltage equations using volt-sec balance in CCM & DCM – Expressionsfor output voltage ripple and inductor current ripple- Numerical Problems.

Analysis of Buck-Boost converters in Continuous Conduction Mode (CCM) and Discontinuous ConductionModes (DCM)

Unit V: DC–AC Converters **12 Hours**

Introduction - Harmonic Analysis -Classification - Single Phase half bridge and full bridge inverters with R and RLloads - Unipolar & Bipolar Switching - Quasi-square wave pulse width modulation - Three Phasesquare wave inverters - 180⁰ conduction mode of operation – PWMinverters -NumericalProblems

Three Phase square wave inverters - 120⁰ conduction mode of operation

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Text Books

1. Power Electronics: Converters, Applications and Design by Ned Mohan, Tore MUndeland, William P Robbins, John Wiley & Sons
2. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hallof India, 2nd edition, 1998
3. Power Electronics: Essentials & Applications by L.Umanand, Wiley, Pvt. Limited, India, 2009.

Reference Books

1. Elements of Power Electronics–Philip T.Krein.oxford.
2. Power Electronics – by P.S.Bhimbra, Khanna Publishers.
3. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. K.Sinha, New Age International (P) Limited Publishers, 1996.

Web References

1. https://nptel.ac.in/courses/108/102/108102145/
2. https://nptel.ac.in/courses/108/101/108101126/
3. https://www.digimat.in/nptel/courses/video/108101126/L01.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	50	50
L3	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Latching Current
2. List the applications of step up choppers.
3. What is shoot through fault? Explain.
4. Draw the circuit diagram of three phase M-3 controlled converter.

L2: Understand

1. Explain the operation of snubber circuit and also design the parameters of snubber circuit.
2. Draw the two-transistor analogy of a SCR? Explain SCR operation with this analogy
3. Explain the operation of single phase two pulse midpoint converter with relevant voltage and current waveforms and also derive the expression for average output voltage.
4. Explain the working of three-phase half wave uncontrolled rectifier with relevant wave forms for 'R' load.

L3: Apply

1. A single phase semi converter is delivering power to RLE load with R= 5Ω, L= 10 mH and E = 80 V. The ac source voltage is 230 V, 50 Hz. For continuous conduction, find the average value of output current for a firing angle of 500 . If one of the SCR is damaged and open circuited find the new value of average output current on the assumption to continuous conduction. Also sketch the output voltage and current waveforms?
2. A boost regulator has an input voltage of Vs = 5 V. The average output voltage Va = 15 V and the average load current Ia = 0.5 A. The switching frequency is 25 kHz. If L = 150 µH and C = 220 µF, determine (i) the duty cycle, (ii) the ripple current of inductor ΔI, (iii) the critical values of L and C..

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PC 20EC305 Digital System Design

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with Pos PO1	PO3	DoK
20EC305.1	Understand the number systems and its logical operations	3	2	L1, L2
20EC305.2	Apply the properties of Boolean theorems for reducing the logical functions	3	1	L2, L3
20EC305.3	Classify and Design simple combinational logic circuits using logic gates and Design various programmable logic devices	3	2	L2, L3, L4
20EC305.4	Design various Registers and Counters using Flip-Flops and Analyze various Sequential Logic Circuits	3	2	L2, L3, L4
20EC305.5	Learn the IEEE standard Hardware Description Language	2	3	L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

UNIT-I: Digital Systems and Number System **13 Hours**

Digital systems, Number systems, Counting in radix, Conversion of one radix to other, Complements of numbers, Signed binary numbers, Arithmetic addition and subtraction, 4-bit codes: BCD codes, Excess-3, Gray code, r's and r-1's complement, Error detecting & Error correcting codes, Basic logic gates, Universal gates, Ex-OR , Ex-NOR gates.

Logic families, Characteristics of Logic families: CMOS, TTL, ECL families.

UNIT-II: Concept of Boolean Algebra **12 Hours**

Basic Theorems and Properties of Boolean algebra, Boolean Functions, Canonical and Standard Forms, Min-terms and Max-terms, Products of Sum Simplification, Sum of Products Simplification, Gate level Minimization: Map Method, Two-Variable K-Map, Three-Variable K-Map, Four Variable K-Maps, Five Variable K-Maps, Don't – Care Conditions, Quine–McCluskey method, NAND and NOR Implementation, Exclusive-OR function, Code converters.

Six variable K-Map, Hazards

UNIT-III: Combinational Logic Circuits & Programmable Logic Devices **12 Hours**

Introduction, Adder, Subtractor, 4-Bit binary adder, 4-Bit binary Subtractor, BCD adder circuit, Carry look-a-head adder circuit, Decoders, Encoders, Multiplexers, Higher order multiplexing, De-Multiplexers, Priority encoder, Magnitude comparator.

Programmable Logic Devices: PROM, PAL, PLA-Basics structures, Realization of boolean function with PLDs, Programming tables of PLDs, merits & demerits of PROM, PAL, PLA comparison, Realization of Boolean functions using PROM, PAL, PLA, Programming tables of PROM, PAL

Parallel Prefix Adders, Binary Multiplier, Vedic Multiplier. Complex Programmable Logic Devices (CPLD), Field Programmable gate arrays (FPGA).

UNIT -IV: Sequential Logic Circuits & Finite State Machines **12 Hours**

Introduction to sequential circuits, Storage elements: Latches, Flip-flops, RS- Latch using NAND and NOR Gates, RS, JK, T and D Flip Flops, Master Slave JK flip flop, Excitation tables and Characteristic equations, Conversion of flip flops. Registers, Shift registers, Universal shift register, Asynchronous counters, Synchronous counters, Ring counter, Johnson counter.

Master slave RS flip flop, Master slave D flip flop, Registers and Counters using reversible logic gates, Vending machine controller

UNIT –V Introduction to VHDL **12 Hours**

Design flow, Program structure, Levels of abstraction, Elements of VHDL: Data types, Data objects, operators and identifiers. Packages, Libraries and Bindings. Subprograms. VHDL Programming using structural and data flow modelling. HDL implementation of combinational and Sequential Logic Circuits.

Modelling of Combinational ICS Using VHDL, Modelling of Sequential ICS Using VHDL

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Textbooks

1. Morris Mano, "Digital Design", 3rd Edition, Prentice Hall of India, 2001
2. Hill and Peterson Mc-Graw Hill, "Switching Theory and Logic Design", 1ST Edition, Tata McGraw-Hill, 2016
3. John F.Wakerly, "Digital Design", 4th Edition, Pearson Prentice Hall, 2008
4. A. Anand Kumar, "Switching theory and logic design", 3rd Edition, Prentice Hall of India, 2016

Reference Books

1. Zvi Kohavi, "Switching & Finite Automata theory", 2nd Edition, Tata McGraw-Hill, 2008
2. R P Jain, "Modern Digital Electronics", 3rd Edition, Tata McGraw-Hill, 2003
3. Charles H. Roth Jr, "Fundamentals of Logic Design", 4th Edition, Jaico Publishers, 1992

Web Resources

1. https://nptel.ac.in/courses/117/105/117105080/
2. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
3. http://webstor.srmist.edu.in/web_assets/srm_mainsite/files/2017/15CS20

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	15	-
L2	40	40
L3	30	30
L4	15	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Find the decimal number equivalent of fractional octal number
2. List any two postulates of Boolean algebra
3. What you mean by non-weighted code?

L2: Understand

1. Explain how combinational logic circuit 4:1 multiplexer works
2. Represent the following Boolean expression to min-terms and max-terms AB+BC'+ABD'+ACD
3. Represent a T flip flop using JK flip flop

L3: Apply

1. Build the Boolean function F (x, y, z) = $\sum$ m (0, 1, 2, 4, 5, 7) by using 4 to 1 Multiplexer
2. Develop a full adder using half adder
3. Construct a 16:1 multiplexer using 8:1 multiplexer

L4: Analyze

1. Distinguish combinational logic circuits and sequential logic circuits.
2. Compare mealy and Moore machine
3. Classify the counters

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PC 20EC308 Digital System Design Lab 0 0 3 1.5

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	
		PO4	PSO1
20EC308.1	Identify and Verify the Logic Gates	3	1
20EC308.2	Design and Verify the Various Combinational Logic Circuits using Basic Logic Gates	3	1
20EC308.3	Design Registers and Counters using Flip-Flops	3	2
20EC308.4	Develop Various Sequential Logic Circuits	3	3
20EC308.5	Simulate and Verify the Combinational and Sequential Logic Circuits	3	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

List of Experiments

1. Design of Logic Gates
2. Design of Adders and Sub-tractor
3. Design of Binary to Gray and Gray to Binary
4. Design of 3 to 8 Decoder
5. Design of 4-bit Comparator
6. Design of 4-bit multiplier
7. Design of 8 x 1 Multiplexer
8. Design of Decade counter
9. Design of 4-bit Ring and John Son Counter
10. Design of Universal shift registers
11. Design of Mealy and Moore machine

References

1. Lab Manual for Digital System Design Lab, Department of Electronics and Communication Engineering, NSRIT

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PC 20EE507 Power Electronics Lab

0 0 3 1.5

Code	Course Outcomes	Mapping with POs	
		PO4	PSO1
20EE507.1	Study the characteristics of various power electronic devices.	3	3
20EE507.2	Analyze the performance of single–phase and three–phase full–wave bridge converters with both resistive and inductive loads.	3	3
20EE507.3	Understand the operation of single-phase AC voltage regulator with resistive and inductive loads	3	3
20EE507.4	Understand the working of Buck converter, Boost converter	3	3
20EE507.5	Understand the working of single–phase square wave inverter and PWM inverter	3	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective PO's

List of experiments

1. Characteristics of Thyristor, MOSFET & IGBT
2. Single -Phase semi converter with R & RL loads.
3. Single -Phase full converter with R & RL loads.
4. Three- Phase full converter with R &RL loads.
5. Single -Phase AC Voltage Regulator with R & RL Loads
6. Single Phase step down Cyclo-converter with R & RL Loads
7. Single Phase dual converter in circulating current & non circulating current mode of operation.
8. Boost converter in Continuous Conduction Mode operation.
9. Buck converter in Continuous Conduction Mode operation.
10. Single -Phase square wave bridge inverter with R & RL Loads
11. Single - Phase PWM inverter

References

1. Lab Manual for Power Electronics Lab, Department of Electrical and Electronics Engineering, NSRIT.
2. P S Bimbhra, "Power Electronics", 2nd Edition Khanna Publishers, 2021.
3. Norman S Nise, "Control Systems Engineering", 3rd Edition John Wiley and sons, 2018.

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AC Technical Paper Writing

0 0 2 0

At the end of the course, students will be able to

No.	Course Outcomes
1	Develop searching latest relevant literature pertaining to the topic of interest
2	Develop self-learning ability to become a lifelong independent learner
3	Develop the habit of writing technical manuscript as per the requirement
4	Develop presentation skills and speak with appropriate technical phrases
5	Explore the research topics and develop research interests
6	Comprehend the latest technologies, techniques, tools, and methodologies

Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes

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Vidyanagar, Nellore (Dist.) - 524 413

MC 20MCX03 Intellectual Property Rights and Patents **2 0 0 0**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO11	PO12	DoK
20MCX03.1	Acquire knowledge on intellectual property rights	-	-	L1,L2
20MCX03.2	Know about the acquisition of trademarks.	-	-	L1,L2
20MCX03.3	Identify the importance of copyrights,patents and Transfer of Ownership.	-	--	L1, L2
20MCX03.4	Reciprocate to new developments of intellectual property rights	-	-	L1, L2
20MCX03.5	International overview of IPR	-	-	L1,L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

UnitI: Introduction to Intellectual property: **4 Hours**

Concepts, types of intellectual property,international organizations, agencies and importance of intellectual propertyrights.IndustrialProperty,technologicalResearch,InventionsandInnovations – Important examples of IPR.,IPR in India and Abroad

Unit II: Introduction toTrade Marks: **4 Hours**

Purpose and function of trademarks, acquisition of trade markrights,selecting and evaluating trademark ,trademark registration processes.Trade Secrets and Industrial Design registration in India and Abroad

Unit III: Registration of Copy Rights **4 Hours**

Fundamentals of copy right law,rights of reproduction, rights to perform the work publicly, copy right ownership issues, copyrightregistration, international copyright laws.
Law of patents: Foundation of patent law, patent searching process, ownership rights andtransfer.

Unit IV: Latest development of intellectual property Rights **4 Hours**

New developments in trademark law; copy right law, patent law, intellectual property audits. Infringementof IPRs,Enforcement Measures,Emerging issues–

Unit V:Enforcement Of IPRs **4 Hours**
International overview on intellectual property, international – trade mark law, copy right law, international patent law international development in trade secrets law.

Text Books

1. Intellectualpropertyright,Deborah,E. Bouchoux,cengagelearning.
2. Intellectual property right - Unleashing the knowledge economy, Prabuddha Ganguli,TataMcGraw Hill PublishingCompanyLtd.
3. Cornish,WilliamRodolph&Llewelyn,David.Intellectualproperty:patents,copyright,trademarks andallied rights. Sweet& Maxwell,8/e,2013.

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Reference Books

1. Cornish,WilliamRodolph.Casesandmaterialsonintellectualproperty.Sweet&Maxwell, 5/e,2006.
2. Lo,JackandPressman,David.Howtomakepatentdrawings:apatentityourselfcompanio n. Nolo, 5/e 2007.

Web References

1. https://www.investopedia.com/terms/i/intellectualproperty.asp
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3217699/
3. https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	60	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Industrial property?
2. What are the fundamentals of copy rights
3. Define patents and its approval process
4. Define copy right law.
5. Define transfor of trade marks.

L2: Understand

1. Explain the role trade scerets in company law.
2. Explain the concept owenership rights of patents with suitable examples
3. Explain the international patent law.
4. Distinguish between copy rights and patents.
5. Explain copt right registration.

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IN	**Summer Internship #1**	**0**	**0**	**0**	**1.5**

At the end of the course, students will be able to

No.	Course Outcomes
1	Demonstrate the theoretical learning outcomes
2	Integrate theory and practice during graduation
3	Comprehend the industry practices in the relevant and allied field of study
4	Develop communication skills in terms of oral, written, and graphical communications
5	Develop problem solving skills
6	Develop work habits and teamwork in a multidisciplinary setting for a successful career after graduation

Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes

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PC 20EC603 Microprocessors and Microcontrollers 3 1 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO9	
20EC603.1	Describe the features and architecture of 8086 Microprocessor & the modes of operation	3	3	L1, L2
20EC603.2	Illustrate different instructions, addressing modes and write assembly programs	3	2	L1, L2, L3
20EC603.3	Illustrate how different peripherals are interfaced with Microprocessor	3	3	L1, L2, L3
20EC603.4	Describe the concepts of 8051 microcontroller's architecture, Addressing modes, interfacing and programs	3	3	L1, L2
20EC603.5	Differentiate the various ARM Processor architectures, functions and interfaces	3	2	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

UNIT I: Introduction to 8086 Microprocessor **11+1 Hours**

Basic Microprocessor architecture, with examples, Microprocessor Unit and Microcontroller Unit, Main features, pin diagram/description, 8086 microprocessor family, internal architecture, Bus interfacing unit, Execution unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configurations*Diode switching times, PN diode clipping circuits.*

Address bus, Data bus, ALE, Interrupts

UNIT II: 8086 Programming **11+1 Hours**

Instruction set, addressing modes, Assembler directives, writing simple programs with an assembler, assembly language program development tools, Program development steps.

Assembler Directives, Instruction set

UNIT III: 8086 Interfacing **11+1 Hours**

Intel 8255 programmable peripheral interface, Interfacing switches and LEDS, Interfacing seven segment displays, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

Interfacing, Interrupt priority, Direct Memory Access

UNIT IV: 8051 Microcontrollers **11+1 Hours**

Architecture, Signal Description, Input/output ports and circuits, Memory Organization, Counters/Timers, serial Communication, Interrupts. Assembly language programming: Instructions, addressing modes, simple programs.
Interfacing to 8051: Memory (RAM, ROM), Stepper motor interface, Keyboard, LCD Interfacing A/D and D/A Converters.

Counters, Timers, Data Transfer through Serial Communication

UNIT V: ARM Processors **11+1 Hours**

ARM Architecture, ARM Processors Families, ARM Cortex-M Series Family, ARM Cortex-M3 Processor Functional Description, functions and Interfaces. Modes of operation and execution, Instruction set summary, System address map, write buffer, bit-banding, processor core register summary, exceptions.

ARM Features, Modes of operation

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Textbooks

1. Douglas V. Hall, Rao S. S. S. P., "Microprocessors and Interfacing – Programming and Hardware ", Tata Mc Graw Hill Education Private Limited, 3rd Edition, 1994
2. Prof Bhurchandi K. M., and Prof Ray A. K., "Advanced Microprocessors and Peripherals: With ARM and an Introduction to Microcontrollers and Interfacing", 3rd Edition, 2010
3. Muhammad Ali Mazidi, Janica Gillespie Mazidi and Rollin D. McKinlay, "The 8051 Microcontrollers and Embedded systems Using Assembly and C", 2nd Edition, Pearson Publications, 2011
4. Joseph Yiu," The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors", 3rd Edition, Newnes, 2013

Reference Books

1. Kenneth J. Ayala," The 8051 Microcontroller", 4th Edition, Tata McGraw Hill Education Private Limited, 1994
2. Dr. Alexander G. Dean," Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers: A Practical Approach in English", Arm Education Media, 2017

Web Resources

1. https://www.youtube.com/watch?v=GapjjO_8Kuk
2. https://www.tutorialspoint.com/microprocessor/microprocessor_8086_overview.html
3. https://www.javatpoint.com/8086-microprocessor
4. http://www.digimat.in/nptel/courses/video/108105102/L31.html
5. https://nptel.ac.in/courses/117/106/117106111/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	40	40
L3	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Microprocessor
2. Define Bus in Microprocessor
3. What is an Interrupt in Microprocessor?
4. Specify the function of ALE Signal
5. Define Pipeline processing
6. List out any four features of 8086 Microprocessor
7. List out any four features of 8051 Microcontroller
8. Write any four Applications of A/D Converters

L2: Understand

1. Illustrate different operations in Stack
2. Explain the functions of BIU and Execution unit
3. Discuss the addressing modes of 8086 Microprocessor with examples
4. Illustrate different instructions of 8086 Microprocessor
5. Discuss the minimum mode of configuration of 8086 Microprocessor
6. Discuss the memory Segmentation of 8086 Microprocessor
7. Discuss the Register Organization of 8051 Microcontroller
8. Explain Timers and Counters in 8051 Microcontroller
9. Describe the Features of ARM Microprocessors

L3: Apply

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1. How to Write simple Assembly level programs?
2. Discuss the procedure of Interfacing A/D Converters to 8086 Microprocessor
3. How to interface stepper motor to 8051 Microcontroller?
4. How to Generate square wave forms using Timer Mode Programming?
5. How to generate quarter second delay in 8051 Microcontroller?

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PC **20EE602 Electrical Measurements and Instrumentation** **3 0 0 3.0**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's PO 2	PSO 1	DoK
20EE602.1	Understand the working principle of basic analog instruments	2	2	L1 - L2
20EE602.2	Illustrate the working of different meters for measurement of Power, Power Factor and Energy	2	2	L1 - L2
20EE602.3	Estimate the values of unknown resistance, inductance and capacitance using bridges.	3	2	L1 - L3
20EE602.4	Explain the working of different Transducers and their applications	2	2	L1 - L2
20EE602.5	Explain the working of different types of digital meters.	3	2	L1 - L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Measuring Instruments **12 Hours**

Classification of measuring instruments, Ammeters and Voltmeters – Basics, range extensions, PMMC
Moving Iron type instruments – expression for the deflecting torque and control torque – errors and compensations, extension of instrument range, Current Transformer construction, theory, ratio and phase angle errors

Potential Transformer constructin, theory,ratio and phase angle errors.

Unit II: Analog Wattmeters and Power Factor Meters **12 Hours**

Electrodynamometer type wattmeter (LPF and UPF), Power factor meters: Dynamometer and M.I type (Single phase and Three phase), construction, theory, torque equation, advantages and disadvantages -Numerical Problems.

Construction,theory,torque equation of M.C. type

Unit III: DC and AC Bridges **12 Hours**

Method of measuring low, medium and high resistance – sensitivity of Wheat stone's bridge, Kelvin's double bridge, Megger – measurement of earth resistance - Numerical Problems
Measurement of inductance – quality factor, Maxwell's bridge, Anderson's bridge, measurement of capacitance and loss angle, Schering Bridge, Wien's bridge, Measurement of Permittivity, Quality factor- Numerical Problems

Hay's bridge, Desauty's bridge

Unit IV: Transducers **12 Hours**

Definition, Classification, Resistive, Inductive and Capacitive Transducer, LVDT, Strain Gauge, Thermistors, Thermocouples, Piezo electric and Photo Diode Transducers.

Digital shaft encoders, Hall effect sensors

Unit V: Digital Meters **12 Hours**

Digital Voltmeter–Successive approximation, ramp and integrating type - Digital frequency meter–Digital multimeter–Digital Tachometer. Digital energy meter, Measurement of phase difference – Frequency.

Hysteresis loop using lissajious patterns in CRO

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Text Books

1. A.K.Sawhney, "Electrical & Electronic Measurement & Instruments", 5th Edition, Dhanpat Rai &Co.Publications, 2021

2. R.K.Rajput, "Electrical and Electronic Measurements and instrumentation", 4th Edition, S.Chand, 2015
3. G.N.Srinivas and S. Narasimha, "Electrical and Electronic Measurements and Instrumentation", 2nd Edition, B S Publications, 2018.

Reference Books

1. E.W. Golding and F. C. Widdis, "Electrical Measurements and Measuring Instruments", 5thEdition, Wheeler Publishers, 2012.
2. W.D. Coopers and Helfrick, "Modern Electronic Instrumentation and Measurements Techniques", Pearson / Prentice Hall of India P. Ltd.2003

Web References

1. https://nptel.ac.in/courses/108/105/108105153/
2. https://www.udemy.com/course/complete-course-in-electrical-measurement-instrumentation/?utm_source=adwords&utm_medium=udemyads&utm_campaign=DSA_Catchall_la.EN_cc.INDIA&utm_content=deal4584&utm_term=_._ag_rp1MsBITcN2H4nODEy1jzOZtQ5UZ5ZUQIPk2NiFYm1ACDEaAtyfEALw_wcB

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	50	50
L3	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the errors usually occur in PMMC instruments?
2. What is the basic principle used in potentiometer?
3. What are the advantages and disadvantages of a Maxwell bridge?
4. Write about spring control of an instrument.
5. How are Instrumental Errors different from gross Errors?

L2: Understand

1. Discuss any 2 essential features of indicating instruments.
2. Explain with the help of a neat sketch the construction and operation of a D'Arsonval galvanometer.
3. Explain the working of Successive - approximation type Digital voltmeter with a neat block diagram.
4. Derive the expression for torque equation of a moving iron instrument.
5. Explain the procedure for measuring a low resistance with the help of kelvin's double bridge.

L3: Apply

1. The four arms of an A.C. bridge network are as follows: Arm AB: an unknown capacitance; Arm BC: a standard capacitor C 3 of 1000pF; Arm CD: a non inductive resistor R4 of 100 in parallel with a capacitor C4 of 0.01μF; Arm DA: a non – inductive resistor R2 of 1000 . The A.C. supply is connected across terminals B, D and the supply frequency is 50 Hz. If the bridge is balanced with the above values, determine the components of the unknown impedance, while deriving the balanced conditions.

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PC **20EE603 Power System Analysis** 3 1 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's PO2	PO3	DoK
20EE603.1	Illustrate the per-unit representation for given power system network	2	2	L2
20EE603.2	Solve load flow equations using Gauss-Seidel method and Newton-Raphson's method.	2	2	L2
20EE603.3	Analyze power system stability..	3	2	L3
20EE603.4	Study the concept of the Zbusbuilding algorithm	2	2	L2
20EE603.5	Understand the excitation control.	3	2	L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Circuit Topology & Per-unit Representation **12 Hours**

Graph theory – definition, Per-unit System representation of a given power system network, Per-unit equivalent reactance diagram Symmetrical fault Analysis:Symmetrical Component Theory: Symmetrical Component Transformation, power in symmetrical components, Sequence Networks. Unsymmetrical Fault Analysis: LG, LL, LLG faults without fault impedance

symmetrical Fault Analysis: LG, LL, LLG faults with fault impedance

Unit II: Power Flow studies **12 Hours**

Power flow problem – significance, classification of buses, Formation of Ybus using direct inspection method, Derivation of Static load flow equations, Load flow solutions using Gauss Seidel Method, Acceleration Factor, Newton Raphson Method in Rectangular and Polar Co-ordinates, Comparison of different load flow methods. (Only derivative approach) problems on 3-bus systems only.

Decoupled and Fast decoupled load flow method

Unit III: Power system stability **12 Hours**

Elementary Concepts of Steady State, Dynamic and Transient Stabilities - Description of: Steady State Stability Power Limit, Transfer Reactance, Synchronizing Power Coefficient, derivation of swing equation, Power Angle Curve and Determination of Steady State Stability

Methods to Improve Steady State Stability.

Unit IV: Z-Bus Algorithm & Symmetrical Fault Analysis: **12 Hours**

Formation of Zbus: Algorithm for the Modification of Zbus Matrix (without mutual impedance).
Symmetrical Fault Analysis: Reactances of Synchronous Machine – Three Phase Short Circuit Currents - Short circuit MVA calculations for Power Systems.

Algorithm for the Modification of Zbus Matrix (witht mutual impedance).

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Unit V: Excitation voltage ans control **12 Hours**

Excitation System Control in synchronous generators, Automatic Voltage Regulators. Series and Shunt Compensators.

Facts devices

Text Books

1. C.L. Wadhwa, "Electrical Power Systems", New Age International Publishers, 7th Edition, 2017.
2. 2.. P.Kundur, "Power System Stability and Control", McGraw Hill Inc, 2nd Edition, 2005
3. Allen J Wood, Bruce F Wollenberg, Gerald B Sheble, "Power Generation, Operation and Control", Wiley India, 3rd Edition, 2013.
4. John J Grainger, William D Stevenson Jr."Power system analysis" Tata McGraw-Hill, 2th Edition, 2012.(Unit-I,II,III,IV)

Reference Books

1. I.J. Nagrath & D.P. Kothari, "Modern Power System Analysis", Tata McGraw-Hill, 4th Edition, 2013.
2. M. A. Pai "Computer Techniques in Power System Analysis", Tata McGraw-Hill Publishing Company, 2nd Edition, 2006.

Web References

1. https://www.youtube.com/watch?v=tb3gCr9m0LU&list=PLtcRcIUOKppXWUMEVXGwwULXgzEBygOK-
2. https://www.youtube.com/watch?v=fBm1dr_gR8k&list=PL36A60B630EBC7B56

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	50	50
L3	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the disadvantages of per unit quantities?
2. What are the merits and demerits of Gauss-Seidel method?
3. What are the causes for large disturbances in the power system?
4. What are the methods considered for improving steady state stability?
5. What is the need of slack bus?

L2: Understand

1. How the Zbus is modified when a new branch Zb is added from a new bus P to reference bus 'Ó'.
2. How do you get the short circuit MVA from per unit impedance?
3. Explain the sequence networks of three phase transformer..
4. Explain the selection of reactors.
5. Describe the latest methods for improving the transient stability

L3: Apply

1. Determine the ZBus using building algorithm for a power system whose element data is given in the following table: Element No. Connected between bus Nos. Self reactance (p.u)

Ele.no.	busno.	Self reactance(p.u)
1	1-2	0.3
2	1-3	0.1
3	2-3	0.2

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4	1-2	0.1

2. A transformer rated at 75 MVA and having a short circuit reactance of 0.02 p.u is connected to the bus bar of a generating station which is supplied through two 12.6 kV feeders each having an impedance of (1.5+j 4) Ω . One of the feeder is connected to the generating station using generator capacity of 50 MVA connected to its bus bars having a short circuit reactance of 0.2 p.u and other feeder to a generator with 25MVA and having a reactance of 0.35 p.u. Calculate the MVA supplied to the fault in the event of a short circuit occurring between the secondary terminals of the transformer.

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PC **20EC606 Microprocessors and Microcontrollers Lab** **0 0 3 1.5**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	
		PO4	PO9
20EC606.1	Develop assembly language programs to perform arithmetic, logical operations, string operations using TASM and 8086 Microprocessor boards	3	2
20EC606.2	Design interfacing circuits using 8086 Microprocessor	2	3
20EC606.3	Construct different waveforms using 8086 Microprocessor and 8051 Microcontroller	3	3
20EC606.4	Develop and implement assembly language programs to perform real time interfacing using 8051Microcontrollers	3	3
20EC606.5	Implement assembly language programs to perform arithmetic operations using ARM Processors	3	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

List of Experiments

1. Programs for 16 -bit arithmetic operations using 8086 programs
2. Perform BCD Addition
3. Write an assembly program for finding factorial of a given number
4. Program for sorting an array
5. Interfacing ADC to 8086
6. Interfacing DAC to 8086
7. Interfacing stepper motor to8086
8. Finding number of 1's and number of 0's in a given 8-bit number
9. Program to find Average of n-numbers
10. Interfacing Traffic Light Controller to8051
11. Timer Mode Programming
12. Write an assembly program to multiply of 2 16-bit binary numbers
13. Write an assembly program to find the sum of first 10 integers numbers
14. Write a program to toggle LED every second using timer interrupt

References

1. Lab Manual for Microprocessors and Microcontrollers of Electronics and Communication Engineering, NSRIT

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PC 20EE607 Electrical Measurements and Instrumentation Lab 0 0 3 1.5

Code	Course Outcomes	Mapping with POs	
		PO4	PSO1
20EE607.1	Understand various measurement techniques used in electrical engineering	3	3
20EE607.2	Understand the calibration of DC and AC Potentiometers.	3	3
20EE607.3	Demonstrate the use of sensors and transducers in electrical and nonelectrical measurements.	3	3
20EE607.4	Apply knowledge of virtual instruments in measurement of analysis of electrical parameters	3	3
20EE607.5	Understand and the characteristics of Thermo couples, LVDT.	3	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective PO's

List of experiments

1. Calibration of dynamometer wattmeter using phantom loading.
2. Crompton D.C. Potentiometer - Calibration of PMMC ammeter and PMMC voltmeter.
3. Kelvin's double Bridge - Measurement of resistance - Determination of tolerance.
4. Capacitance Measurement using Schering Bridge.
5. Inductance Measurement using Anderson Bridge.
6. Calibration of LPF Wattmeter – by direct loading.
7. Measurement of 3 phase power with single watt meter and 2 No's of C.T.
8. Thermocouple – characteristics.
9. LVDT – characteristics.
10. Capacitive transducers characteristics.
11. Piezoelectric transducer characteristics.

References

1. Lab Manual for Control Systems Lab, Department of Electrical and Electronics Engineering, NSRIT
2. A K Sawhney, "Electrical and Electronic measurement and instruments", Dhanpat Rai and Sons Publications, 2002.
3. E W Golding and F C Widdis, "Electrical measurements and measuring instruments", Wheeler publishing, 5th Edition, 2006.

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PC 20EE608 Power Systems and Simulation Lab **0 0 3 1.5**

Code	Course Outcomes	Mapping with POs	
		PO4	PSO1
20EE608.1	Obtain Sequence impedances and calculate the dielectric strength of 3 phase Transformer by using hardware lab Equipment	3	3
20EE608.2	Obtain the response of Single area Load frequency control with &without control	3	3
20EE608.3	Understand the Load flow studies using NR method and Gauss- seidel method	3	3
20EE608.4	Analyze and calculate the Power Angle Characteristics of 3phase Alternator with infinite bus bars.	3	3
20EE608.5	Understand Economic load dispatch with & without losses Economic load dispatch with losses.	3	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective PO's

List of experiments

1. Sequence impedances of 3 phase Transformer.
2. Dielectric strength of Transformer oil.
3. Single area Load frequency control with &without control
4. Double area Load frequency control with & without control
5. Sequence impedances of 3 phase Alternator by Fault Analysis.
6. Sequence impedances of 3 phase Alternator by Direct method.
7. ABCD parameters of Transmission line.
8. Power Angle Characteristics of 3phase Alternator with infinite bus bars.
9. Load flow studies using Gauss- seidel method
10. Load flow studies using N-R method
11. Economic load dispatch with & without losses
12. Economic load dispatch with losses.

References

1. Lab Manual for Power System and Simulation Lab, Department of Electrical and Electronics Engineering, NSRIT

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SC 20EES04 P-SPICE

1 0 2 2.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO5
20EES04.1	Understand the P-SPICE software	3
20EES04.2	Explain the circuits for various types of loads	3
20EES04.3	Understand the working of single-phase AC voltage controller	3
20EES04.4	Explain working of Buck and Boost converter	3
20EES04.5	Understand the working of single-phase inverter	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective PO's

List of Experiments

1. Introduction to PSPICE software
2. PSPICE Simulation of Series RLC Circuits for Step, Pulse & Sinusoidal Inputs
3. Study VI characteristics of a diode using PSPICE
4. PSPICE Analysis of Single-Phase Full Converter with RL & RLE Loads
5. Single phase AC voltage controller using RL loads
6. PSPICE Simulation of Integrator
7. PSPICE Simulation of Differentiator
8. Introduction to PSPICE modelling
9. Simulation of Boost Converters
10. Simulation of Buck Converters
11. Single Phase Inverter with PWM Control

Text Books

1. Susan A. Riedel, James W.Nilsson, "Introduction to PSpice for Electric Circuits", 6th Edition, Pearson, 2007
2. Franz J. Monssen, "OrCAD PSpice with Circuit Analysis", 4th Edition, Pearson, 2000.

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20MCX04 Indian Traditional Knowledge

2 0 0 0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO5	PO7	PO12	
20MCX04.1	Identify the concept of Traditional knowledge and its importance	1	3	3	2	L1, L2
20MCX04.2	Explain the need and importance of protecting traditional knowledge	1	2	3	2	L1, L2
20MCX04.3	Illustrate the various enactments related to the protection of traditional knowledge	1	3	3	2	L1, L2
20MCX04.4	Interpret the concepts of Intellectual property to protect the traditional knowledge	1	2	3	2	L1, L2
20MCX04.5	Explain the importance of Traditional knowledge in Agriculture and Medicine	1	3	3	2	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create

UNIT I: Introduction to traditional knowledge **6 hours**

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

UNIT 2: Protection of traditional knowledge **6 hours**

The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT 3: Legal framework and TK **6 hours**

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

UNIT 4: Traditional knowledge and intellectual property **6 hours**

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

UNIT 5: Traditional Knowledge in Different Sectors **6 hours**

Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

Text Books:

1. Amit Jha, "Traditional Knowledge System in India", 2009.

Reference Books:

1. Amit Jha, "Traditional Knowledge System in India", 2002
2. Kapil Kapoor, Michel Danino, "Knowledge Traditions and Practices of India", CBSE, 2012

Web Links:

1.https://www.youtube.com/watch?v=LZP1StpYEPM
2.http://nptel.ac.in/courses/121106003/

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HS 20HSX04 Professional Ethics 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO8	PO12	DoK
20HSX04.1	Understand the ethics and Apply ethics in society	3	1	L1,L2,L3
20HSX04.2	Discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.	3	1	L1,L2,L3
20HSX04.3	Know the code of ethics and industrial standreds	3	1	L1,L2,L3
20HSX04.4	Understand the rights and responciabilitys of an employee at work place	3	1	L1,L2,L3
20HSX04.5	Understand environmental ethics and CSR of companies	3	1	L1,L2,L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit: Introduction to Ethics **10 Hours**

Need and importance of ethics, objectives , morals, values and ethics – integrity – work ethic – service learning – civic virtue – respect for others – living peacefully –honesty – courage – valuing time – cooperation – commitment – empathy – self-confidence..

Unit II :Engineering Ethics **10 Hours**

Senses of 'engineering ethics' – variety of moral issues – types of inquiry – moral dilemmas – moral autonomy – consensus and controversy – models of professional roles – self-interest – self respect-customs and religion.

Unit III : Engineering As Social Experimentation **10 Hours**

Engineering as experimentation – engineers as responsible experimenters– codes of ethics –industrial standards – a balanced outlook on law.

Unit IV:Safety, Responsibilities And Rights **10 Hours**

Safetyand Risk – Assessment of Safety and Risk – Risk Benefit Analysis - Safety lessons from Challenge- Collective Bargaining – Confidentiality – Conflicts of Interest – OccupationalCrime–ProfessionalRights–EmployeeRights.

UnitV:Global Issues **10 Hours**

MultinationalCorporations–EnvironmentalEthics–ComputerEthics –WeaponsDevelopment- Engineersas Managers–ConsultingEngineers–MoralLeadership–CodeofConduct– CorporateSocialResponsibility.

Text Books

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill,New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "EngineeringEthics",Prentice Hall of India, NewDelhi, 2004.

Head of the Department

Reference Books

1. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for PersonalIntegrity and Social Responsibility" McGraw Hill education, India Pvt. Ltd.,New Delhi2013Web References
2. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011

3. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.

Web reference:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	30
L3	40	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List the human values and explain
2. Give an overview of Engineering Ethics
3. What is meant by Professional Responsibility?
4. What are the safety lessons one can learn in the *Challenger* case?
5. Discuss in detail about the employee rights.
6. Discuss on the engineer's role in weapon development.

L2: Understand

1. Illustrate the ethical aspect principle of caring or sharing, with an example.
2. Explain various actions of an engineer leading to dishonesty.
3. Justify the safety and other obligations of professional engineers.
4. Discuss the problems with law in engineering practice.
5. Explain in detail about the effect of information on risk assessments
6. Explain the role of engineers as 'expert witness' and 'advisors'.

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20EES05 ECAD

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO10	PSO2	
20EES05.1	Draw symbolic representation of electrical components manually.	3	1	1	L3
20EES05.2	Draw free hand sketches, isometric and orthographic views of electrical machines and components.	3	1	1	L3
20EES05.3	Use CAD tools to draw simple electrical components and machines.	3	1	1	L3
20EES05.4	Use CAD to create electrical circuits with components.	3	1	1	L3
20EES05.5	Edit electrical line drawings and control panel layouts in CAD.	3	1	1	L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

List of Experiments:

1. Sketch the symbols of the given type of electric lamps, electric wiring accessories.
2. Interpret orthographic Projection of the given Electrical Machine parts or electrical components.
3. Interpret the isometric Projections of the given Electrical Machine parts or electrical components.
4. Absolute Coordinate Method: Commands: LIMITS, UNITS, LINE and ARC.
5. Relative coordinate Method: Commands: LIMITS, UNITS, LINE and ARC.
6. Relative polar coordinate method: Commands: LIMITS, UNITS, LINE and ARC.
7. 2D figures: Commands: LINE, CIRCLE, OIT'SE'I, TRIM, FILLET, ARC, POLYGON, ELLIPSE, COPY, MIRROR, TRIM, ROTATE and CHAMFER
8. Isometric drawings: commands: LIMITS, UNITS, ZOOM, GID, SNAP, LINE, COPY, ISOPLANE: ELLIPSE, TRIM, ERASE, PROPERTIES and SAVE.
9. Draw cable layout diagrams.
10. Draw layouts of substations.
11. Draw layouts of earthing systems.

Textbooks:

1. Gaurav Verma, Matt Weber, "AutoCAD Electrical 2022 Black Book", CADCAMCAE works, USA., 2021.
2. Prof. Sham Tickoo, "AutoCAD Electrical 2021 for Electrical Control Designers", CADCIM Technologies, USA, 2020.

Web References:

1. www.mycadsite.com/tutorials/level_3/isometric-drawing-in-autocad-3-2.htm accessed on 27th June, 2016
2. www.cadlearning.com/courses/autocad-mechanical-training-tutorials/. accessed on 27th June, 2016
3. http://www.staff.city.ac.uk/~ra600/MEI 105/Tutorials/CAD-I/Tutorial%20CAD-Ia.pdf, accessed on 28th June, 2016
4. www.youtube.com/watch?v=Nv8skZZcUlw , accessed on 29th June, 2016

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PE 20EE001 Advanced Power Electronics 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with Pos			DoK
		PO1	PO2	PSO1	
20EE001.1	Evaluate different dc-dc voltage regulators	2	2	1	L1-L2
20EE001.2	Explain resonant converters	2	2	1	L1-L2
20EE001.3	Understand phase shifting converter for a multi-level converter	2	2	1	L1-L3
20EE001.4	Explain phase shifting converter for a multi-pulse converter	2	2	1	L1-L2
20EE001.5	Understand various multi-level inverter configurations	2	2	1	L1-L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Switching Voltage Regulators **12 Hours**

Introduction; Linear power supply (voltage regulators); Switching voltage regulators; Review of basic dc-dc voltage regulator configurations -Buck, Boost, Buck-Boost converters and their analysis for continuous and discontinuous mode; Other converter configurations like Flyback converter, Forward converter, Half bridge, Full bridge configurations, Push-pull converter, Cuck converter, Sepic Converter; Design criteria for SMPS;

Multi-output switch mode regulator

Unit II: Resonant Converters **12 Hours**

Introduction, Need of resonant converters, Classification of resonant converters, Load resonant converters, Resonant switch converters, zero-voltage switching dc-dc converters, zero current switching dc-dc converters,

clamped voltage topologies

Unit III: Multi-level converters **12 Hours**

Need for multi-level inverters, Concept of multi-level, Topologies for multi-level: Diode Clamped, Flying capacitor and Cascaded H-bridge multilevel Converters configurations; Features and relative comparison of these configurations applications,

carrier based PWM technique for multi-level converters

Unit IV: Multi pulse Converters **12 Hours**

Concept of multi-pulse, Configurations for m-pulse (m=12,18,24 ….) converters, Different phase shifting transformer (Y-Y1, Y-Y2, Y-Z1 and Y-Z2) configurations for multi-pulse converters

Applications of multi pulse converters

Unit V: HVDC Transmission **12 Hours**

Introduction, Operation of 12-pulse converter as receiving and sending terminals of HVDC system, Equipment required for HVDC System and their significance, Comparison of AC and DC transmission

Control of HVDC transmission

Textbooks

1. Ned Mohan, Tore M. Undeland and William P, "Power Electronics – Converters, Applications and Design" 5th edition ,Robbins John Willey & sons,2015
2. Drives Bin Wu John "High Power Converters and AC" 4th edition, John Willey & sons Inc,2013
3. Clean Power Derek, "Power Electronic Converter Harmonics – Multipulse Methods", 3rd edition, IEEEPress

Reference Books

1. P.C.Sen "Modern Power Electronics" 3rd edition S. Chand and Co. Ltd.,2012
2. L. Umanand Wiley " Power Electronics Essentials and Applications" 3rd edition, India Pvt Ltd 2009
3. Vijay K. Sood Kluwer "HVDC and FACTS Controllers Applications of Static Converters in Power System, 5th edition, Academic Publishers, 2008

Web References

1. https://onlinecourses.nptel.ac.in/noc20_ee28/preview
2. http://ieeexplore.ieee.org/document/6493452/
3. https://www.nature.com/articles/s41467-020-16262-0

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	40	40
L3	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is the need of resonant converters?
4. State important advantages, disadvantages and applications of SMPS.
5. Give comparison of HVAC and HVDC transmission.
6. Discuss need of multilevel inverter.

L2: Understand

1. Explain in brief Static VAR Compensator (SVC). Compare it with STATCOM.
2. Explain concept of multilevel inverter.
3. Discuss principle of series compensation. Explain operation of static synchronous series compensator (SSSC).
4. Draw block diagram of HVDC transmission system. Mention equipment required for HVDC system.

L3:Apply

1. Compare 12 pulse and 18 pulse converter based on its harmonic analysis.
2. Discuss principle of shunt compensation. Explain operation of fixed capacitor- thyristors controlled reactor.

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PE 20EE002 Digital Control Systems

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's PO1	PO6	DoK
20EE002.1	Explain the concept of sample and hold operation and apply Z-transforms to Digital systems	2	2	L1 - L2
20EE002.2	Understand the theory of z–transformations and application for the mathematical analysis of digital control systems.	2	2	L1 - L2
20EE002.3	Explain the stability of digital controlsystems	3	2	L1 - L3
20EE002.4	Ubderstand the concept of state space to test the performance of digital controlsystems	2	2	L1 - L3
20EE002.5	Study the design of state feedback control by "the pole placement method.	3	2	L1 - L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction and Signal processing — 12 Hours

Introduction to analog and digital control systems – Advantages of digital systems sample and hold operations, Sampling theorem, Reconstruction of original sampled signal to continuous-time signal, A/D and D/A conversion, applications of A/D and D/A conversion

Frequency domain characteristics of zero order hold.

Unit II: Review of Z-transforms — 12 Hours

Z-Transform method for solving difference equations; Pulse transfer function, block diagram analysis ofsampled – data systems, mapping between s-plane and z-plane: Primary strips

Complementary Strips.

Unit III: Stability analysis — 12 Hours

Mapping between the s–Plane and the z–Plane – Primary strips and Complementary strips – Stability criterion – Modified Routh's stability criterion and Jury's stability test

Stability analysis using Liapunov theorems.

Unit IV: State space representation — 12 Hours

State Space Representation of discrete time systems, solving discrete time state space equations, State transitionmatrix and it's Properties, Methods for Computation of State Transition Matrix, Discretization of continuoustime state – space equations. Concepts of Controllability and Observability, Testsfor controllability and Observability

Duality between Controllability and Observability

Unit V: State feedback controllers — 12 Hours

Design of state feedback controller through pole placement – Necessary and sufficient conditions – Ackerman's formula. Applications of state feedback controllers

Advanced feedback controllers.

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Text Books

1. Discrete–Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition
2. B.C. Kuo, "DigitalControlSystems", 2 nd Edition, Oxford University Press, Feb 2012. (Units - 2, 3)

3. M. Gopal, "Digital Control Engineering", 2 nd Edition-New Age International Publications, 2014.

Reference Books

1. Karl J Astrom& B. Wittenmark, "Computer controlled systems, Theory and & Design", 3 rd Edition, Prentice Hall Information Sciences & System sciences series,1997.
2. M.Gopal, "Digital Control and State Variable Methods", 4 th Edition, TMH, April-2012.

Web References

1. http://mtc-m18.sid.inpe.br/col/sid.inpe.br/mtc m18@80/2008/03.17.15.17.24/doc/mirrorget.cgi?languagebutton=pt-BR&metadatarepository=sid.inpe.br/mtc-m18@80/2009/02.09.14.45.33&index=0&choice=full
2. http://portal.acm.org/author_page.cfm?id=81100182444&coll=GUIDE&dl=GUIDE&trk=0&CFID=27536532&CFTOKEN=71744014

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	50	50
L3	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What State Transition Matrix?
2. Write about Discretization of continuous time state – space equations?
3. Define stability of digital control systems
4. What is meant by sampling and hold operations?
5. What are digital compensators?
6. State the sampling theorem

L2: Understand

1. Write about a) State Transition Matrix b) Pulse Transfer Function Matrix c) Discretization of continuous time state – space equations.
2. Explain the shifting and scaling operator with suitable examples.
3. Describe the linear time invariant and casual systems.
4. What is State transition matrix? state its Properties. Also explain any two methods for Computation of State Transition Matrix.
5. Discuss the design procedure of state feedback controller through pole placement technique.

L3: Apply

1. Prove that the discrete-time control system defined by x[(k+1)T] = G x(kT), y(kT) = C x(kT) is complete observable.

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PE **20EE003 Utilization Of Electrical Energy** **3 0 0 3.0**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's PO1	PO2	PO3	DoK
20EE003.1	Identify a suitable motor for electric drives and industrial applications	3	1	2	L1-L2
20EE003.2	Identify most appropriate heating or welding techniques for suitable applications	3	1	2	L1-L2
20EE003.3	Understand various levels of illuminosity produced by different illuminating sources.	3	1	2	L1-L3
20EE003.4	Design different lighting systems by taking inputs and constraints in view for different layouts.	3	1	2	L1-L3
20EE003.5	Understand the speed/time characteristics of different types of traction motors.	3	1	2	L1-L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: **12 Hours**

Illumination fundamentals

Introduction, terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter–Scurces of light

Various Illumination Methods

Discharge lamps. MV and SV lamps–Basic principles of light control–Types and design of Indoor lighting and Outdoor lighting–LED lighting, Energy conservation.

Comparison between tungsten filament lamps and LED lamps

Unit II: **12 Hours**

Electric Heating

Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating.

Electric Welding

Electric welding–Resistance and arc welding–Electric welding equipment

Comparison between AC and DC Welding, Applications of Electric Heating and Electric Welding

Unit III: Selection of Motor **12 Hours**

Choice of motor, type of electric drives, starting and running characteristics–Speed control–Temperature rise—Types of industrial loads–continuous–Intermittent and variable loads–Load equalization, Introduction to energy efficient motors.

Applications of electric drives

Unit IV: Electric Traction - I **12 Hours**

System of electric traction and track electrification–Special features of traction motor– Mechanics of train movement–Speed–time curves for different services – Trapezoidal and quadrilateral speed time curves.

Review of existing electric traction systems in India

Unit V: Electric Traction - II **12 Hours**

Calculations of tractive effort–power–Specific energy consumption for given run–Effect of varying acceleration and braking retardation–Adhesive weight and braking retardation adhesive weight and coefficient of adhesion

Principles of energy efficient motors

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Text Books

1. Partab, "Art & Science of Utilization of electrical Energy", 5th edition, Dhanpat Rai & Sons, 2014.

2. C.L. Wadhwa, "Generation, Distribution and Utilization of electrical Energy" 2nd Edition, New Age International (P) Limited, Publishers, 1997

Reference Books

1. N V Suryanarayana, "Utilization of Electrical Power including Electric drives and Electric Traction", 2nd editionNew age International (P) Limited, publishers, 1996.

Web References

1. https://nptel.ac.in/courses/108/105/108105060/
2. https://youtu.be/ftr5Q891LDw

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	40	30
L3	30	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are different types of Motor control?
2. What is Adhesive weight:
3. List out the electrical characteristics of DC Shunt motors.

L2: Understand

1. Explain the Operating Characteristics of a DC series motor using the Curves.
2. Explain the operation of Ajax Wyatt Furnace.
3. Discuss about the Speed-Time curves in Traction

L3: Apply

1. For a three-phase induction motor, maximum torque is thrice the full-load torque and starting torque is 1.9 times the full-load torque. In order to get a full-load slip of 6%, calculate the percentage reduction in rotor circuit resistance neglect stator impedance.
2. The rotor of a six-pole, 50-Hz, and 3-φ induction motor has a resistance of 0.3Ω per phase and sums at 960 rpm. If the load torque remains unchanged, calculate the additional rotor resistance that will reduce the speed by 20%.
3. A 4.5-kW, 200-V, and 1-φ resistance oven is to have nichrome wire heating elements. If the wire temperature is to be 1,000°C and that of the charge 500°C. Estimate the diameter and length of the wire. The resistivity of the nichrome alloy is 42.5 μΩ-m. Assume the radiating efficiency and the emissivity of the element as 1.0 and 0.9, respectively.

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PE 20EE004 Machine Modelling and Analysis 3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's PO3	PSO 1	DoK
20EE004.1	Explain the basic concepts of AC/ DC machine modeling.	2	1	L1 - L2
20EE004.2	Understand the dynamic modeling and phase transformation	2	1	L1 - L2
20EE004.3	Explain various methodologies in small signal machine modeling.	2	1	L1 - L2
20EE004.4	Understand the modeling of synchronous machine modeling	2	1	L1 - L2
20EE004.5	Explain the performance and dynamic modeling of synchronous machines	2	1	L1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Basic concepts of Modelling 12 Hours

Basic Two - pole Machine representation of Commutator machines, 3 phase synchronous machine with and without damper bars and 3 - phase induction machine.DC Machine modeling: Mathematical model of separately excited D.C motor –Steady State analysis - Transient State analysis - Sudden application of Inertia Load - Transfer function of Separately excited D.C Motor - Mathematical model of D.C Series motor, Shunt motor - Linearization Techniques for small perturbations

Theory of DC Machines

Unit II: Reference Frame Theory 12 Hours

Reference frame theory Real time model of a two phase induction machine-Transformation to obtain constant matrices - three phase to two phase transformation - Power equivalence. Dynamic modeling of three phase Induction Machine Generalized model in arbitrary reference frame - Electromagnetic torque - Derivation of commonly used Induction machine models - Stator reference frame model - Rotor reference frame model Synchronously rotating reference frame model - Equations in flux linkages - per unit model

Theory of Induction Machines

Unit III: Small Signal Modeling 12 Hours

Small Signal Modeling of Three Phase Induction Machine Small signal equations of Induction machine – derivation - DQ flux linkage model derivation - control principle of Induction machine.Single phase induction motor - Cross field theory of single - phase induction machine.

Single phase induction motor

Unit IV: Modeling of Synchronous Machine 12 Hours

Synchronous machine inductances – voltage equations in the rotor's dq0 reference frame - electromagnetic torque - current in terms of flux linkages - simulation of three phase synchronous machine- modeling of PM Synchronous motor.

Theory of synchronous Machines

Unit V: Dynamic analysis of Synchronous Machine 12 Hours

Dynamic performance of synchronous machine, three -phase fault, comparison of actual and approximate transient torque

characteristics, Equal area criteria.

Synchronous machine torque equation

Text Books

1. R. Krishnan, "Electric Motor Drives - Modeling, Analysis& control", First edition, Pearson Publications, 2002.
2. P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive systems", Second Edition, IEEE Press.
3. Dynamic Simulation of Electric Machinery using MATLAB by ONG, Chee-Mun - Prentice Hall PTR

Reference Books

1. P.S.Bimbra, "Generalized Theory of Electrical Machines", Fifth edition, Khanna publications, - 1995.
2. Chee Mun Ong –"Dynamic simulation of Electric machinery using MATLAB / Simulink", Prentice Hall of India Publications.

Web References

1. http://nptel.ac.in/courses/108106023/
2. https://nptel.ac.in/courses/108/106/108106023/#
3. http://www.infocobuild.com/education/audio-video-courses/electronics/AnalysisOfElectricMachines-IIT-Madras/lecture-09.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	60
L2	50	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Why damper bars are used?
2. What are the commonly used induction machine models?
3. What meant by reference frame theory?
4. State electro magnetic torque in induction motor
5. Define and write relation for stored magnetic energy

L2: Understand

1. Draw the basic circuit model for a 3-phase induction motor for stator as well as rotor currents
2. Derive the dynamic model of a 3-phase induction motor in synchronizing rotating reference frame
3. Discuss in detail about phase transformation and active transformation
4. Explain the generalized mathematical model of the series motor. List out the assumptions pertaining to the use of generalized mathematical model of dc machines.
5. Explain the transfer function analysis of a separately excited DC motor.

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PE 20EE005 Sensors and Transducers

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's PO1	PO5	DoK
20EE005.1	Understand basic operation of sensors.	2	2	L1 - L2
20EE005.2	Explain different types of sensors	2	2	L1 - L2
20EE005.3	Understand basic operation of transducer	2	2	L1 - L2
20EE005.4	Explain different types of amplifiers	2	2	L1 - L2
20EE005.5	Explain various types of electric quantities	2	2	L1 - L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction to Sensors — 12 Hours

Definition, principle of sensing & transduction, classification. Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity. Variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type, calculation of sensitivity. Stretched diaphragm type: microphone, response characteristics.

Stretched diaphragm type: microphone, response characteristics

Unit II: Thermal and Magnetic Sensors — 12 Hours

Material expansion type: solid, liquid, gas & vapor. Resistance change type: RTD materials, tip sensitive & stem sensitive type, Thermister material, shape, ranges and accuracy specification. Thermo emf sensor: types, thermoelectric power, general consideration, Junction semiconductor type IC and PTAT type. Radiation sensors: types, characteristics and comparison. Pyroelectric type. Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics.

Wiedemann effect for yoke coil sensors, Thomson effect.

Unit III: Introduction to Transducers — 12 Hours

Stain Gages, Load Cells, Proximity Sensors, Pneumatic Sensors, Light Sensors, Tactile Sensors, Fiber Optic Transducers, Digital Transducers, Recent Trends – Smart Pressure Transmitters, Selection of Sensors, Rotary – Variable Differential Transformer, Synchros and Resolvers.

Induction Potentiometers, Micro Electromechanical Systems

Unit IV: Signal Condition — 12 Hours

Introduction, Functions of Signal Conditioning Equipment, Amplification, Types of Amplifiers, Mechanical Amplifiers Fluid Amplifiers, Electrical and electronic Amplifiers.

Data Acquisition Systems and Conversion:Introduction, Objectives and Configuration of Data Acquisition System, Data Acquisition Systems,.

Optical Amplifiers, Data Conversion

Unit V: Data Transmission and Telemetry — 12 Hours

Data/Signal Transmission, Telemetry. Measurement of Non – Electrical Quantities:Pressure Measurement.

Modified maxwell equation

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Text Books

1. Patranabis D, "Sensors and Transducers", 5th Edition, Prentice Hall India Learning Private Limited, 2003
2. Murty D.V.S, "Transducers and Instrumentation", 2nd Edition, Prentice Hall India Learning Private Limited, 2008
3. Ian Sinclair., "Sensors And Transducers", 2nd Edition, Elsevier, 2011

Reference Books

1. S. Vijayachitra., "Transducers Engineering", 4th Edition, Prentice Hall of India Pvt. Ltd., 2010

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1. https://nptel.ac.in/courses/108/104/108104087/
2. https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/syllabus/
3. https://www.edx.org/course/electricity-and-magnetism-maxwells-equations

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	60
L2	50	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is principle of transduction?
2. What is the functions of Signal Conditioning Equipment?
3. What is proximity sensor?
4. What is the tactile sensor?
5. What are the configurations of Data Acquisition System?

L2: Understand

1. Explain the basic parameters that are to be possessed by a sensor.
2. Differentiate between Electrical and electronic Amplifiers.
3. Determine the objectives of Data Acquisition System.
4. Explain Variable Differential Transformer.
5. Explain the characterisitcs of Fiber Optic Transducers.

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PE 20EE006 Solid State Electric Drives

3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's PO 1	PO 5	DoK
20EE006.1	Explain the fundamentals of electric drive	2	2	L1 - L2
20EE006.2	Analyze the operation of controlled converter dc motors and four quadrant operation of dc motors using dual converters.	2	2	L1 – L3
20EE006.3	Explain the converter control of dc motors in various quadrants.	3	2	L1 – L2
20EE006.4	Explain the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters. various slip power recovery schemes.	2	2	L1 - L2
20EE006.5	Explain the speed control mechanism of synchronous motors	3	2	L1 - L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Fundamentals of Electric Drives — 12 Hours

Electric drive – Block diagram of electic drive- Dynamics of electric Drive - Equivalent Drive Paramaeters– Load torque components — Steady state stability – Load equalization.

Nature and classification of load torques Active load and passive loads

Unit II: Multi Quadrant & Dual converter operation of DC drives

Four quadrant operation of drive (hoist control) -Braking methods: Dynamic braking – Plugging braking methods. Principal of operation of 1-phase half and fully controlled converter fed DC motor drive- Principle of operation of dual converters and dual converter fed DC motor drives -Numerical problems.

Regenerative braking method

Unit III: Control of DC Motor Drives — 12 Hours

1-phase half and fully controlled converter fed separately and self-excited DC motor drive – Output voltage and current waveforms – Speed-torque expressions – Speed-torque characteristics.
Single quadrant – Two quadrant and four quadrant chopper fed separately excited and series excited motors – Continuous current operation– Output voltage and current waveforms – Speed–torque expressions – Speed–torque characteristics

Four quadrant operations

Unit IV: Stator side control of 3-phase Induction motor Drive: — 12 Hours

Stator voltage control using 3-phase AC voltage regulators – Waveforms– Variable Voltage Variable Frequency control of induction motor by PWM voltage source inverter – Closed loop v/f control of induction motor drives (qualitative treatment only).
–Speed torque characteristics of 3-phase induction motor

Unit V: Rotor side control of 3-phase Induction motor Drive — 12 Hours

Rotor side control of 3-phase Induction motor Drive - Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics – Advantages –Applications.
- Introduction to permanent magnet synchronous motors - principal of operatin and types of Control techniques of PMSM –block diagram of Cloased loop control of PMSM Drive.
Advantages –Applications of Slip power recovery schemes

Text Books

1. Fundamentals of Electric Drives – by G K Dubey Narosa Publications
2. Power Semiconductor Drives, by S.B. Dewan, G.R.Slemon, A.Straughen, Wiley-India Edition.
3. Power Electronics handbook by Muhammad H.Rashid, Elsevier.

Reference Books

1. Electric Motors and Drives Fundamentals, Types and Applications, by Austin Hughes and Bill Drury, Newnes.
2. Thyristor Control of Electric drives – Vedam Subramanyam Tata McGraw Hill Publicstions.
3. Power Electronic Circuits, Devices and applications by M.H. Rashid, PHI.

Web References

1. https://nptel.ac.in/courses/108/105/108105153/
2. https://www.youtube.com/watch?v=g8l3Ckx4AIQ&list=PLQLdKyBqWCpHeitTB8UlkuYsmhbRnb2V&ab_channel=ElectricalandElectronicsEngineering

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	50	50
L3	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the converters used for the speed control of induction motor below the rated frequency?
2. What are the disadvantages of rotor resistance control?
3. Draw the schematic diagram of two quadrant chopper
4. How the variable frequency control is used for synchronous motor speed control?

L2: Understand

1. Explain the different types of load torques and enlist different motors to suit these torques.
2. Explain the operation of a dc series motor supplied from single phase full converter with free-wheeling diode.
3. Describe type-D chopper fed two-quadrant drive operation with necessary equivalent circuits and waveforms.
4. Describe the closed loop self control of synchronous motor with VSI.

L3: Apply

1. A three phase, 440 V, 4-pole 50 Hz induction motor is driving a constant torque load of 80 Nm. The parameters of the motor are: r1 = 0.4 Ω, r2= 0.1 Ω, xeq = 4 Ω and N1/N2 = 2. Calculate the magnitude of the injected voltage that would reduce the motor speed to 1000 rpm. Also calculate the power received by the source of the injected voltage.
2. A three phase, 480 V, 4-pole 60 Hz Y-connected induction motor has inductive reactance of 4 Ω and stator resistance of 0.6 Ω, the rotor resistance referred to stator is 0.8 Ω. The motor is driving constant load torque of 60 Nm at a speed of 3500 rpm. Calculate motor speed and starting current if the frequency is reduced to 50 Hz.

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PE 20EE007Advanced Control Systems 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with Po's PO3	PSO1	DoK
20ESX03.1	State space representation of control system and formulation of different state models are reviewed.	-	3	L1 – L3
20ESX03.2	Understand the design of control system using the pole placement technique.	-	3	L1 – L3
20ESX03.3	Analyze nonlinear systems using the describing function technique	2	1	L1 - L3
20ESX03.4	Understand the stability analysis using phase plane analysis.	3	1	L1 – L3
20ESX03.5	Understand the stability analysis using Lyapunov method.	3	3	L1 – L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: State space analysis **12 Hours**

State Space Representation – Solution of state equation – State transition matrix, –Canonical forms – Controllable canonical form – Observable canonical form, Jordan Canonical Form.

The concept of state – State Equations for Dynamic systems

Unit II: Controllability, observability and design of pole placement **12 Hours**

Controllability, observability and design of pole placement
Tests for controllability and observability for continuous time systems – Time varying case –Minimum energy control – Time invariant case – Principle of duality – Controllability and observability form Jordan canonical form and other canonical forms – Effect of state feedback on controllability and observability – Design of state feedback control through pole placement.

Controllable Companion Form, Observable Companion Form (For Siso and Mimo Systems)

Unit III: Non-Linear Systems **12 Hours**

Introduction – Non-Linear Systems – Types of Non – Linearities – Saturation – Dead Zone – Backlash – Jump Phenomenon etc; - Singular Points – Introduction to Linearization of nonlinear systems, properties of Non-Linear Systems – Describing function – describing function analysis of nonlinear systems.

Applications of frequency response analysis, transfer function

Unit IV: Stability of Non-Linear Systems **12 Hours**

Stability analysis of Non-Linear systems through describing functions Introduction to phase – plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase – plane analysis of nonlinear control systems.

Graphical Representation of Stability, Optimum Switching Curve and applications

Unit V: Stability Analysis **12 Hours**

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

Asymptotic Stability and Instability; Sign-Definiteness of Scalar Function

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Textbooks

1. Nagarath I.J. and .Gopal M, 'Control Systems Engineering", 2nd Edition, New age International Publications,2018.
2. Benjamin C.Kuo, "Automatic control systems", 8th Edition, John Wiley and sons, 2014.
3. Norman S Nise, "Control Systems Engineering", 3rd Edition, John Wiley and sons, 2018.

Reference Books

1. Katsuhiko Ogata, "Modern Control Engineering", 3rd Edition, Prentice Hall of India Pvt. Ltd, , 2015.
2. Nagoorkani A, "Control Systems", 3rd Edition, RBA publications, 2017.

Web References

1. https://www.youtube.com/watch?v=W2jzxNeEAPU&list=PLooDK0dmOTDb-9czkkO_b13evBJqE9BaL
2. https://www.youtube.com/watch?v=bbm79UcNN0&list=PLbMVogVj5nJTNkhtkCEKQHhPOr2bpS3za

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	40	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define state
2. Define state variable
3. Define controllability
4. Define observability
5. What is saturation?

L2: Understand

1. Explain the concept of state? Write the observable canonical form?
2. Describe the controllability tests for continuous time systems.
3. State and explain the Lyapunov's instability theorem

L3: Apply

1. Convert the following state model into the Jordan canonical form and there from comment on controllability and observability

$$\dot{x}(t) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -2 & -4 & -3 \end{bmatrix} x(t) + \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ -1 & 1 \end{bmatrix} u(t), \quad y(t) = \begin{bmatrix} 0 & 1 & -1 \\ 1 & 2 & 1 \end{bmatrix} x(t)$$

2. Draw a phase plane portrait of the following system

$$\ddot{\theta} + \dot{\theta} + \sin\theta = 0.$$

3. Find a Lyapunov's function for the following system

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -1 & 1 \\ 2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

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PE 20EE008 Reactive Power Compensation and Management 3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's PO3	PSO 1	DoK
20EE008.1	Understand objectives specifications of load compensation	2	1	L1 - L2
20EE008.2	Understand steady state reactive power compensation in transmission system	2	1	L1 - L2
20EE008.3	Understand reactive power coordination	2	1	L1 - L2
20EE008.4	Understand importance of user reactive power management	2	1	L1 - L2
20EE008.5	Understand power management in electric traction systems and arc furnaces	2	1	L1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Load Compensation 12 Hours

Objectives and specification: Reactive power characteristics, inductive and capacitive approximate biasing, load compensator as a voltage regulator, phase balancing and power factor correction of unsymmetrical loads examples.

Reactive power, Voltage regulator, power factor

Unit II: Steadystate Reactive Power Compensation In Transmission System 12 Hours

Uncompensated line: Types of compensation, passive shunt and series and dynamic shunt compensation, examples transient state reactive power compensation in transmission systems: Characteristic time periods, passive shunt compensation, static compensations, series capacitor compensation, compensation using synchronous condensers, examples.

Types of compensation, Synchoronous condensors

Unit III: Reactive Power Coordination 12 Hours

Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations – effects of under voltages – frequency – Harmonics, radio frequency and electromagnetic interferences

Quality of power supply, Harmonics.

Unit IV: User Side Reactive Power Management 12 Hours

KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations

KVAR, Basics of capacitors.

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Unit V: Reactive Power Management in electric traction systems and arc furnaces 12 Hours

Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements – remedial measures –power factor of an arc furnace.

Traction systems, Arc furnace.

Text Books

1. D M Tagare, "Reactive power Management", 1st Edition, Tata McGraw Hill, , 2004
2. TJE Miller, "Reactive power control in Electric power systems", 1st Edition, Wiely Publication, 1982.

Reference Books

1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just "Reactive Power Compensation: A Practical Guide", Wiely publication, 4th Edition, 2012.

Web References

1. https://www.accessscience.com/content/reactive-power-compensation-technologies/YB084380
2. http://een.iust.ac.ir/profs/Arabkhabouri/Electrical%20Drives/Books/
3. https://ktu.edu.in/eu/att/attachments.htm?download=file&id=156232

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	60
L2	50	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. what are different methods of load shaping
2. Define reactive power control?
3. What are the different Types of compensation?
4. State shunt compensation?
5. What are the objectives of reactive power planning

L2: Understand

1. Describe Reactive Power Management
2. Draw the reactive power characteristics and also explain with neat figures and circuit diagrams
3. Discuss how Reactive Power Management or Planning is found by means of mathematical modelling
4. How power factor correction and voltage regulation can be achieved by means of compensation
5. Discuss how a Load Compensator works as a voltage regulator

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PE 20EE009 Basic Industrial Automation

3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's			DoK
		PO2	PO3	PSO 1	
20EE009.1	Understand different types of amplifiers and their characteristics	2	3	2	L1,L2
20EE009.2	Analyzing the performance of Electronic Controlled DC motors	2	3	2	L4
20EE009.3	Distinguish between various types of Industrial Heating methods	2	3	2	L4
20EE009.4	Illustrate the understanding of various industrial timing circuits	3	3	2	L1,L2
20EE009.5	Understand PLC functions to timing and counting applications	3	3	2	L1,L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Analysis And Design of Small Signal Low Frequency BJT Amplifiers — 12 hours

Review of transistor biasing, Classification of Amplifiers – Distortion in amplifiers, Analysis of CE, CC, and CB Amplifiers and CE Amplifier with emitter resistance, low frequency response of BJT Amplifiers, effect of coupling and bypass capacitors, Design of single stage RC coupled amplifier Different coupling schemes used in amplifiers, Analysis of Cascaded RC Coupled amplifiers,.

Cascode amplifier, Darlington pair

Unit II: Regulators For Voltage And Motor Speed — 12 hours

Voltage compensator – Solid state DC voltage regulation – DC shunt motor – Armature control and field control of motor speed – Electronic control of DC motor – Speed regulator action – Full wave motor speed regulation by one SCR.

Switched Mode voltage regulator

Unit III: Industrial Heating — 12 hours

Induction heating – Principles- Theory – Merits – Applications – High frequency power source for induction heating. Dielectric heating –Theory – Electrodes used in dielectric heating – Method of coupling of electrodes to RF generator – Thermal losses in dielectric heating.

Electrical Heating

Unit IV: Industrial Timing Circuits — 12 hours

Constituents of industrial timing circuits – Timers – Classification of timers – Thermal timers –Electromechanical timers – Electronic timers – Classification of electronic timers – Digital timing element –Digital counters – SCR delay timer – IC electronic timer

Fridge Timer

Unit V: Programmable Logic Controllers — 12 hours

Number system and codes – Basics of PLC programming – Timer and counter instructions – Data manipulation instructions.

Shaft register and sequence instructions

Text Books

1. Frank D. Petruzella, Industrial Electronics , McGraw Hill International Editions, 1996.
2. G.K. Mithal, Ravi Mithal, Industrial Electronics, Khanna Publishers, Delhi, 1995
3. Gopal. K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, 28th edition, 2011.

Reference Books

1. M. H. Rashid, " Power Electronics: Circuits, Devices and Applications" , Prentice Hall of India 3rd Edition, 2014.
2. Ned Mohan, Tore M. Undeland, " Power Electronics – Converters, Applications and Design ",Wiley India Edition, 3rd Edition, 2012.
3. Biswanath Paul " Industrial Electronics and Control " by PHI publications, 3rd Edition, 2014.
4. John W. Webb & Ronald A.Reiss," Programmable Logic Controllers-Principles and Applications ", 5th Edition, PHI, 2009.

Web References

1. https://nptel.ac.in/courses/108/108/108108077/
2. https://www.youtube.com/watch?v=VilOmXnoEC0&t=10s

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	45
L2	30	45
L4	40	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Explain VI characteristics of SCR.
2. Explain about triggering of TRIAC in different modes.
3. Write about the 3-terminal IC voltage regulators

L2: Understand

1. Discuss the principle and operation of ARC welding with neat sketch.
2. Draw the circuit diagram and waveforms of input current and output voltage of a single phase full wave ac voltage controller with resistive load.
3. Understanding the behaviour, turn on and turn off methods of SCR

L4: Analyze

1. Evaluate the characteristics of TRIAC circuit.
2. Evaluate the speed regulation of motor by SCR.
3. Classify the different types Industrial Timing Circuits

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PE 20EE010 Process Instrumentation 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO2	PO3	
20EE010.1	Understand the instrumentation for heat exchangers and dryers	3	1	2	L1-L2
20EE010.2	Explain instrumentation for evaporators & crystallizer	3	1	2	L1-L2
20EE010.3	Examine the instrumentation for distillation columns.	3	1	2	L1-L2
20EE010.4	Analyze the operation of Boiler Instrumentation	3	1	2	L1-L2
20EE010.5	Describe the instrumentation for pumps and compressors.	3	1	2	L1-L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Instrumentation for heat exchangers and dryers 12 Hour

Operation of heat exchanger, controlled and manipulated variables in heat exchanger control problem, instrumentation for feedback, feed-forward, cascade control strategies for heat exchanger, controlled and manipulated variables in dryer control problem, instrumentation for feedback and feed-forward control of various types of dryers.
Selection of devices required in instrumentation.

Types and operation of dryers

Unit II: Instrumentation for evaporators & crystallizer 12 Hour

Types and operation of evaporators, Controlled and manipulated variables in evaporator control problem, instrumentation for feedback, feed-forward, cascade control strategies for evaporators, controlled and manipulated variables in crystallizer control problem, instrumentation for control of various types of crystallizers.
Selection of devices required in instrumentation.

Types and operation of crystallizers

Unit III: Instrumentation for distillation columns 12 Hour

Operation of distillation column, manipulated and controlled variables in distillation column control, instrumentation for flow control of distillate, reflux ratio control, pressure control schemes.
Material and energy balance of distillation column.

Top and bottom composition control

Unit IV: Boiler Instrumentation 12 Hour

Operation of boiler, manipulated and controlled variables in boiler control, safety interlocks and burner management system, instrumentation for boiler pressure controls, boiler drum level controls, steam temperature control, optimization of boiler efficiency, operation and types of reactors, instrumentation for temperature, pressure control in CSTRs.
Continuous / regulatory functions related to batch processes.

Air to fuel ratio controls

Unit V: Instrumentation for pumps and compressors 12 Hour

Types and operation of pumps, manipulated and controlled variables in pump control problem, pump control methods and instrumentation for pump control, capacity control methods of compressors, instrumentation for control of different

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variables in centrifugal, rotary and reciprocating compressors including surge and anti-surge control. Methods to increase performance of pump and compressor.

Types and operation of compressors

Textbooks:

1. "Chemical Process Control", Stephanopoulos George, Prentice Hall of India.
2. "Boiler Control System", D. Lindsey, McGraw Hill Publishing Company.

Reference Books:

1. "Process Control, Instrument Engineering Hand book", B.G. Liptak, Chilton Book Company.
2. "Hand book of Process Instrumentation", Considine McGraw Hill Publishing company.

Web References:

1. https://nptel.ac.in/courses/108/105/108105064/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	60	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List out the types of dryers.
2. List out cascade control strategies for evaporators.
3. Define Feed – forward control.

L2: Understand

1. Explain the pump control methods and instrumentation for pump control.
2. Discuss about the cascade control strategies for evaporators.
3. Describe the Operation of distillation column.

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PE 20EE011 Switchgear Protection 3 0 0 3

Pre – Requisite: Power Generation and Transmission, Power Distribution and Distributed Generation

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20EE011.1	Describe the basic principles of arc interruption, circuit breaking principles, operation of various types of circuit breakers		L3
20EE011.2	Explain the classification, operation, construction and application of different types of electromagnetic protective relays		L3
20EE011.3	Illustrate the characteristics of distance relays and the principles and operations of different types of static and Digital relays.		L3
20EE011.4	Describe different protection schemes for protecting generators, transformers, feeders and bus bars.		L3
20EE011.5	Summarize various types of over voltages in a power system and principles of different protective Schemes for insulation coordination.		L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Circuit Breakers **9 Hours**

Principle of operation – RRRV – Current chopping- Resistance Switching-Circuit Breaker ratings and specifications, Testing of Circuit Breakers. Constructional features and selection of LT breakers (Miniature circuit breakers/Metal clad circuit breakers/Earth leakage circuit breaker) and HT breakers (Air Blast Circuit Breaker-Oil circuit breakers-SF6 CB-Vacuum Circuit Breakers). Auto reclosing.

Difference between a Fuse, an Isolator and a Circuit breaker

Unit II: Protective Relays-I **9 Hours**

Principle of Operation and Construction of Attracted armature, Balanced Beam, induction Disc and Induction Cup relays. Relays Classification - Instantaneous, DMT and IDMT types - Application of relays - Over current, under voltage, Directional, Differential and Percentage Differential relay

Fundamental requirements of protective relays

Unit III: Protective Relays-II **9 Hours**

Electromagnetic Protection - Universal Torque Equation - Distance relays - Impedance, Reactance and Mho and Off-Set Mho relays, Characteristics of Distance Relays and Comparison - Static and digital Relays –Static relay components-Static Relays versus Electromagnetic Relays - Microprocessor Based digital relays - impedance, directional, reactance, Mho & offset Mho and mathematical expression for distance relay

Types of protection

Unit IV: Protection of Generator, Transformer, Feeders and Busbars **9 Hours**

Generator Protection: Protection of Generators against Stator faults, Rotor faults, and Abnormal Conditions - Restricted Earth and inter turn Fault Protection - Numerical Problems on % Winding Unprotected. Transformer Protection: Percentage Differential Protection of transformers - Design of CT's Ratio - Buchholz relay protection - Numerical Problems. Feeder and Busbar Protection: Protection of lines - Over Current, Three-zone Distance Relay using Impedance Relays and Carrier Current Protection - Protection of Busbars – Differential protection.

Static relays versus electromagnetic relays

Unit V: Grounding Techniques and Over Voltage Protection **9 Hours**

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Grounded and Ungrounded Neutral Systems- Effects of Ungrounded Neutral on system performance Methods of Neutral Grounding –Solid, Resistance, Reactance- Arcing Grounds and Grounding Practices. Protection against Over Voltages- Generation of over voltages in power System-Protection against lightning over voltages- Valve type and Zinc-Oxide Lightning Arresters - Insulation Coordination-BIL, Impulse Ratio, Standard Impulse Test Wave - Volt-Time Characteristics

Voltage surge, lightning

Text Books

1. Badri Ram, Vishwakarma. D.N, "Power System Protection and Switchgear", MGH Publications, 2nd Edition 2011
2. T.S.Madhava Rao ,"Power system protection- Static Relays with microprocessor applications", 2nd Edition, TMH, 2008

Reference Books

1. Paithankar and S.R.Bhide, "Fundamentals of Power System Protection ",PHI, 2nd Edition 2010
2. C R Mason, "Art & Science of Protective Relaying", 2nd edition,1966, Wiley Eastern Ltd.
3. Bhavesh Bhalja," Protection and Switch Gear", 3rd edition,2011, oxford. Web References

Web References

1. https://nptel.ac.in/courses/108107167
2. https://www.electrical4u.com/electrical-switchgear-protection/
3. https://www.electricalpaathshala.com/2019/02/switchgear-and-protection/
4. https://www.youtube.com/watch?v=CdVnBLQDmoA (Elementary principles of arc interruption)
5. https://www.youtube.com/watch?v=GKI2mn3zp44 (oil circuit breakers)
6. https://www.youtube.com/watch?v=ngbMkLKpgTw (SF6 circuit breakers)
7. https://www.youtube.com/watch?v=2247gMbc6Lk (Differential relays)

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Label the circuit diagram of relay
2. List the advantages of vacuum circuit breaker
3. Define arc voltage
4. List any three problems associated with differential relay

L2: Understand

1. Formulate the expression for restriking voltage
2. Illustrate the SF6 circuit breaker with neat diagram
3. Explain any three types of lightning arresters
4. Classify voltage balance differential relay and translay relay
5. Explain the working principle of restricted earth fault relay for the protection of stator winding of alternator

L3: Apply

1. For 132kV system the reactance and capacitance up to location of circuit breaker is 3ohms, and 0.015μF, respectively. Find i) frequency of transient oscillation, ii) maximum value of restriking voltage iii) RRRV

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2. A star connected 3-phase,10MVA, 7.5 kV alternator has a per phase reactance of 10%. It is protected by Merz-Price circulating current principle which is set to operate for fault currents not less than 200A. Find the value of earthing resistance to be protected in order to ensure that only 10% of the alternator winding remains unprotected.
3. Find the time of operation of a 5 amp 3 second over current relay having current setting of 95% and time setting multiplier of 0.6 connected to supply circuit through a 400/5 current transformer when the circuit carries a fault current of 4000A. Use the following table

Operating Time	2	4	6	8	10	9
PSM	2	2.5	3	3.5	4	4.5

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PE 20EE012 Digital Signal Processing

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Pre – Requisite : Linear Algebra and Differential Equations, Signals & Systems

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20EE012.1	Apply the difference equations concept for analyzation of Discrete time systems	-	L3
20EE012.2	Apply the FFT algorithm for solving the DFT of a given signal		L3
20EE012.3	Design and realize the IIR Digital filter from the given specifications		L3
20EE012.4	Design and realize the IIR Digital filter from the given specifications		L3
20EE012.5	Apply the signal processing concepts on DSP Processor		L3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction **12 Hours**

Introduction to Digital Signal Processing: Discrete-time signals & sequences, Classification of discrete-time systems, stability and causality of LTI systems, Response of LTI systems to arbitrary inputs. Solution of linear constant coefficient difference equations. Frequency domain representation of discrete-time signals and systems. Review of Z-transforms, solution of difference equations using Z-transforms, System function.

Discrete time Fourier transform

Unit II: Discrete Fourier Transform **12 Hours**

Discrete Fourier transforms: Properties of DFT, linear filtering methods based on DFT, Fast Fourier transforms (FFT)-Radix-2 decimation-in-time and decimation-in-frequency FFT Algorithms, Inverse FFT.

Discrete Fourier Series, DFS Properties

Unit III: Design of IIR Digital Filters & Realizations **12 Hours**

Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital filters from analog filters, Design Examples, Analog and Digital frequency transformations. Basic structures of IIR systems, Transposed forms.

Lattice structures of IIR systems

Unit IV: Design of FIR Digital Filters & Realizations **12 Hours**

Characteristics of FIR Digital Filters, Frequency response. Design of FIR Digital Filters using Window technique and Frequency Sampling technique, Comparison of IIR & FIR filters. Basic structures of FIR systems.

Lattice structures, Lattice-ladder structures

Unit V: Introduction to DSP Processors **12 Hours**

Introduction to programmable DSPs: Multiplier and Multiplier Accumulator, Modified bus structures and memory access schemes in P-DSPs, Multiple Access Memory, Multi-ported memory, VLIW architecture, Pipelining, Special addressing modes, On-Chip Peripherals. Architecture of TMS320C5X, Bus Structure, Central Arithmetic Logic Unit, Auxiliary Register ALU, Index Register, Block Move Address Register, Parallel Logic Unit, Memory mapped registers.

Some flags in the status registers

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Narasaraopeta - 522 601, Dist. Guntur, A.P.

Textbooks

1. John G. Proakis and Dimitris G. Manolakis, " Digital Signal Processing, Principles, Algorithms, and Applications", 4th Edition, Pearson Education / Prentice Hall of India, 2009.
2. Oppenheim A V. and Schaffer R W., " Discrete Time Signal Processing",3rd Edition, Prentice Hall of India

3. Venkataramani B. and Bhaskar M., " Digital Signal Processors – Architecture, Programming and Applications", TATA McGraw Hill, 2002

Reference Books

1. Ramesh Babu P., " Digital Signal Processing", 7th Edition, Scitech Publications, 2018
2. Robert J. Schilling and Sandra L. Harris, " Fundamentals of Digital Signal Processing using MATLAB" Thomson, 2007
3. Alan V. Oppenheim and Ronald W. Schafer, 'Digital Signal Processing", Prentice Hall of India, 2006
4. Tarun Kumar Rawat, "Digital Signal Processing", Oxford University Press, 2014

Web Resources

1. https://nptel.ac.in/courses/117/102/117102060/
2. https://nptel.ac.in/courses/117/105/117105134/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	30	30
L3	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is the condition for stability of an LTI system?
2. What are the limitations of DSP?
3. Define DFT and IDFT
4. How FFT is more efficient to determine DFT of sequence?
5. Why IIR filters do not have linear phase?
6. What is meant by frequency warping effect?
7. Write two advantages of Kaiser widow
8. List the on-chip peripherals
9. List the special feature of DSP architecture

L2: Understand

1. What are the basic elements of a DSP system? Explain
2. Find the linearity, invariance and causality of the following systems
   y(n) = x(-n+2) ii) y(n) = x(n²)+ x(-n)
3. State and prove the periodicity and time shifting property in DFS
4. Prove that the convolution in time-domain leads to multiplication in frequency domain for discrete time signals
5. Establish the relation between DFT and Z-transform
6. Compare bilinear transformation and impulse invariant mapping
7. Distinguish between FIR and IIR filters
8. Explain the need for the use of window sequence in the design of FIR filter
9. With neat block diagram, explain about the pipelining
10. What are the special addressing modes of DSP? Explain

L3: Apply

1. Find the impulse response $h[n]$ of the system described by the difference equation $8y(n) + 6y(n-1) = x[n]$
2. Determine the unit step response for the system given by the difference equation Y(n) +3 y(n-1)+2 y(n-2)=2x(n)-x(n-1)
3. Compute the DFT of the three point sequence x(n) = { 2, 1, 2 }; Using the same sequence, compute the 6 point DFT and compare the two DFTs
4. Compute the DFT for the sequence (1, 2, 0, 0, 0, 2, 1, 1) using radix -2 DIF FFT and radix-2 DIT- FFT algorithm
5. Find the circular convolution of the sequences x[n]={ 1,4,0,9,-1} and h[n]= {-3,-4,0,7}

6. Determine the system function $H(z)$ of the lowest order Chebyshev digital filter with the following specification
   (i) 3dB ripple in pass band $0 \leq w \leq 0.25\pi$
   (ii) 30 dB attenuation in stop band $0.35\pi \leq w \leq \pi$
7. Design a digital IIR low pass filter using Butterworth approximation with Pass band edge at 1000 Hz, Stop band edge at 1500 Hz for a sampling frequency of 5000 Hz. The filter is to have a Passband ripple of 0.5 dB and Stop band ripple below 30 dB
8. Obtain the direct form I, direct form II and Cascade form realization of the following system function
   Y(n) = 0.1 y(n-1) + 0.2 y(n-2) + 3x(n) + 3.6 x(n-1) + 0.6 x(n-2)
9. Design an FIR digital low pass filter with cut off frequency 1.2 radian and length $N = 7$. Use frequency sampling method
10. Design an ideal high pass filter with a frequency response
    Hd (ejw) = 1 for $\pi/4 \leq |w| \leq \pi$
    = 0 for $|w| \leq \pi/4$ Find the values of h(n) for N = 11 using Hamming window. Find H (z) and determine the magnitude response

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PE 20EE013 HVDC & FACTS

3 0 0 3

Pre – Requisite : Power Electronics

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20EE013.1	Compare AC and DC systems, Describe the Types of HVDC Links and FACTS devices and explain various parameters in HVDC.		L2
20EE013.2	Analyze the Graetz circuit with various conditions.		L2
20EE013.3	Describe various control schemes, Analyze the harmonics and design the Filters in HVDC.		L2
20EE013.4	Understand the Operation of various Shunt devices and their control.		L2
20EE013.5	Understand the Operation of various Series devices and their control.		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction to HVDC and FACTS **9 Hours**

Introduction, Comparison of AC and DC Transmission (Economics of power transmission, technical performance and Reliability), Description of DC transmission system (Types of DC links and Converter Station), Modern trends in HVDC technology.

FACTS Concepts

Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, Benefits from FACTS controllers.

Application of DC transmission systems

Unit II: ANALYSIS OF HVDC CONVERTERS **9 Hours**

Introduction, Analysis of Graetz circuit –with grid control but no overlap-with grid control and overlap less than 60°-relationship between AC and DC quantities-equivalent circuit of rectifier, Inversion- equation of average direct current and voltage in terms of β and γ– equivalent circuit of inverter, 12 Pulse converters-relations between AC and DC quantities.

Graetz circuit

Unit III: HVDC System Control & Harmonics and Filters: **9 Hours**

Basic means of control-desired features of control-actual control characteristics-constant minimum ignition angle control-constant current control-constant extinction angle control-tap changer control-power control and current limits, System control hierarchy, firing angle control- IPC-EPC.

Introduction, Design of DC and AC filters (design and types of filters)

Generation of harmonics (Characteristics and Non characteristics harmonics)

Unit IV: Static Shunt Compensation: **9 Hours**

Objectives of Shunt Compensation, midpoint voltage regulation voltage Instability prevention, Improvement of Transient Stability, Methods of controllable VAR generation – Variable Impedance type only.

Power Oscillation Damping

Unit V: Static Series Compensators: **9 Hours**

Concept of series capacitive compensation, Sub Synchronous Oscillation Damping. Functional requirements of GTO Thyristor Controlled Series Capacitor (GCSC), control schemes of Thyristor Switched Series Capacitor (TSSC), and Thyristor Controlled Series Capacitor (TCSC) control schemes for GCSC, TSSC and TCSC.

Improvement of Transient Stability, Power Oscillation Damping

Textbooks:

1. K. R.Padiyar, "HVDC Transmission Systems", 2ndedition (in Two Colour), New Age International publishers, 2012.
2. N. G. Hingoraniand, L.Gyugui, "Understanding FACTS Concepts and Technology of Flexible AC Transmission Systems", B.S. Publications, Indian Reprint 2000.

Reference Books:

1. E. Uhlmann, "Power Transmission by Direct Current", Springer 1st edition, 2012.
2. Vijay K. Sood, "HVDC and FACTS Controller: Application of Static Converters in power systems", IEEE Power Electronics and Power Systems series, Kluwer Academic publishers, Boston, First edition January 2004.
3. E.W. Kimbark, "Direct Current Transmission", Wiley Inter Science-New York, 1971.
4. R. Mohan Mathur, Rajiv K Varma, "Thyristor based FACTS Controller for Electrical Power Systems", John Wiley Sons, 2011.
5. X. P. Zhang, C. Rehtanz, B.Pal, "Flexible AC Transmission System Modeling and Control", Springer, 2006.

Web References:

1. https://nptel.ac.in/courses/108104013
2. https://nptel.ac.in/courses/108107114

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	60
L2	60	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List out any 3 advantages of HVDC.
2. What are the different loading capability limits?
3. List any 2 advantages of FACTS controllers.
4. What is power oscillation damping?
5. What is System control hierarchy?

L2: Understand

1. Explain dynamic stability considerations of a system.
2. Explain mid-point voltage regulation
3. Explain power oscillation damping

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PE 20EE014 Programmable Control Devices and Applications 3 0 0 3

Pre-Requisite : Digital System Design

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20EE014.1	Introduction to basic PLC modules		L2
20EE014.2	Explain about different PLC operations		L2
20EE014.3	Discuss different PLC registers		L2
20EE014.4	Describe various data handling functions		L2
20EE014.5	Discuss different applications of PLC		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction to PLC **9 Hours**

PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment programming formats, construction of PLC ladder diagrams.

Devices connected to I/O modules

Unit II: PLC Programming and Operations **9 Hours**

PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation. Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction.

Flow chart for spray process system

Unit III: PLC Registers **9 Hours**

Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions,.

Number conversion functions

Unit IV: Data handling functions **9 Hours**

SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

Changing a bit shift register

Unit V: Applications of PLC's **9 Hours**

Object counter, Types of fixtures and their suitable applications, Selection of lamp and projector, Calculation of their wattage and number and their arrangement, PID Controller, Study of Boolean Gates, Timers and counters

Calculation of space to mounting height ratio

Text Books

1. Job Dan Otter, "Programmable Logic Controller", P.H. International, Inc. USA, 2009
2. Gary Dunning, "Introduction to PLCs", 4th Edition, McGraw Hill, 2019
3. Gurpreet Kaur and SK Sahdev, "Programmable Logic Controller and Microcontrollers", 2nd Edition, Uneek Publications, Jalandhar, 2013.

Reference Books

1. John R. Hackworth, "Programmable Logic Controllers: Programming Methods and Applications", 5th Edition, Pearson, 2013.

2. Parr and E A, "Programmable Controllers: An Engineer's Guide", Elsevier Science,3rd Edition, 2018.

Web References

1. https://www.nielit.gov.in/calicut/content/online-course-industrial-automation-plc-scada
2. https://www.ambitautomation.in/courses/industrial-automation/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is I/O module?
2. What are different operational procedures?
3. What are output registers?
4. What is matrix function?
5. What is object counter?

L2: Understand

1. Explain construction of PLC ladder diagrams.
2. Explain ladder diagram construction.
3. Explain architecture functions.
4. Explain Characteristics of Registers.
5. Explain master control relay jump.

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PE 20EE015 Virtual Instrumentation 3 0 0 3

Pre – Requisite: Instrumentation

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20EEH08.1	Define virtual instrumentation concepts		L2
20EEH08.2	Describe acquisition methodologies		L2
20EEH08.3	Compare traditional and virtual instrumentation.		L2
20EEH08.4	Discuss operating systems required for virtual instrumentation		L2
20EEH08.5	Illustrate implementation methods for instrumentation		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

UNIT I: INTRODUCTION **9 Hours**

Virtual Instrumentation - Definition and Flexibility - Block diagram and Architecture for Virtual Instruments versus Traditional Instruments Instrumentation -VI Programming techniques - VI, sub VI, Loop and Charts, Arrays, Clusters and Graphs, Case and Sequence Structures, Formula nodes, String and File Input / Output

Virtual Instrumentation, VI programming techniques

UNIT II: DATA ACQUISTITION IN VI **9 Hours**

A/D and D/A converters, Plug-in Analog Input / Output cards – Digital Input and Output Cards, Organization of the DAQ VI system – Opto isolation – Performing analog input and analog output – Scanning multiple analog channels – Issues involved in selection of Data acquisition cards – Data acquisition modules with serial communication – Design of digital voltmeter with transducer input –Timers and Counters.

DAQ VI System, Timers, Counters.

UNIT-III: COMMUNICATION NETWORKED MODULES **9 Hours**

Introduction to PC Buses – Local buses: - ISA, PCI, RS232, RS422 and RS485 – Interface Buses: - USB, PCMCIA, VXI, SCXI and PXI –Instrumentation Buses:- Modbus and GPIB – Networked busses – ISO/OSI Reference model, Ethernet and TCP/ IP Protocols.

Interface Buses, Instrumentation Buses

UNIT-IV: REAL TIME CONTROL IN VI **9 Hours**

Designs using VI Software - ON/OFF controller – Proportional controller – Modeling and basic control of level and reactor processes – Case studies on development of HMI, SCADA in VI

Proportional controller, SCADA IN VI

UNIT-V: OPERATING SYSTEM AND HARDWARE OVERVIEW **9 Hours**

PC architecture, current trends, operating system requirements, PC based instrumentation, analog and digital interfaces, PXI and SCXI main frame - modular instruments – Transducers – power, speed and timing considerations.

Analog and digital interfaces, Transducers

Text Books

1. Gary W. Johnson, Richard Jennings," LabVIEW Graphical Programming", 3rd edition, McGraw-Hill Professional Publishing, 2019

2. Lisa K Wells, "Lab view for Everyone", 3rd edition, Prentice Hall of India, 2020.

Reference Books

1. Barry Paton, "Sensor, transducers and Lab view", Prentice Hall of India 2020.
2. Buchanan,W. "Computer buses", CRC Press 2020.

Web References

1. https://www.ni.com/
2. https://www.halvorsen.blog/documents/programming/labview/labview.php

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Virtual Instrumentation.?
2. Mention the role of hardware's in V?
3. What is Transducers?
4. What are VI Programming techniques?
5. What is Opto-isolation?

L2: Understand

1. Draw and explain the graphical and VI models with design flow.
2. Explain SCADA in VI.
3. Explain PC based instrumentation
4. Explain Instrumentation Buses.
5. Explain TCP/ IP Protocols.

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PE 20EE016 ANALYSIS OF POWER CONVERTERS 3 0 0 3

Pre – Requisite: Power Electronics

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20EE016.1	Understand basic concepts of Single Phase rectifiers		L2
20EE016.2	Explain operation of three phase rectifiers with different loads		L2
20EE016.3	Operation and application of Converters		L3
20EE016.4	Explain principle of operation of inverters		L2
20EE016.5	Knowledge of AC Voltage Controllers		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Over view of switching devices and Single Phase AC-DC Converters **9 Hours**

Power MOSFET, IGBT, GTO, GaN devices-static and dynamic characteristics, gate drive circuits for switching devices.
Single phase Half and fully controlled converters with R, RL load – Evaluation of input power factor and harmonic factor, output voltage, ripple and distortion -Continuous and Discontinuous load current - effect of source impedance and overlap – Numerical Problems

half controlled and fully controlled converters with R-L-E load

Unit II: Three Phase AC-DC Converters **9 Hours**

Three phase half wave controlled converter with R, RL load. Three phase half controlled bridge converter with R, RL load, Three phase fully controlled bridge converter with R, RL load – Evaluation of input power factor and harmonic factor, output voltage, ripple and distortion -Continuous and Discontinuous load current - effect of source impedance and overlap – Numerical Problems.

Semi and fully controlled converter with R-L-E load

Unit III: DC-DC Converters and Power Factor Correction Converters **9 Hours**

Analysis of buck-boost converters, CUK converter – Numerical problems, Full bridge converter – Resonant and quasi – resonant converters.
Single-phase single stage boost power factor corrected rectifier, power circuit principle of operation, and steady state- analysis, three phase boost PFC converter

Analysis of buck and boost converter

Unit IV: DC-AC Inverters **9 Hours**

Principle of operation-Voltage control of single phase inverters - sinuscidal PWM – modified PWM – phase displacement Control – Trapezoidal, staircase, stepped, harmonic injection and delta modulation. Voltage Control of Three-Phase Inverters- Sinusoidal PWM – 60° PWM – Third Harmonic PWM – Space Vector Modulation-Comparison of PWM Techniques – Voltage source and Current source inverters –Variable dc link inverter.

Single PWM and multiple PWM Techniques

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Unit V: AC Voltage Controllers and Cycloconverters **9 Hours**

Static Characteristics of TRIAC- Principle of phase control: single phase and three phase AC voltage controllers with R Load– various configurations – evaluation of output voltage and current expressions.
Single phase and three phase cyclo-converters – power factor Control – Introduction to matrix converters.

Single Phase and Three phase AC voltage controllers with R-L load

Text Books

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Pierson Prentice HallIndia, New Delhi, 2004.
2. P.S.Bimbra, "Power Electronics", Khanna Publishers, Eleventh Edition, 2003.
3. Ned Mohan,T.M Undeland and W.P Robbin, "Power Electronics: converters, Application and design" John Wiley and sons.Wiley India edition, 2006.

Reference Books

1. Cyril W.Lander, "power electronics", Third Edition McGraw hill-1993
2. P.C Sen.," Modern Power Electronics ", Wheeler publishing Co, First Edition, New Delhi-1998.
3. Power Electronics by Vedam Subramanyam, New Age International publishers, New DelhiSecond Edition, 2006

Web References

1. https://nptel.ac.in/courses/117103148

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is difference between Mosfet and IGBT?
2. What is firing angle?
3. What are limits for inverter operation?
4. What is VSI and CSI?
5. What are the V-I characteristics of TRIAC?

L2: Understand

1. Explain free wheeling diode operation.
2. Explain in detail about fully controlled converter with R and RL load.
3. Explain the design of boost converter.
4. Explain PWM techniques for inverter operation.
5. Explain power conversion using single phase AC Voltage Controller with R load.

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PE 20EE017 Multivariable Control System 3 0 0 3

Pre – Requisite: Control System

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20EE017.1	Introduction of multivariable control		L2
20EE017.2	Explain the types of linear system models		L2
20EE017.3	Explain different conditions of a linear system		L2
20EE017.4	Describe the types of deedback control		L2
20EE017.5	Explain various types of system control		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction to Multivariable Control **9 Hours**
Introduction, Process and Instrumentation, Process Variables ,The Process Behavior, Control Aims, Modes of Operation, The Need for Feedback, Model-free vs. Model-based Control, The Importance of Considering Modeling Errors

Multivariable Systems, Implementation and Structural Issues

Unit II: Linear System Representation: Models and Equivalence **9 Hours**
Introduction: Objectives of Modeling, Types of Models, First-principle Models: Components, Internal Representation: State Variables, Linear Models and Linearization, Input/output Representations, Systems and Subsystems: Interconnection, Discretised Models.

Equivalence of Representations, Disturbance Models

Unit III: Linear Systems Analysis **9 Hours**
Introduction, Linear System Time-response, Stability Conditions, Discretisation, Gain, Frequency response, System Internal Structure, Block System Structure (Kalman Form).

Hierarchical Control

Unit IV: Solutions to the Control Problem **9 Hours**
The Control Design Problem, Control Goals, Variables Selection, Control Structures, Feedback Control, Feed forward Control, Two Degree of Freedom Controller

changing a bit shift register

Unit V: Decentralized and Decoupled Control **9 Hours**
Introduction: Plant Decomposition, Grouping of Variables, Multi-loop Control, Pairing Selection, Decoupling, Enhancing SISO Loops with MIMO Techniques: Cascade Control, Other Possibilities, Sequential.

Hierarchical Design and Tuning

Text Books

1. Albertos Pedro, "Multivariable Control Systems", 4th Edition, Springer, 2019
2. Katsuhiko Ogata, "Modern Control Engineering", 3rd Edition, Prentice Hall of India Pvt. Ltd, , 2015.
3. Nagoorkani A, "Control Systems", 3rd Edition, RBA publications, 2017.

Reference Books

1. Skogestad S, "Multivariable Feedback Control", 2nd Edition, Wiley, 2018.

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2. Nagarath I.J. and .Gopal M, "Control Systems Engineering", 2nd Edition, New age International Publications, 2018

Web References

1. https://www.nielit.gov.in/calicut/content/online-course-industrial-automation-plc-scada
2. https://www.ambitautomation.in/courses/industrial-automation/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is I/O module?
2. What are different operational procedures?
3. What are output registers?
4. What is matrix function?
5. What is object counter?

L2: Understand

1. Explain construction of PLC ladder diagrams.
2. Explain ladder diagram construction.
3. Explain architecture functions.
4. Explain Characteristics of Registers.
5. Explain master control relay jump.

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PE 20EE018 Power System Operation and Control 3 0 0 3

Pre – Requisite: Power Generation and Transmission, Power Distribution and Distributed Generation

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20EE018.1	Outline the economic operation of thermal power plants		L2
20EE018.2	Summarize hydro-thermal scheduling		L3
20EE018.3	Examine the behavior of single area power system for change in load demand	-	L3
20EE018.4	Demostrate the behavior of two area power system for various operating scenarios		L3
20EE018.5	Explain reactive power and voltage control in power system		L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Economic Operation of Power Systems **9 Hours**

Optimal operation of Generators in Thermal power stations, Heat rate curve, Cost Curve, Incremental fuel and Production costs, Input, output characteristics – Optimum generation allocation with line losses neglected, Optimum generation allocation including the effect of transmission line losses , Loss Coefficients , General transmission line loss formula.

Lambda -Iteration methods

Unit II: Hydro Thermal Scheduling **9 Hours**

Optimal scheduling of Hydrothermal System: Mathematical Formulation, Solution Technique. Optimal unit commitment problem, Need for unit commitment, Constraints in unit commitment, Cost function formulation, Solution methods, Priority ordering.

Dynamic programming

Unit III: Load Frequency Control-I **9 Hours**

Modeling of steam turbine, Generator, Mathematical modeling of speed governing system,Transfer function – Necessity of keeping frequency constant, Definitions of Control area, Single area control system, Block diagram representation of an isolated power system, Steady state analysis, Dynamic response, Uncontrolled case.

Proportional plus Integral control of single area and its block diagram representation

Unit IV: Load Frequency Control-II **9 Hours**

Block diagram development of Load Frequency Control of two area system uncontrolled case and controlled case. Tie-line bias control. Load Frequency Control and Economic dispatch control.

Performance Index and optimal load frequency control

Unit V: Reactive Power and Voltage Control **9 Hours**

Production and absorption of reactive power, Methods of voltage control-shunt reactor, shunt capacitors series capacitors, synchronous condensers. Static-VAR-systems. Principles of transmission system compensation, Modelling of reactive compensating devices. Application of tap-changing transformers to transmission systems, Distribution system voltage regulation. Modelling of transformer ULTC control system.

Need of FACTS controllers

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Text Books

1. I.J.Nagrath&D.P.Kothari, "Modern Power System Analysis", Tata McGraw–Hill Publishing Company Ltd, 4th Edition, 2011
2. P.Kundur, "Power System Stability and Control", McGraw Hill Inc, 2nd Edition, 2005

Reference Books

1. John J.Grainger, William D.Stevenson,Gary W. Chang, "Power System Analysis" Tata McGraw Hill,2nd edition, 2016.
2. O.I.Elgerd, "Electric Energy systems Theory"Tata McGraw-hill Publishing Company Ltd., 2nd edition, 2005
3. S.S.Vachera, "Power System analysis & Stability", Khanna Publishers, 3rd edition, 2005

Web References

1. https://npti.gov.in/power-system-operation
2. https://www.udemy.com/course/power-system-analysis-part-3-power-flow-and-short-circuit
3. https://www.coursera.org/learn/power system operation and control

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	30
L2	40	30
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define optimal operation.
2. Define Incremental fuel cost.
3. Define control area.
4. Define regulation.
5. List the factors affecting power system security.

L2: Understand

1. Develop an algorithm for determination of optimal operation by neglecting line losses
2. Develop the solution for long term hydro-thermal scheduling.
3. Describe the Economic dispatch control and Load frequency control.
4. Demonstrate operation of two area load frequency control.
5. Demonstrate the application of tap-changing transformers to transmission systems

L3: Apply

1. Explain Input-Output characteristics of power plants
2. Explain short term hydro-thermal scheduling.
3. Explain the significance of Economic dispatch control and Load frequency control.
4. Demonstrate operation of two area load frequency control.
5. Demonstrate the application of tap-changing transformers to transmission systems

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PE 20EE019 Automotive Electrical Engineering 3 0 0 3

Pre – Requisite: Power Electronics, Instrumentation

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's PO 1	PO 3	DoK
20EE019.1	Understand the construction of different accessories	3	2	L2
20EE019.2	Explain the principle and construction of various starting systems	3	2	L2
20EE019.3	Discuss various types of charging systems	3	2	L2
20EE019.4	Understand the fundamentals of automotive electronics	2	2	L2
20EE019.5	Explain various types of sensors and activators	2	2	L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Batteries And Accessories **9 Hours**

Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on batteries, maintenance and charging. Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn, wiper system and trafficator.

Principle of lead acid battery, various tests on batteries, LED lighting system

Unit II: Starting System **9 Hours**

Condition at starting, behavior of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, care and maintenances of starter motor, starter switches.

Illumination at horizontal and vertical plane from point source

Unit III: Charging System **9 Hours**

Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cutout. Voltage and current regulators, compensated voltage regulator, alternators principle and constructional aspects and bridge rectifiers, new developments.

Selection of utilisation factor, reflection factor and maintenance factor

Unit IV: Fundamentals Of Automotive Electronics **9 Hours**

Current trends in automotive electronic engine management system, electro magnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system.

Calculation of illumination level available on road

Unit V: Sensors And Activators **9 Hours**

Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors, relay.

Recommended method for aiming of lamp

Text Books

1. Young A.P. & Griffiths. L. "Automotive Electrical Equipment", ELBS & New Press- 1999.
2. William B.Riddens "Understanding Automotive Electronics", 5th edition - Butter worth Heinemann Woburn, 1998.

Reference Books

1. Bechhold "Understanding Automotive Electronics", SAE, 1998.
2. Crouse, W.H "Automobile Electrical Equipment", McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.
3. Judge A.W "Modern Electrical Equipment of Automobiles", Chapman & Hall, London, 1992.
4. Kholi.P.L "Automotive Electrical Equipment", Tata McGraw-Hill Co., Ltd., New Delhi, 1975.
5. Robert Bosch "Automotive Hand Book", SAE (5th Edition), 2000.

Head of the Department

6. Ganesan.V. "Internal Combustion Engines", Tata McGraw-Hill Publishing Co., New Delhi, 2003.

Web References

1. https://nptel.ac.in/courses/108/105/108105060/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What head light dazzling?
2. What is crankshaft position,?
3. What Uniformity ratio?
4. What is coolant temperature?
5. What is manifold pressure?

L2: Understand

1. Explain construction of lead acid battery.
2. Explain behaviou of starter at the time of starting.
3. Explain electro magnetic interference suppression.
4. Explain onboard diagnostic system.
5. Explain air mass flow in a engine.

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Board of Studies (EEE)

PE **20EE020 Wireless Sensor and Instrument Networks** 3 0 0 3

Pre – Requisite: Instrumentation

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20EE020.1	Explain the basic technology of wireless sensor		L2
20EE020.2	Explain different wireless communication technology		L2
20EE020.3	Discuss different protocols and data transfer techriques		L2
20EE020.4	Understand the architecture of different wireless sensors and networks		L2
20EE020.5	Explain various applications of wireless sensors and networks		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Instruments and Instrumentation **9 Hours**

Introduction, measurements, Instrument architecture ,Digital instrument hardware and software, Sensor technology, advanced sensor's, instrument and sensor communication and networks, industrial instrumentation systems, noise and ditortion

Noise in electronic systems, noise in digital systems

Unit II: Wireless Communication **9 Hours**

Introduction, Wireless Communication principles, electromagnetic wave propogation, RF components, Analog modulation and multiplexing, Analog modulation and multiplexing, frequency spreading, multiple access techniques

Carrier sense multiple access, space division multiple access

Unit III: Data transfer, Networks, Protocols, and Standards **9 Hours**

Introduction, data transfer, security in data flow, network essentials and topologies, protocols, standards, wireless networks, PANs, LANs, and WLANs, Network, Data and Information management

Industrial sensor buses and networks

Unit IV: Wireless Sensor and Instrument Networks **9 Hours**

Wireless sensor architecture, network design of wireless sensors, wireless instrument architecture, wireless sensor and instrument network design, wireless integrated network sensors, plug and play sensors and networks

Industrial wireless sensors and networks

Unit V: Wireless Sensor and Instrument Application **9 Hours**

Commercial wireless sensors and instruments, wireless instruments in research and development, sensor networks in research and development, Industrial wireless sensor and instrument networks

Radio frequency identification

Text Books

1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", 4th Edition, John Wiley, 2019
2. Jagannathan Sarangapani, "Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control", 3rd Edition, CRC Press, 2015.

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Vidyanagar, Nellore(Dist.) - 524 413

Reference Books

1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks- Technology, Protocols, and Applications", John Wiley, 2007.
2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

Web References

1. https://www.nielit.gov.in/calicut/content/online-course-industrial-automation-plc-scada
2. https://www.ambitautomation.in/courses/industrial-automation/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is sensor networks ?
2. What is Personal area networks (PANs)?
3. What is MAC protocol?

L2: Understand

1. Explain Technologies for Wireless Sensor Networks
2. Explain hidden node and exposed node problem.
3. Explain Based MAC Protocols with Scheduling Mechanisms
4. Explain the Demand Routing Protocols.
5. Explain Wireless fidelity systems.

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OE 20CEO01 Urban Environmental Services 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs PO6	PO7	PO12	DoK
20CEO01.1	Identify urban – health relationships	3	3	1	L1, L2
20CEO01.2	Demonstrates the connection between urban built form and health outcomes	3	3	1	L1, L2
20CEO01.3	Discuss the distribution of health risks of urban transportation grid	3	3	1	L1, L2
20CEO01.4	Assess and plan for community needs in health-care infrastructure	3	3	1	L1, L2
20CEO01.5	Identify preliminary opportunities for advancing urban health outcomes	3	3	1	L1, L2

1: Weakly Contributing | 2: Moderately Contributing | 3: Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Health and Planning 9 Hours

Introduction, The Historical Link, Dividing Health and Planning, Urban Health – Basic Conceptions in the Literature, Urban Form, Physical Activity.

Health Promotion

Unit II: Built Urban Form and Health 9 Hours

Renewing the Health-Urban Link, The Urban form, The Metropolitan Sprawl Index, Using Measured Urban Forms to Assess Health Effects, Environmental Factors and Physical Activity

Alternatives to Metropolitan Sprawl Index

Unit III: Transportation Systems 9 Hours

Transport Planning, Private Motor Vehicles as Health Risks, Private Motor Vehicles and Obesity, Public Transport, Mixed-use Medium-density and Pedestrian Travel, Proximity and Individual Factors.

Residential and Travel Preferences

Unit IV: Spatial Access to Health Services 9 Hours

Introduction, The Concept of Access, Dimensions of Spatial Access, Primary Care Supply and Access, Spatial Access and Travel Behaviour, Access and Mortality.

Access to health care Aligned with Transport

Unit V: Challenges and Opportunities 9 Hours

Introduction, Challenges, Conceptual Frameworks, Investigative Methods and Data Collection, Limited Policy Capacity, Fragmented Initiatives, Opportunities, Interdisciplinary Engagement, Major Conceptual Programs, Priorities for future Research.

Promotion of physical activity in daily routines

Text Books

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 3rd Edition, University Grants Commission, 2021
2. George Luber and Jay Lemery, "Global Climate Change and Human Health", 1st Edition Jossey-Bass, 2015

Reference Books

1. Pataki, Diane E., et al. "Coupling biogeochemical cycles in urban environments: ecosystem services, green solutions, and misconceptions" Frontiers in Ecology and the Environment, 2011
2. Frank, L., Engelke, P., and Schmid, T., "Health and Community Design: The Impact of The Built Environment on Physical Activity", Island Press, Washington, D.C., 2003
3. Eiichi Taniguchi, Tien Fang Fwa and Russell G Thompson, "Urban Transportation and Logistics", CRC Press, 2014

Web References

1. https://www.oecd.org/health/health-systems/32066565.pdf
2. https://www.pdfdrive.com/urban-environment-proceedings-of-the-10th-urban-environment-symposium-e157051203.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. How is natural environment different from urban environment?
2. How does the urban environment affect health and well-being?
3. How can urban areas improve health?

L2: Understand

1. Explain the most important problem related to health in urban area
2. Describe the differences between physical activity for transportation and physical activity for recreation
3. Consider a study that evaluates the health of people in two communities, one with sidewalks and one without. The study authors find that the rate of lung cancer is higher in the community without sidewalks, and conclude that sidewalks protect against lung cancer. What concerns would you have about accepting this conclusion?

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OE 20CSO01 Data Structures and Algorithms

3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CSO01.1	Understand the advanced data structures and algorithms	-	L1, L2, L3
20CSO01.2	Demonstrate through abstract properties of various data structures such as stacks, queues and lists to implement efficient programs using data structures.	-	L1, L2, L3
20CSO01.3	Demonstrate through various searching & sorting techniques	-	L1, L2, L3
20CSO01.4	Apply data structures and algorithms to solve real world problems.	-	L1, L2, L3
20CSO01.5	Apply algorithm analysis techniques to evaluate the performance of an algorithm.	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Data Structures & Algorithms **9 hours**

Introduction to Data Structure, Data Organization, Abstract Data Types, Elementary data types; Basic concepts of data Structures; performance measures for data structures, Time and Space Complexity. Introduction to Algorithms, Asymptotic notations and common functions, Algorithm Specifications: Performance Analysis and Measurement

Efficiency of an Algorithm

Unit II: Arrays and Linked Lists **9 hours**

Arrays- Definition, Different types of Arrays, Application of arrays, Sparse Matrices and their representations. Linked lists- Definition, Implementation of Singly Linked Lists, Doubly Linked List, Operations on a Linked List, Insertion, Deletion and Traversal. Stack-Basic Concept of Stack, Stack as an ADT and operations in stack. Queue-Basic Concept of Queue, Queue as an ADT and Operations in Queue

Generalized Linked List, Applications of Stack and Queue **9 hours**

Unit III: Trees and Graphs

Trees- Basic concept of Binary tree, Operations in Binary Tree, Tree Height, Level and Depth, Binary Search Tree, Insertion, Deletion, Traversals, Search in BST, 2-4 trees. Graph-Matrix Representation Of Graphs, Elementary Graph operations/Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree)

Applications of Tress and Graph

Unit IV: Algorithm Design Techniques I **9 hours**

Divide and Conquer-General method, Merge sort, Quick sort. Brute force- approach, bubble sort, Linear Search techniques

Preferences of Merge and quick sort techniques.

Unit V: Algorithm Design Techniques II **9 hours**

Greedy Technique, General method, Knapsack problem, Job sequencing with deadlines, Minimal cost spanning tree algorithms (Prim's and Kruskal's), Dynamic Programming: General method, 0/1 knapsack problem, All pair shortest path algorithm

Usages of Greedy algorithms.

Text Books

1. Reema Thareja, "Data Structures Using C", Second Edition, Oxford, 2014
2. Horowitz, Sahni and Anderson Freed, "Fundamentals of Data Structures in C", Second Edition, 2008
3. Mark Allen Weis , "Data Structures and Algorithm Analysis in C", Second edition, Pearson, 1997

Reference Books

1. Salaria R.S., "Data Structures and Algorithms using C", Fifth Edition, Khanna Publishing, 2018
2. Richard F Gilberg, "Data Structures: A PseudoCode Approach With C++" Fifth edition, Thomson Press(India), 2004
3. Amitava Nag and Jyothi Prakash Singh, "Data Structures and Algorithms Using C", Second Edition, Vikas Publishing, 2009

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Web References

1. https://www.springboard.com/library/software-engineering/data-structures-and-algorithms/
2. https://www.geeksforgeeks.org/data-structures/
3. https://www.programiz.com/dsa

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Describe Data Structure and Algorithm
2. Illustrate some applications of stack
3. Describe about a Queue
4. List two applications of Data Structures

L2: Understand

1. Classify data structures
2. Explain about asymptotic notations
3. Differentiate Linked List, Stack and Queue
4. Explain about different sorting algorithms

L3: Apply

1. Implement the append method, which should add a new element onto the tail of the linked list
2. Implement stack using arrays and linked lists
3. Implement Queue using arrays and Linked Lists
4. Illustrate the importance of recursion

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OE 20AIO01 Machine Learning for Engineers 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20AIO01.1	Describe different types of learnings		L1, L2
20AIO01.2	Explain different supervised learning algorithms		L1, L2
20AIO01.3	Explain different unsupervised learning algorithms	-	L1, L2
20AIO01.4	Describe various types of machine learning models		L1, L2
20AIO01.5	Choose appropriate machine learning model and algorithm for given task		L1, L2

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to learning **9 hours**

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression

Examples of regression

Unit II: Linear Models **9 hours**

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines

Applications of perceptron

Unit III: Trees and Probabilistic Models **9 hours**

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbour Methods – Unsupervised Learning – K means Algorithms – Vector Quantization

Self-Organizing Feature Map

Unit IV: Dimensionality Reduction and Evolutionary Models **9 hours**

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms

Markov decision process

Unit V: Graphical Models **9 hours**

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models

Tracking Methods

Text Books

1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, "Machine Learning", 1st Edition, McGraw Hill Education, 2013

Reference Books

1. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", 1st Edition, Cambridge University Press, 2012.
2. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", 1st Edition, Wiley, 2014.

3. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)", 3rd Edition, MIT Press, 2014

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Machine Learning.
2. List the types of Machine Learning.
3. State Bayes Theorem.
4. What is Regularization?

L2: Understand

1. Demonstrate Linear Regression.
2. Explain Back Propagation Algorithm.
3. Illustrate Decision Tree Induction process
4. Explain Genetic Operations with examples

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OE Introduction to Database Management Systems

3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with Pos	DoK
20DSO01.1	Describe the basic concepts of DBMS And different data models		L1,L2
20DSO01.2	Apply Constrains on relations		L2,L2,L3
20DSO01.3	Apply SQL commands on relations	-	L1,L3
20DSO01.4	Understand PL/SQL operations		L1,L2,L3
20DSO01.5	Understand the principles of database normalization and Transaction management system.		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction to Databases **9 Hours**

Overview of Data Base Systems, Database System Applications, File System VS Database System, Data Abstraction, Levels of Abstraction, Data Independence Instances and Schemas, Different Data Models, Database Languages, Data Base Users and Administrator, Database System Structure, N-tier Architecture, Database design and ER diagrams, Design Entities, Attributes and Entity sets, Relationships and Relationship Sets, Advanced Features of ER Model

History of DBMS

Unit II: Relational Model, Relational Algebra and Relational calculus **9 Hours**

Relational Model: Introduction to the Relational Model, Integrity Constraint and key constraints over relations, Logical data base Design, Views, Destroying / Altering Tables and Views - Relational Algebra: Selection and Projection, Set Operations, Aggregate Operations, Renaming, Joins,
Division, Additional Relational Algebraic operations - Relational calculus: Tuple Relational Calculus, Domain Relational Calculus

Expressive Power of Algebra and Calculus

Unit III: Structured Query Language **9 Hours**

SQL: Concept of different Database Languages over SQL - DDL, DML, DCL, Set operations, SQL Commands, Nested queries, Aggregate Functions, Null Value, Referential Integrity Constraints, views.

Compare all Database Languages

Unit IV: Schema Refinement and Normalization **9 Hours**

Understand PL/SQL block, components of PL/SQL block, Control statements and conditional statements in PL/SQL Embedded SQL, Triggers, Cursors, Stored procedures packages

Compare all Normal Forms

Unit V: Normalization **9 Hours**

Understand the principles for Relational Database Design, Functional Dependencies, Trivial and Nontrivial Dependencies, Closure Set of
Functional Dependencies, Closure Set of Attributes. - Normalization: 1NF, 2NF, 3NF, BCNF, Lossless Join and Dependency Preserving decomposition,
4NF and 5N. Transaction Concept, ACID Properties, States of Transaction, Implementation of Atomicity & Durability, Schedules,

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Concurrency Control without Locking

Text Books

1. Abraham Silber Schatz, Henry F Korth, S Sudarshan, "Database System Concepts", 6th Edition, McGraw-Hill International Edition, 2013
2. Date CJ, Kannan A, Swamynathan S, "An Introduction to Database Systems", 8th Edition, PearsonEducation, 2006
3. Raghurama Krishnan, Johannes Gehrke, "Data base Management Systems", 3rd Edition, TATA McGraw Hill, 2008

Reference Books

1. Elmasri Navrate, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016
2. Peter Rob & Carlos Coronel, "Data base Systems design, Implementation, and Management", 10th Edition, Pearson Education, 2013

Web References

1. https://www.javatpoint.com/dbms-tutorial
2. https://www.geeksforgeeks.org/introduction-of-dbms-database-management-system-set-1/?ref=lbp

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	30	40
L3	40	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List types of database users
2. List out all types of data models present
3. Give syntaxes to Create and Alter a table
4. What is Redundancy?
5. List out the properties of transactions

L2: Understand

1. Compare the database system with conventional file system
2. Demonstrate the use of DISTINCT keyword in SQL select statement
3. Explain the following SQL constructs with examples:

(1) Order by (2) group by and having (3) as select (4) schema

4. Explain the difference among Entity, Entity Type & Entity Set
5. Illustrate ACID properties

L3: Apply

1. Choose a relation R with 5 attributes ABCDE and the following FDs: A ->B, BC->E, and ED ->A. Is R in 3NF? Justify?
2. Apply Normalization technique for the following relation up to 3NF:

Bank (acno, cust_name, ac_type, bal, int_rate, cust_city, branchId, branch_nm, br_city)

3. Construct a transaction state diagram and describe each state that a transaction goes through during its execution?
4. Demonstrate serializability concept

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Board of Studies (CSE - DS)

OE 20ECO01 Architectures and Algorithms of IoT

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20ECO01.1	Demonstrate the Architecture and applications of IoT		L1, L2
20ECO01.2	Explain the protocol concept and data bases of IoT		L1, L2, L3
20ECO01.3	Construct the IoT device design space and Platform design		L1, L2, L3
20ECO01.4	Explain the IoT network model and Event analysis		L1, L2, L3
20ECO01.5	Demonstrate the Industrial Internet of Things and its Architecture		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: The IoT Landscape **12 Hours**

What Is IoT?, Applications , Architectures , Wireless Networks, Devices, Security and Privacy , Event-Driven Systems.

Ethernet

Unit II: IoT System Architectures **10 Hours**

Introduction, Protocols Concepts, IoT-Oriented Protocols, Databases, Time Bases, Security.

Message Queuing Telemetritransport (MQTT)

Unit III: IoT Devices **12 Hours**

The IoT Device Design Space, Cost of Ownership and Power Consumption, Cost per Transistor and Chip Size, Duty Cycle and Power Consumption.

Platform Design

Unit IV: Event-Driven System Analysis **14 Hours**

IoT Network Model - Events, Networks, Devices and Hubs, Single-Hub Networks, Multi-hub Networks, Network Models and Physical Networks, IoT Event Analysis - Event Populations, Stochastic Event Populations, Environmental Interaction Modeling.

Event Transport and Migration

Unit V: Industrial Internet of Things **12 Hours**

Introduction, Industrie 4.0, Industrial Internet of Things (IIoT), IIoT Architecture, Basic Technologies, Applications and Challenges.

Integrated IIoT

Textbooks

1. Dimitrios Serpanos and Marilyn Wolf, "Internet-of-Things (IoT) Systems Architectures, Algorithms, Methodologies", Springer, Cham, 2018
2. Vijay Madisetti and Arshdeep Bahga, " Internet of Things (A Hands-on Approach)", Universities Press, 2015

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N.S.Raju Institute of Technology (Autonomous)
Sontyam, Visakhapatnam - 531 173

Reference Books

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and Sons Ltd, UK, 2014
2. Oliver Hersent, David Boswarthick and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", John Wiley and Sons Ltd., UK, 2012

Web Resources

1. https://books.google.co.in/books?isbn=1119969093
2. https://books.google.co.in/books?isbn=135123093X

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	35	35
L3	35	35
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is IoT?
2. List any three applications of IoT
3. Define protocol concept of IoT
4. Define data base
5. What is Duty cycle?

L2: Understand

1. Explain the Architecture of IoT
2. Explain the Security and privacy of IoT
3. Illustrate the Protocol Concept of IoT
4. Explain the Date bases of IoT
5. Demonstrate the IoT Device Design Space

L3: Apply

1. Identify the Wireless Networks for IoT
2. Model the Event-Driven Systems for IoT
3. Construct the IoT-Oriented Protocols
4. Construct the Platform Design for IoT

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Board of Studies (ECE)

OE 20EEC01 Introduction to Renewable Energy Sources 3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's PO1	PO7	DoK
20EEC01.1	Understand the significance of solar energy	2	2	L1, L2
20EEC01.2	Provide the importance of Wind Energy	2	2	L1, L2
20EEC01.3	Understand the role of ocean energy in the Energy Generation	3	2	L1, L2
20EEC01.4	Explain the utilization of Biogas plants and geothermal energy	2	2	L1, L2
20EEC01.5	Explain the concept of energy Conservation	2	2	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Solar Energy **12 Hours**

Solar Radiation, Measurements of Solar Radiation, Flat Plate And Concentrating Collectors, Solar Direct Thermal Applications, Solar Thermal Power Generation, Fundamentals of Solar , Photo Voltaic Conversion, PV Characteristics Solar Cells, Solar PV Power Generation, Solar PV Applications.

Thermal analysis of flat plate collectors

Unit II: Wind Energy **12 Hours**

Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Wind Turbine Generator

Betz Criteria

Unit III: Ocean Energy **12 Hours**

Ocean Thermal Energy Conversion (OTEC), Principle of operation, development of OTEC plants, Tidal and wave energy, Potential and conversion techniques, mini-hydel power plants

Open and closed OTEC Cycle

Unit IV: Bio Mass **12 Hours**

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gasdigesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.

I.C Engine Operation

Unit V: Geo Thermal Energy and Energy Conservation **12 Hours**

Resources, types of wells, methods of harnessing the energy, scope in India. Principles of energy conservation, the different energy conservation appliances, cooking stoves, Benefits of improved cooking stoves over the traditional cooking stoves

Hydro Thermal, Geo-pressured, Hot dry rocks

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Text Books

1. R K Gupta and S C Bhatia "Renewable Energy" Woodhead publishing India Pvt. Ltd.,2019
2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", Second Edition, IEEE Press, Wiley, 2013
3. Ranjan Rakesh, Kothari D. P.& Singal K. C., "Renewable Energy Sources And Emerging Technologies", 2 nd Edition, PHI, 2013
4. Mukund R. Patel, "Wind and Solar Power Systems – Design, Analysis and Operation", 2nd Edition, Taylor & Francis, 2006

Reference Books

1. S Sukhatme, J Nayak, "Solar Energy: Principles of Thermal Collection and Storage", 3rd Edition, Tata Mcgraw Hill , 2003.
2. Tiwari and Ghosal, "Renewable energy resources", 2nd edition, Narosa Publishing house, 2001
3. B H Khan, "Non conventional energy resources", 2 nd Edition, Tata Mcgraw Hill, 2001

Web References

1. https://nptel.ac.in/courses/121/106/121106014/
2. https://www.edx.org/learn/renewable-energy
3. https://www.coursera.org/learn/renewable-energy-resources-and-technologies

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	30
L2	60	70
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is meant by Solar Thermal Energy?
2. Give the classification of small hydro power stations.
3. What are the various losses occurring in the fuel cell?
4. List various Biomass resources.
5. What is the basic principle of Tidal Power?

L2: Understand

1. Explain in detail about flat plate collectors and give its advantage and disadvantages.
2. Explain the principle of working of a H2 - O2 fuel cell.
3. Explain about Dry, Wet and Hot water Geo thermal systems.
4. Compare between Geo thermal power plant and Conventional thermal power plant.
5. Explain about the site requirements to construct a Tidal Power Plant.

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Board of Studies (EEE)

OE 20MEO01 Nano Technology

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	DoK
20MEO01.1	Describe the fundamental science of nanomaterials	L2
20MEO01.2	Demonstrate the preparation of nanomaterials	L1,L2
20MEO01.3	Explain of the challenges on safe nanotechnology	L1,L2
20MEO01.4	Develop knowledge in characteristic nanomaterial	L1,L2,L3
20MEO01.5	Apply Nanoscience for industrial applications	L1,L2,L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction — 11+1 Hours

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties.

Introduction to properties and motivation for study (qualitative only)

Unit II: General Methods Of Preparation — 11+1 Hours

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation.

Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE

Unit III: Nano materials — 11+1 Hours

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays-functionalization and applications-Quantum wires.

Quantum dots-preparation, properties and applications

Unit IV: Characterization Techniques — 11+1 Hours

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA.

SIMS-Nano-indentation

Unit V: Applications — 11+1 Hours

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal. Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology. Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition.

Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

TEXT BOOKS:

1. Edelstein A.S and Cammearata R.C, Eds., "Nanomaterials: Synthesis, Properties And Applications", Institute Of Physics Publishing, Bristol And Philadelphia, 1996.
2. John Dinardo N, "Nanoscale Characterization Of Surfaces & Interfaces", 2nd Edition, Weinheim Cambridge, Wiley-VCH, 2000
3. Murthy B.S and Shankar P, " Nanoscience and NanoTechnology" , 1st Editon, Springer Publications,2013
4. Louis Hornyak and Tibbals H F, " Introducton to Nanoscience and NanoTechnology" , 1stEdition,Talor Francis CRC Press,2008

REFERENCE BOOKS:

1. Timp G, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations", Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Web references:

1.http://www.nano.gov
2.http://mrsec.wisc.edu/edetc/IPSE/links.html
3.http://nptel.ac.in/courses/112105182/9
4.IOPSCIENCE—Nanotechnology

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	60	20
L2	40	40
L3	-	40
L4	-	-
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1.What is Nano technology?

2.How does Nano Technology Works?

3.What are Nano Materials?

4.Who is Developing Nano technology?

L 2: Understand

1. What Are Some Of The Most Interesting Nanoparticles Found In Nature (Not Manufactured In The Lab)?
2. Given The Nano-Size Of The Particles, Are There Any Effective Respirator Filters To Guard Against Inhalation?
3. What Do You Feel The Repercussions Are For Extended Life Through Utilization Of Nanotechnology?
4. What Is The Risk Of Not Developing Nanotech (In Health Care, Environmental Protection, Economic Development)?

L 3: Applying

1.How are safety tests carried out in nano tech?

2. Seems that (nano)tech is moving fast. Is there a risk that results of safety testing will be out-of-date as soon as printed? How to keep up pace?

3. Discuss about targeted drug delivery using nanoparticles.

Head of the Department

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Chairman
Board of Studies (ME)

OE 20SHO01 Women and Society

3 0 0 3

Code	Course Outcomes	Mapping with POs	DoK
20SHO01.1	This course aims to generate awareness on various factors that constructs and shapes gender identity and perpetuates gender discrimination.		L1,L2
20SHO01.2	This course aims to generate awareness on various factors that constructs and shapes gender identity and perpetuates gender discrimination.		L1,L2
20SHO01.3	The course will examine how feminist analysis & methodology redefines traditional categories and disciplinary concepts through its attention to gender as a social category		L1,L2
20SHO01.4	The course further aims to sensitize students on emerging areas of gender discrimination and its possible resolution		L1,L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Objectives:

This course aims to generate awareness on various factors that constructs and shapes gender identityand perpetuates gender discrimination.

UNIT -I WOMEN AND SOCIETY **9 Hours**

Understanding Sex- Gender, Gender shaping Institutions, Theories of Gender construction Understanding Sexism and Androcentrism, Understanding Patriarchy and Theories of Patriarchy, Privateand Publicdichotomy, Sexual Division of Work, Patriarchy practices in different institutions and Text Books.

UNIT -II FEMINIST THEORY **9 Hours**

Rise of Feminism, Introduction to various stands of Feminism- Liberal Feminism, Radical Feminism, Marxist Feminism, Socialist Feminism, Cultural Feminism, Eco-Feminism, Post-Colonial Feminism, and Post Modern Feminism. Waves of Feminism.

UNIT -III WOMEN'S MOVEMENT **9 Hours**

The socio-economic conditions of women during the age of Industrial revolution the Call for Women's Rights 1848, Women's rights movement 1848-1920, Historical Developments of Social Reform Movements in India, Women's groups and organizations, Women's Movement Movements for UniformCivil code and ShahBano case, Dalit women and the question of double marginality.

UNIT –IV GENDER ROLES AND PSYCHOLOGY OF SEX **9 Hours**

Difference Conceptualization of gender roles and gender role attitudes, Gender: Aggression, Achievement, Communication, Friendship and Romantic, Relationships Sex Differences in Mental Health Trauma relating to Rape, Taboo, Childhood Sexual Abuse, Domestic Violence, Sexual Harassment at Work Place, Educational Institutions, Eve Teasing etc.

UNIT – V GENDER AND REPRESENTATION **9 Hours**

Gender and Mass Media- Print Media, Gender and Mass Media-Electronic Media, Gender and Films, Advertisements, Mega Serials, Stereotyping and breaking the norms of women's roles Women's Representation in Literary Texts.

Suggested reading:

1. Basabi Chakrabarti, Women's Studies: Various Aspects. Urbi Prakashani, 2014
2. Arvind Narrain.Queer:Despised Sexuality Lawand Social Change.Book for Change.2005
3. Chandra Talpade Mohanty, Feminism without Borders:DecolonizingTheory, Practicing Solidarity. Duke University Press.
4. Flavia Agnes.Lawand Gender Inequality:The Politics of Women's Rights in India.Oxford University Press,2001
5. Sonia Bathla, Women, Democracy and the Media: Cultural and Political Representations inthe Indian Press,Sage,NewDelhi,1998.

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Board of Studies CSE (S&H)

Head of the Department

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OE 20CEO02 Ecology, Environment and Resource Management 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs			DoK
		PO6	PO7	PO12	
20CEO02.1	Discuss the role that humans play in affecting the characteristics of the environment	3	3	1	L1, L2
20CEO02.2	Understand the interrelationships between land, sea, the atmosphere and the living things that occupy these environments	3	3	1	L1, L2
20CEO02.3	Distinguish between economic growth and economic development and outline the nature of a sustainable economy	3	3	1	L1, L2
20CEO02.4	Identify the environmental attributes to be considered for the EIA study	3	3	1	L1, L2
20CEO02.5	Develop a thorough understanding of Environmental Policies and legislations practiced in India	3	3	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction 9 Hours

Meaning, scope and evolution of ecology. Man, environment and ecosystem. Components of nature, Structue and Function, Flow of material, Ecological Succession, Trophic levels, Food chain, Food web, Ecological pyramids.

Adaptation, Environmental Zones

Unit II: Ecosystem and its relevance to Environment 9 Hours

Resources and human settlements impact of advanced agricultural methods, Impact of urbanization and industrialization on nature. Urban ecosystem approach evolution and significance. Settlement planning.

Energy Conservation

Unit III: Resource Management and Sustainable Development 9 Hours

Sustainable Development, Fundamentals concerning Environment and Sustainable Development, Economy, Poverty, Human Settlement Issues, Land Resources, Forests, Mountains, Agriculture, Biodiversity, Protection of Oceans, Industry and Business.

Planning for environmentally sensitive areas

Unit IV: Environmental Impact Assessment 12 Hours

Meaning, Significance and framework. Methodologies, Checklist, Matrices, Network and social cost-benefit analysis. Sources and acquisition of environmental information. Environment impact studies of development projects.

EIA Case Studies

Unit V: Environmental Policies and Legislations in India 9 Hours

Major environment policies and legislations in India - The Ministry of Environment & Forests, The Central Pollution Control Board. Policies to protect environment in India – Environment Protection Act, 1986, National Conservation Strategy and Policy Statement on Environment and Development, 1992, Policy Statement for the abatement of Pollution, 1992, National Environment Policy, 2006, Vision Statement on Environment and Health. Legislations and Rules for the protection of Environment in India.

Five year plans in relation to environmental aspects

Text Books

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 3rd Edition, University Grants Commission, 2021
2. Walter E. Westman, "Ecology, Impact Assessment and Environmental Planning", John Wiley & Sons, 1985
3. Chadwick A., "Introduction to Environmental Impact Assessment", Taylor & Francis, 2007

Reference Books

1. Charles H. Southwick D., "Ecology and the Quality of Our Environment", Van No strand Co New York, 1976
2. Barthwal, R.R., "Environmental Impact Assessment", New Age International, New Delhi, 2002

Web References

1. http://iced.cag.gov.in/?page_id=256
2. http://econdse.org/wp-content/uploads/2016/07/chapter-1-gupta.pdf
3. https://www.researchgate.net/publication/341521590_Chapter_5_Environmental_Policy_in_India
4. https://www.preventionweb.net/files/15417_nationalenvironmentpolicyandstrateg.pdf

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Ecology?
2. List any three ways in which humans directly influence environmental conditions
3. What is the goal of sustainable development?
4. List the three sequential phases of EIA
5. Enlist any four principles of National Environmental Policy of India

L2: Understand

1. Explain the key principles of the ecosystem approach to conserving natural resources
2. Explain the impact of urbanization on nature
3. How does sustainable development make economic sense for society?
4. Discuss the importance of EIA activities for developing countries
5. Discuss the objectives and founding principles of India's National Environmental Policy

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Board of Studies (CE)

OE 20CSO02 Designing the Internet of Things 3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CSO02.1	Illustrate the IoT in different contexts	-	L1, L2
20CSO02.2	Outline the Design Principles for Connected Devices	-	L1, L2
20CSO02.3	Explain the Internet Principles & Application Layer Protocols	-	L1, L2
20CSO02.4	Apply the Prototyping concepts in IoT	-	L1, L2
20CSO02.5	Analyse the Prototyping Embedded Devices	-	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Overview of Internet of Things **9 hours**

The flavour of the Internet of Things, The "Internet" of "Things", Technology of IoT, Enhanced Objects, Who is making the Internet of things.

Applications of IoT

Unit II: : Design Principles for Connected Devices **9 hours**

Calm & Ambient Technology, Magic as Metaphor, Privacy: Keeping secrets, Web Thinking for Connected Devices

Examples of Connected Devices

Unit III: : Internet Principles **9 hours**

Internet Communications-IP,TCP, The IP protocol suite(TCP/IP), UDP, IP Addresses-DNS, static IP Address assignment, Dynamic IP Address assignment, IPV6, MAC Addresses, TCP & UDP Ports, Application Layer Protocols

HTTPS: Encrypted HTTP

Unit IV: Thinking About Prototyping **9 hours**

Sketching, Familiarity, Costs versus Ease of prototyping, Prototypes & Production, Open Source versus Closed Source

Embedded Platforms

Unit V: Prototyping Embedded Devices **9 hours**

Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, BeagleBone Black, Electric Imp

Aurdino Components

Textbooks

1. Adrian, McEwen & Hakim Casimally, "Designing The Internet of Things", John Wiley and Sons, 2014
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", Wiley, 2019

Reference Books

1. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things Principles and Paradigms", Morgan Kaufmann,2016
2. Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain, "Internet Of things With Raspberry Pi And Arduino", CRC Press/Taylor & Francis Group, 2019

Web Resources

1. https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/
2. https://tutorialspoint.dev/computer-science/computer-network-tutorials/the-new-internet-internet-of-everything
3. https://www.javatpoint.com/iot-internet-of-things

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Vidyanagar, Nellore-524 413
Andhra Pradesh

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define IoT
2. What are the Enhanced objects for IoT?
3. What is a Prototype?
4. Define Sketching
5. Define DNS

L2: Understand

1. Explain the following terms related to Protocols: UDP, TCP
2. Discuss in detail about MAC Addresses
3. Define Prototyping? Describe the Embedded Computing Basics
4. Explain Application Layer Protocols
5. Discuss the Costs versus Ease of prototyping

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Chairman
Board of Studies (CSE)

OE **20AIC02 Fundamentals of Deep Learning** 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20AIO02.1	Describe the fundamental concept of artificial neural networks		L1, L2
20AIO02.2	Describe the function of different deep neural networks		L1, L2
20AIO02.3	Explain different deep learning algorithms	-	L1, L2
20AIO02.4	Describe the functioning of convolution and recurrent neural networks		L1, L2
20AIO02.5	Choose appropriate deep neural network for given application		L1, L2

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction to Deep Learning **9 hours**

Basics: Biological Neuron, Idea of computational units, McCulloch– Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

Logic gates with perceptron

Unit 2: Feedforward Networks **9 hours**

Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization – Regularization, autoencoders

Applications of multilayer perceptron

Unit 3: Convolution Networks **9 hours**

Convolutional Networks: The Convolution Operation - Variants of the Basic Convolution Function - Structured Outputs – Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features- LeNet, AlexNet

Applications of CNN

Unit 4: Recurrent Neural Networks **9 hours**

Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks –The Long Short-Term Memory

Applications of RNN

Unit 5: Applications of Deep Neural Networks **9 hours**

Applications: Large-Scale Deep Learning - Computer - Speech Recognition - Natural Language Processing

Healthcare applications

Text Books

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, UK, 2017
2. Antonio Gulli and Sujit Pal, "Deep Learning with Keras ", Packt Publishing Ltd, Birmingham, UK, 2017

Reference Books

1. Deng & Yu, "Deep Learning: Methods and Applications", Now Publishers, 2013.
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

Web References

1. https://www.coursera.org/specializations/deep-learning

Head of the Department
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T.G.Pulla Reddy Engineering College (Autonomous)
Kurnool-518 007

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List any 4 benefits of artificial neural networks
2. List any 4 features of ANN
3. What are deep neural networks?
4. Define supervised and unsupervised learning
5. Define generalization

L2: Understand

1. Explain the design parameters of deep neural networks
2. Describe the dimensionality reduction techniques
3. Explain backpropagation algorithm
4. Describe any 2 applications of deep networks for image processing
5. Write about any 5 applications of deep networks

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Board of Studies (CSE- AI & ML)

OE 20DSO02 Introduction to Data Science

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20DSO02.1	Understand Fundamentals of Data Science Terminology.		L1, L2
20DSO02.2	Demonstrate different computing tools involved in data handling.		L1, L2
20DSO02.3	Understand Knime Tool.	-	L1, L2
20DSO02.4	Understand Machine Learning Concepts		L1, L2
20DSO02.5	Apply domain expertise to solve real world problems using data science		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Data Science **9 Hours**

Analysing the Pieces of the Data Science Puzzle, Exploring the Data Science Solution Alternatives, Defining Big Data by the Three Vs, Grasping the Difference between Data Science and Data Engineering, Making Sense of Data in Hadoop, Identifying Alternative Big Data Solutions, Converting Raw Data into Actionable Insights with Data Analytics, Distinguishing between Business Intelligence and Data Science, Defining Business-Centric Data Science

Identifying Data Science Users; Data Engineering in Action: A Case Study

Unit II: Computing for Data Science - 1 **9 Hours**

Using Python for Data Science, Using Open Source R for Data Science.

Sorting Out the Python Data Types; R's Basic Vocabulary

Unit III: Computing for Data Science - 2 **9 Hours**

Using SQL in Data Science, Doing Data Science with Excel and Knime

Basic SQL Commands; Knime Basics

Unit IV Machine Learning, Probability and Statistical Modelling **9 Hours**

Defining Machine Learning and Its Processes, Considering Learning Styles, Seeing What You Can Do, Exploring Probability and Inferential Statistic, Quantifying Correlation, Reducing Data Dimensionality with Linear Algebra, Modeling Decisions with Multi-Criteria Decision Making, Introducing Regression Methods

Linear Regression

Unit V Applying Domain Expertise to Solve Real-World Problems Using Data Science **9 Hours**

Data Science in Journalism,Delving into Environmental Data Science, Data Science for Driving Growth in E-Commerce, Using Data Science to Describe and Predict Criminal Activity

Applying statistical modeling to natural resources in the raw; Deploying web analytics to drive growthh

Text Books

1. Lillian Pierson and Jake Porway,"Data Science For Dummies", 2nd Edition,For Dummies, 2017

Reference Books

1. Joel Grus, "Data Science from Scratch", 2nd Edition, O'Reilly Media, 2015
2. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020

Web Resources

1. https://www.simplilearn.com/tutorials/data-science-tutorial/
2. https://www.w3schools.com/datascience/

Head of the Department
Dept of Electrical & Electronics Engg.,
Sri Krishna Institute of Technology
Bangalore-560 090

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is data science? Identify three areas or domains in which data science is being used
2. Give three examples of structured data formats
3. Name three measures of centrality and describe how they differ
4. What is supervised learning? Give two examples of data problems where you would use Supervised learning

L2: Understand

1. How do data analysis and data analytics differ?
2. Relate likelihood of a model given data, and probability of data given a model. Are these two the same? Different? How?

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Board of Studies (CSE-DS)

OE 20ECO02 IoT for Smart Grids

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20ECO02.1	Demonstrate the Smart Grid concept ,Need for smart grid		L1, L2
20ECO02.2	Explain the Energy Management System functions		L1, L2, L3
20ECO02.3	Describe how modern power distribution system functions		L1, L2
20ECO02.4	Explain the Advanced metering infrastructure and AMI protocols		L1, L2, L3
20ECO02.5	Identify suitable communication networks for Smart Grid applications		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Smart Grid **12 Hours**

Introduction - Evolution of Electric Grid, Smart Grid Concept - Definitions and Need for Smart Grid – Functions – Opportunities – Benefits and challenges, Difference between conventional & Smart Grid.

Technology Drivers

Unit II: Energy Management System **12 Hours**

Energy Management System (EMS) - Smart substations - Substation Automation – Feeder Automation, SCADA – Remote Terminal Unit – Intelligent Electronic Devices – Protocols, Phasor Measurement Unit – Wide area monitoring protection and control, Smart integration of energy resources – Renewable, intermittent power sources.

Energy Storage

Unit III: Distribution Management System **12 Hours**

Distribution Management System (DMS) – Volt / VAR control – Fault Detection, Isolation and Service Restoration, Outage management System, Customer Information System, Geographical Information System, Effect of Plug in Hybrid Electric Vehicles.

Network Reconfiguration

Unit IV: Smart Meters **12 Hours**

Introduction to Smart Meters – Advanced Metering infrastructure (AMI), AMI protocols – Standards and initiatives, Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing.

Peak Time Pricing

Unit V: Communication Networks & IoT **12 Hours**

Elements of communication and networking – architectures, standards, PLC, Zigbee, GSM, BPL, Local Area Network (LAN) - House Area Network (HAN) - Wide Area Network (WAN) – Broadband over Power line (BPL) - IP based Protocols - Basics of Web Service and CLOUD Computing.

Cyber Security for Smart Grid

Textbooks

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

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Reference Books

1. Mini S. Thomas and John D McDonald, "Power System SCADA and Smart Grids", CRC Press, 2015
2. Kenneth C. Budka, Jayant G. Deshpande and Marina Thottan, "Communication Networks for Smart Grids", Springer, 2014

Web Resources

1. https://books.google.co.in/books?isbn=1119969093
2. https://books.google.co.in/books?isbn=135123093X

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	35	35
L3	35	35
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define a Smart grid
2. List any three Benefits of Smart grid
3. What is SCADA?
4. List any three Intelligent Electronic Devices
5. Define a Fault Detection

L2: Understand

1. Explain the need of Smart Grid
2. Demonstrate the Smart Grid Concept
3. Explain the Energy Management System (EMS)
4. Classify and explain the Smart integration of energy resources
5. Illustrate Effect of Plug in Hybrid Electric Vehicles

L3: Apply

1. Identify the Outage management System
2. How to utilize the Distribution Management System (DMS)? explain

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Chairman
Board of Studies (ECE)

OE 20EEO02 Electrical Safety and Management 3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20EEO02.1	Understand the Indian electricity rules and their significance		L1, L2
20EEO02.2	Explain the safety standard in residential, commercial, and agricultural		L1, L2
20EEO02.3	Learn about electrical safety installation, testing and commission		L1, L2
20EEO02.4	Understand about electrical safety in distribution system		L1, L2
20EEO02.5	Explain flash-overs and corona discharge		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Indian Electricity Regulations and Acts and their Significance 12 Hours

Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage – earthing of system neutral – Rules regarding first aid and fire fighting facility.

The Electricity Act2003 (Part 1,2,3,4 & 5) and Control Authority Safety Regulations

Unit II: Electrical Safety in Residential, Commercial and Agriculture Installations 12 Hours

Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

System grounding and Equipment grounding

Unit III: Safety During Installation, Testing and Commissioning, Operation and Maintenance 12 Hours

Preliminary preparations – safe sequence – risk of plant and equipment –safety documentation – field quality and safety - personal protective equipment – safety clearance notice – safety precautions – safeguards for operators – safety

Magnetic Hot sticks, protective clothing and industrial clothing

Unit IV: Electrical Safety in Hazardous Areas 12 Hours

Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours.

Hazards associated with currents and voltages

Unit V: Electrical Safety Shocks and their Prevention 12 Hours

Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

Objectives of Safety and Security Measures

Head of the Department
Dept. of Electrical & Electronics Engg.

Text Books

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.
2. Pradeep Chaturvedi, "Energy Management Policy, Planning and Utilization", Concept Publishing Company, 1997
3. John M Madden, "Electrical Safety and Law, Planning and Utilization", 5th Edition, Routledge, 2017

Reference Books

1. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1998.
2. Martha J Boss and Gayle Nicoll, "Electrical Safety", 1st Edition, CRC Press, 2014
3. Gupta, B.R., "Electrical Safety", 1st Edition, American Technical Publishers, 2018

Web References

1. https://nptel.ac.in/courses/108/104/108104087/
2. https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/syllabus/
3. https://www.edx.org/course/electricity-and-magnetism-maxwells-equations

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	40
L2	70	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Give the classification of electrical installations.
2. State the disadvantages of low power factor.
3. What is safety documentation system?
4. State preliminary preparations before commencing the installation.

L2: Understand

1. Write the objectives and scope of Indian Electricity Act and Indian Electricity Rule.
2. Explain the importance of earthing system neutral.
3. Write a note on Do's and Don't for safety in the use of domestic electrical appliances.
4. Explain the classification of equipment/enclosure for hazardous locations.

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Dept. of Electrical & Electronics Engg.
NSRIT

OE 20MEO02 Fundamentals of Automobile Engineering 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	DoK
20ME302.1	Introduction to fundamentals of automobiles, lubrication, Tires and safety.	L1, L2
20ME302.2	Classify and identify the steering system	L2, L3
20ME302.3	Classify and identify the Transmission system	L2, L3
20ME302.4	Define and compare the suspension, breaking and electrical system.	L2,L4
20ME302.5	Identify and Interpret the specifications and safety precautions..	L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction **11+1 Hours**

Componentsoffourwheelerautomobile–chassisandbody–powerunit–typesofautomobileengines,engineconstruction, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps–crank case ventilation–. Types – wheels and tyres. Safety Introduction, safety systems-seat belt, airbags, bumper, anti lock brake system (ABS), windshield, suspension sensors, traction control, mirrors, central locking and electric.

windows, speed control.

Unit II: TRANSMISSION SYSTEM **11+1 Hours**

Power transmission–rear wheel drive, front wheeldrive,4wheeldrive Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchromesh gear boxes, epicyclic gear box, over drive torque converter, propeller shaft – Hotch – Kiss drive.

Torque tube drive, universal joint, differential rear axles.

Unit III: STEERING SYSTEM **11+1 Hours**

Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering. types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism ,steering gears, –types

Steering linkages.

Unit IV: SUSPENSION, BREAKING AND ELECTRICAL SYSTEM **11+1 Hours**

SUSPENSION SYSTEM: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system. BRAKING SYSTEM: Mechanical brake system, hydraulic brake system, master cylinder, wheel cylindertandemmaster cylinder requirement of brake fluid

ELECTRICAL SYSTEM: Charging circuit, generator, current – voltage regulator – starting system, bendixdrivemechanismsolenoidswitch,lightingsystems,horn,wiper,fuelgauge–oilpressuregauge,enginetemperatureindicatoretc.

Pneumatic and vacuum brakes.

Unit V: ENGINESPECIFICATION AND MAINTENANCE **11+1 Hours**

Introduction-engine specifications with regard to power, speed, torque, no.of cylinders and arrangement, lubrication and cooling etc. engine service, reboring, decarburization ,Nitriding of crankshaft. service details of engine cylinder head, valves and valve mechanism, piston-connecting rod assembly, cylinder block, crank shaft and main bearings, engine reassembly-precautions. Types of pollutants, mechanism of formation, concentration measurement, methods of controlling-enginemodification,exhaustgastreatment-thermalandcatalyticconverters-useof alternative fuels for emission control

National and International pollution standards .

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N.S. Raju Institute of Technology (Autonomous)
Sontyam, Visakhapatnam-531 173

Text Books

1. Automotive Mechanics–Vol.1&Vol.2/KirpalSingh/standardpublishers
2. Automobile Engineering/WilliamCrouse/TMHDistributors
3. Automobile Engineering/P.SGill/S.K.Kataria&Sons/NewDelhi
4. Automobile Engineering/CSrinivasan/McGrawHill

Reference Books

1. AutomotiveEnginssTheoryandServicing/JamesD.HaldermanandChaseD.MitchellJr.,/Pearso neducationinc.
2. AutomotiveEngineering/KNewton,W.Steeds&TKGarrett/SAE
3. AutomotiveMechanics: PrinciplesandPractices/ JosephHeitner/VanNostrandReinhold

Web References

1. https://nptel.ac.in/noc

Internal Assessment Pattern

Cognitive Level	Internal Assessment#1(%)	Internal Assessment#2(%)
L2	40	30
L3	40	30
L4	20	40
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the differences between two and four stroke engines.
2. Define the Octane number & Cetane number
3. Explain the significance of governor in automobiles?
4. What is an automotive differential and how does it work?
5. Why are car steering wheels round?
6. Why entropy decreases with the increase in temperature?

L2: Understand

1. Describe the Atkinson cycle..
2. Explain the flywheel with neat sketch.
3. What is an injector pressure in heavy vehicles? Why it is used?
4. Discuss the service the piston – connecting rod assembly with neat sketch.
5. Discuss the magneto ignition.
6. What is 3-way converter?

L3: Classify

1. Name the different cooling methods with neat sketches.
2. Describe with P-V diagrams the two used cycles for internal combustion engines.

L4: Interpret

1. In a 4-stroke, 4-stroke cylinder diesel engine running 5000 r.p.m., how many times the fuel will be injected per second
2. Name the car with engine having 4-valves and 5- valves per cylinder.gas at a pressure of1.5Mpa,the gas expands according to the process Which represented by a straight line on a pressure volume. The final pressure is 0.15MPa. Calculate the work done on a gas by the piston

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Board of Studies (ME)

OE 20CEO03 Disaster Risk Mitigation and Management 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CEO03.1	Identify various types of disasters, their causes, effects & mitigation measures		L1, L2
20CEO03.2	Understand various phases of disaster management cycle and create vulnerability and risk maps		L1, L2
20CEO03.3	Understand the approaches of risk and vulnerability	-	L1, L2
20CEO03.4	Explain the concept of disaster management and emerging approaches		L1, L2
20CEO03.5	Understand the mitigation measures		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

UNIT I: Natural Disasters **9 Hours**

Natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.
Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation.

Ozone Depletion

Unit II: Disaster Management Principles **9 Hours**

Evolution of disaster risk management concept Disaster management cycle – Prevention, Preparedness, Mitigation, Rescue and Recovery Integrated and Comprehensive disaster risk reduction approach, Strategies and Policies.

Disaster management cycle

Unit III: Risk and vulnerability **9 Hours**

Hazard, risk and vulnerability: Physical, social and economic dimensions, Vulnerability in changing climate, Climate change and Disasters, Risk Analysis Techniques, Risk: Identification, reduction and transfer, Approaches to mapping social vulnerability, Participatory disaster risk assessment, Action plans, Strategy for survival.

Vulnerability in changing climate

UNIT IV: Disaster Management **9 Hours**

Preparedness through (IEC) Information, education & communication, pre-disaster stage (mitigation), Effect to mitigate natural disaster at national and global levels. International strategy for disaster reduction.
Emerging approaches in Disaster Management-Concept of disaster management, national disaster management framework, financial arrangements, role of NGOs, community –based organizations and media.

National disaster management framework

UNIT V: Risk Mitigation **9 Hours**

Definition, Concept, Importance, Guiding Principles, Tools, Approaches, Strategies Sustainable Development, Sustainable Land Use Planning, Technology and the Environment. Emerging Technologies in Disaster Mitigation, Remote Sensing, GIS, Disaster Mapping, Aerial Photography, Land Use Zoning

Emerging technologies in disaster mitigation

Text Books

1. Khanna, B. K., "Disasters: All you wanted to know about", New India Publishing Agency,New Delhi, 2005
2. Edwards, B., " Natural Hazards", Cambridge University Press, U.K., 2005
3. Chakraborty, S. C., "Natural Hazards and Disaster Management", Pargatishil Prokashak,Kolkata, 2007

Reference Books

1. Sahni, P., "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, NewDelhi, 2002
2. Prashant K. Srivastava, Sudhir Kumar Singh, Mohanty, U. C., Tad Murty, "Techniques for Disaster Risk Management and Mitigation", 2020

Web References

1. https://books.google.com
2. http://cbseacademic.nic.in

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define climatic change
2. List any four effects of natural disasters
3. Define disaster Management

L2: Understand

1. Explain about risk assessment
2. Outline the principles of disaster management
3. Differentiate between hazard, risk and vulnerability

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Head of the Department
Dept. of Civil Engg.
Chairman
Board of Studies (CE)

PC 20CS404 Operating Systems

3 0 0 3.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20CS404.1	Describe the structure, components and functionalities of operating system		L1, L2
20CS404.2	Describe the process management activities of operating system		L1, L2
20CS404.3	Illustrate the use of process synchronization tools	-	L1, L2
20CS404.4	Describe the various memory management and allocation techniques		L1, L2
20CS404.5	Demonstrate different secondary storage management strategies and file system		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Operating System Concepts — 9 Hours

What Operating System Do, Operating System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments, Operating Systems Services, System Call, Types of System Call, Operating System Generation, System Boot

The Shell, Mobile Operating System, Choice of Interface

Unit II: Process Management — 9 Hours

Process Concept: The Process, Process State, Process Control Block, Threads, Process Scheduling: Scheduling Queues, Schedulers, Context Switch, Operations on Processes, Inter Process Communication, Multithread Programming: Overview, Benefits, Multithreading Models, Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

Process Termination, Multiprocess Architecture

Unit III: Synchronization — 9 Hours

Background, The Critical-section problem, Peterson's Solution, Synchronization hardware, Semaphores, Classic Problems of Synchronization, Monitors, Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Transactional Memory, Two Phase Locking

Unit IV: Memory Management — 9 Hours

Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table, Virtual Memory Management: Background, Demand paging, Page replacement, Thrashing, Mass-Storage Structure: Overview of Mass-Storage Structure, Harddisk Drives, Volatile Memory, HDD Scheduling-FCFS Scheduling, SCAN Scheduling of a Disk-Scheduling Algorithm.

Buddy System, Prepaging

Unit V: File system Interface — 9 Hours

File Concept, Access Methods, Directory and Disk Structure, File System Mounting, File Sharing, Protection, Implementing File Systems: File System Structure, File System Implementation, Directory Implementation, Allocation Methods, Free-Space Management.

Consistency Checking, Malware, Denial of service

Text Books

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", Tenth Edition, John Wiley and Sons Inc., 2018
2. William Stallings, "Operating Systems - Internals and Design Principles", Ninth Edition, Pearson, 2018

Reference Books

1. Andrew S. Tanenbaum, "Modern Operating Systems", Fourth Edition, Pearson, 2015
2. Charles Crowley, "Operating Systems: A Design-Oriented Approach", First Edition, Tata McGraw Hill Education, 2001

3. Dhananjay M. Dhamdhere, "Operating Systems: A Concept-Based Approach", Third Edition, McGraw Hill Higher Education, 2017

Web Resources

1. http://nptel.ac.in/downloads/106108101/
2. https://www.coursera.org/learn/iot/lecture/MrgxS/lecture-3-1-operating-systems
3. https://www.geeksforgeeks.org/operating-system-introduction-operating-system-set-1/
4. https://www.unt.edu/public/cop4610/ree/Notes/PPT/PPT8E/CH12-OS8e.pdf
5. https://in.udacity.com/auth?next=/course/introduction-to-operating-systems--ud923

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	40
L2	50	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Operating System
2. What are operating system services?
3. List any four types of system calls
4. What is a process? List any four fields of process control block
5. What are the necessary conditions for a deadlock?
6. Differentiate between binary and counting semaphore.
7. What are the various attributes that are associated with an opened file?

L2: Understand

1. Discuss the essential properties of operating systems -Batch, Interactive, Timesharing Real time and Distributive
2. Explain how multiprogramming increases the utilization of CPU
3. Why system calls are needed in operating system?
4. Distinguish between logical address and physical address
5. What is the difference between a process and thread?
6. How does the system detect thrashing? What can the system do to eliminate this problem?
7. Consider the following four processes represented as (Process, Arrival Time, Burst Time) with the length of CPU burst in milliseconds.
   ((P1, 0, 10), (P2, 1, 7), (P3, 2, 13), (P4, 3, 11)). Using preemptive SJF scheduling: (i) Draw Gantt chart (ii) Calculate average waiting time.
8. Why semaphores are important? Suggest the solution for bounded buffer problem with semaphores
9. Explain the steps involved in handling a page fault with a neat sketch

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OE 20AIO03 Fundamentals of AI

3 1 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20AIO03.1	Describe the foundational principles of artificial intelligence		L1, L2
20AIO03.2	Formalise the given problem using different AI methods		L1, L2
20AIO03.3	Explain different concepts of logic	-	L1, L2
20AIO03.4	Describe the different methods of knowledge representation		L1, L2
20AIO03.5	Explain the principles and applications of expert systems		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction to Artificial Intelligence — 9+3 Hours

Introduction – History - Intelligent systems - Foundations of AI – Applications – Tic-Tac-Tie game playing - Development of AI languages - Current trends in AI

Unit II: Problem Solving — 9+3 Hours

Problem solving: State-Space search and Control strategies: Introduction - General problem solving - Characteristics of problem - Exhaustive searches - Heuristic search techniques – Iterative deepening A* - Constraint satisfaction - Problem reduction and game playing: Introduction - Problem reduction - Game playing – Alpha beta pruning - Two-player perfect information games

Unit III: Logic concepts — 9+3 Hours

Introduction -Propositional calculus - Proportional logic - Natural deduction system - Axiomatic system - Semantic tableau system in proportional logic - Resolution refutation in proportional logic

Unit IV: Knowledge Representation — 9+3 Hours

Introduction - Approaches to knowledge representation - Knowledge representation using semantic network - Extended semantic networks for KR - Knowledge representation using frames - Advanced knowledge representation techniques: Introduction - Conceptual dependency theory - Script structure - Cyctheory - Case grammars

Unit V: Expert Systems — 9+3 Hours

Expert system and applications: Introduction - Phases in building expert systems - Expert system versus traditional systems - Rule-based expert systems - Blackboard systems - Truth maintenance systems - Application of expert systems

Text Books

1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007

Reference Books

4. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008
5. Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006
6. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013

Web Resources

6. https://nptel.ac.in

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Board of Studies CSE (AI&ML)

DE 20DSO03 Introduction to Big Data

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20DSO03.1	Identify the Knowledge of Big Data		L1, L2
20DSO03.2	Demonstrate Hadoop Framework for handling Big Data		L1, L2
20DSO03.3	Illustrate the Architectural Concepts of HDFS in Hadoop Ecosystem	-	L1, L2
20DSO03.4	Illustrate MapReduce Framework		L1, L2
20DSO03.5	Explain Spark & RDD		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Big Data — 9 Hours

What is Big Data, Evolution of Big Data, Types of Big Data, Sources of Big Data,5Vs of Big Data, Big Data Analytics, Big Data Applications, Google File System

Uses of Big Data in Retail Industry

Unit II: Introduction to Hadoop — 9 Hours

Introducing Hadoop, Hadoop History, Hadoop-definition, Comparing SQL Databases and Hadoop, Hadoop Cluster, Hadoop Modes, Hadoop Features, The building blocks of Hadoop, NameNode, DataNode, Secondary NameNode, Job Tracker, Task Tracker

Hadoop Cluster

Unit III: Hadoop Ecosystem &HDFS — 9 Hours

Hadoop and its Ecosystem, Hadoop Ecosystem Components, Hadoop Ecosystems Tools, Hadoop Distributed File System, Concept of Block in HDFS Architecture, Features of HDFS, HDFS Read and Write Mechanism, Rack awareness in HDFS, Introducing HBase, Hive, Pig

HDFS Read/Write

Unit IV: Introduction to MapReduce — 9 Hours

Hadoop MapReduce Framework, Architecture, Phases, MapReduce Job Types, Uses of MapReduce, Techniques to Optimize MapReduce Jobs, Limitations of MapReduce.

MapReduce Phases

Unit V: Introduction to Spark and RDD — 9 Hours

Introduction to Spark, DataFrames - DataFrames role in Spark, Introduction to RDD, RDD operations, Creating RDDs, RDD Operations, Working with Key/Value Pairs.

DataFrames

Text Books

1. DT Editorial Services, "Big Data – Hadoop2, MapReduce, Hive, YARN, Pig, R and Data Visualization", Black Book, DreamTech Press, 2019.
2. Sridhar Alla, "Big Data Analytics with Hadoop 3" - Packt Publications, 2018.
3. Holden Karau, Andy Konwinski, Patrick Wendell & MateiZaharia, "Learning Spark" O'reilly Publications, 2015.

Reference Books

1. Chuck Lam, "Hadoop in Action", 1st Edition, MANNING Publications, 2016.
2. Balamurugan Balusamy, Nandhini Abirami R, SeifedineKadry, Amir H. Gandomi, "Big Data: Concepts, Technology, and Architecture" 1st Edition, Wiley Publications, 2021.
3. Thomas Erl, Wajid Khattak, Paul Buhler, "Big Data Fundamentals: Concepts, Drivers &Techniques", 1st Edition, Pearson Publications, 2016.

Web Resources

1. https://hadoop.apache.org/
2. https://spark.apache.org/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Big Data.
2. List the characteristics of Big Data.
3. Define Hadoop.
4. What are Hadoop components?
5. What are RDD operations?

L2: Understand

1. Explain HDFS Read & Write mechanism.
2. Explain Rack awareness in HDFS.
3. Explain MapReduce workflow in detail.
4. Describe the working with Key/value pairs in RDDs.

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OE 20ECO03 Privacy and Security in IoT

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20ECO03.1	Understand the basic knowledge of cryptography, networking and web security		L1, L2, L3
20ECO03.2	Explain Architecture of IoT and its Applications		L1, L2, L3
20ECO03.3	Understand the Attacks against IoT System	-	L1, L2, L3
20ECO03.4	Explain Secure Bootstrapping for IoT System		L1, L2, L3
20ECO03.5	Understand the IoT system security and Trust zone		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Cryptography and Network Securities **9 Hours**

Cryptography , networking, Web Security: Secure socket layer and transport layer security, System Security: Intruders , Viruses and related threads, trusted systems

Secure Shell (SSH)

Unit II: Introduction to IoT **9 Hours**

Internet of Things (IoT), Need of IoT, Applications, Architecture, Enabling technologies, IoT security and privacy.

IoT protocols

Unit III: Attacks against IoT **9 Hours**

Attacks against IoT system (hardware + software), Attacks against IoT network protocols, Attacks against industry IoT

Attacks against Web systems

Unit IV: Secure Bootstrapping for secure IoT system **9 Hours**

Trusted boot, Secure boot, TPM and its usages, Remote attestation, tamper resistant-proof-response hardware and its usage

Bootstrapping for IoT

Unit V: IoT System Security and TrustZone **9 Hours**

System security, TrustZone hardware architecture, TrustZone software architectures.

Web security

Text Books

1. Syed Rameem Zahra, Mohammad Ahsan Chishti ,"Security and Privacy in the Internet of Things " 1st Edtion ,Chapman & Hall, 2020
2. Fei Hu ,"Security and Privacy in Internet of Things (IoTs) Models, Algorithms, and Implementations", 1st Edition CRC Press

Reference Books

1. Ravi Ramakrishnan, Loveleen Gaur "Internet of Things Approach and Applicability in Manufacturing " , 1st Edtion ,Chapman & Hall, 2019
2. Vijay Madisetti, Arshdeep Bahga, Internet of Things, "A Hands on Approach", UniversityPress,2015

Web Resources

1. https://lss.at.ufl.edu/help.shtml
2. http://cms.uflib.ufl.edu/ask

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Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	30
L3	40	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is cryptography ?
2. List the applications of IoT
3. What is Attacks against IoT system ?

L2: Understand

1. Explain about networking
2. Explain Enabling technologies of IoT
3. Explain Attacks against IoT network protocols

L3: Apply

1. Discus about web security
2. Write about Architecture of IoT
3. Explain Attacks against industry IoT

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OE 20EEO03 Low Cost Automation 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20EEO03.1	Understanding automation of assembly lines	-	L2
20EEO03.2	Automation Using Hydraulic Systems		L2
20EEO03.3	Describe Automation Using Pneumatic Systems		L2
20EEO03.4	Explain Automation Using Electronic Systems		L2
20EEO03.5	Explain Assembly Automation		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

UNIT I :Automation Of Assembly Lines 9 Hours

Concept of automation-mechanization and automation - Concept of automation in industry - mechanization and automation - classification, balancing of assembly line using available algorithms -Transfer line-monitoring system (TLMS) using Line Status - Line efficiency - Buffer stock Simulation in assembly line

Transfer line-monitoring system (TLMS) using Line Status ,Line efficiency

UNIT II: Automation Using Hydraulic Systems 9 Hours

Design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. - Selection of hydraulic fluid, practical case studied on hydraulic circuit design and performance analysis - Servo valves, electro hydraulic valves, proportional valves and their applications.

Servo valves, electro hydraulic valves, proportional valves and their applications

UNIT III: Automation Using Pneumatic Systems 9 Hours

Pneumatic fundamentals - control elements, position and pressure sensing -logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods – step counter method - compound circuit design - combination circuit design. Pneumatic equipments - selection of components - design calculations -application - fault finding – hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

Low cost automation - Robotic circuits

UNIT IV: Automation Using Electronic Systems 9 Hours

Introduction - various sensors – transducers - signal processing - servo systems - programming of microprocessors using 8085 instruction - programmable logic controllers

Programming of microprocessors using 8085 instruction - programmable logic controllers

UNIT V: Assembly Automation 9 Hours

Types and configurations - Parts delivery at workstations - Various vibratory and non-vibratory devices for feeding - hopper feeders, rotary disc feeder, centrifugal and orientation - Product design for automated assembly.

Product design for automated assembly.

Text Books

1. Anthony Esposito, "Fluid Power with applications", Prentice Hall international, 2009.
2. Mikell P Groover-"Automation, Production System and Computer Integrated Manufacturing", Prentice Hall, Publications, 2007

Reference Books

1. Kuo .B.C, "Automatic control systems", Prentice Hall India, New Delhi, 2007.
2. Peter Rohner, "Industrial hydraulic control", Wiley Edition, 1995.
3. Mujumdar.S.R, "Pneumatic System", Tata McGraw Hill 2006.

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is automation?
2. What is Pneumatic fundamentals?
3. What is transducers?
4. What is switching circuits?
5. What is Buffer stock Simulation?

L2: Understand

1. Explain Line efficiency.
2. Explain Selection of hydraulic fluid.
3. Explain Pneumatic equipments
4. Explain programmable logic controllers.
5. Explain Parts delivery at workstations.

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OE 20MEO03 Industrial Automation

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20MEO03.1	Identify various concepts of automation and work part transport mechanisms.	-	L2
20MEO03.2	Illustrate the assembly systems and their applications.	-	L3
20MEO03.3	Describe the importance of handling systems and identification systems.	-	L3
20MEO03.4	Apply the concepts of part families and machine cells into various production systems	-	L2
20MEO03.5	Recognize the importance of automated inspection and to distinguish the various control systems	-	L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

Unit I: Manufacturing and Automation-Over View — 9 Hours

Production systems, Automation in production systems, Automation principles and strategies, Reasons for Automation, Manufacturing operations, Functions in Manufacturing, Information processing in Manufacturing plant layout, production facilities. Basic elements of an automated system, levels of automation; Hardware components for automation and process control, programmable logic controllers and personal computers. Automation for machining operations.

Unit II: Assembly Systems and Line Balancing — 9 Hours

Process-Assembly lines-manual single stations assembly, Manual assembly line, automated assembly system-Line balancing. Automated Assembly Systems – Design for automated assembly-Types of automated assembly systems-Parts feeding devices

Unit III: Automated Material Handling Systems — 9 Hours

Automated Material Handling and storage system: Material Handling and Identification Technologies: Material handling, equipment, Storage systems, performance and location strategies, Automated storage systems, AS/RS, types. Functions, material handling equipment-Conveyors, AGVS, Industrial Robots-Anatomy, Robot configurations, work volume-AS/RS. Automatic identification methods, Barcode technology, RFID

Unit IV: Manufacturing Cells — 9 Hours

Manufacturing Systems and Automated Production Lines: Manufacturing systems: components of a manufacturing system, Single station manufacturing cells, Automated production lines, Applications, Transfer lines

Unit V: Control Systems — 9 Hours

Control Systems-Process Industries Versus Discrete Manufacturing Industries, Continuous Versus Discrete Control: Continuous Control Systems, Discrete Control Systems, Computer Process Control: Control Requirements, Capabilities of Computer Control.

Text Books

1. Mikell P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, Kindle Edition, Prentice Hall of India, 2016.

Reference Books

1. C. Roy, "Robots and Manufacturing Automation", Asfahl John Wiley & Sons
2. Krishna Kant, "Computer Based Industrial Control", EEE-PHI, 2nd edition, 2010

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N.S. Institute of Technology
Kanuru, Vijayawada-520 007

Web References

1. www.nptel.iitm.ac.in
2. www.btechguru.com

Internal Assessment Pattern

Cognitive Level	InternalAssessment#1(%)	InternalAssessment#2(%)
L1	40	30
L2	40	30
L3	20	40
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is industrial automation?
2. What are the different costs included in industry in designing the particular product ?
3. What is production volume?
4. List the categorization of production system.
5. What are the types of automation?
6. What are the features of Flexible Automation?
7. What is factory type of Integral automation?
8. Define process.
9. What are process variables?
10. What is meant by control system in automation?

L2: Understand

1. Explain Automation principles and strategies
2. Compare Manual assembly line, automated assembly system
3. Illustrate Material handling, equipment, Storage systems, performance and location strategies
4. Demonstrate components of a manufacturing system
5. Compare Continuous Control Systems, Discrete Control Systems

L3: Apply

1. Apply the basic elements of an automated system for industrial automation
2. Apply different types of automated assembly systems for moderate plants
3. Apply the Barcode technology, RFID for industrial automation
4. Discuss Automated production lines, Applications, Transfer lines
5. Design the capabilities of computer control systems

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OE 20SHO02 Design Thinking

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20SHO02.1	Explain the fundamentals of Design Thinking and innovation		L2
20SHO02.2	Empathize and analyse model action plan		L2
20SHO02.3	Describe the principles of innovation and idea generation for product design	-	L2
20SHO02.4	Apply design thinking techniques for given tasks		L2
20SHO02.5	Apply the design thinking techniques for solving problems in various sectors		L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction to Design Thinking — 9 Hours

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry

Unit II: Design Thinking — 9 Hours

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brain storming, product development

Unit III: Innovation — 9 Hours

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation. Measuring the impact and value of creativity. Product Design: problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications

Unit IV: Design Thinking for Strategic Innovation — 9 Hours

An exercise in design thinking – implementing design thinking for better process. Implement design thinking process in various Industries. Design thinking for Start-ups

Unit V: Design thinking in Various Sectors — 9 Hours

Case studies in Information Technology, Finance, Education, Management and Retail sector. Analyze and Prototyping, Usability testing, Organizing and interpreting results

Case study learning outcomes:

1. Make use of practical design thinking methods in every stage of problem with the help of method templates
2. Apply design thinking to a problem in order to generate innovative and user-centric solutions
3. Empathize with end user and initiate a new working culture based on user-centric approach
4. Prototype and run usability tests for unbiased examination of the product in order to identify problem

Text Books

1. Tim Brown, Harper Bollins, Change by Design, 2009
2. David Lee, Design Thinking in the Class Room, Ulysses Press

Reference Books

1. Design the Future, Shrutin N Shetty, Norton Press
2. William Lidwell, Kritina Holden, Jill Butler, Universal Principles of Design
3. Chesbrough H., The Era of Open Innovation
4. Chitale A. K. and Gupta R. C., Product Design and Manufacturing, Prentice Hall

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Web References

1. https://nptel.ac.in/courses/110105124
2. https://onlinecourses.nptel.ac.in/noc19_mg60/preview
3. www.tutor2u.net/business/presentations/. /productlifecycle/default.html
4. https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf
5. www.bizfilings.com › Home › Marketing › Product Development
6. https://www.mindtools.com/brainstm.html
7. https://www.quicksprout.com/. /how-to-reverse-engineer-your-competit
8. www.vertabelo.com/blog/documentation/reverse-engineering https://support.microsoft.com/en-us/kb/273814
9. https://support.google.com/docs/answer/179740?hl=en
10. https://www.youtube.com/watch?v=2mjSDIBaUIM
11. thevirtualinstructor.com/foreshortening.html
12. https://dschool.stanford.edu/.../designresources/.../ModeGuideBOOTCAMP2010L.pdf
13. https://dschool.stanford.edu/use-our-methods/ 6.
14. https://www.interactiondesign.org/literature/article/5-stages-in-the-design-thinking-process 7.
15. https://www.nngroup.com/articles/design-thinking/ 9.
16. https://designthinkingforeducators.com/design-thinking/ 10.
17. www.designthinkingformobility.org/wp-content/.../10/NapkinPitch_Worksheet.pdf

Activity Based Learning (Suggested Activities in Class) / Practical Based learning

http://dschool.stanford.edu/dgift/

Internal Assessment Pattern

Cognitive Level	Internal Assessment # 1 (%)	Internal Assessment # 2 (%)
L1	20	20
L2	50	50
L3	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What do you mean by design thinking?
2. How design thinking works within a product development process

L2: Understand

1. Explain the elements and principles of design
2. Differentiate between creativity and innovation

L3: Apply

1. How design thinking helped financial sector to gain the consumer 'trust'?

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HO 20EEH01 SMART GRID

4 0 0 4

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's PO1	PO2	PO3	DoK
20EEH01.1	Get acquainted with different smart devices and smart meters	3	1	2	L1-L2
20EE H01.2	Describe how modern power distribution system functions	3	1	2	L1-L2
20EE H01.3	Identify suitable communication networks for Smart Grid applications	3	1	2	L1-L2
20EE H01.4	Identify suitable smart meters for Smart Grid applications	3	1	2	L1-L2
20EE H01.5	Describe basics of Communication Networks & IOT	3	1	2	L1-L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction to Smart Grid — 12 Hours

Introduction - Evolution of Electric Grid, Smart Grid Concept - Definitions and Need for Smart Grid – Functions – Opportunities – Benefits and challenges, Technology Drivers

Difference between conventional & Smart Grid

Unit II: Energy Management System — 12 Hours

Energy Management System (EMS) - Smart substations - Substation Automation - Feeder Automation, SCADA – Remote Terminal Unit – Protocols, Phasor Measurement Unit – Wide area monitoring protection and control, Smart integration of energy resources – Renewable, intermittent power sources – Energy Storage.

Intelligent Electronic Devices

Unit III: Distribution Management System — 12 Hours

Distribution Management System (DMS) – Volt / VAR control – Fault Detection, Isolation and Service Restoration, Network Reconfiguration, Outage management System, Geographical Information System, Effect of Plug in Hybrid Electric Vehicles.

Customer Information System

Unit IV: SMART METERS — 12 Hours

Introduction to Smart Meters – Advanced Metering Infrastructure (AMI), AMI protocols – Standards and initiatives, Demand side management and demand response programs, Demand pricing and Time of Use,

Real Time Pricing, Peak Time Pricing

Unit V: Communication Networks & IOT — 12 Hours

Elements of communication and networking – architectures, standards, PLC, Zigbee, GSM, BPL, Local Area Network (LAN) - House Area Network (HAN) - Wide Area Network (WAN) - Broadband over Power line (BPL) - IP based Protocols - Basics of Web Service and CLOUD Computing,

Cyber Security for Smart Grid.

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Textbooks:

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

Reference Books:

1. Mini S. Thomas, John D McDonald, "Power System SCADA and Smart Grids", CRC Press, 2015
2. Kenneth C. Budka, Jayant G. Deshpande, Marina Thottan, "Communication Networks for Smart Grids", Springer, 2014.

Web References:

1. https://nptel.ac.in/courses/108/107/108107113/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define smart grid concept and explain its necessity.
2. Compare micro grid and smart grid.
3. Compare conventional metering and smart metering.

L2: Understand

1. Explain IED application for monitoring and protection.
2. Explain how the automatic meter reading can make the system smarter.
3. Explain the smart substation.

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HO 20EEH02 Advanced Smart Power Grids

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's PO 2	Mapping with PO's PSO 1	DoK
20EEH02.1	Understand smart grids and analyze the smart grid policies and developments in smart grids.	2	2	L1 - L2
20EEH02.2	Develop concepts of smart grid technologies in hybrid electrical vehicles	2	2	L1 - L2
20EEH02.3	Understand smart substations, feeder automation, GIS.	3	2	L1 - L3
20EEH02.4	Analyze micro grids and distributed generation systems	2	2	L1 - L2
20EEH02.5	Analyze the effect of power quality in smart grid and to understand latest developments in ICT for smart grid.	3	2	L1 - L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction to Smart Grid — 12 Hours

Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient &Self-Healing Grid.

Present development & International policies on Smart Grid

Unit II: Smart Grid Technologies Part 1 — 12 Hours

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors,

Home & Building Automation, Phase Shifting Transformers.

Unit III: Smart Grid Technologies Part 2 — 12 Hours

Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage.

Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).

Unit IV: Micro grids and Distributed Energy Resources — 12Hours

Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, microturbines.

Captive power plants, Integration of renewable energy sources

Unit V: Power Quality Management in Smart Grid: — 12Hours

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN).

Wide Area Network (WAN).

Text Books

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and DemandResponse", CRC Press
3. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010

Reference Books

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley
2. Jean Claude Sabonnadière, NouredineHadjsaïd, "Smart Grids", Wiley Blackwell 19
3. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009
4. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press
5. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving

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1. https://www.google.com/aclk?sa=l&ai=DChcSEwi965uQ7-r1AhXEwJYKHYCJDkQYABAAGgJ0bA&ae=2&sig=AOD64_0RNc3a64DXk7r07Vbp47On1IZgCA&q&nis=1&adurl&ved=2ahUKEwjA7pKQ7-r1AhWgslYBHUwNCoAQ0Qx6BAgDEAM
2. https://www.smartgrid.gov/the_smart_grid/smart_grid.html
3. https://nptel.ac.in/courses/108/107/108107113/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	50	50
L3	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define smart grid concept
2. Compare micro grid and smart grid.
3. State the issues of interconnecting the micro grid with the utility grid.
4. What is power quality control technologies?
5. How the power quality can be improved in smart grid
6.

L2: Understand

1. Explain the role of HAN in smart grid
2. Draw the flow chart of procedure for monitoring power quality and issues of power quality monitoring
3. Explain Bluetooth, Wi-Fi and GPS
4. Explain Wi-Max based communication and wireless mesh network.

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L3: Apply

1. Explain the power quality issues in power grid related to renewable energy sources
2. Describe the significance of electromagnetic compatability in power system with power grid

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HO 20EEH03 Electric Power Quality 4 0 0 4

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with Po's			DoK
		PO1	PO6	PSO1	
20EEH03.1	Differentiate different types of power quality problems.	3	2	1	L1-L2
20EEH03.2	Explain the sources of voltage sag, voltage swell, interruptions, transients, long duration over voltages in a power system.	3	2	1	L1-L2
20EEH03.3	Explain the principle of voltage regulation and power factor improvement methods.	3	2	1	L1-L3
20EEH03.4	Explain the harmonics in a power system.	3	2	1	L1-L2
20EEH03.5	Demonstrate the relationship between distributed generation and power quality.	3	2	1	L1-L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction 12 Hours

Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long–duration voltage variations –Short–duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations.

Understanding of transmission lines, Different types of losses and conditions

Unit II: Voltage imperfections in power systems 12 Hours

Power quality terms – Voltage sags – Voltage swells and interruptions – Sources of voltage sag, swell and interruptions – Nonlinear loads – IEEE and IEC standards. Source of transient over voltages – Principles of over voltage protection – Devices for over voltage protection – Utility capacitor switching transients.

Causes and Effects of Transient Voltages

Unit III: Voltage Regulation and power factor improvement 12 Hours

Principles of regulating the voltage – Device for voltage regulation – Utility voltage regulator application – Capacitor for voltage regulation – End–user capacitor application – Regulating utility voltage with distributed resources – Flicker – Power factor penalty – Static VAR compensations for power factor improvement.

Capacitor Banks, Synchronous Condenser, Phase Advancers.

Unit IV: Harmonic distortion and solutions 12 Hours

Voltage distortion vs. Current distortion – Harmonics vs. Transients – Harmonic indices – Sources of harmonics – Effect of harmonic distortion – Impact of capacitors, transformers, motors and meters – Point of common coupling – Passive and active filtering – Numerical problems

The Effects of Harmonics on Power Quality and Energy Efficiency

Unit V: Distributed Generation, Power Quality and Monitoring 12 Hours

Resurgence of distributed generation – DG technologies – Interface to the utility system – Power quality issues and operating conflicts – DG on low voltage distribution networks. Power quality monitoring and considerations – Historical perspective of PQ measuring instruments – PQ measurement equipment – Assessment of PQ measuring data – Application of intelligent systems – PQ monitoring standards.

various real time monitoring of power quality

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Textbooks

1. Dugan R.C., McGranaghan M.F., Santoso S., and Beaty H.W., "Electrical Power Systems Quality", Second Edition, McGraw–Hill, 2012, 3rd edition.
2. Bollen M.H.J., "Electric power quality problems", IEEE series-Wiley India publications,2011.

Reference Books

1. Primer, Kennedy B.W., "Power Quality", First Edition, McGraw–Hill, 2000.
2. Bollen M.H.J., "Understanding Power Quality Problems: Voltage Sags and Interruptions", First Edition, IEEE Press; 2000.
3. Arrillaga J. and Watson N.R., "Power System Harmonics", Second Edition, John Wiley & Sons, 2003.
4. Kazibwe W.E. and Sendaula M.H., Van Nostrad Reinhold, "Electric Power Quality control Techniques", New York.

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1. http://www.gcebargur.ac.in/sites/gcebargur.ac.in/files/lectures_desk/electrical_power_systems_quality.pdf
2. http://nptel.ac.in/courses/108106025/Power%20quality_in_power_distribution_systems.pdf
3. https://www.accessengineeringlibrary.com/browse/power-quality-in-electrical-systems#

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	40	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the causes for interruptions?
2. Write the remedies to improve power quality?
3. Distinguish power quality and voltage quality
4. Write different types of DG technologies
5. Write standards of power quality monitoring
6. Write different types of non linear loads

L2: Understand

1. Explain different types of transients
2. Explain about various solutions for over voltage protection
3. Explain about long duration and short duration voltage variations

L3: Apply

1. Draw block diagram of advanced power quality monitoring systems and explain
2. Explain impact of DG on low voltage distribution networks
3. Explain Static VAR compensation for power factor improvement

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PO 20EEH04 Electric Vehicle Technologies

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20EEH04.1	Outline various electric and hybrid vehicle architectures		L2
20EEH04.2	Understand about drives and control.		L2
20EEH04.3	Select battery, battery indication system for EV applications		L3
20EEH04.4	Analyse battery charger for an EV		L4
20EEH04.5	Demonstrate different configurations of electric vehicles and its components		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction to Electric and Hybrid Electric Vehicles **12 Hours**

Sustainable transportation, Brief history of electric vehicles (EV's), Hybrid electric vehicles, Fuel cell vehicles, Architectures of EV, Series HEV, Parallel HEVs, Diesel HEVs, PHEV & FCEV, Hybridization ratio, Interdisciplinary Nature of HEVs, Challenges and key technology of HEVs.

Unit II: Electric Machines and Drives in HEVs **12 Hours**

Introduction to induction motor drives and control Principle of operation and analysis of BLDC motor Drive, PMSM drive and SRM drive.

Unit III: Power Factor and energy instruments **12 Hours**

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, Design of Hybrid Electric Vehicle and Plug-in Electric Vehicle

Unit IV: Energy Management System **12 Hours**

Energy Management Strategies, Automotive networking and communication, EV charging standards, V2G, G2V, V2B, V2H. Business: E-mobility business, electrification challenges, Business- E-mobility business, electrification challenges

Unit V: Mobility and Connectors **12 Hours**

Connected Mobility and Autonomous Mobility- case study E-mobility Indian Roadmap Perspective. Policy: EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs. Connectors- Types of EV charging connector, North American EV Plug Standards, DC Fast Charge EV Plug Standards in North America, CCS (Combined Charging System), CHAdeMO, Tesla, European EV Plug Standards

Text Books

1. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003.
2. Husain, I. "Electric and Hybrid Vehicles" Boca Raton, CRC Press, 2010.
3. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003

Reference Books

1. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012.
2. Tariq Muneer and Irene Illescas Garcia, "The automobile, In Electric Vehicles: Prospects and Challenges", Elsevier, 2017.
3. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013

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1. https://nptel.ac.in/courses/108/106/108106170/
2. https://www.youtube.com/watch?v=3E1SXG7VkQk&list=PLHRG-unM84XgZd9HKQAmKdE12-1eRSe

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20EEH05 Energy Audit Conversation and Management

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20EEH05.1	To understand energy efficiency, scope, conservation and technologies.		L2
20EEH05.2	To design energy efficient lighting systems.		L2
20EEH05.3	To estimate/calculate power factor of systems and propose suitable compensation techniques		L2
20EEH05.4	To understand energy conservation in HVAC systems		L2
20EEH05.5	To calculate life cycle costing analysis and return on investment on energy efficient technologies.		L1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Basic Principles of Energy Audit and management **12 Hours**

Energy audit – Definitions – Concept – Types of audit – Energy index – Cost index – Pie charts –Sankey diagrams – Load profiles – Energy conservation schemes and energy saving potential – Numerical problems – Principles of energy management – Initiating, planning, controlling, promoting, monitoring, reporting – Energy manager – Qualities and functions – Language – Questionnaire – Check list for top management.

Unit II: Lighting **12 Hours**

Modification of existing systems – Replacement of existing systems – Priorities: Definition of terms and units – Luminous efficiency – Polar curve – Calculation of illumination level – Illumination of inclined surface to beam – Luminance or brightness – Types of lamps – Types of lighting – Electric lighting fittings (luminaries) – Flood lighting – White light LED and conducting Polymers – Energy conservation measures.

Unit III: Power Factor and energy instruments **12 Hours**

Power factor – Methods of improvement – Location of capacitors – Power factor with non linear loads – Effect of harmonics on Power factor – Numerical problems. Energy Instruments – Watt–hour meter – Data loggers – Thermocouples – Pyrometers – Lux meters – Tong testers – Power analyzer.

Unit IV: Space Heating and Ventilation **12 Hours**

Ventilation – Air–Conditioning (HVAC) and Water Heating: Introduction – Heating of buildings – Transfer of Heat–Space heating methods – Ventilation and air–conditioning –Insulation–Cooling load – Electric water heating systems – Energy conservation methods.

Unit V: Economic Aspects and Financial Analysis **12 Hours**

Understanding energy cost - Economics Analysis – Depreciation Methods – Time value of money – Rate of return – Present worth method – Replacement analysis – Life cycle costing analysis.

Need of investment, appraisal and criteria - Calculation of simple payback period–Return on investment – Net present value – Internal rate of return – numerical examples – Applications of life cycle costing analysis – Return on investment – Numerical examples.

Text Books

1. Hand Book of Energy Audit by Sonal Desai- Tata McGraw hill
2. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd–2nd edition, 1995
3. Energy management and conservation –k v Sharma and P.venkataseshaiah-I K International Publishing House pvt.ltd,2011.

Reference Books

1. Energy management by W.R. Murphy & G. Mckay Butter worth, Elsevier publications. 2012
2. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.
3. Energy management by Paul o' Callaghan, Mc–Graw Hill Book company–1st edition, 1998.
4. Energy management hand book by W.C.Turner, John wiley and sons.

Web References

1. https://nptel.ac.in/courses/108/104/108104087/
2. https://www.edx.org/course/electricity-and-magnetism-maxwells-equations
3. https://www.udemy.com/course/energy-audit/

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HO 20EEH06 Electrical Load Estimation

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20EEH05.1	Understand the basic concepts of Estimation		L2
20EEH05.2	Explain estimation and costing of residential and commercial buildings		L2
20EEH05.3	Explain estimation of industrial installations		L2
20EEH05.4	Condition monitoring and Testing of various electrical equipment		L2
20EEH05.5	Learn Distribution systems, its types and substations		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: General Principles of Estimation **12 Hours**

Introduction to estimation & costing, Electrical Schedule, Catalogues, Market Survey and source selection, Recording of estimates, Determination of required quantity of material, Labor conditions, Determination of cost material and labour, Contingencies, Overhead charges, Profit, Purchase system, Purchase enquiry and selection of appropriate purchase mode, Comparative statement, Purchase orders, Payment of bills, Tender form, General idea about IE rule, Indian Electricity Act and major applicable I.E rules.

Unit II: Estimation of Domestic Installations **12 Hours**

Standard practice as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates including cost as per schedule rate pattern and actual market rate

Unit III: Estimation of Industrial Installations **12 Hours**

Relevant IE rules and IS standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, starters, preparation of list of materials, estimating and costing exercises on workshop with single phase, 3-phase motor load and the light load (3-phase supply system) ,Service line connections estimate for domestic and Industrial loads (over-head and Under- ground connections) from pole to energy meter.

Unit IV: Estimation of Over Head Transmission & Distribution Lines **12 Hours**

Introduction, Typical AC electrical power system, Main components of overhead lines, Factors governing height of pole, Determination of size of conductor for overhead transmission line, Points to be considered at the time of erection of overhead lines, Positioning of conductors and attachment to insulators, Jumpers, Tee-offs, Earthing of transmission lines, Clearances of conductor from ground, Spacing between conductors, Testing and commissioning of overhead distribution lines, Some important specifications.I.C

Unit V: Estimation of Substations **12 Hours**

Introduction, Classification of substation, Indoor substations, Outdoor substations, Selection and location of site for substation, Main Electrical Connections, Graphical symbols for various types of apparatus and circuit elements on substation main connection diagram, Key diagram of typical substations, Equipment for substation and switchgear installations

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Text Books

1. J.B Gupta, S.K Kataria and Sons "A Course in Electrical Installation, Estimating and Costing" 2nd edition, 2013
2. Raina & Battacharya, Wiley Eastern "Electrical Design: Estimation & Costing" 2nd edition, 2009

Reference Books

1. Surjeet Singh, Dhanpat Rai & Co. "Estimating and Costing" 2nd edition, 2003.
2. S.L Uppal, "Estimating and Costing" , 2nd edition, Khanna Publishers, 2004.
3. N Alagappan and B Ekambaram, "Electrical Estimating and Costing" 2nd edition, Tata Mcgraw Hill, 2006.

Web References

1. http://www.electricaltechnology.org/2015/05/earthing-and-electrical-grounding-types-of-earthing.html
2. http://mptransco.nic.in/tender files/volume-v.pdf (Transmission Line Materials and Installation work)
3. https://www.ergon.com.au/__data/assets/pdf_file/0004/146839/NI000401R121-Subs-Design-Manual.pdf

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PO 20EEH07 Challenges and Impact of Electric Vehicles on Smart Grid 4 0 0 4.0

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's	DoK
20EEH07.1	Describe vehicle electrification and impact of charging strategies.		L2
20EEH07.2	Describe the influence of EVs on power system		L2
20EEH07.3	Describe the frequency control and voltage reserve from EVs		L2
20EEH07.4	Explain ICT solutions of EV development		L2
20EEH07.5	Explain decentralized charging schemes		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction of Vehicle electrification **12 Hours**
Introduction, Impact of charging strategies, EV charging options and infrastructure, energy, economic and environmental considerations, Impact of EV charging on power grid, effect of EV charging on generation and load profile, Smart charging technologies, Impact on investment

Unit II: Influence of EVs on power system **12 Hours**
Introduction, identification of EV demand, EV penetration level for different scenarios, classification based on penetration level, EV impacts on system demand: dumb charging, multiple tariff charging, smart charging, case studies

Unit III: Frequency Control Reserves & Voltage support from EVs **12 Hours**
Introduction, power system ancillary services, electric vehicles to support wind power integration, electric vehicle as frequency control reserves and tertiary reserves, voltage support and electric vehicle integration, properties of frequency regulation reserves, control strategies for EVs to support frequency regulation.

Unit IV: ICT solutions to support EVs deployment **12 Hours**
Introduction, Architecture and model for smart grid & EV, ICT players in smart grid, smart metering, information & communication models, functional and logical models, technology and solution for smart grid: interopersbility, communication technologies.

Unit V: EV charging facility planning **12 Hours**
Energy generation scheduling, different power sources, fluctuant electricity, centralized charging schemes, decentralized charging schemes, energy storage integration into Microgrid, Design of V2G Aggregator

Text Books

1. Amir Khajepour, Saber Fallah and Avesta Goodarzi, "Electric and Hybrid Vehicles Technologies, Modelling and Control: A Mechatronic Approach", John Wiley & Sons Ltd, 2014.
2. James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2013.

Reference Books

1. Crouse W.H, Anglin D.L, "Automotive Transmission and Power Train construction", McGraw Hill,2016
2. J.Gabrielleen,"Automotive In-Vehicle Networks", John Wiley & Sons, Limited, 2008

Web References

1. https://www.coursera.org/lecture/electric-utilities/5-2-smart-grid-YUPgW

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2. https://online.stanford.edu/courses/xeiet237-transforming-grid-ai-renewables-storage-evs-and-prosumers
3. https://nptel.ac.in/courses/108/102/108102121/

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HO 20EEH08 Optimization Techniques

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs	DoK
20EE403.1	Understanding of the logics of various optimization techniques.		L2
20EE403.2	Formulate and solve optimization problems.		L2
20EE403.3	Interpret and analyze the solutions of optimization algorithms.		L2
20EE403.4	Use software tools in engineering design optimization problems.		L2
20EE403.5	Demonstrate various types of methods of optimization		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction **12 Hours**

Optimization – Optimal Problem Formulation, Engineering Optimization Problems, Optimization Algorithms, Numerical Search for Optimal Solution. Graphical Method, Big M Method, Two Phase Method.

Unit II: Single variable optimization - I **12 Hours**

Optimality criteria, Bracketing Methods - Exhaustive Search Method, - Region Elimination Method-Interval Halving, Fibonacci Search, Golden Section Search, Interpolation Methods, Point Estimation Method- Successive Quadratic Search, Gradient Based Method.

Unit III: Single variable optimization – II **12 Hours**

Initial Value Problems for Ordinary Differential Equations: Single Step Methods, Euler and Modified Euler Methods, Fourth Order Runge – Kutta Method for Solving First and Second Order Equations. Case Study and Simulation.

Unit IV: Multivariable optimization **12 Hours**

Optimality Criteria, Unconstrained Optimization - Solution by Direct Substitution Unidirectional Search- Direct Search Methods, - Steepest Descent Method, Shortest Path Algorithm Hook - Jeeves Pattern Search Method, Gradient Based Method, Newton's Method, Conjugate Gradient Method, Constrained Optimization-Kuhn- Tucker, Lagrange Multiplier Method. Case Studies and Simulation

Unit V: Stochastic methods of optimization **12 Hours**

Random Search Methods, Evolutionary Computation-Introduction, Survival of The Fittest, Fitness Computation, Cross Over, Mutation, Reproduction, Particle Swarm Optimization, Introduction to Multi-Objective Optimization. Case Study and Simulation.

Textbooks:

1. S. S. Rao, "Optimization Theory & Applications", New Age international ltd. Publishers, Second edition, 1995
2. Kalyan Moy Deb, "Optimization for Engineering Design Algorithms & Examples" Prentice Hall of India, New Delhi 2004.

Reference Books:

1. Edwin K. P. Chong, and Stanislaw H. Zak, "An Introduction to optimization", Wiley- interscience series in discrete mathematics and optimization, second edition, 2004.
2. M. Asghar Bhatti, "Practical optimization methods with mathematics applications", Springer Verlag Publishers, 2000.
3. G. A Vijayalakshmi Pai & S. Rajashekharan "Neural Network, Fuzzy Logic, Genetic Algorithms Synthesis & Applications", PH India,2003.

Web References:

1. https://www.youtube.com/watch?v=aJKuM4U-eYg
2. https://nptel.ac.in/courses/106/105/106105173/
3. https://www.youtube.com/watch?v=K9gjuXjJeEM

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HS 20EEH09 Illumination Engineering **4 0 0 4.0**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's PO 1	PO 6	DoK
20EEH09.1	Understand basic concepts of lighting	3	2	L2
20EEH09.2	Explain different methods to measure light	3	2	L2
20EEH09.3	Describe different types of interior lighting	3	2	L2
20EEH09.4	Explain different types of street lighting	2	2	L2
20EEH09.5	Understand different types of flood lighting	2	2	L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction of Light **12 Hours**

Types of illumination, Day lighting, Supplementary artificial lighting and total lighting, Quality of good lighting, Factors affecting the lighting-shadow, glare, reflection, Colour rendering and stroboscopic effect, Methods of artificial lighting, Lighting systems-direct, indirect, semi direct, semi indirect, Lighting scheme, General and localised

Direct, Indirect, Semi Direct, Semi Indirect Lighting Systems.

Unit II: Measurement of Light **12 Hours**

Definition of luminous flux, Luminous intensity, Lumen, Candle power, Illumination, M.H.C.P, M.S.C.P, M.H.S.C.P, Lamp efficiency, Brightness or luminance, Laws of illumination, Inverse square law and Lambert's Cosine law, Concept of polar curve, Calculation of luminance and illumination in case of linear source, round source and flat source

Illumination At Horizontal And Vertical Plane From Point Source

Unit III: Design of Interior Lighting **12 Hours**

Definitions of maintenance factor, Uniformity ratio, Direct ratio, Coefficients of utilisation and factors affecting it, Illumination required for various work planes, Space to mounting height ratio, Types of fixtures and relative terms used for interior illumination such as DLOR and ULOR, Selection of lamp and luminance

Selection Of Utilization Factor, Reflection Factor And Maintenance Factor

Unit IV: Design of Outdoor Lighting : Street Lighting **12 Hours**

Types of street and their level of illumination required, Terms related to street and street lighting, Types of fixtures used and their suitable application, Various arrangements in street lighting, Requirements of good street lighting, Selection of lamp and luminaire, Calculation of their wattage, Number and arrangement, Calculation of space to mounting height ratio.

Calculation Of Illumination Level Available On Road

Unit V: Design of Outdoor Lighting : Flood Lighting **12 Hours**

Terms related to flood lighting, Types of fixtures and their suitable applications, Selection of lamp and projector, Calculation of their wattage and number and their arrangement, Calculation of space to mounting height ratio,

Recommended Method For Aiming Of Lamp

Text Books

1. Joseph Le Roy Hayde Proteus Steinmetz, "Radiation, Light and Illumination: A Series of Engineering Lectures Delivered at Union College", BiblioLife, 2009
2. Jack L. Lindsey,, "Applied Illumination Engineering", 4th Edition, PHI, 1991
3. John Matthews, "Introduction to the Design and Analysis of Building Electrical Systems", 2nd Edition, Springer, 1993.

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1. M.A. Cayless, "Lamps and Lighting", 5thEdition, Routledge, 1996.
2. Leopold Bloch, "Science of Illumination: An Outline Of The Principles Of Artificial Lighting", Kessinger Pub, 2008.

Web References

1. https://nptel.ac.in/courses/108/105/108105060/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What luminous flux?
2. What is lighting scheme?
3. What Uniformity ratio?
4. What is semi-indirect lighting?
5. What is candle power?

L2: Understand

1. Explain Terms related to street and street lighting.
2. Explain Inverse square law and Lambert's Cosine law.
3. Explain on what basis lamp and luminance are selected
4. Explain the requirements of good street lighting.
5. Explain differebt types of pictures used for street lighting.

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HO 20EEH10 Design and Testing of Battery Management System for Electric Vehicles

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with Pos	DoK
20EEH10.1	Discuss about the different types of energy storage system.		L2
20EEH10.2	Describe about the battery characteristic & parameters.		L2
20EEH10.3	Design of different battery models		L2
20EEH10.4	Apply the concepts of battery management system and design the battery pack.		L3
20EEH10.5	Explain about the battery testing, disposal and recycling.		L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Energy Storage System — 12 Hours

Batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li-Ion & Li-poly, Metal Air Battery, Zinc Chloride battery; Ultra capacitors; Flywheel Energy Storage System; Hydraulic Energy Storage System; Comparison of different Energy Storage System

Unit II: Battery Characteristics & Parameters — 12 Hours

Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications: Variables to characterize battery operating conditions and Specifications to characterize battery nominal and maximum characteristics; Efficiency of batteries; Electrical parameters Heat generation- Battery design performance criteria for Electric vehicles batteries- Vehicle propulsion factors- Power and energy requirements of batteries

Unit III: Battery Modelling — 12 Hours

General approach to modelling batteries, simulation model of a rechargeable Li-ion battery, simulation model of a rechargeable NiCd battery, Parameterization of the NiCd battery model, Simulation examples.

Unit IV: Battery Pack and Battery Management System — 12 Hours

Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface, SOC Estimation, Battery thermal management system, Battery Management System: Definition, Parts: Power Module, Battery, DC/DC Converter, load, communication channel, Battery Pack Safety, Battery Standards & Tests.

Unit V: Battery Testing, Disposal & Recycling — 12 Hours

Battery design, battery testing, limitations for transport and storage of cells and batteries, Recycling, disposal and second use of batteries. Battery Leakage: gas generation in batteries, leakage path, leakage rates. Ruptures: Mechanical stress and pressure tolerance of cells, safety vents, Explosions: Causes of battery explosions, explosive process, Thermal Runway: High discharge rates, Short circuits, charging and discharging. Environment and Human Health impact assessments of batteries, General recycling issues and drivers, methods of recycling of EV batteries

Textbooks

1. Guangjin Zhao, "Reuse and Recycling of Lithium-Ion Power Batteries", John Wiley & Sons. 2017. (ISBN: 978-1-1193-2185-9)
2. Arno Kwade, Jan Diekmann, "Recycling of Lithium-Ion Batteries: The LithoRec Way", Springer, 2018. (ISBN: 978-3-319-70571-2)
3. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", JohnWiley& Sons Ltd., 2016.

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Reference Books

1. Chris Mi, Abul Masrur& David Wenzhong Gao, "Hybrid electric Vehicle- Principles & Applications with Practical Properties", Wiley, 2011.
2. Pistoia G., Wiaux J.P., Wolsky S.P., "Used Battery Collection and Recycling", Elsevier, 2001. [ISBN: 0-444-50562-8]"
3. Crompton T.R., "Battery Reference Book-3rd Edition", Newnes- Reed Educational and Professional Publishing Ltd., 2000.
4. James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2003.

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1. https://www.researchgate.net/publication/337434169_Power_Electronics_Converters_for_an_Electric_Vehicle_Fast_Charging_Station_with_Energy_Storage_System_and_Renewable_Energy_Sources
2. https://www.researchgate.net/publication/305288782_Power_electronics_in_smart_grid_distribution_power_systems_a_review

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20EEH11 Advanced Power System Protection

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with PO's			DoK
		PO2	PO7	PO10	
20EEH11.1	Define various Electromagnetic and static relays	3	2	2	L1
20EEH11.2	Outline various types of distance relays	3	2	2	L2
20EEH11.3	Analyse compensation for correct distance measurement	3	2	2	L4
20EEH11.4	Develop various digital relaying algorithms	3	2	2	L3
20EEH11.5	Experiment with microprocessor in implementation of digital relaying algorithms	3	2	2	L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction to Protective Relays **12 Hours**

Current transformers for protection, Coupling capacitor voltage transformers, transient performance of current transformer, CCVT potential transformer, review of electromagnetic relays static relays. Over current relays-time current characteristic, current setting time setting, directional relay, static over current relays

Unit II: Distance protection-I **12 Hours**

Impedance, reactance, mho, angle impedance relays, Input quantities for various types of distance relays, effect of arc resistance on the performance of distance relays, selection of distance relays, MHO relay with blinders, quadrilateral relay, elliptical relay, Restricted mho, impedance directional, reactance relays, Swiveling characteristics.

Unit III: Distance protection-II **12 Hours**

Compensation for correct distance measurement, reduction of measuring units, switched schemes, Pilot relaying schemes, Wire pilot protection, circulating current scheme, balanced voltage scheme, transley scheme, carrier current protection, phase comparison carrier current protection, carrier aided distance protection.

Unit IV: Digital relaying techniques **12 Hours**

Digital relaying algorithms, differential equation technique, discrete Fourier transform technique, Walsh-Hadamard transform technique, rationalized Haar transform technique, removal of dc offset.

Unit V: Microprocessor based protective relays **12 Hours**

Over current, directional, impedance, reactance relays, generalized mathematical expressions for distance relays, mho and offset mho relays, quadrilateral relay, Microprocessor implementation of digital distance relaying algorithms.

Text Books

1. Badri Ram, "Power System Protection and Switchgear", Tata McGraw-Hill Education, 2011.
2. Madhava Rao, "Power System Protection: Static Relays with microprocessor Applications", Tata Mc Graw-Hill Education, 2004.
3. C. Christopoulos and A. Wright "Electrical Power System Protection", Springer International,2nd Edition 2013

Reference Books

1. Mark Brown, Ramesh Balakrishnan, L. G. Hewitson. Newans, "Practical Power System Protection" Elsevier, 2015
2. L. P. Singh, "Digital Protecton- Protective Relaying from Electromechanical to Microprocessor" By New Age International 2016

Web References

1. https://nptel.ac.in/courses/108/107/108107167/
2. https://www.youtube.com/watch?v=QsGn7H_14VY&list=PLLy_2iUCG87BIJ6ZIiVIRCx2Crf9_fJMB

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PE-I 20EEH12 Power System Stability

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At the end of the course, students will be able to

Code	Course Outcomes	Mapping with Pos	DoK
20EEH12.1	Determine the model of synchronous machines.		L2
20EEH12.2	Know the steady state stability studies of synchronous machines		L2
20EEH12.3	Get the knowledge of solution methods of transient stability.		L3
20EEH12.4	Know the effect of different excitation systems in power systems.		L3
20EEH12.5	Know the effect of different voltage regulators in power systems.		L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: System Dynamics **12 Hours**

Synchronous machine model in state space from computer representation for excitation and governor system –modelling of loads and induction machines.

Unit II: Steady state stability **12 Hours**

steady state stability limit – Dynamics Stability limit – Dynamic stability analysis – State space representation of synchronous machine connected to infinite bus-time response.

Unit III: Digital Simulation of Transient Stability **12 Hours**

Swing equation machine equations – Representation of loads – Alternate cycle solution method – Direct method of solution – Solution Techniques: Modified Euler method – Runge Kutta method.

Unit IV: Automatic Voltage Regulators **12 Hours**

Effect of governor action and excite on power system stability effect of saturation, saliency & automatic voltage regulators on stability.

Unit V: Excitation Systems **12 Hours**

Rotating Self-excited Exciter with direct acting Rheostatic type voltage regulator – Rotating main and Pilot Exciters with Indirect Acting Rheostatic Type Voltage Regulator – Rotating Main Exciter, Rotating Amplifier and Static Voltage Regulator – Static excitation scheme.

Text Books

1. Kimbark "Power System Stability" 3rd edition Vol. I&II, III, Wiley, 2022
2. Anderson and Fund "Power System control and stability", IEEE Press.

Reference Books

1. Prabha kundur "Power systems stability and control" , TMH. 2013
2. Glenn.W.Stagg& Ahmed. H.El.Abiad "Computer Applications to Power Systems" TMH.
3. M.A.Pai, TMH. "Computer Applications to Power Systems " IEEE press 2008
4. S.S.Vadher "Power Systems Analysis & Stability" , S.S.VadheraKhanna Publishers, 2013

Web References

1. https://nptel.ac.in/courses/108/106/108106026/
2. https://unacademy.com/course/power-system-stability-484/WPVY3084
3. https://www.electrical4u.com/power-system-stability/

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20CEM01 Air Pollution 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20CEM01.1	Identify different types of pollution and their sources
20CEM01.2	Identify the meteorological components
20CEM01.3	Outline the impact on local and global effects of air pollution on human, materials, properties and vegetation
20CEM01.4	Explain various types of air pollution control equipment and their working principles
20CEM01.5	Understand sampling methods and monitoring of air pollution

Unit I: Introduction **9 Hours**

Definition of air pollution, Sources and causes of air pollution, Types and classification of air pollution - Natural contaminants, Particulate, Gases and Vapors, Primary and secondary air pollutants

Unit II: Meteorology **9 Hours**

General atmospheric circulation, Atmospheric stability, Effect of meteorology on Plume dispersion, Inversion, Wind profiles and stack plume patterns

Unit III: Effects of Air Pollution **9 Hours**

Effects of air pollution on human beings, plants and animals and properties. Global effects-Green house effect, Ozone depletion, heat island, dust storms, Automobile pollution sources and control, Photochemical smog

Unit IV: Air Pollution Control **9 Hours**

Particulate matter and gaseous pollutants - Settling chambers, Cyclone separators, Scrubbers, Filters & Electrostatic precipitator

Unit V: Air Quality Sampling and Monitoring **9 Hours**

Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution), Monitoring and analysis of air pollutants

Text Books

1. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, "Environmental Engineering", Mc Graw Hill, International Edition, 2017
2. Rao M. N., Rao H. V. N., "Air Pollution", 1st Edition, Mc Graw Hill, 2004

Reference Books

1. Martin, Crawford, "Air Pollution Control Theory", Tata McGraw Hill, New Delhi, 1986
2. Bulkeley, H., "Cities and Climate Change", Routledge, London, 2013
3. Rao C. S., "Environmental Pollution Control Engineering," Wiley Eastern Limited, New Delhi, 1992
4. Gurjar, B. R., Molina, L., Ojha, C. S. P., "Air Pollution: Health and Environmental Impacts", CRC Press, 2010

Web References

1. http://www.epa.gov
2. http://www.indiaenvironmentportal.org.in
3. http://nptel.iitm.ac.in
4. http://www.filtersource.com
5. https://dgserver.dgsnd.gov

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Board of Studies (CE)

20CSM01 E-Commerce

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20CSM01.1	Explain the role of new internet economy in E-Commerce
20CSM01.2	Explain the architecture of World Wide Web
20CSM01.3	Describe the E-Commerce process models and E-Payment System
20CSM01.4	Illustrate the network models in customization and internal commerce
20CSM01.5	Explain the E-commerce models in advertising and marketing of business

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction **9 Hours**

Electronic Commerce- Architectural Frame work, anatomy of E-commerce applications, E-Commerce consumer applications, E-commerce organization applications

E-Commerce and media convergence

Unit II: World Wide Web & Network security **9 Hours**

Client-Server Network security, World Wide Web (WWW) as the architecture, Web background: Hypertext Publishing, Technology behind the web, Security and the web,

Emerging Client-Server Security Threats

Unit III: E-Payment Systems **9 Hours**

Consumer Oriented Electronic Commerce- Mercantile Process models, E-Payment systems- Digital Token-Based, smart cards, credit cards, risk and E- Payment systems

Designing E-Payment Systems

Unit IV: EDI Implementation and Intra organizational E-Commerce **9 Hours**

Standardization and EDI, EDI Software implementation, Value added networks, Intra organizational E-Commerce- Workflow Automation and Coordination, Customization and Internal Commerce, Supply chain management (SCM).

EDI Envelope for Message Transport

Unit V: Advertising and Marketing on the Internet **9 Hours**

Corporate Digital Library- Document Library, digital document types, corporate data warehouses, Advertising and marketing- Information based marketing, Advertising on Internet, online marketing process, market research.

Charting the Online Marketing Process

Text Books

1. Ravi Kalakota and Andrew B. Whinston., "Frontiers of electronic commerce", First Edition, Pearson Education , 2011
2. Jaiswal S., " E-Commerce", Second Edition,Galgotia,2010

Reference Books

1. Dave Chaffey., "E-business & E- commerece management- strategy, implementation and Practice", Fifth edition, Pearson Education, 2015.
2. Kenneth C, "E-Commerce: Business.Technology.Society", First Edition, Pearson Education, 2008

Web References

1. https://www.techopedia.com/definition/18226/corporate -data-warehouse-cdw
2. http://ecmrce.blogspot.com
3. http://data.conferenceworld.in

Internal Assessment Pattern

CognitiveLevel	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Write any four important E-Commerce organization Applications
2. Write about any four requirements of EDI
3. Write short notes on Risks in E-Payment systems
4. Write short notes on Market research
5. What are the factors for design of electronic payment system?

L2: Understand

1. How enterprise resource planning and supply chain management software differs in their goals and implementations
2. How product or service customization is adopted in intraorganizational commerce?
3. Explain Merchantile's model from the Merchant's perceptive
4. Explain in detail about E-Payment systems
5. Discuss about mercantile transaction using credit cards

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20MEM01 Biomaterials

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20MEM01.1	Classify various biomaterials
20MEM01.2	Identify the Metallic implant materials
20MEM01.3	Describe the failure modes of implant materials
20MEM01.4	Apply Ceramic implant materials
20MEM01.5	Develop the Biocompatibility & Toxicological properties in of biomaterials

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

Unit I: Introduction **09 Hours**

Definition of biomaterials, requirements & classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra- vascular system). Surface properties of materials.

physical properties of materials, mechanical properties.

Unit II: Metallic implant materials **09 Hours**

Stainless steel, Co-based alloys, Ti and Ti-based alloys. Importance of stress-corrosion cracking. Host tissue reaction with bio metal, corrosion behavior and the importance of passive films for tissue adhesion. Hard tissue replacement implant: Orthopedic implants, Dental implants. Soft tissue replacement implants: Percutaneous and skin implants.

Vascular implants, Heart valve implants-Tailor made composite in medium.

Unit III: Polymeric implant materials **09 Hours**

Polyolefin's, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetyls. (Classification according to thermo sets, thermoplastics and elastomers).Viscoelastic behavior: creep-recovery, stress-relaxation, strain rate sensitivity. Importance of molecular structure, hydrophilic and hydrophobic surface properties, migration of additives (processing aids), aging and environmental stress cracking. Physiochemical characteristics of biopolymers. Biodegradable polymers for medical purposes, Biopolymers in controlled release systems.

Synthetic polymeric membranes and their biological applications.

Unit IV: Ceramic implant materials **09 Hours**

Definition of bio ceramics. Common types of bio-ceramics: Aluminum oxides, Glass ceramics, Carbons. Bio resorbable and bioactive ceramics. Importance of wear resistance and low fracture toughness. Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction). Composite implant materials: Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement

(short and long fibers, fibers pull out).

Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions.

Unit V: Biocompatibility & Toxicological screening of biomaterials **09 Hours**

Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situimplantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization.

carcinogenicity, mutagenicity and special tests.

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Text Books

1. Biomaterials Science: An Introduction to Materials in Medicine, By Buddy D. Ratner, et. al. AcademicPress, San Diego, 1996.
2. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
3. J B Park, Biomaterials – Science and Engineering, Plenum Press, 1984.
4. Comprehensive structural interity, Vol.9: Bioengineering Editors: Mithe, Ritchie and Kanhalo, ElsevierAcademic Press, 2003.

Reference books

1. Biomaterials Science: An introduction to Materials in Medicine, Edited by Ratner, Hoffman, Schoet and Lemons, Second Edition: Elsevier Academic Press, 2004.

Web References

1. https://nptel.ac.in/content/syllabus_pdf/113104009.pdf
2. RBM603 BIOMATERIALS Syllabus free download
3. UP Technical University BE BM Syllabus
4. RBM603 Syllabus, BM Unit-wise Syllabus – BE 6th Semester

Internal Assessment Pattern

CognitiveLevel	InternalAssessment#1(%)	InternalAssessment#2(%)
L1	10	10
L2	30	30
L3	60	60
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Write about classification of biomaterials?
2. State the applications of biomaterials?
3. List the advantages and disadvantages biomaterials?
4. Write about Effects of physiological fluid on the properties of biomaterials?
5. Define importance of stress-corrosion cracking?

L2: Understand

1. Surface properties of materials
2. Comparison of properties of some common biomaterials
3. Corrosion behavior and the importance of passive films for tissue adhesion
4. Visco elastic behavior: creep-recovery, stress-relaxation, strain rate sensitivity

L3: Apply

1.Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out). Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions

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Board of Studies (ME)

20EEM01 Basic Control Systems 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20EEM01.1	Determine time response specifications of second order systems
20EEM01.2	Determine error Constants for different types of input signals
20EEM01.3	Understand various levels of illuminosity produced by different illuminating sources.
20EEM01.4	Design different lighting systems by taking inputs and constraints in view for different layouts.
20EEM01.5	Understand the speed/time characteristics of different types of traction motors.

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction to Control Systems **09 Hours**

Classification of control systems, open loop and closed loop control systems and their differences, Feedback characteristics, transfer function of linear system, differential equations of electrical networks, translational and rotational mechanical systems

Differences between Closed loop and Open Loop Control Systems

Unit II: Time Response Analysis **09 Hours**

Standard test signals time response of first and second order systems time domain specifications, steady state errors and error constants

Definitions of Time domain Specifications

Unit III: Stability **09 Hours**

The concept of stability, Routh's stability criteria – Limitations of Routh's stability, effect of addition of poles and zeros, introduction to root locus.

Basics of Routh's Criteria

Unit IV: Frequency response **09 Hours**

Introduction to frequency domain specifications, basics of bode plot, Phase margin, Gain Margin. Introduction to Polar plots, its phase margin and gain margin. Introduction to Nyquist stability criteria

Definitions of Frequency domain Specifications

Unit V: State Space Analysis **09 Hours**

Concepts of state, state variables and state model, state space representation of transfer function, diagonalization, solving the time invariant state equations, State Transition Matrix and its Properties, concepts of controllability and observability.

Basics of Matrix operations

Text Books

1. I.J.Nagarath and M.Gopal, "Control Systems Engineering", Newage International Publications, 5th Edition, 2014.
2. Kotsuhiko Ogata, Modern Control Engineering, Prentice Hall of India, 5th edition, 2014

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Reference Books

1. S.Palani, "Control Systems Engineering", Tata Mc Graw Hill Publications, 3rd Edition, 2012.

Web References

1. https://nptel.ac.in/courses/107/106/107106081/
2. https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	30	30
L2	40	30
L3	30	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the various standard test signals?
2. Define concept of observability.
3. What is state transition matrix? Write its properties.

L2: Understand

1. Explain how Routh Hurwitz criterion can be used to determine the absolute stability of a system
2. Explain about feedback characteristics.
3. Describe the effect of addition of poles and zeros.

L3: Apply

1. The characteristic polynomial of a system is s5+2s6+3s5+s4+5s3+2s2+s+7=0. Determine the the stability of the system using Routh's stability criteria.
2. Determine range of K for stability of unit feedback system whose open loop transfer function is G(s) = K/s(s+1)(s+2).
3. For a system having G(s) = 25/s(s+10) and units negative feedback, find its time response specifications.

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Board of Studies (EEE)

20ECM01 Semiconductor Devices & Circuits 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20ECM01.1	Classify different types of semiconductors with energy band diagrams
20ECM01.2	Explain the operation and characteristics of PN junction diode and special diodes
20ECM01.3	Classify and Analyze different types of rectifiers
20ECM01.4	Demonstrate the flow of current in different configurations of the transistor & the concept of DC biasing and transistor stabilization
20ECM01.5	Analyze and Design the small signal low frequency amplifiers

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Semiconductor Physics **09 Hours**

Atomic structure, Neil Bohr's atomic theory, definition of conductors, insulators and semiconductors, energy level diagrams. Semiconductors: Classification and types, intrinsic and extrinsic, P-type and N-type semiconductors, majority and minority carriers, recombination, effect of temperature.

Fermi Level, Charge Densities in Semiconductors

Unit II: Semiconductor Diodes and Special Diodes **09 Hours**

Formation of depletion region, barrier potential, reverse breakdowns, PN junction as diode, symbol, biasing modes, V-I characteristics, diode current equation, effect of temperature on diode current, ideal diode. Special Diodes: Zener diode, Photo Diode, LED - Working, characteristics and applications.

Diode Switching times, Varactor diode, Tunnel Diode

Unit III: Rectifiers and Filters **09 Hours**

Half wave Rectifier, Full wave rectifier, Bridge Rectifier - Operation, Input and output wave forms. Filters: Inductor filter, Capacitor filter, π filter, Comparison of various filter circuits in terms of ripple factors.

LC filter, Multi section π filter

Unit IV: Transistors and Biasing Techniques **09 Hours**

Junction transistor, Transistor current components, Transistor configurations, Transistor as an amplifier, characteristics of transistor in CB and CE configurations. Need for biasing, operating point, Load line analysis, fixed bias and self bias, Stabilization against variations in VBE, Ic, and β, Stability factor, Thermistor and Sensistor bias compensation techniques, Thermal runaway.

Ebers-Moll model of a transistor, Punch through/reach through, Thermal stability

Unit V: Small Signal Low Frequency Transistor Amplifier Models **09 Hours**

BJT: Two port network, Transistor hybrid model, Determination of h-parameters, Generalized analysis of transistor amplifier model using h-parameters, Exact and approximate analysis of CB and CE amplifiers, Comparison of transistor amplifiers.

Effects of emitter bypass capacitor (Ce) on low frequency response

Textbooks

1. Lal Kishore K., "Electronic Devices and Circuits", 4th Edition, Bright Sky Publications, 2016
2. Millman J. and Christos C. Halkias, "Electronic Devices and Circuits", 4th Edition, Tata Mc-Graw Hill, 2010
3. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2009
4. Boylestad R. L. and Louis Nashelsky, "Electronic Devices and Circuits", 10th Edition, Pearson Publications,2009

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Reference Books

1. Salivahanan S., Suresh Kumar and Vallavaraj N. A., "Electronic Devices and Circuits", 2nd Edition, Tata Mc-Graw Hill, 2012
2. Donald A. Neamen, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill, 2010
3. Millman J. and Halkias C., "Integrated Electronics", 2nd Edition, Tata Mc-Graw Hill, 2009
4. Singh B. P. and Rekha, "Electronic Devices and Integrated Circuits", 3rd Edition, Pearson publications, 2009
5. Mittal G. K., "Electronic Devices and Circuits", 3rd Edition, Khannan Publishers, 2008

Web Resources

1. www.elprocus.com/p-n-junction-diode-theory-and-working/
2. http://fourier.eng.hmc.edu/e84/lectures/ch4/node3.html
3. http://nptel.ac.in/courses/117103063/11

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	35
L2	40	35
L3	20	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Semiconductor
2. What is ideal diode?
3. List any three applications of Zener diode
4. What is rectifier?
5. Define ripple factor
6. What is BJT?
7. What is thermal runaway?
8. Define stability

L2: Understand

1. Describe the formation of P type semiconductor
2. Draw and explain V-I characteristics of PN junction diode
3. Describe the construction and operation of Photo diode
4. With neat circuit diagram describe the operation of bridge rectifier
5. Explain, why Zener diode is used in reverse bias with the help of characteristics
6. Draw and explain the input and output Characteristics of Common base configuration
7. With neat sketches explain the V-I characteristics of NPN transistor in common emitter configuration
8. Write a short note on Thermal Runaway
9. Explain thermister compensation technique

L3: Apply

1. Show that the efficiency of half wave rectifier is 40.6%
2. Show that the efficiency of full wave rectifier is 81.2%
3. Obtain an expression of stability factor for fixed bias
4. With suitable expressions explain self bias of BJT
5. Obtain the expressions for voltage gain and current gain of small signal low frequency common emitter amplifer

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20AIM01 Fundamentals of Neural Networks

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20AIM01.1	Describe the concepts of artificial neural networks
20AIM01.2	Compare functions of biological and artificial neural networks
20AIM01.3	Explain the architecture and functioning of Single Layer feed forward networks
20AIM01.4	Describe architecture and functioning of Multi-layer networks
20AIM01.5	Explain associative memory networks

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction to Neural Networks **9 hours**

Introduction - Humans and Computers - Organization of the Brain – Biological Neuron - Biological and Artificial Neuron Models - Characteristics of ANN - McCulloch-Pitts Model - Historical Developments - Potential Applications of ANN

Unit 2: Essentials of ANN **9 hours**

Artificial Neuron Model - Operations of Artificial Neuron - Types of Neuron Activation Function - ANN Architectures - Classification Taxonomy of ANN – Connectivity - Learning Strategy (Supervised, Unsupervised, Reinforcement) - Learning Rules

Unit 3: Single Layer Feedforward Networks **9 hours**

Introduction - Perceptron Models: Discrete - Continuous and Multi-Category - Training Algorithms: Discrete and ContinuousPerceptron Networks – Limitations of the Perceptron Model

Unit 4: Multi - Layer Feedforward Networks **9 hours**

Generalized Delta Rule - Derivation of Backpropagation (BP) Training - Summary of Backpropagation Algorithm - Kolmogorov Theorem, Learning Difficulties and Improvements

Unit 5: Associative Memory Networks **9 hours**

Paradigms of Associative Memory - Pattern Mathematics - Hebbian Learning - General Concepts of Associative Memory - Bidirectional Associative Memory (BAM) Architecture - BAM Training Algorithms: Storage and Recall Algorithm - BAM Energy Function

Text Books

1. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Networks Using MATLAB 6.0", Tata McGraw-HillCompanies, 2006
2. Simon Haykin, "Neural Networks: A Comprehensive Foundation", Second Edition, Pearson Education, Asia
3. James A. Freeman, David M. Skapura, "Neural Networks: Algorithms, Applications, and Programming Techniques", Addison-Wesley Publishing Company

Reference Books

1. B. YagnaNarayana, "Artificial Neural Networks", Prentice Hall India, 2013
2. Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.
3. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education

Web Resources

1. https://www.tutorialspoint.com/artificial_neural_network/index.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1	Internal Assessment #2
L1	50	50
L2	50	50
Total (%)	100	100

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Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

5. Define Neural Computing
6. Define ANN and Neural Computing
7. List any 4 design parameters in the design of Artificial Neural Network
8. What kinds of transfer functions can be used in each layer?
9. Define Pattern Association
10. What is Adaline Model?
11. What are the types of Learning?
12. What is simple artificial neuron?
13. List any 4 applications of Artificial Neural Network
14. Define Delta Learning rule

L2: Understand

4. Describe on the process of assigning and updating weights in a artificial neural network
5. What are the design steps to be followed for using ANN for your problem?
6. Describe least square algorithm with example
7. Why XOR Problem cannot be solved by a single layer perceptron? Write an alternative solution for it
8. Explain Back Propagation Network with necessary diagrams and equations
9. Write the differences between Hetero Associative Memories and Interpolative Associative Memories

Head of the Department

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VI 20DSO03 Introduction to R Programming 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20DSO03.1	Understand the basic concepts of R programming
20DSO03.2	Understand about Scalars and Vectors
20DSO03.3	Implement Lists and data Frames
20DSO03.4	Implement Tables and Statistical Distributions
20DSO03.5	Implement Functions in R programming

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction **9 Hours**

Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations

Variable Scope & Default Arguments

Unit II: Control Structures And Vectors **9 Hours**

Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes

Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations

Higher-Dimensional Arrays

Unit III: Lists **9 Hours**

Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, Data Frames, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations

Merging Data Frames

Unit IV: Factors and Tables **9 Hours**

Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Lik Operations on Tables, Extracting a Sub table, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions

aggregate () Function, Set Operations

Unit V: Functions **9 Hours**

Scripts to Functions, Making the Script, Transforming the Script, Using the Function, Reduce the number of Lines, Adding more Arguments, Dots, Using Functions as Arguments, Crossing the Boarders, Choices with If-Else Statements, vectorizing Choices, Looping Through Values

Coping and Scoping of Functions

Head of the Department

Text Books

1. Norman Matloff, " The Art of R Programming- A Tour of Statistical Software Design ", 2011
2. Roger D. Peng, " R Programming for Data Science " , 2012

Reference Books

1. Garrett Grolamund, Hadley Wickham, "Hands-On Programming with R: Write Your Own Functions andSimulations", 1st Edition, 2014
2. Andrie de Vries, Joris Meys, "R For Dummies", 2nd Edition, 2015

Web References

1. https://swayam.gov.in/nd1_noc19_ma33/preview
2. https://data-flair.training/blogs/object-oriented-programming-in-r/
3. http://www.r-tutor.com/elementary-statistics
4. https://www.tutorialspoint.com/r/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Write about vectors in R
2. Write any three type conversions in R
3. What is a data structure in R?
4. Write any two Boolean operators in R
5. Write any two linear vector algebra operations

L2: Understand

1. Explain the importance of data frame
2. How to apply same functions to all rows and columns of a matrix? Explain with example
3. Explain about Finding Stationary Distributions of Markov Chains
4. Describe R functions for Reading a Matrix or Data Frame from a File
5. Explain different matrix operation function in R

L3: Apply

1. Implement binary search tree with R
2. Write R script to create a line graph
3. Create a R language code to generate first n terms of a Fibonacci series
4. Apply R program to implement quicksort
5. Apply R code to the function by using if else
   commandf(x) = x if x<1/2
   = (1-x) if 1/2<x<1
   = 0 otherwise

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20SHM01 Psychology

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20SHM01.1	Focuses on classical/operant conditioning, reinforcement schedules, and observational learning to help students obtain an understanding of learning and conditioning
20SHM01.2	Understand the properties of Senses
20SHM01.3	Understand the state of Consciouness, Sleep & Dreams
20SHM01.4	Understand the importance of learning
20SHM01.5	Understanding the components of memory, language, cognition, problem solving, and the many forms of memory will be the focus of this course

Unit I: Introduction — 9 Hours

Definition of Psychology, Psychology as a Science: Methods of psychology, Different schools of Psychology and modern perspectives of psychology - Scope and branches of psychology

Unit II: Sensation and Perception — 9 Hours

General Properties of Senses, subliminal stimuli, Selective Attention, Physiological correlates of Attention, Internal influences on Perception - Learning, Set, Motivation and Emotion, External influences on perception - Figure Ground separation, Movement, organization, illusions, Perceptual constancies, Depth perception, Binocular and Monocular Depth, Perception; Perceptual defense and perceptual vigilance, sensory deprivation, sensory bombardment

Unit III: Consciousness — 9 Hours

Fundamental Process, Active and passive roles of consciousness, Sleep and Dreams, Meditation, Hypnosis, Psi Phenomena, Alternate states of consciousness, Natural and Drug induced

Unit IV: Learning — 9 Hours

Definition of learning, Theories of learning, Classical conditioning, Operant conditioning, Cognitive Learning, Social Learning

Unit V: Memory — 9 Hours

Meaning and nature of memory, Theories of memory: Information processing theories - sensory register, short term memory, rehearsal; Levels of processing theories, Long term memory - organizations, TOT, semantic and episodic memory, encoding and storing long term memories, role of organization, role of imagery, role of constructive processes; Retrieval from long term memory, Forgetting- Motivated forgetting, Interference, Decay through disuse, Techniques of improving memory

Text Books

1. Morgan C. T., King, R. A., Weisz, J. R. and Schopler J., Introduction to Psychology, 7th Edition, Singapore: Mcgraw - Hill, 2007
2. Myers D. G., Psychology, 5th Edition, Worth Publishers: New York, 2004
3. Kalat J., Introduction to Psychology, 8th Edition, Wordsworth Pub. Co., 2007

Reference Books

1. Feldman R. S., Understanding Psychology, 6th Edition, Tata McGraw - Hill, New Delhi, 2006
2. Kosslyn S. M. and Rosenberg R. S., Psychology in Context, 3rd Edition, Pearson Education Ltd., 2006

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1. https://www.all-about-psychology.com/learn-psychology.html
2. https://study-uk.britishcouncil.org/plan-studies/choosing-course/subjects/psychology
3. https://www.youtube.com/watch?v=k-P1BEk6hhE

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Board of Studies (BS&H)

20SHM02 Statistical Methods

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20SHM02.1	Demonstrate statistical techniques in real life problems
20SHM02.2	Gain statistical knowledge on measures of central tendency and variation
20SHM02.3	compute sample space, event, relative frequency, probability, conditional probability, independence
20SHM02.4	familiar with some standard discrete and continuous probability distributions
20SHM02.5	Understand the theory of sampling techniques and their practical applications

Unit I: Introduction — 9 Hours

Definition and classification of statistics, Stages in statistical investigation, Definition of some basic terms, Applications, uses and limitations of statistics, Scales of measurement, methods of data collection and presentation, Diagrammatic and graphical presentation of data

Unit II: Treatment of Data — 9 Hours

Frequency distributions, stem-leaf displays, measures of central tendency (mean,median,mode,quantiles), measures of variation (range, quartile deviation, mean deviation, standard deviation), standard scores, moments (about origin and mean) skewness and kurtosis

Unit III: Elementary Probability — 9 Hours

Introduction, definitions of random experiment, samplespace, events, types of events, countingrules, permutation and combinations rule, definition of probability in several approaches, some probability rules, conditional probability and independence, bayes theorem

Unit IV: Probability Distributions — 9 Hours

Definition of random variables and probability distributions, Introduction to expectation: mean and variance of a random variable, Common discrete probability distributions: Binomial and Poisson, Common continuous probability distributions: normal, t and chi-square distributions

Unit V: Sampling Techniques — 9 Hours

Basic concepts: population, sample, parameter, statistic, sampling frame, sampling units , Reasons for sampling, Sampling and non sampling errors, probability sampling techniques (simple, stratified, systematic), Non probability sampling methods

Text Books

1. Bluman A. G., Elementary Statistics: A Step by Step Approach, 2nd Edition, Wm. C. Brown Communications, Inc., 1995
2. Spiegel M. R. and Stephens L. J., Schaum's Outline of Statistics, Schaum's Outline Series , 4th Edition, 2007
3. Gupta C.B. and Gupta, V., An Introduction to Statistical Methods, Vikas Publishing House, Pvt. Ltd., India, 2004

Reference Books

1. Richard A., Gupta C. B.", Probability and Statistics for Engineers", Miller & Fruend ,Pearson's Edition, 2010
2. Freund, J. E. and Simon G. A., Modern Elementary Statistics, 9th Edition, 1998
3. Snedecor G.W. and Cochran W. G.,Statistical Methods, 7th Edition, 1980
4. David S. M., McCabe P. and Craig B., Introduction to the Practice of Statistics, 6th Edition, W. H. Freeman, 2008

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1. https://onlinecourses.nptel.ac.in/noc21_ma74/preview
2. https://archive.nptel.ac.in/courses/111/105/111105077/
3. http://www.nitttrc.edu.in/nptel/courses/video/111105077/L10.html

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20MBM01 General Management

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20MBM01.1	Understand basic functions of management
20MBM01.2	Understand the planning process and strategic formulation
20MBM01.3	Know the nature of the organization process
20MBM01.4	Understand the staffing objectives and functions
20MBM01.5	Understand the directing process and controlling methods

Unit I: Management Introduction — 09 Hours

Concept, Nature, Process and Significance of Management, Managerial Roles (Mintzberg), An Overview of Functional areas of Management - Marketing, Finance, Production, HRM, IT,R & D, Development of Management Thought - Classical, Neo – classical

Unit II: Planning — 09 Hours

Process and Types, Decision - making concept and process, Bounded rationality, Management by objectives, Corporate Planning - Environment analysis and Diagnosis, Strategy Formulations

Unit III: Organizing — 09 Hours

Concept, Nature, Process and Significance, Authority and Responsibility relationships - Delegation, Decentralisation, Departmentation basis and formats (Project and Matrix), Formal and Informal Organisation, Changing patterns in organisation structures in the knowledge economy

Unit IV: Staffing — 09 Hours

Human Resource Planning, Objectives, Factors influencing Human Resource Planning, HR Planning Process, Job Analysis, Recruitment, Process and Sources of Recruitment, Selection, Process of selection and Techniques, Errors in selection Retention of employees

Unit V: Directing and Control — 09 Hours

Motivating and Leading People at work - basic concepts, Communication - nature, process, networks and barriers, Effective Communication Managerial Control - Concept and process, Designing an Effective Control System, Techniques –Traditional and Modern (PERT and CPM)

Note: Discuss case studies from every unit

Text Books

1. Singh B. P. and Chhabra T. N., Management Concepts and Practices, Dhanpat Rai, New Delhi
2. Singh B. P. and Singh A. K., Essentials of Management, Excel Books, New Delhi
3. Dwivedi R. S. Management – An Integrated Approach, National Publishing House

Reference Books

1. Weihrich, Heing and Harold Koontz, Management a Global Perspective, Mc - Graw Hill, New Delhi
2. Stoner, James A. F., Freeman A. E. and Gilbert D. A., (Jr.), Management, Prentice Hall of India Pvt. Ltd.
3. Ivancevich, John M., Donnelly J. H. and Gibson J. L., Management: Principles and Functions, AITBS, New Delhi
4. Luthans, Fred, Introduction to Management, Mc - Graw Hill
5. Jones, Gareth R and Jennifer M., George, Contemporary Management, Tata Mc-Graw Hill

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1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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Board of Studies (MBA)

MI 20MBM02 Human Resource Planning 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20MBM02.1	Understand staffing concept Write sound job descriptions, job specifications
20MBM02.2	Develop a structured, job - related interview for talent acquisition across all the verticals
20MBM02.3	Know the training and development strategies of a firm
20MBM02.4	Understand compensation management and performance management process
20MBM02.5	Understand the role of trade unions in a firm

Unit I: Introduction 09 Hours

Human resource planning concepts, Concept of Staffing, Factors affecting Staffing, Staffing Process. Job Analysis – Concept, Job - Specifications, Job - Description, Process and Methods, Advantages of Job Analysis. Job Designing: Introduction, Definition, Modern Techniques, Factors affecting Job Design

Unit II: Talent Acquisition 09 Hours

Recruitment and Selection: Needs-recruitment process - alternative to recruitment, Concept of Selection, Criteria for Selection, Process. Screening – Pre and Post Criteria for Selection, Interviewing – Types and Guidelines for Interviewer & Interviewee, Types of Selection Tests, Selection Hurdles and Ways to Overcome Them, Current trends in Recruitment and Selection

Unit III: Training & Development 09 Hours

Induction – Concept, Types - Formal/Informal Induction, Advantages of Induction, Training Vs Development, Need, Process of Training, Methods of Training, Development techniques, need for development, Career Planning, training and development policies, linking training and development to company's strategy

Unit IV: Compensation and Performance Management 09 Hours

Compensation management process, Forms of pay, Financial and non – financial compensation - Factors influencing Wage fixation, Performance Appraisal System, Methods of Performance Appraisal, Performance management process

Unit V: Managing Industrial relations 09 Hours

Managing Industrial Relations – Components of IR - Trade Unions, Functions of Trade Union – Employee Participation – Importance and Schemes, Collective Bargaining – Grievance Redressal, Industrial Dispute – Settlement mechanism

Note: Discuss case studies from every unit

Text Books

1. Subba Rao P., Human Resource Management, Himalaya, Mumbai
2. Aswathappa K., Human Resources and Personnel Management, Tata McGraw-Hill
3. Armstrong M., Performance Management: Key Strategies and practical Guidelines, Kogan Page, London

Reference Books

1. Gary Dessler, Human Resources Management. Pearson Publication
2. Mamnoria C. B., Personnel Management
3. Recruitment and Selection: Theories and Practices, Dipak Kumar Bhattacharyya, Cengage, India

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1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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Board of Studies (MBA)

20CEM02 Climate Change Mitigation and Adaptation

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20CEM02.1	Understand the concept of climate change scenarios
20CEM02.2	Outline the causes for the changes in the climate
20CEM02.3	Identify the impacts of climate change on various sectors
20CEM02.4	Adopt the methodologies in finding the changes in climate
20CEM02.5	Demonstrate the climate change adaptation and mitigation options forsecuring sustainable development

Unit I: Fundamentals of Climate Change — 9 Hours

Greenhouse gases, radiative forcing potential, carbon dioxide equivalency, natural climate forcing factors, emissions sources and sinks

Unit II: Observed Changes and its Causes — 9 Hours

Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change –Evidences of Changes in Climate and Environment – on a Global Scale and in India.

Unit III: Impacts of Climate Change — 9 Hours

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios -Projected Impacts for Different Regions- Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

Unit IV: Clean Technology and Energy — 9 Hours

Clean Development Mechanism -Carbon Trading- examples of future Clean Technology -Biodiesel – Natural Compost – Eco-Friendly Plastic – Alternate Energy – Hydrogen – Biofuels -Solar Energy – Wind – Hydroelectric Power.

Unit V: Adaptation and Mitigation Responses — 9 Hours

Policy, Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC, Concept framework of urban adaptation to climate change, Mitigation Efforts in India and Adaptation funding.

Text Books

1. Jan C. Van Dam, "Impacts of Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003
2. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007

Reference Books

1. Pielke, R., "Lifting the taboo on adaptation", Nature 445 (7128), 597-598, 2007
2. Bulkeley, H., "Cities and Climate Change", Routledge, London, 2013

Web References

1. IPCC Fourth Assessment Report – The AR4 Synthesis Report
2. https://www.coursera.org/learn/climate-change-mitigation
3. https://www.usc.edu.au/study/courses-and-programs/courses/course-library/ens/ens204-climate-change-mitigation-and-adaptation

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Board of Studies (CE)

MI 20CSM02 Knowledge Discovery and Databases 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20CSM02.1	Illustrates the basic concepts of database management system
20CSM02.2	Able to summarize mining and preprocessing of data
20CSM02.3	Outline the functionalities of data mining(characterization)
20CSM02.4	Able to explain the processes of association analysis
20CSM02.5	Illustrate the features of various clustering techniques

Unit I: Introduction to Database and Data Warehouse 9 Hours

Overview of Data, What is Database and What is Database Management Base System, Meaning of Entity, Relation, Database Design and ER diagrams, Attributes, DMBS Software's available in Market, Structured Query Language (SQL)
What is Data Warehouse, Types of Data Warehouse, On-Line Analytical Processing (OLAP)

Unit II: Data Mining Introduction 9 Hours

Introduction to Data Mining Systems, Knowledge Discovery Process, Data Mining Techniques, Issues, Data Objects and Attribute Types, Statistical Description of Data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and Discretization, Data Visualization

Unit III: Classification 9 Hours

Introduction and Basic Concepts of Classification, What is Training Data, Supervisory Learning and Unsupervisory Learning. Decision Tree Induction, Working of Decision Tree and Building a Decision Tree, Bayes' Theorem, Classification by Back Propagation

Unit IV: Association 9 Hours

What is Association Analysis, Frequent Item Set Generation, Association Rule Generation using Apriori Algorithm.

Unit V: Clustering and Outlier Analysis 9 Hours

What is Cluster Analysis, Different Types of Clusters, Partition Method – K-Means Algorithm, Hierarchical Methods – Hierarchical Cluster Algorithm, Density Based Method- DBSCAN and Outlier Analysis, What is Outlier Analysis?

Practicing Tool: SQL, Weka, Python and R

Text Books

1. Raghurama Krishnan, Johannes Gehrke, "Data base Management Systems", Third Edition, TATA McGraw Hill, 2008.
2. Jiawei Han and MichelineKamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2012.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson, 2016

Reference Books

1. Alex Berson, Stephen J.Smith, –"Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, 35th Reprint 2016.
2. K.P. Soman, ShyamDiwakar and V. Ajay, – "Insight into Data Mining Theory and Practice", Eastern Economy Edition, Prentice Hall of India, 2006.
3. Ian H.Witten, Eibe Frank, – "Data Mining: Practical Machine Learning Tools and Techniques", Second Edition, Elsevier.

Head of the Department

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1. https://www.tutorialspoint.com/
2. https://www.coursera.org/learn/

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20MEM02 Micro Electromechanical Systems

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20MEM02.1	Acquire the operation of micro devices, micro systems and their applications
20MEM02.2	Ability to design the micro devices, micro systems using the MEMS fabrication process.
20MEM02.3	Acquire basic approaches for various sensor design
20MEM02.4	Acquire basic approaches for various actuator design
20MEM02.5	Gain the technical knowledge required for computer-aided design, fabrication, analysis and characterization of nano-structured materials, micro- and nano-scale devices.

Unit I: Basic Concepts

9 Hours

Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA. MECHANICAL SENSORS AND ACTUATORS: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology

Unit II: Thermal Sensors and Actuators

9 Hours

Thermal energy basics and heat transfer processes, thermisters, thermo devices, thermo couple, micro machined thermo couple probe, peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

Unit III: Micro-Opto-Electro Mechanical Systems

9 Hours

Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement, MAGNETIC SENSORS AND ACTUATORS: Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe-based storage device

Unit IV: Micro Fluidic Systems

9 Hours

Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemo resistors, chemo capacitors chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluorescence detection, calorimetric spectroscopy

Text Books

1. Nitaigour Premchand Mahalik, "MEMS" TMH Publishing co.

Reference Books

1. Chang Liu," Foundation of MEMS", Prentice Hall Ltd.
2. Sergey EdwrdLyshevski, "MEMS and NEMS", CRC Press, Indian Edition.
3. Tai-Ran Hsu, "MEMS and Micro Systems: Design and Manufacture", TMH Publishers.
4. Thomas M Adams, "Richard A Layton Introductory MEMS", Springer International Publishers.

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N.S. Raju Institute of Technology
Sontyam, Visakhapatnam

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1. https://nptel.ac.in/courses/117/105/117105082/

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Board of Studies (ME)

Head of the Department
Dept. of Electrical & Electronics Engg.
N.S. Raju Institute of Technology (Autonomous)
Sontyam, Visakhapatnam - 531 173

20EEM02 Basics of Electrical Machines and Drives 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20EEM02.1	Understand the basic concepts of different types of electrical drives
20EEM02.2	Able to explain the performance characteristics of electrical drives
20EEM02.3	Study the different methods of starting D.C motors and induction motors
20EEM02.4	Study the conventional and solid-state D.C. drives
20EEM02.5	Study the conventional and solid-state A.C. drives

Unit I: Introduction **9 Hours**

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

Unit II: Drive Motor Characteristics **9 Hours**

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound – single phase and three phase induction motors

Unit III: Starting Methods **9 Hours**

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors

Unit IV: Conventional and Solid-State Speed Control of D.C. Drives **9 Hours**

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system – Using controlled rectifiers and DC choppers –applications.

Unit V: Conventional and Solid-State Speed Control of A.C. Drives **9 Hours**

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme Using inverters and AC voltage regulators – applications

Textbooks

1. Nagrath I.J. & Kothari D.P, "Electrical Machines", Tata McGraw-Hill, 2006
2. Vedam Subrahmaniam, "Electric Drives (Concepts and Applications)", Tata McGraw-Hill, 2010

Reference Books

1. Partab. H., "Art and Science and Utilisation of Electrical Energy", Dhanpat Rai and Sons, 2017
2. Pillai.S.K "A First Course on Electric Drives", Wiley Eastern Limited, 209
3. Singh. M.D., K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 2006.

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1. https://link.springer.com/book/10.1007/978-3-319-72730-1
2. https://www.routledge.com/Electrical-Machine-Drives-Fundamental-Basics-and Practice/Franchi/p/book/9781138099395

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20ECM02 Digital Electronics

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20ECM02.1	Utilize theory of Boolean algebra & the underlying features of various number systems
20ECM02.2	Choose the concepts of Boolean algebra for the minimization of switchingfunctions
20ECM02.3	Design of various combinational logic circuits using basic gates
20ECM02.4	Design various simple programmable logic devices to complexprogrammable logic devices & arrays
20ECM02.5	Develop of various sequential logic circuits

Unit I: Introduction to Boolean Algebra and Switching Functions — 9 Hours

Conversion from One Radix to Another Radix, r - 1 and r's complement, 4 Bit Codes: BCD, Excess - 3, 2421, 84 – 2 – 1, 9's Compliment Code, Gary Code etc. Realization of logic operations for Basic and Universal gates

Unit II: Boolean Minimization — 9 Hours

Minimization of Logic Functions using Boolean Theorems, Minimization of Switching Functions using K-Map Up to 6 Variables, Quine - McCluskey Method, Standard SOP And POS forms

Unit III: Finite State Machines and Bipolar Logic Families — 9 Hours

Design of synchronous FSMs, Asynchronous FSMs. Bipolar Logic Families (ECL), MOS logic families (NMOS and CMOS) and their electrical behaviour

Unit IV: Memory Elements — 9 Hours

Basic structures and realization of Boolean functions using PROM, PAL, PLA, PLD, CPLD, FPGA, Buffers. Logic Implementation using Programmable Devices (ROM, PLA, FPGA)

Unit V: Elementary Combinational and Sequential Digital Circuits — 9 Hours

Adders, Subtractors, Multiplexer, Demultiplexer, Encoder, Decoder, Comparators, Latches, Flip-flops, Shift registers, Counters

Text Books

1. Taub, H. and Schilling, D., "Digital Integrated Electronics", McGraw Hill, 1977
2. Hodges, D.A. and Jackson, H.G., "Analysis and Design of Digital Integrated Circuits", International Student Edition, McGraw Hill, 1983
3. Hill, F.J. and Peterson, G.L., "Switching Theory and Logic Design", John Wiley, 1981
4. Anand Kumar, A., "Switching Theory and Logic Design", 3rd Edition, Prentice Hall International Learning, 2016

Reference Books

1. Kohavi, Z., "Switching and Finite Automata Theory", McGraw Hill,1970
2. Jain, R.P., "Modern Digital Electronics", 3rdEdition, Tata McGraw Hill, 2003
3. Charles Roth, H. and Larry Kinney, L.Jr., "Fundamentals of Logic Design", 7th Edition, Cengage Learning, 2014

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2. https://nptel.ac.in/courses/117/105/117105080/
3. https://gate.iitkgp.ac.in/gate_syllabus.html
4. https://www.ee.iitb.ac.in/web/academics/courses/EE221

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20AIM02 Machine Learning with Python 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20AIM02.1	Solve simple computational problems with python
20AIM02.2	Identify and use appropriate functions to handle data in python code
20AIM02.3	Describe the foundational concepts and terminologies of machine learning
20AIM02.4	Explain various unsupervised learning algorithms
20AIM02.5	Evaluate the performance of the machine learning algorithm

Unit 1: Basics of Python Programming **9 Hours**

Introduction to Python: evolution, features – Python IDE installation – Syntax –Comments – Variables – Data types – Numbers – Strings – Booleans – Operators – Control statements – Data structures: lists, dictionary, tuples, sets, arrays – Functions

Unit 2: Python modules for ML **9 Hours**

NumPy – Pandas – SciPy – Matplotlib

Unit 3: Introduction to Machine Learning **9 Hours**

Machine Learning essentials: data set, mean, median, mode, standard deviation, percentile, data distribution, normal distribution – Types of learning: supervised, unsupervised – Supervised learning: classification and regression – Classification algorithms: KNN, Naïve Bayes classifier, Decision trees, Linear models, SVM

Unit 4: Unsupervised Learning and Pre-processing **9 Hours**

Types of unsupervised learning – Challenges in unsupervised learning – Pre-processing and Scaling – Dimensionality reduction: Principal Component Analysis – Clustering: k-means, agglomerative, DBSCAN

Unit 5: Data Representation and Model Evaluation **9 Hours**

Categorical variables: one-hot encoding – Binning – Discretization – Automatic feature selection – Model evaluation: cross-validation –Grid search – Evaluation metrics and scoring

Text Books

1. Andreas C. Miller and Sarah Guido, "Introduction to Machine Learning with Python – A guide for Data Scientist", O.Reilly Publisher, 1st edition, 2016
2. Peter Flach, "Machine Learning – The art and science of algorithms that make sense of data", Cambridge Press, 2012
3. Tom Michell, "Machine Learning", McGraw Hill, 2014

Reference Books

1. Peter Harington, "Machine Learning in Action", Cengage Publications, 2012
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2012

Web Resources

1. https://www.tutorialspoint.com/python
2. https://www.w3schools/python

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Board of Studies CSE (AI/ML)

M 20DSM02 Data Management and Analysis 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20DSM02.1	Understand database and be familiar with relational database concepts
20DSM02.2	Demonstrate knowledge of terms, methods of ER Modelling
20DSM02.3	Demonstrate knowledge of trends in data management in Entity Clustering
20DSM02.4	Demonstrate how to acquire, transform, analyse in SQL
20DSM02.5	Demonstrate how to solve problems in accounting using Transactions

Unit I: Database Concepts and Design Concepts **9 Hours**

Why Databases? Data Versus Information, Why Database Design is Important? Evolution of File System Data Processing, Problems with File System Data Processing, Database Systems, Relational Database Model- A Logical View of Data, Keys, Integrity Rules, Relational Algebra, Relationships within the Relational Database, Data Redundancy

Unit II: Entity Relationship (ER) Modeling **9 Hours**

Entities, Attributes, Relationships, Connectivity and Cardinality, Existence Dependence, Relationship Strength, Weak Entities, Relationship Participation, Relationship Degree, Recursive Relationships, Associative Entites, Developing an ER diagram

Unit III: Entity Clustering **9 Hours**

Entity Integrity: Selecting Primary Keys, Natural Keys and Primary Keys, Primary Key guidelines, when to use Composite Primary Keys, when to use Surrogate Primary Keys, Design Cases: Learning Flexible Database Design

Unit IV: Introduction to SQL **9 Hours**

Data Definition Commands, Data Manipulaton Commands, SELECT Queries, Additional Data Definition Commands, Additional SELECT Query Keywords, Creating VIEW, Joining Database Tables

Unit V: Transaction Management and Concurrency Control **9 Hours**

What is Transaction? Concurrency Control, Concurrency Control with Locking Methods, Concurrency Control with Time Stamping Methods, Concurrency Control with Optimistic Methods

Text Books

1. Carlos Coronel and Steven Morris," Database systems: Design, Implementation, & Management", 13th Edition. Cengage Learning. ISBN-13: 978-1337627900, 2019
2. Sholom M. Weiss, Nitin Indurkhya, Tong Zhang, and Fred Damerau, "Text Mining: Predictive Methods for Analyzing Unstructured Information", First Edition. Springer, 2020

Reference Books

1. Hector Garcia-Molina, Jeffrey D. Ullman, and Jennifer Widom, "Database Systems: The Complete Book". 2nd Edition. Pearson, 2001
2. Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining: Concepts and Techniques". 3rd Edition. Elsevier. 2006

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1. https://www.niti.gov.in/verticals/data-management-and-analysis
2. https://searchdatamanagement.techtarget.com/definition/data-management
3. https://nptel.ac.in/courses/110/104/110104094/

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20SHM03 English for the Media

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20SHM03.1	Understand what media literacy is and its importance
20SHM03.2	Introduce the essential requirements of writing for the media
20SHM03.3	Familiarise the learners with the process of writing for the media
20SHM03.4	Make them familiar with the specific use of english in the field of media
20SHM03.5	Generate interest in various aspects of media and thereby equip them with the basic writing skills required for the same

Unit I: Introduction to Media Literacy **9 Hours**

Understand what media literacy is and its importance, analyze and interpret media messages through guided questions, Practice reading strategies to preview a text & skimming and scanning when you read
Practice reading for the main idea, Define and accurately use content - related vocabulary in course activities and games, Apply comprehension strategies as you read, watch, and listen to a variety of texts and multimedia sources Demonstrate your understanding of these texts and key course ideas through comprehension check quizzes and a discussion board response

Unit II: Writing for the Print Media **9 Hours**

Newspaper: Writing headlines – Analysing newspaper articles- Practising interview skills – Planning and writing a newspaper article
Magazine: Composing magazine covers – Planning the contents of a magazine – Giving instructions for a photo shoot – Planning and writing a true life story

Unit III: Writing for Radio, Television and Film **9 Hours**

Radio: Understanding the language of radio presenters – Understanding the production process – Planning a newslist – Giving post production feedback.
Television: Understanding the pre-production process – Organising a filming schedule – Filming on location – Editing a TV documentary
Film: Writing a screenplay – Pitching successfully – Organizing a shoot – Writing a film review

Unit IV: Writing for Advertisements **9 Hours**

Advertisement : Creating a print advert –Creating a screen advert –Presenting a finished advert- Analysing market trends – Setting up a marketing communication strategy – Organising the relaunch of a product – Evaluating the success of a Relaunch

Unit V: Writing for the New Media **9 Hours**

New Media: Briefing a website designer – Analysing problems and providing solutions – Planning and writing a blog – Creating a podcast- Vlogs – Graphic novel [It is suggested for students to follow the different styles of reporting in various media and to familiarize themselves with the emerging trends in the new media]
Core Reading: Ceramella, Nick and Elizabeth Lee. Cambridge English for the Media. CUP, 2008

Text Books

1. Ryan, Michael and James W Tankard. Writing for Print and Digital Media, McGraw-Hill, 2005
2. Allen, Victoria, Karl Davis et. al., Cambridge Technicals Level 3 Digital Media, Hodder, 2016
3. Hayward, Susan. Cinema studies: The Key Concepts, Routledge, 1996

Reference Books

4. Parthasarathy, Rangaswami, Here is the News! Reporting for the Media.Sterling Publications, 1996
5. Axford, Barrie and Richard Huggins. New Media and Politics, Sage, 2001

Web References

1. https://www.google.co.in/books/edition/Designing_New_Media/
2. https://www.google.co.in/books/edition/AS_Media_Studies
3. https://www.google.co.in/books/edition/Social_Media_and_Democracy

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20SHM04 Statistical Inference

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20SHM04.1	Understand the concept of sampling distribution for large and small samples
20SHM04.2	Calculate the estimator of a parameter using point estimation and bias
20SHM04.3	Compare means and variances of two independent or paired samples using interval estimation
20SHM04.4	Understand the framework of hypothesis testing for carrying out statistical inference
20SHM04.5	Carry out the NP tests with due regard to the assumptions underlying these procedures

Unit I: Sampling Distribution — 9 Hours

Population, Samples, Parameter and statistics, Standard error, Sampling distribution of a statistic, Sampling distribution of mean (known and unknown variance) for large and small samples, Sampling distribution of difference of means, Central limit theorem

Unit II: Point Estimation — 9 Hours

Definition of point estimator, General properties of estimators, Uniformly minimum variance unbiased estimators, Sufficient statistics, Factorization theorem, CR Rao inequality, Cramer - Rao lower bound and UMVUE, Methods of finding point estimators by MLestimation, Method of moments

Unit III: Interval Estimation — 9 Hours

Notion of interval estimation, Review of sampling distributions, Confidence Intervals, Confidence interval for the mean (population variance is known and unknown), Confidence interval for the variance (population mean is known and unknown), Confidence interval for the difference between two means

Unit IV: Testing of Hypothesis — 9 Hours

Statistical hypothesis, null and alternative hypothesis, Simple and composite hypotheses,Test of hypothesis, critical region, type I and type II errors and their probabilities, Simple null hypothesis versus simple alternative, Neyman - Pearson lemma, Examples from the normal population, Tests on the mean, Tests on the variance

Unit V: Non-Parametric Methods — 9 Hours

Introduction, assumptions of Npmethods, Advantages and disadvantages,Testing a hypothesis about median, Test for randomness, sign test, Wilcoxon signed rank test

Text Books

1. Gupta Kapoor V. K., " Fundamentals of Mathematical Statistics", Sultan Chand Publications, New Delhi
2. Rao C. R., Linear Statistical Inference and its Applications, Wiley Eastren Publications

Reference Books

6. Richard A.,Gupta C. B. ", Probability and Statistics for Engineers", Miller & Fruend, Pearson's Edtion, 2010
7. Rohatgi V. ,K. Statistical Inference, Dover Publications, 2003
8. Iyengar T. K. V., Krishna Gandhi B., Prasad M. V. S. S. N., "Probability and Statistics", Revised Edition, 2012
9. Wasserman L., "A Concise Course in Statistical Inference", Springer Publications, 2004

Web References

5. https://archive.nptel.ac.in/courses/111/105/111105043/
6. https://onlinecourses.nptel.ac.in/noc20_ma19/preview
7. https://onlinecourses.swayam2.ac.in/cec20_ma01/preview

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20MBM03 Organizational Behaviour 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20MBM03.1	Understand basic concepts of organizational behavior and its nature
20MBM03.2	Understand the basic concepts personality, values and motivation
20MBM03.3	Understand inter personal behavior and its significance
20MBM03.4	Know the group behavior and its dynamics
20MBM03.5	Know about organizational climate, culture and organizational change

Unit I: Introduction 9 Hours

Organisational Behaviour - Concept and Emergence of OB Concept, Nature and Theoretical frameworks, Disciplines contributing to the field of OB, Historical Background - Hawthorne Studies, Psychological foundations

Unit II: Individual Behaviour 9 Hours

Personality, Learning, Values and Attitudes, Perception, Learning-Behaviourist, cognitive and social learning; Stress at work. Motivation -Maslow's Need Hierarchy, Herzberg's Two Factors Theory

Unit III: Inter - Personal Behaviour 9 Hours

Interpersonal communication and Feedback, Transactional Analysis (TA), Johari Window. Managingmis/) behaviour at work, Substance abuse, cyber slacking, Aggression, and Violence

Unit IV: Group Behaviour 9 Hours

Group Dynamics, Cohesiveness and Productivity, Management of Dysfunctional groups, Group Decision Making, Organisational Politics.
Leadership- Concept and Styles, Fielder's Contingency Model. House's Path - Goal Theory, Leadership Effectiveness

Unit V: Organizational Process 9 Hours

Organizational Climate: Concept, Determinants, Organization Culture - Concept, Forming, Sustaining, and Changing a Culture, Organizational effectiveness - concept and measurement. Organizational change - resistance and management.

Note: Discuss case studies from every unit

Text Books

1. Singh B. P. and Chhabra T. N., Management Concepts and Practices, Dhanpat Rai, New Delhi
2. Singh B. P. and Singh A. K., Essentials of Management, Excel Books, New Delhi
3. Dwivedi R. S. Management – An Integrated Approach, National Publishing House

Reference Books

1. Udai Pareek, Organizational Behavior, 3rd Edition, Oxford University Press, 2011
2. Subba Rao P., "Management and Organizational Behavior", 3rd Edition, Himalaya Publishing House, 2017
3. Ghuman, K. and Aswathappa K., Management: Concepts, Practice and Cases, Tata Mc - Graw Hill

Web References

8. https://nptel.ac.in/courses/105/102/105102012/
9. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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MBA **20MBM04 Compensation Management & Employee Welfare Laws** **3 0 0 3**

At the end of the course, students will be able to

Code	Course Outcomes
20MBM04.1	Understand different pay structures and pay levels
20MBM04.2	Know about wage act 1936 and its implications
20MBM04.3	Understand the factors influence the wage fixation
20MBM04.4	Understand the components of bonus act 1965
20MBM04.5	Understand various incentive plans and international compensation concept

Unit I: Compensation Management **9 Hours**

Compensation management process, forms of pay, financial and non - financial compensation. Compensation Strategies, Assessing job values, pay structures, designing pay levels, construction of optimal pay structure. Paying for performance, skills and competence. International pay systems: comparing costs and systems

Unit II: The Payment of Wages Act, 1936 **9 Hours**

Objects, Application, Responsibility for payment of wages, Fixation of wage periods, time - limits, Deduction from wages, Remedies available to worker, Powers of authorities, Penalty for offences

Unit III: The Minimum Wages Act, 1948 **9 Hours**

Objects, application, minimum fair and living wages, determination of minimum wage, taxation of minimum wage, advisory board, remedy to worker for non - payment of minimum wages

Unit IV: The Payment of Bonus Act, 1965 **9 Hours**

Objects, Scope and Application, Definitions, Calculation ofamount payable as Bonus, Eligibility and Disqualifications for Bonus, Minimum & maximum Bonus, Application of Act in Establishment in Public Sector, Bonus linked with Production or Productivity

Unit V: Incentives Incentive Plan **9 Hours**

Individual incentives, pay for performance, compensation of special group Benefits, legally required benefits: Retirement, medical and other benefits, Employee profit sharing, employee stock option, gain sharing International Compensation: Recognizing variation, the social contract, Culture and pay, Preliminary considerations of international compensation

Text Books

1. Belchor, David W., "Compensation Administration", Prentice Hall, Englewood Cliffs. NT.
2. Henderson R. I., Compensation Management in a Knowledge Based World, New Delhi: Pearson Education
3. Milkovich G., Newman J. and Ratnam C. S. V., Compensation, Tata Mc – Graw Hill, Special Indian Edition

Reference Books

1. Armstrong M.& Murlis H., Reward Management: A Hand book of Salary administration, London: Kegan Paul
2. Sharma J. P., An Easy approach to Company and Compensation Laws, New Delhi: Ane Books Pvt. Ltd.
3. Malik P. L., Hand book of Labourer and Industrial Law, Eastern Book Company
4. Government of India Report of the National Commission on Labour Ministry of Labour and Employment, New Delhi. (latest)

Web References

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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MI 20CEM03 Sustainability and Pollution Prevention Practices 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20CEM03.1	Concept of sustainability and its goals
20CEM03.2	Sources and effects of environmental pollution
20CEM03.3	Identify the prevention measures for environmental protection
20CEM03.4	Approach for analysis and assessment of developmental activities and their impacts on environment
20CEM03.5	Objectives and components of environmental management

Unit I: Concept of Sustainability and Development 9 Hours

Sustainability and its goals, Growth and development, Development and environment, Causes for industrialization, Changing life styles, Regulatory aspects of industrialization, Overall impact of industrialization and Urbanization on quality of human life, Global environmental issues

Unit II: Pollution, Monitoring and Control 9 Hours

Definition, types and sources of pollution, Quality standards for air, water, soil; types of pollutants; Methods of monitoring and control of air, water, soil Pollution (Physicochemical and bacteriological sampling and analysis); effects of pollution on plants, animals and Human beings.

Unit III: Measures for Environmental Protection 9 Hours

Formal and informal environmental education, awareness for nature conservation and protection, environmental ethics and morality, conservation of natural habitats, National parks and wild life sanctuaries, role of youth and women, role of NGO's, urban planning and land-use pattern

Unit IV: Environmental Impact Assessment 9 Hours

Definition, significance and scope of impact assessment, Need & objective, types of environmental impacts, methods of environmental impacts, major steps in impact assessment procedure, generalised approach to impact analysis

Unit V : Environmental Management 9 Hours

Objectives and components of environmental management need for training, Environmental Impact Statement and Environment Managemental Plan, Role of remote sensing in environmental management, Sustainable use of natural resources, management of soil, wildlife and its methods, agriculture management, Public participation in resource management

Text Books

1. Lars F. Niklasson, "Improving the Sustainable Development Goals: Strategies and the Governance Challenge", 2009
2. Herman Koren, "Best Practices for Environmental Health: Environmental Pollution, Protection, Quality and Sustainability", 21 April, 2017
3. McCully, P, "Rivers no more: the environmental effects of dams (pp. 29-64)", Zed Books, 1996
4. McNeill, John R, "Something New Under the Sun: An Environmental History of the Twentieth Century", 2000

Reference Books

1. Environmental Chemistry - A.K. De, New Age Int. Pub. Co., New Delhi, 1990
2. Lave, L.B and Upton, "Toxic Chemicals, Health and the Environment", The Hopkins Press Ltd., London, 1987
3. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. "Environmental and Pollution Science. Academic Press", 2011

Web References

1. http://mcic.ca
2. https://www.drishtiias.com
3. https://www.jica.go.jp

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Board of Studies (CE)

MI 20CSM03 Database Security

3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20CSM03.1	Explain the Cossets DBMS
20CSM03.2	Explain the Constrains in Database
20CSM03.3	Describe different Database Schemas
20CSM03.4	Illustrate Desecrate Data Models and Water Marking Processes
20CSM03.5	Explains Geospatial Data Models and Access Methods

Unit I: Database Introduction **9 Hours**

Introduction to Database – Relational Database & Management System, Data Abstraction (Physical Level, Logical Level & View Level) - Multi-level Database, Distributed Database, Database Architecture.

Unit II: Database Securities **9 Hours**

Security issues in Database – Integrity constraints, Access Control (Grant & Revoke Privileges) - Statistical Database, Differential Privacy. Distributed Database Security.

Unit III: Schema Models **9 Hours**

Security in Data Warehouse & OLAP – Introduction, Fact table, Dimensions, Star Schema, Snowflake Schema, Multi-Dimension Range Query, Data Cubes.

Unit IV: Data Mining Introduction **9 Hours**

Data Mining – Introduction - Randomization methods, Data Swapping, Database Watermarking – Basic Watermarking Process - Discrete Data, Multimedia, and Relational Data, Different Data Migration Techniques.

Unit V: Geospatial Database **9 Hours**

Geospatial Database Security – Geospatial data models – Geospatial Authorization, Access Control Models: Geo-RBAC, Geo- LBAC

Text Books

1. Michael Gertz., Sushil Jajodia., "Handbook of Database Security: Applications and Trends", ISBN-10: 0387485325, Springer, 2007
2. Osama S. Faragallah., El-Sayed M. El-Rabaie., Fathi E. Abd El-Samie., Ahmed I. Sallam., Hala S. El-Sayed., "Multilevel Security for Relational Databases", ISBN 978-1-4822- 0539-8, CRC Press, 2014.

Reference Books

1. Bhavani Thuraisingham., "Database and Applications Security: Integrating Information Security and Data Management", CRC Press, Taylor & Francis Group, 2005.
2. Elmasri Navrate., "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2016.
3. Peter Rob., Carlos Coronel., "Database Systems Design, Implementation and Management," Tenth Edition, Pearson Education, 2013

Head of the Department
Dept of Computer & Electronics Engg
Sanjivani College of Engineering, Kopargaon

Web Resources

1. http://www.nptelvidecs.in/2012/11/database-managementsystem.html
2. https://www.ibm.com/in-en/cloud/learn/database-security
3. http://data.conferenceworld.in

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ME 20MEM03 Surface Engineering 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20MEM03.1	Decide the surface preparation methods suitable for different substrate materials.
20MEM03.2	Apply knowledge on properties offered by different Coatings based on the application requirement.
20MEM03.3	Interpret the testing &evaluation of metallic coatings.
20MEM03.4	Explain the effect of process parameters on the properties & microstructure of the surface coating processes.
20MEM03.5	Explain the importance & role of surface modifications to achieve several technological properties.

Unit I: Fundamentals of Surface Engineering **9 Hours**

Introduction to surface engineering, Scope of surface engineering for different engineering materials, Surface Preparation methods such as Chemical, Electrochemical, Mechanical: Sand Blasting, Shot peening, Shot blasting, Hydro-blasting, Vapor Phase Degreasing etc., Coatings: Classification, Properties and applications of Various Coatings

Unit II: Chemical Conversion Coating **9 Hours**

Chromating, Phosphating, and Anodizing, Thermochemical processes: Methodology used, mechanisms, important reactions involved, Process parameters and applications.

Unit III: Coating from Vapor Phase **9 Hours**

PVD, and CVD: Various Methods used, mechanisms, important reactions involved, Process parameters and applications.

Unit IV: Metallic coating **9 Hours**

Hot Dipping, Galvanizing, Electrolytic and Electro less plating: Methodology used, mechanisms, important reactions involved, Process parameters and applications. Testing/ evaluation of metallic coatings.

Unit V: Thermal spray coatings **9 Hours**

Processes, Types of spray guns, Comparison of typical thermal spray processes, Surface Preparation, Finishing Treatment, Coating Structures and Properties, Applications.

Text Books

1. J. R. Davis, "Surface Engineering for Corrosion and Wear Resistance", 1st Edtion, 1997.
2. George J, "Rudzki -Surface Finishing Systems metal and non-metal finishing handbook-guide", 1st Edition, Metals Park: ASM, 1983.
3. James A. Murphy, "Surface Preparation and Finishes for Metal, McGraw-Hill", New York 1971.
4. P. G. Sheasby and R. Pinner, "Surface treatment and finishing of Aluminium and its alloy", 1st Edition, ASM, Metals Park, 1987.

Reference Books

1. Friction Stir Welding and Processing, Rajiv Sharan Mishra, Partha Sarathi De, Nilesh Kumar, International 2006.
2. Friction Stir Welding and Processing, R.S. Mishra and M.W. Mahoney, ASM International, 2007.
3. Advances in Friction-Stir Welding and Processing, M-K Besharati-Givi and P. Asadi, ASM International 2008.

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N.G.N. Polytechnic College
Kanchipuram

Web References

1. www.nptel.iitm.ac.in
2. www.btechguru.com
3. www.ocw.mit.edu
4. www.corrosion-doctors.org

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Board of Studies (ME)

M 20EEM03 Electrical Engineering Material Science 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20EEM03.1	Understand the phenomena of metal conductivity
20EEM03.2	Explain the properties of di-electric properties
20EEM03.3	Understand the magnetic properties of materials
20EEM03.4	Explain the types of semi-conductors
20EEM03.5	Understand the modern techniques used for studying the material science

Unit I: Conductivity of Metal **9 Hours**

Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, Equation of motion of an electron, current carried by electrons, mobility, energy levels of a molecule, emission of electrons from metals, thermionic emission, photo electric emission, field emission, effect of temperature on electrical conductivity of metals, electrical conducting materials

Unit II: Dielectric Properties **9 Hours**

Introduction, effect of a dielectric on the behavior of a capacitor, polarization, the dielectric constant of monatomic gases, frequency dependence of permittivity, dielectric losses, significance of the loss tangent, dipolar relaxation, frequency and temperature dependence of the dielectric constant, dielectric properties of polymeric system,

Unit III: Magnetic Properties of Materials **9 Hours**

Introduction, Classification of magnetic materials, diamagnetism, paramagnetism, ferromagnetism, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials

Unit IV: Semiconductors **9 Hours**

Energy band in solids, conductors, semiconductors and insulators, types of semiconductors, Intrinsic semiconductors, impurity type semiconductor, diffusion, thermal conductivity of semiconductors, electrical conductivity of doped materials

Unit V: Modern Techniques for Materials Studies **9 Hours**

Optical microscopy – Electron microscopy – Photo electron spectroscopy – Atomic absorption spectroscopy – Introduction to Biomaterials and Nanomaterials

Text Books

1. Joseph Le Roy Hayde Proteus Steinmetz, "Radiation, Light and Illumination: A Series of Engineering Lectures Delivered at Union College", BiblioLife, 2019
2. Jack L. Lindsey, "Applied Illumination Engineering", 4th Edition, PHI, 2011
3. John Matthews, "Introduction to the Design and Analysis of Building Electrical Systems", 2nd Edition, Springer, 2013.

Reference Books

1. M.A. Cayless, "Lamps and Lighting", 5th Edition, Routledge, 2016.
2. Leopold Bloch, "Science of Illumination: An Outline Of The Principles Of Artificial Lighting", Kessinger Pub, 2018.

Web References

1. https://nptel.ac.in/courses/108/105/108105060/

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Board of Studies (EEE)

MI 20ECM03 Analog Electronic Circuits 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20ECM03.1	Demonstrate the concept of DC biasing and transistor stabilization leading to the design of amplifiers
20ECM03.2	Classify, analyze types of multistage amplifiers
20ECM03.3	Classify, analyze and design different types of feedback amplifiers and Oscillators
20ECM03.4	Analyze the response of different signals for linear and Nonlinear wave shaping circuits
20ECM03.5	Understand the internal operation of Op-Amp and its Applications

Unit I: Transistor Biasing 9 Hours

Need for biasing, operating point, BJT biasing methods, basic stability, fixed bias, collector to base bias, self-bias, Stabilization against variations in VBE, Ic, and β, Stability factors, (S, S', S'').

Unit II: BJT and Multistage Amplifiers 9 Hours

BJT: Transistor at high frequencies, Hybrid- π common emitter transistor model, Hybrid π conductance, Hybrid π capacitances, Multistage Amplifiers: Classification of amplifiers, methods of coupling, cascaded transistor amplifier.

Unit III: Feedback Amplifiers and Oscillators 9 Hours

Feedback Amplifiers: Feedback principle and concept, types of feedback, classification of feedback amplifiers. Oscillators: Oscillator principle, condition for oscillations, types of oscillators, RC-phase shift and Wien bridge oscillators with BJT, generalized analysis of LC Oscillators, Hartley and Colpitt's oscillators using BJT.

Unit IV: Linear Wave Shaping 9 Hours

Linear wave shaping: High pass, low pass RC circuits, response for sinusoidal, step, pulse, square, ramp and exponential inputs. RC network as differentiator and integrator, Attenuators, Diode clippers.

Unit V: Linear Applications of Op-Amp 9 Hours

Internal Block Diagram of various stages of Op-Amp and Roll of each Stage, Characteristics of Op-Amp, Ideal and Practical Op-Amp specifications, Inverting and Non-inverting amplifier, Integrator and differentiator, Difference amplifier, Instrumentation amplifier.

Text Books

1. Robert, L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits Theory", 10th Edition, Prentice Hall of India, 2009.
2. Millman, J, TaubH, Mothiki Surya Prakash Rao and Millman's, "Pulse Digital and Switching Waveforms", 2nd Edition, Tata McGraw-Hill, 2008.
3. Ramakanth A. Gayakwad, "Op-Amps & Linear ICs", Prentices Hall of India, 1987.

Reference Books

1. Donald A. Neaman, "Electronic Circuit Analysis and Design", 3rd Edition, Tata Mc Graw-Hill, 2010
2. Paul Gray, Hurst, Lewis and Meyer, "Analysis and Design of Analog Integrated Circuits", 4th Edition, John Wiley &Sons, 2005
3. Anand Kumar, A., "Pulse and Digital Circuits", 2nd Edition, Prentice Hall of India, 2005
4. Sanjay Sharma, "Operational Amplifiers & Linear Integrated Circuits", 2nd Edition, S. K. Kataria & Sons, 2010.

Web Resource

1. https://nptel.ac.in/courses/108102112
2. https://www.udemy.com/course/analog-electronics-basic-concepts/

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20AIM03 Interpretable Machine Learning

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At the end of the course, students will be able to

Code	Course Outcomes
20AIM03.1	Introduction to interpretability
20AIM03.2	Different interpretable models
20AIM03.3	Explain the software's for interpretable models.
20AIM03.4	Illustrate plotting of prediction changes.
20AIM03.5	Explains individual predictions of any black box classification model.

Unit I: Introduction **9 Hours**

Importance of Interpretability, Taxonomy of Interpretability Methods, Scope and evaluation of Interpretability, Properties of Explanations, Human-friendly Explanations

Unit II: Interpretable Models-I **9 Hours**

Data Sets-Regression, Text Classification. Interpretable Models -Linear Regression, Logistic Regression, Decision Tree, Decision Rules, Decision Rule Fit

Unit III: Interpretable Models-II **9 Hours**

Generalized Linear Models (GLM) - Non-Gaussian Outcomes, Advantages; Generalized Additive Models (GAM) - Nonlinear Effects, Advantages and software; Other interpretable Models: Naive Bayes Classifier, K-Nearest Neighbors

Unit IV: Model Agnostic Methods **9 Hours**

Partial Dependence Plot (PDP), Accumulated Local Effects (ALE) Plot, Feature Interaction, Functional Decomposition, Permutation Feature Importance, Global Surrogate.

Unit V: Local Model Agnostic Methods **9 Hours**

Individual Conditional Expectation (ICE), Local Surrogate (LIME), Counterfactual Explanations, Scoped Rules (Anchors), Shapley Values.

Text Books

1. "Interpretable Machine Learning, A Guide for Making Black Box Models Explainable", By Christoph Molnar - 2020
2. "Interpretable Machine Learning with Python, Learn to Build Interpretable High-performance Models with Hands-on Real-world", By Serg Masis - 2021

Reference Books

1. "Explainable AI: Interpreting, Explaining and Visualizing Deep Learning", By Andrea Vedaldi, Grégoire Montavon, Klaus-Robert Müller, Lars Kai Hansen, Wojciech Samek,2019.
2. "Interpreting Machine Learning Models, Learn Model Interpretability and Explainability Methods", By Anirban Nandi, Aditya Kumar Pal - 2021

Web References

1. https://christophm.github.io/interpretable-ml-book/index.html
2. https://ai.googleblog.com/2021/12/interpretable-deep-learning-for-time.html
3. https://arxiv.org/abs/2103.10689

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Board of Studies CSE(AI/ML)

MI 20DSM03 Data Governance 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20DSM03.1	Understanding of the role computation can play in solving problems and optimization techniques
20DSM03.2	Understanding the usage of computational techniques.
20DSM03.3	Understanding Stochastic programming and statistical thinking
20DSM03.4	Identify the problem using Monte Carlo simulations
20DSM03.5	Plotting with the pylab package

Unit I: Introduction, Data Literacy and Concepts **9 Hours**

Data is an asset, Data governance and governance, Data management, The governance "V", Solutions Other terms, Some final core concepts

Unit II: Overview: A Day in the life of a Data Governance Program and its Capabilities **9 Hours**

What does it look like? - The scope of data governance and data management, Business model, Content, Development methods -Federation, Elements of data governance programs, Principles, Policies, Metrics, The critical success factors for data governance

Unit III: The Data Governance Business Case **9 Hours**

The business case, Objectives of the business case for data governance, Components of the business case - The big picture (vision), Program risks, Business alignment, Costs of data quality issues, Costs of missed opportunities, Data debt, Obstacles, impacts, and changes, Presentation of the case. The process to build the business case - Fully understand business direction, identify possible opportunities, identify usage opportunities, define business benefits, confirm business benefits, quantify costs. Prepare the business case documentation, Approach considerations

Unit IV: Overview of Data Governance Development and Deployment **9 Hours**

Types of approaches, The data governance delivery framework, Process overview, Engagement, Strategy, Architecture and design, Implementation, Operation, and changes

Unit V: Engagement **9 Hours**

Initiation- Obtain program approval, Develop DG rollout team structure. Definition- Define DG for your organization, identify business units (subject to DG), Identify business capabilities that need data governance (and don't have it). Scope- Define scope and constraints with the initial plan for DG, Approve scope and constraints. Assessment- Information maturity, Change capacity, Data environment

Text Books

1. John Ladley, "Data Governance", Academic Press, Second Edition, 2012.

Reference Books

1. Evren Eryurek, Uri Gilad, "Data Governance: The Definitive Guide", O'Reilly Media, Inc., 2021.

Web Resources

1. https://nptel.ac.in/courses/110/106/110106072/
2. https://nptel.ac.in/courses/110/104/110104094/

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MI 20SHM05 Journalism 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20SHM05.1	Understand the concepts of mass communication in general and journalism in particular
20SHM05.2	Impact fundamentals of journalism, evolutionary process, basics concepts, practices and recent trends
20SHM05.3	Get exposed to different faces of journalism
20SHM05.4	Get trained to develop inquisitive and analytical skills to be successful in media
20SHM05.5	Prepare the report for the representation

Unit I: Introduction **9 Hours**

Journalism: Meaning, Definition Nature, Scope, Functions; Truth, Objectivity, verification, independent monitor, forum for criticism and comment, watch dog role of press and democracy principles of journalism will stop types of journalism: print, broadcast and online

Unit II: Process Control and Capability Analysis **9 Hours**

Mass Media And Development - Early Journalism in the world, India and Karnataka global context Colin rise of advocacy journalism, professionalism, modern journalism and mobile journal journalism. Community journalism, rural journalism, yellow journalism, penny press, tabloid press, and citizen journalism

Unit III: Process-monitoring and Control Techniques **9 Hours**

Journalism as a profession, responsibilities and criticism, do you know any his interest understanding the public taste, press as a tool in social service relationship between press and other mass media

Unit IV: Acceptance Sampling **9 Hours**

Normative theories of press enter relevance to the present day; wire services- Indian and international news agencies

Unit V: Reliability and Life Testing **9 Hours**

Photojournalism- caption writing, photo feature, visual composition- case studies Danish Siddiq, Jimmy Nelson, Margaret Brooke-white, Philip JonesGriffits, Rathika Ramaswami Raghu Rai exercise assignments analysis of daily newspaper in the classroom practice of writing new stories on various topics writing reports on civic problems incorporating information from civil organization based on interviews prepare questions for a specific interview rewriting news stories from newspapers for magazine filing report of more press conferences filing report for an actual press conference practice of writing to wall journal twice a week

Text Books

1. Keval J. Kumar (2001), Mass Communication in India, Jaico Publication, New Delhi
2. Seema Hasan (2010), Mass Communication – Principles and Concepts, CBS Publishers and distributors, New Delhi
3. V S Gupta & Vir Bala Aggarwal (2001), Handbook of Journalism and Mass Communication, Concept Publishing Company, New Delhi

Web References

3. http://wikipedia.org/wiki//media_of_india#cite
4. http://wikipedia.org/wiki//mass%2520_media__of_india#cite
5. http://wikipedia.org/wiki//mass_media_of_india#cite-buzzle

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Chairman
Board of Studies

M 20SHM06 Statistical Quality Control 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20SHM06.1	Identify application of various Statistical quality tools
20SHM06.2	Use control chart techniques for quality improvement
20SHM06.3	planning, establishing, and operating SQC procedures
20SHM06.4	Design a procedure testing incoming batches
20SHM06.5	Carry out reliability testsand perform statistical analysis

Unit I: Introduction **9 Hours**

Quality Improvement in the Modern Business Environment, Modeling Process Quality, Methods and Philosophy of Statistical Process Control

Unit II: Process Control and Capability Analysis **9 Hours**

Control Charts for Variables, Control Charts for Attributes, Process and Measurement System Capability Analysis

Unit III: Process-monitoring and Control Techniques **9 Hours**

Cumulative Sum and Exponentially Weighted Moving Average Control Charts, Univariate Statistical Process Monitoring and Control Techniques

Unit IV: Acceptance Sampling **9 Hours**

Concepts of acceptance sampling, Lot-by-lot acceptance sampling for attributes, Other acceptance sampling techniques

Unit V: Reliability and Life Testing **9 Hours**

Common models and distributions, Estimation of mean life with complete samples, Reliability Estimation, Types of reliability tests

Text Books

1. Montogomery D. C, Introduction to Statistical Quality Control (5th Edition) Wiley eastrenLtd, 2005
2. Gupta.V,Kapoor,V.K Fundamentals of Applied Statistics Sultan Chand Publications, New Delhi

Reference Books

1. Chang D. and Macmillan S. (1992). Statistical Quality Design and Control. Contemporary Concepts and Methods
2. Mahajan M. Statistical Quality Control, Danpatrai & Co Delhi
3. Gupta R.C Statistical quality Control and Quality management,10th Edition, Kanna Publishers, New Delhi

Web References

6. https://www.digimat.in/nptel/courses/video/112107259/L01.html
7. https://freevideolectures.com/course/4539/nptel-operations-management/49
8. https://freevideolectures.com/course/4384/nptel-engineering-metrology/48

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Head of the Department

Chairman
Board of Studies (BS&H)

20MBM05 Entrepreneurship and Business Venture Planning 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20MBM05.1	Know the role of entrepreneurship development in economy
20MBM05.2	Understand the entrepreneurship and creativity
20MBM05.3	Understand the concept of project planning
20MBM05.4	Understand the sources of financing to ventures
20MBM05.5	Know the methods of entrepreneurship training

Unit I: Introduction 9 Hours

Concept of Entrepreneurship, Role of entrepreneurship in economic Development; factors impacting emergence of entrepreneurship, types of entrepreneurs. Characteristic of successful entrepreneurs; Women Entrepreneurs, Social entrepreneurship, Entrepreneurial challenges

Unit II: Entrepreneurship Development 9 Hours

Types of start-ups, Entrepreneurial class Theories, Entrepreneurial training; EDP Programme, Characteristics of entrepreneurial leadership, Components of Entrepreneurial Leadership, Source of innovative ideas, Entrepreneurship and creativity.

Unit III: Project Planning 9 Hours

Concept of Project and classification of Project, Identification, Project Formulation, Project Report, Project Design, Project Appraisal, Profitability Appraisal, Social cost benefit analysis, financial analysis, Developing a Marketing plan-customer analysis, sales analysis, steps in marketing research, Marketing Mix: business plan preparation, elements of a business plan; Business plan failures

Unit IV: Project Financing & Venture Capital 9 Hours

Financing Stages; Sources of Finance; Venture Capital; Criteria for evaluating new-venture proposals; Evaluating the Venture Capital-process; Sources of financing for Indian entrepreneurs.

Unit V: Entrepreneurship Training 9 Hours

Designing appropriate training programmers to inculcate entrepreneurial spirit, significance of entrepreneurial training, training for new and existing entrepreneurs, role of entrepreneurship development institutes, MSMES in providing entrepreneurial training.

Note: Discuss case studies from every unit

Text Books

1. Kumar, Arya and Entrepreneurship: Creating and Leading an Entrepreneurial Organization, Pearson, India.
2. Hishrich, Peters, Entrepreneurship: Starting, Developing and Managing New Enterprise, Irwin.

Reference Books

1. Allen K. R., Launching New Ventures: An Entrepreneurial Approach, Cengage Learning.
2. Rama Chandran K., Entrepreneurship Development, Tata McGraw-Hill, India.
3. Roy, Rajeev, Entrepreneurship, Oxford University Press
4. Vasant, Desai, Small – Scale Industries and Entrepreneurship, Himalya Publication, India

Head of the Department

Web References

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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Chairman
Board of Studies (MBA)

20MBM06 Performance Management and Talent Management 3 0 0 3

At the end of the course, students will be able to

Code	Course Outcomes
20MBM06.1	Know about performance management process
20MBM06.2	Understand the performance management system
20MBM06.3	Understand the issues and challenges in implementation of performance management system
20MBM06.4	Understand the talent management approaches
20MBM06.5	Understand the talent management practices and process of companies

Unit I: Introduction **9 Hours**

Performance management process, Objectives of performance management system; Historical development in India, Performance management and performance appraisal, Linkage of performance management system with other HR practices

Unit II: Performance Management System **9 Hours**

Performance planning, Ongoing support and coaching, Performance measurement and evaluation, Performance management and appraisal; Methods of performance appraisal, Appraisal Communication; Counselling, Identifying potential for development, Linking pay with performance

Unit III: Issues in Performance Management **9 Hours**

Implementing performance management system - Strategies and challenges, Role of HR professionals in performance management, Performance management as an aid to learning and employee empowerment, Performance management documentation, Performance management audit, Ethical and legal issues in performance management

Unit IV: Talent Management **9 Hours**

Concept and approaches, Frame work of talent management, Talent identification, integration and retention

Unit V: Talent Management Practices and Process **9 Hours**

Building the talent pipeline, Managing employee engagement, Key factors and different aspects of talent management, using talent management processes to drive culture of excellence

Note: Discuss case studies from every unit

Text Books

1. Bhattacharyya, D. K., "Performance Management Systems and Strategies", Pearson Education
2. Robert B, "Performance Management", McGraw-Hill Education, India
3. ASTD, "Talent Management: Strategies for success from six leading companies", Cengage Learning

Reference Books

1. Armstrong M, & Baron A, "Performance Management and Development", Jaico Publishing House, Mumbai
2. Rao T. V, "Hurconomics for Talent Management: Making the HRD missionary business – driven", Pearson Education

Web References

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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Chairman
Board of Studies (MBA)

ICC 20ICC01 Competitive Programming

2 0 8 6

Version: 01.00

Duration	240 hours (2 hours theory and 14 hours practical per week) as specified above
Industry Collaborator	M/s. Demy Software Solutions, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC01.1	Understand the basics of Programming	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC01.2	Explain various types of Operators, operations, relations, and techniques in programming	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC01.3	Demonstrate gaming basics	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC01.4	Execute various Operations on Linked lists	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC01.5	Explore various applications of the techniques.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC01.6	Solving various problems of Binary Trees, insertion, deletion and updation.	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Deliverables

WEEK 1 - Introduction- Execution of a program, Decimal - Binary conversion, Ranges of Data Types and constraints, Complexity Analysis of Algorithms, Big-O Notation, Time & Space Analysis and Constraints, Importance of constraints

WEEK 2 - Bit-Manipulation, Bitwise operators, Bit-masking, Modular Arithmetic, Recursion, Thinking Recursively, Recurrence Relations, Sorting Techniques, Two Pointer Technique

WEEK 3 - Binary Search, Applications of Binary Search, Lower Bound & Upper Bound, Finding Frequency, Optimization problems, Hashing, Hashing Techniques, Collision Resolutions, Inbuilt Libraries

WEEK 4 - Maps and Sets, Subarrays and Sub sequences, String matching, Sieve of Eratosthenes, Segmented Sieve, Game Theory, Nims Game, Counting Game

WEEK 5 - Prefix and Suffix concepts, Collecting water, Stacks, Balanced Parentheses, Largest Histogram Area, Queues, Sliding Window Maximum

WEEK 6 - Linked Lists, Various Operations on linked lists, LRU Cache, Cloning Linked list with random pointer, Doubly-linked list

WEEK 7 - Binary Trees, BT and FBT, Traversals, Various operations on Binary Trees, Binary Search Trees, Insertion, Updating and Deletion

WEEK 8 - More Problems on Binary Trees, Iterative Traversals, Least Common Ancestor, Heaps, Quick Select, Running Median, Trie, Introduction and Implementation

Head of the Department

WEEK 9 - Problems on Tries, Maximum XOR pair, Partitioning of string, 1D Dynamic Programming, Approaching DP problem, Problems on Overlapping subproblems, Problems on Optimal Substructure, Longest Increasing Subsequence

WEEK 10 - 2D Dynamic Programming, Compute NCR, Knapsack, Matrix chain multiplication, Graphs, Introduction and Implementation, Dijkstra, Topological sort.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	9 (Nine)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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Chairman
Board of Studies

Head of the Department
Dept of Electrical & Electronics Engg.
N S Raju Institute of Technology Autonomous
Sontyam, Visakhapatnam - 531 173

ICC 20ICC02 Web Technologies – Transferring to Practice

2 0 8 6

Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. Demy Software Solutions, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC02. 1	Learn the basics and application of HTML	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 2	Understand the CSS3 module operation	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 3	Explain JAVA script and its application	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 4	Demonstrate the basics of jQuery	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 5	Study the basics of Bootstrap and its application	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 6	Understand the basics of Angular JS	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Module 1

Introduction HTML, HTML Basics, HTML Elements, HTML5 Semantic, HTML Attributes, HTML Headings, HTML Paragraph, HTML Styles, HTML Formatting, HTML Quotations, HTML Computer Code, HTML Comments & Colours, HTML CSS, Links and Images, HTML Lists, HTML Blocks, HTML Classes, HTML Layout, HTML Responsive, HTML I frames, HTML JavaScript, HTML Head, HTML Entities and URI Code, HTML Symbols and XHTML, HTML Charset and Forms

Module 2

Introduction CSS3, CSS3 Syntax, CSS3 How To, CSS3 Colours, CSS3 Backgrounds, CSS3 Boarders, CSS Padding, CSS Height/Width, CSS3 Gradients, CSS3 Shadows, CSS3 Text, CSS3 Fonts, CSS3 2D Transforms, CSS3 3D Transforms, CSS Links, CSS Lists, CSS Tables, CSS Box Model, CSS Outline, CSS Display, CSS Max-width, CSS Position, CSS Float, CSS Inline-block, CSS Align, CSS Combinators, CSS Pseudo-class, CSS Pseudo-element, CSS Navigation Bar, CSS Dropdowns, CSS Tooltips, CSS3 Images, CSS Attr Selectors, CSS Forms, CSS Counters, CSS3 Animations, CSS3 Buttons, CSS3 Pagination, CSS3 Multiple Columns, CSS3 User Interface, CSS3 Box Sizing, CSS3 Filters, CSS3 Media Queries, CSS3 Responsive

Module 3:

Introduction to JavaScript, Java Script Language Basics, JavaScript Objects, JavaScript Scope, JavaScript Events, JavaScript Strings, JavaScript Numbers, JavaScript Math, JavaScript Arrays, JavaScript Boolean, JavaScript Comparisons, JavaScript Conditions, JavaScript Switch, JavaScript Loops, JavaScript Type Conversion, JavaScript RegExp, JavaScript Errors, JavaScript Debugging, JavaScript Hoisting, JavaScript Strict Mode, JavaScript Functions, JavaScript Objects, JavaScript Forms, JavaScript HTML DOM, JavaScript BOM

Module 4:

Introduction to jQuery, jQuery Syntax, jQuery Selectors, jQuery Events, jQuery Effects, jQuery HTML, jQuery Traversing, jQuery AJAX, jQuery Misc.

Module 5:

Introduction to Bootstrap, Bootstrap Basics, Bootstrap Grids, Bootstrap Themes, Bootstrap CSS, Bootstrap JS

Module 6:

Introduction to AngularJS, AngularJS Expressions, AngularJS Modules, AngularJS Data Binding, AngularJS Scopes, AngularJS Directives & Events, AngularJS Controllers, AngularJS Filters, AngularJS Services, AngularJS HTTP, AngularJS Tables, AngularJS Select, Fetching Data from MySQL, AngularJS Validation, AngularJS API, AngularJS Animations, AngularJS i18n and i10n

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

Head of the Department
Dept.of E... Engg.
N.S. Raju Institute of Technology (Autonomous)
Sontyam, Visakhapatnam - 531 173

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Board of Studies

ICC 20ICC03 Java Spring boot

2 0 8 6

Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. Demy Software Solutions, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC03.1	Understand the JAVA programming.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.2	Execute various methods in JAVA programming	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.3	Study and execute the OOPS concept	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.4	Demonstrate the debugging and testing of units	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.5	Learn the basics of Spring Boot	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.6	Explore the applications of Spring Boot and JAVA	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Java

Introduction to the course, software tools set up, Introduction about programming, Hello World Project and defining the main method. Variables, Starting with out expressions, Primitive data types, byte short, float, char, Boolean, double, casting.

Operators, operands, expressions. If else statement, Bit wise Operator, Ternary operator, Operator precedence and operator challenge. Keywords and expressions, statements white space and Indentation, code blocks, if then else statement.

Methods in Java, final Method. Code problems on JAVA – HACKERRANK. Method Overloading and Over riding, Control flow statements – if else, while do while, Problems on coding – Prime Number, Even Number, Fibonacci series

OOPS concept – classes, constructors and inheritance, composition, encapsulation, polymorphism, Arrays, Java list, Auto boxing and unboxing. Inner and Abstract classes and interfaces, Java Generics, Naming conventions and package, static and final keywords.

Java Collections, Debugging and unit testing, Data Bases. Basic input and output including Java.util, Concurrency in Java, Lambda expression, regular expressions

Spring Boot:

Introduction to Spring Boot – Build a hello world API, Understanding Spring boot project, Auto configuration. Create a Spring boot web application development, overview of spring boot project. Annotations, step by step code and debugging

Introduction to Junits, Mockito. Spring boot deep dive with rest API

Head of the Department
Dept. of Electrical & Electronics Engineering
N.S. Raju Institute of Technology (Autonomous)
Sontyam, Visakhapatnam - 531 173

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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Head of the Department
Dept of Electrical & Electronics Engg

Chairman
Board of Studies

20ICC04 Robotic Process Automation

2 0 8 6

Version: 01.00

Duration	240 hours (2 hours theory and 14 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC04.1	Explore the Robotic Automation Process	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04. 2	Understand the Process Flow and basic inputs and outputs	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04. 3	Demonstrate the functioning of Business Objects	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04. 4	Demonstrate the application of Object Studio attributes	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04. 5	Explain the Case management and additional features	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04. 6	Understand the functioning of Error management	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Module: 1 – Robotic Automation Process Studio

Running a Process, Basic Skills, Process Validation, Decision Stage, Calculation Stage, Data Items

Module: 2 – Process Flow

Decisions, Circular Paths, Controlling Play, Set Next Stage, Breakpoints, Collections and Loops, Layers of Logic, Pages for Organization

Module: 3 – Inputs and outputs

Input Parameters, Stepping and Pages, Data Item Visibility, Data Types, Output Parameters, Start-up Parameters, Control Room, Process Outputs

Module: 4 – Business Objects

Object Studio, Business Objects, BLUE PRISM CONTENT, Action Stage, Inputs and Outputs, The Process Layer

Module: 5 – Object Studio

Creating a Business Object, Application Modeler, Spying Elements, Attributes, Attribute Selection, Launch, Wait, , Timeouts, Terminate, Write, Press, Attach and Detach, Read, Actions, Action Inputs and Outputs, Data Items as Inputs

Module: 6 – Error Management

Exception Handling, Recover and Resume, Throwing Exceptions, Preserving the Current Exception, Exception Bubbling, Exception Blocks, Exception Handling in Practice.

Module: 7 – Case Management

Queue Items Commercial In Confidence, BLUE PRISM CONTENT, Work Queue Configuration, Defer, Attempts, Pause and Resume, Filters Reports

Module: 8 – Additional Features

Safe Stop, Collection Actions, Choice Stage, Logging, Log Viewer, System Manager, Process/Business Object, Grouping, Process and Object References, Export and Import

Module: 9 – Consolidation Exercise

Order System Process

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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Head of the Department
Dept of Electrical & Electronics Engg.
N.S. Raju Institute of Technology
Sontyam, Visakhapatnam

Chairman
Board of Studies

ICC 20ICC05 Information Security and Forensics

2 0 8 6

Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC05. 1	Understand the basic terminology of various servers, networking, security and hacking.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 2	Explore the web applications, testing, debugging, hacking, etc.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 3	Understand the coding techniques	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 4	Demonstrating the usage of tools for testing, hacking, etc.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 5	Execute the code using various algorithms	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 6	Perform various case studies to dive deep.	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Domain 1 – Introduction & Terminology

Global Anonymous: Proxy Server, TOR Browser, VPN, SOCKS, RDP, Psiphon, Surface Web, Deep Web, Dark Web, etc., Terminology about Web, Servers, Systems, Network Programming Languages, Hacking, IT Security, Intro to OWASP Top 10 Vulnerability. Intro to Bug Bounty & Enterprise Security and Risk Management with IT Security Life Cycle, Case Studies of Hacking, IT Security & C Forensics. Phishing + Live Hacking Impact Demonstration

Domain 2 – Hacking to Explore

Web Application Penetration Testing based in OWASP TOP 10 Vulnerabilities with Live Ex. Live Demonstration of SQLi, XSS, CSRF, and other bugs with tools and with Manual Testing. Bug Bounty, Latest CMS Exploitation, Cryptography & Practical Implementation, SSL Vulnerabilities & Live Testing, Mobile Hacking, Sniffing, Virus, Ransomware, Intro to Carding & Luhn algorithm

Domain 3 – Defence in Depth

Secure Code Review & Code Brabbing Techniques, Enterprise Security, Risk Management & Report, Tools & Web Apps Penetration Testing, Hacking Attacks & Case Studies, WAF, Firewall, Honeypots, UTM, Introduction to Security Compliance, Introduction to Mobile Apps Pen testing, Defence for Vulnerabilities

Domain 4 – Hacking Automation

Virtualization, Tools for Penetration Testing & Hacking, Kali Linux & It's Applications with Uses, Cloud Security & It's Fundamentals, SQLMAP, Metasploit, nmap etc, Exploits & Incident Response Analysis, Intro to Exploit Development & Research.

Assessment	
Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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Head of the Department
Dept of Chemistry
N.S.Raju Institute

Chairman
Board of Studies

ICC 20ICC06 Battery System – Design Engineering

2 0 8 6

Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. Vihaan Electrix, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC06. 1	Determine specifications of the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.2	Design the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.3	evaluate each design option based on parameters such as safety, performance and cost	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.4	Testing and validation of the design	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.5	perform safety test to minimize overcharging and overheating	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.6	perform failure mode and effect analysis of the Battery System	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Determining specifications of the Battery system

Electric Vehicle level specifications, EV specifications into Battery System level specifications, Battery potential and load requirement based on Electric Vehicle specification, list various design options / specifications available at each component level of the Battery system, selection of battery system specifications to suit specifications of cells and modules, Battery system circuit based on Battery application, electrical, mechanical or thermal interface requirements, statistical modelling and state diagrams for the battery operations.

Designing the Battery system:

Cross-functional partners to integrate the battery into the final system, designing, building, and testing code to satisfy design requirements, hardware, and software systems for battery protection, charging and gauging, design connections between anode / cathode terminals through use of suitable busbars, simulations of the designed circuit, charging and discharging of the battery in a controlled manner.

Testing and validation of the design:

design areas where checking and testing is essential, requirements for continuous automation test case, correct application for activation, using technologies of traction battery and battery charger.

Performing safety test:

test plans for batteries at the component and system level, safety test to minimize overcharging and overheating.

Performing cycle test:

failure mode and effect analysis (FMEA) of the battery system, SoC for determining electrolyte's specific gravity in each cell

by using hydrometer.

Performing load test:

load testing to remove AMPS from a battery, electrical worst-case (circuit performance), rigorous failure /root cause on battery related problems.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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Head of the Department
Dept. of Electrical & Electronics Engg.
NSRIT

Chairman
Board of Studies

ICC 20ICC07 Block Chain Technology

2 0 8 6

Version: 01.00

Duration	150 hours (2 hours theory and 14 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC07.1	Learn basics of Blockchain	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.2	Understand various Types of Blockchain	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.3	Demonstrate the concepts of Blockchain	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.4	Study the basics of Ethereum	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.5	Learn Solidity	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.6	Implement the Dapp	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Introduction to Blockchain

Definition of Blockchain, History of Blockchain, Explaining Distributed Ledger, Blockchain ecosystem, Explaining Distributed Ledger

Types of Blockchain

Private/Consortium/Permission-less, Public/Permissioned implementation difference, What Blockchain has to offer across Industry? Companies currently using Blockchain, Overview of what we are going to study in this course,

Key Concepts of the Blockchain

Mining -Mining algorithm, Node, peer, and block explanation, Merkle tree and Blockchain, Consensus Mechanisms- proof of work, proof of stake, How Bitcoin Blockchain works? What is Transaction?

Introduction to Ethereum

Ethereum: Blockchain with smart contract, What is Ether? Bitcoin vs Ethereum Blockchain, What is Ethereum wallet? What is Smart Contract? Ethereum clients, Geth Introduction, Setting up Private Blockchain using Geth.

Learn Solidity

Introduction to solidity, Hands on solidity, Understand and implement different use cases, Implement and deploy smart contract on Blockchain.

Implement Dapp

Setting up the environment, Tools to install – Truffle, MetaMask ,Testrpc, Implement and deploy your first Dapp, Different use cases for implementation of Dapp.

Future Scope

Talk about the future of the Blockchain, What is Hyperledger? What is Hash graph? Discussion on current

research on Blockchain, Understand current industry challenges and needs.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC08 Network Administration

2 0 8 6

Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC08.1	Understand the processes of updation, Installation of Operating System.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.2	Understand the mapping of Hardware devices	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.3	Demonstrate the management of group and Computer accounts	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.4	Explain the File System Management	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.5	Study the server administration	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.6	Explore the disaster recovery	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Overview of Networking.

Installing or Upgrading a Network Operating System, Preparing for installation, Installing from different installation mediums, Upgrade process, Identifying setup errors

Managing Hardware Devices

Understanding device drivers and PnP. Adding new devices. Hardware resource settings and driver signing, Hardware profiles

Creating and Managing Accounts

User authentication. User profiles. Creating, managing and troubleshooting user accounts.

Implementing Group and Computer Accounts

Creating group objects. Group types and scopes. Build-in groups. Creating and managing computer accounts.

Managing File Access

Introduction to file systems. Creating and managing shared folders. Managing shared folder permissions. NTFS permissions

Managing Disks and Data Storage

Disk management concepts. Managing partitions and volumes. Fault tolerant disk strategies. Monitoring disk health. Disk utilities.

Advanced File System Management

File and folder attributes. Advanced attributes. Disk quotas The distributed file system.

Implementing and Managing Printers

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N.S. Raju Institute of Engineering & Technology
Sontyam, Visakhapatnam-531173

Installing and sharing printers, Configuring and managing printer resources.

Using Group Policy

Creating and editing group policy objects. Group policy inheritance.

Server Administration

Procedures and standards. Terminal services and remote administration. Delegating administrative authority. Software update services.

Monitoring Server Performance and Disaster Recovery

Task manager, event viewer and performance console. Planning disaster recovery. Backing up data. Automated system recovery.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC09 Product Engineering

2 0 14 9
Version: 01.00

Duration	240 hours (2 hours theory and 14 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC09.1	Understand the basics of Manufacturing Process	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.2	Explain the Manufacturing Design	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.3	Explore various Production Processes	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.4	Demonstrate various Production Machine Operations	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.5	Study the Product monitoring	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.6	Execute the Product Logistics	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Deliverables

Manufacturing Process Overview

Product concepts, Market feasibility, Engineering design, Prototyping, Production, Marketing/sales

Manufacturing Design

Product analysis: Materials, Cost
Production methods: Assembly lines, Work cells, Inventory, Work flow
Quality control: Production monitoring, Product testing

Production Processes

Machine and process overviews: Boring and machining, Presses, Molding/Casting, Welding, Finishing, Assembly
Materials: Applicable types, Cost, Availability

Production Machine Operations

Presses, Molding/Casting, Drilling/Boring, Machining, Welding, Finishing, Advanced Intelligence, Automation, Programmable Logic Controllers

Production Monitoring

Monitoring production processes: Baselines, Environmental control
Quality improvement: Production improvement

Finished Product Logistics

Delivery methods, Delivery options, Customer interaction

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Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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Dept. of Electrical & Electronics Engg.
Nadimpalli Satyanarayana Raju Institute of Technology
Sontyam, Visakhapatnam-531 173

Chairman
Board of Studies

ICC 20ICC10 Machine Learning Engineer

2 0 8 6

Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. Vihaan Electrix, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC10.1	Evaluate the existing Machine Learning (ML) processes	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.2	Analyse large and complex datasets to extract insights and select the appropriate technique to be used	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.3	Develop models to achieve the business objectives	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.4	Analyses the machine learning algorithms that could be used to solve a given problem	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.5	Perform statistical analysis to resolve data set problems	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.6	Train models and optimize their hyper-parameters	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Deliverables

Prepare to Develop Machine Learning (ML) Systems:

Machine Learning (ML) processes, appropriate datasets and data representation methods, large and complex datasets to extract insights, need of retraining the existing machine programs based on objectives, data validation strategies, pre-processing or feature engineering for a given dataset, data augmentation pipelines, models to achieve the business objectives, along with the relevant metrics to track.

Develop and Assist in the Implementation of Machine Learning (ML) Systems:

Machine learning algorithms, Logistic Regression, and Naive Bayes, based on statistical modelling procedures, data cleaning to remove the irrelevant data and ensure its quality and accuracy, data acquisition process, prepare the data by transforming textual and graphical data into numbers for use in the machine learning system, create data pipeline depending on the machine learning application needs Linear Regression, , differences in data distribution, statistical analysis to resolve data set problems, solve complex problems with multi-layered data sets, use data modelling and evaluation strategy to find patterns and predict unseen instances, evaluate and transform data science prototypes.

Perform machine learning tests:

Design machine learning systems/applications and self-running Artificial Intelligence (AI) software to automate predictive models, carry out machine learning tests, interpret the test results and make appropriate adjustments based on test results, carry out research and implement best practices to improve the existing machine learning infrastructure, optimize existing machine learning libraries and frameworks based on testing, create useful information from unstructured data by auto-tagging images and text-to-speech conversions.

Train and retrain models:

Train models and optimize their hyper-parameters, analyses the errors of the model and develop appropriate strategies to rectify them, retrain the existing systems based on new machine learning model, document the machine learning processes as per the organizational policy, follow the latest machine learning developments and technologies.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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N.S.R.I.T.
Sangivalasa, Visakhapatnam-531 162

Chairman
Board of Studies

CC 20ICC11 Data Scientist

2 0 8 6
Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. Vihaan Electrix, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC11. 1	Determine specifications of the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11. 2	Design the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11. 3	evaluate each design option based on parameters such as safety, performance and cost	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11. 4	Testing and validation of the design	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11. 5	perform safety test to minimize overcharging and overheating	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11. 6	perform failure mode and effect analysis of the Battery System	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Determining specifications of the Battery system

Electric Vehicle level specifications, EV specifications into Battery System level specifications, Battery potential and load requirement based on Electric Vehicle specification, list various design options / specifications available at each component level of the Battery system, selection of battery system specifications to suit specifications of cells and modules, Battery system circuit based on Battery application, electrical, mechanical or thermal interface requirements, statistical modelling and state diagrams for the battery operations.

Designing the Battery system:

Cross-functional partners to integrate the battery into the final system, designing, building, and testing code to satisfy design requirements, hardware, and software systems for battery protection, charging and gauging, design connections between anode / cathode terminals through use of suitable busbars, simulations of the designed circuit, charging and discharging of the battery in a controlled manner.

Testing and validation of the design:

design areas where checking and testing is essential, requirements for continuous automation test case, correct application for activation, using technologies of traction battery and battery charger.

Performing safety test:

test plans for batteries at the component and system level, safety test to minimize overcharging and overheating.

Performing cycle test:

failure mode and effect analysis (FMEA) of the battery system, SoC for determining electrolyte's specific gravity in each cell by using hydrometer.

Performing load test:

load testing to remove AMPS from a battery, electrical worst-case (circuit performance), rigorous failure /root cause on battery related problems.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC12 Industrial IOT

2 0 8 6
Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC12.1	Understand the basics of IIOT & IOT	1, 2, 3 & PSO1	3	L1-L3
20ICC12.2	Demonstrate the components of IIOT & IOT	1, 2, 3 & PSO1	3	L1-L3
20ICC12.3	Describe the Communication Technologies of IIoT	1, 2, 3 & PSO1	3	L1-L3
20ICC12.4	Analyze the Visualization and Data Types of IIoT	1, 2, 3 & PSO1	3	L1-L3
20ICC12.5	Describe the methods of Retrieving the data	1, 2, 3 & PSO1	3	L1-L3
20ICC12.6	Explain the Control & Supervisory Level of Automation	1, 2, 3 & PSO1	3	L1-L3

Deliverables

MODULE 1: Introduction & Architecture

Theory

IIoT and connected world, the difference between IoT and IIoT, Architecture of IIoT, IOT node, Challenges of IIOT.

Practice

Introduction to Arduino, ESp8266, Introduction to raspberry Pi.

MODULE 2: IIOT Components

Theory

Fundamentals of Control System, introductions, components, closed loop & open loop system.

Introduction to Sensors (Description and Working principle): Sensor, Types of sensors, working principle of basic Sensors - Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11). Digital switch, Electro Mechanical switches.

Practice

Measurement of temperature & pressure values of the process using raspberry pi/node mcu.

Modules and Sensors Interfacing (IR sensor, Ultrasonic sensors, Soil moisture sensor) using Raspberry pi/node mcu.

Modules and Actuators Interfacing (Relay, Motor, Buzzer) using Raspberry pi/node mcu.

MODULE 3: Communication Technologies of IIoT

Theory

Communication Protocols: IEEE 802.15.4, ZigBee, Z Wave, Bluetooth, BLE, NFC, RFID

Industry standards communication technology (LoRAWAN, OPC UA, MQTT), connecting into existing Modbus and Profibus technology, wireless network communication.

Practice

Demonstration of MQTT communication.

Demonstration of LoRa communication.

MODULE 4: Visualization and Data Types of IIoT

Theory

Front-end EDGE devices, Enterprise data for IIoT, Emerging descriptive data standards for IIoT, Cloud data base, Cloud computing, Fog or Edge computing. Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT.

Practice

Visualization of diverse sensor data using dashboard (part of IoT's 'control panel')

Sending alert message to the user, ways to control and interact with your environment)

MODULE 5: Retrieving Data

Theory

Extraction from Web: Grabbing the content from a web page, Sending data on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M).

Practice

Device control using mobile Apps or through Web pages.

Machine to Machine communication.

MODULE 6: Control & Supervisory Level of Automation

Theory

Programmable logic controller (PLC), Real-time control system, Supervisory Control & Data Acquisition (SCADA). HMI in an automation process, ERP & MES.

Practice

Digital logic gates programming using ladder diagram.

Implementation of Boolean expression using ladder diagram.

Simulation of PLC to understand the process control concept.

MODULE 7: Application of IIOT

Case study: Health monitoring, Iot smart city, Smart irrigation, Robot surveillance.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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