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 permitted based 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)

Electronics and Communication Engineering

Preamble: The curriculum of B. Tech. (Electronics and Communication Engineering) program offered by the Department of Electronics and Communication 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 the 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 is 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 to facilitate the learners to achieve their Professional and Career Accomplishments.

The Vision

To become recognized forerunner in Electronics and Communication Engineering by producing competent and responsible graduates.

The Mission

1. To prepare technically competent graduates by establishing a conducive learner centric academic environment that uses innovative teaching learning processes
2. To create research interests in the graduates by bringing in real time engineering challenges through industry collaborations
3. To make the graduates socially responsible citizens who provide sustainable solutions maintaining ethical and professional standards

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 Electronics and Communication Engineering of NSRIT will

1. Continue to demonstrate the application of domain knowledge in solving real time problems and provide research based sustainable solutions in different specializations of Electronics and Communication Engineering or allied branch of engineering and technology and lead a satisfactory job employment with 21st century skills
2. Continue to involve themselves in life-long learning by enriching his/her competency in the chosen field of interest through professional experience, advanced studies, learning new age skills that demands dynamism for a continued better prospect to accomplish their professional and career goals
3. Continue to demonstrate the skill sets that are very much essential to work successfully for a rewarding career in an interdisciplinary environment

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 behavior 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 Electronics and Communication Engineering of NSRIT will be able to demonstrate the following outcomes in terms knowledge, skill and behavioral 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 analyze 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/Developmentof Solutions)
4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. (Conduct investigations of complex problems)
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. (Modern Tool Usage)
6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. (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 inmultidisciplinary 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. To demonstrate the ability to design and develop complex systems in the areas of next generation Communication Systems, IoT based Embedded Systems, Advanced Signal and Image Processing, latest Semiconductor technologies, RF and Power Systems
2. To demonstrate the ability to solve complex Electronics and Communication Engineering problems using latest hardware and software tools along with analytical skills to contribute touseful, frugal and eco-friendly 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	18.0
ES	Engineering Science	24.0	22.5	24.0
PC	Professional Core	48.0	55.5	54.0
PE	Professional Elective	18.0	15.0	15
OE	Open Elective	18.0	12.0	12
IN	Internship (s), Project & Seminars	15.0	16.5	16.5
SC	Skill Oriented Courses	-	10.0	10
MC	Mandatory Courses	-	-	-
Total no. of credits		160	160	160

Electronics and Communication 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

Semester I

No.	Course Code	Course	POs	Contact Hours L	T[1]	P	C	
01	20HSX01	Communicative English	10	3	0	0	3.0	HS
02	20BSX11	Linear Algebra and Differential Equation	1, 12[2]	3	1	0	3.0	BS
03	20BSX23	Applied Chemistry	1	3	1	0	3.0	BS
04	20ESX02	Programming for Problem Solving using 'C'	1	3	1	0	3.0	ES
05	20ESX05	Basic Electrical and Electronics Engineering	1	3	0	0	3.0	ES
06	20BSX24	Applied Chemistry Lab	1, 4	-	-	3	1.5	BS
07	20HSX02	Communicative English Lab	10	-	-	3	1.5	HS
08	20ESX07	Programming for Problem Solving using 'C' Lab	1	-	-	3	1.5	ES
		Sub-total		15	03	09	19.5	

Semester II

01	20BSX12	Partial Differential Equations and Vector Calculus	1	3	1	0	3.0	BS
02	20BSX33	Applied Physics	1,3	3	1	0	3.0	BS
03	20ESX01	Engineering Drawing	1,5,10	1	0	4	3.0	ES
04	20EE201	Network Analysis & Synthesis	1,3,10,PSO1	3	1	0	3.0	ES
05	20EC201	Principles of Electronics & Communication System	1	3	0	0	3.0	ES
06	20BSX34	Applied Physics Lab	1,4	0	0	3	1.5	BS
07	20EE202	Network Analysis and Electrical Technology Lab	1, 4	-	-	3	1.5	ES
08	20EC202	Electronics Workshop	4	0	0	3	1.5	ES
09	20MCX01	Environmental Science	1	3	0	0	-	MC
		Sub-total		16	03	13	19.5	

Semester III

01	20BSX14	Complex Variables and Transforms	1	3	1	0	3	BS
02	20EC302	Electronic Devices and Circuits	1,2,3, PSO1	3	0	0	3	PC
03	20EC303	Signals and Systems	1,2,PSO2	3	1	0	3	PC
04	20EC304	Random Variables and Stochastic Processes	1,2	3	1	0	3	PC
05	20EC305	Digital System Design	1,2,3,PSO2	3	0	0	3	PC
06	20EC306	Electronic Devices and Circuits Lab	4,9, PSO1	0	0	3	1.5	PC
07	20EC307	Signals and Systems Lab	4,5,9, PSO2	0	0	3	1.5	PC
08	20EC308	Digital System Design Lab	4,9, PSO2	0	0	3	1.5	PC
09	20ECS01	Printed Circuit Board Design	4	1	0	2	2.0	SC
10	20MCX02	Constitution of India[3]	-	2	0	0	0	MC
		Sub-total		18	03	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)

Semester IV

No.	Course Code	Course	POs	Contact Hours L	T	P	C	
01	20HSX03	Managerial Economics & Financial Analysis	11	3	0	0	3.0	HS
02	20EE403	Control Systems	3,PSO1	3	1	0	3.0	ES
03	20EC403	Pulse and Digital Circuits	1,2,3, PSO1	3	0	0	3.0	PC
04	20EC404	Electromagnetic Waves & Transmission lines	1,2,3,7,PSO1	3	1	0	3.0	PC
05	20EC405	Electronic Circuit Analysis	1,2,3, PSO1	3	1	0	3.0	PC
06	20EC406	Pulse and Digital Circuits Lab	4,9,PSO1	0	0	3	1.5	PC
07	20EC407	Electronic Circuit Analysis Lab	4,5,9,PSO1	0	0	3	1.5	PC
08	20EE408	Control Systems Lab	4,PSO1	0	0	3	1.5	ES
09	20ECS02	Basics of Python Programming	1,5	1	0	2	2.0	SC
			Sub-total	16	3	11	21.5	

Semester V

01	20EC501	Analog & Digital Communications	1,2,3,PSO1	3	1	0	3	PC
02	20EC502	Linear & Digital IC Applications	1,2,3,PSO1	3	1	0	3	PC
03	20EC503	Antennas & Wave Propagation	1,2,3,7,PSO1	3	1	0	3	PC
04	-	Professional Elective I	-	3	0	0	3	PE
05	-	Open Elective I	-	3	0	0	3	OE
06	20EC506	Linear & Digital IC Applications Lab	4,5,9,PSO2	0	0	3	1.5	PC
07	20EC507	Analog & Digital Communications Lab	4,5,9,PSO1,2	0	0	3	1.5	PC
08	20ECS03	Fundamentals of Internet of Things	1,2,3,4,9, PSO1	0	0	4	2.0	SC
09	-	Technical Paper Writing[4]	-	-	-	2	-	AC
10	20MCX03	Intellectual Property Rights and Patents[5]	-	2	0	0	0.0	MC
11	-	Summer Internship #1[6] / CSP	4,5,9,10,PSO1	0	0	0	1.5	EX
			Sub-total	17	3	12	21.5	

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

Semester VI

No.	Course Code	Course	POs	Contact Hours L	T	P	C	
01	20EC601	Microwave Engineering	1,2,3,7,PSO1	3	1	0	3.0	PC
02	20EC602	Digital Signal Processing	1,2,3,4,PSO1	3	1	0	3.0	PC
03	20EC603	Microprocessors and Microcontrollers	1,2,3	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	Microprocessors and Microcontrollers Lab	4,5,9,PSO2	0	-	3	1.5	PC
07	20EC607	Digital Signal Processing Lab	4,5,PSO2	0	-	3	1.5	PC
08	20EC608	Microwave and Radiating Systems Lab	4,5,6,PSO1,2	0	-	3	1.5	PC
09	20ECS04	Fundamentals of Machine Learning	1,2,3	1	-	2	2.0	SC
10	20MCX04	Indian Traditional Knowledge[7]	-	2	-	-	-	MC
		Sub-total		18	3	11	21.5	
Semester VII								
01	-	Professional Elective III	-	3	0	0	3	PE
02	-	Professional Elective IV	-	3	0	0	3	PE
03	-	Professional Elective V	-	3	0	0	3	PE
04	-	Open Elective III	-	3	0	0	3	OE
05	-	Open Elective IV	-	3	0	0	3	OE
06	20HSX04	Professional Ethics	8	3	0	0	3	HS
07	20ECS05	Android App Development	1,2,3,5,PSO1	1	0	2	2	SC
08	-	Summer Internship #2[8]	4,5,9,10,PSO1	-	-	-	3	IN
		Sub-total		19	0	2	23.0	
Semester VIII								
01	-	Full Semester Internship#3[9]	5,8,9,10,PSO1	0	0	0	6	IN
02	-	Capstone Project	1-10,PSO1&2	0	0	0	6	CR
		Sub-total		-	-	-	12.0	
		Total Credits					160	

[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

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	20EC001	Computer Hardware Description Language	-	3	0	0	3.0	PE
2	20EC002	Communication Systems	-	3	0	0	3.0	PE
3	20EC003	Artificial Intelligence	-	3	0	0	3.0	PE
4	20EC004	Computer Architecture and Organization	-	3	0	0	3.0	PE
5	20EC005	Advanced Electromagnetic	-	3	0	0	3.0	PE
6	20EC006	Electronic Measurements & Instrumentation	-	3	0	0	3.0	PE
Professional Elective #2								
7	20EC007	VLSI Design	-	3	0	0	3.0	PE
8	20EC008	Wireless Communications and Networks	-	3	0	0	3.0	PE
9	20EC009	Speech Processing	-	3	0	0	3.0	PE
10	20EC010	Computer Networks	-	3	0	0	3.0	PE
11	20EC011	RF Components and Circuit Design	-	3	0	0	3.0	PE
12	20EC012	Bio-Medical Instrumentation	-	3	0	0	3.0	PE
Professional Elective #3								
13	20EC013	Digital VLSI	-	3	0	0	3.0	PE
14	20EC014	Satellite Communications	-	3	0	0	3.0	PE
15	20EC015	Digital Image Processing Techniques	-	3	0	0	3.0	PE
16	20EC016	Embedded System Design	-	3	0	0	3.0	PE
17	20EC017	Smart Antennas	-	3	0	0	3.0	PE
18	20EC018	Process Control Instrumentation	-	3	0	0	3.0	PE
Professional Elective #4								
19	20EC019	Analog VLSI	-	3	0	0	3.0	PE
20	20EC020	Radar Engineering	-	3	0	0	3.0	PE
21	20EC021	Video Processing and Applications	-	3	0	0	3.0	PE
22	20EC022	Embedded Internet of Things	-	3	0	0	3.0	PE
23	20EC023	Micro Electro Mechanical Systems	-	3	0	0	3.0	PE
24	20EC024	Modern Industrial Automation	-	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								
25	20CEO01	Urban Environmental Service	-	3	0	0	3.0	OE
26	20CSO01	Data Structures and Algorithms	-	3	0	0	3.0	OE
27	20AIO01	Machine Learning for Engineers	-	3	0	0	3.0	OE
28	20DSO01	Introduction to Database Management Systems	-	3	0	0	3.0	OE
29	20ECO01	Architectures and Algorithms of IoT	-	3	0	0	3.0	OE
30	20EEO01	Introduction to Renewable Energy Sources	-	3	0	0	3.0	OE
31	20MEO01	Nano Technology	-	3	0	0	3.0	OE
32	20SHO01	Women and Society	-	3	0	0	3.0	OE
Open Elective #2								
33	20CEO02	Ecology, Environment and Resource Management	-	3	0	0	3.0	OE
34	20CSO02	Internet of Things	-	3	0	0	3.0	OE
35	20AIO02	Fundamentals of Deep Learning	-	3	0	0	3.0	OE
36	20DSO02	Introduction to Data Science	-	3	0	0	3.0	OE
37	20ECO02	IoT for Smart Grids	-	3	0	0	3.0	OE
38	20EEO02	Electrical Safety and Management	-	3	0	0	3.0	OE
39	20MEO02	Fundamentals of Automobile Engineering	-	3	0	0	3.0	OE
Open Elective #3								
40	20CEO03	Disaster, Risk Mitigation and Management	-	3	0	0	3.0	OE
41	20CS404	Operating Systems	-	3	0	0	3.0	OE
42	20AIO03	Fundamentals of AI	-	3	0	0	3.0	OE

43	20CSO03	Introduction to Big Data	-	3	0	0	3.0	OE
44	20ECO03	Privacy and Security in IoT	-	3	0	0	3.0	OE
45	20EEO03	Low-cost Automation	-	3	0	0	3.0	OE
46	20MEO03	Industrial Automation	-	3	0	0	3.0	OE
47	20SHO02	Design Innovations	-	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	20ECH01	Low Power VLSI Design	-	4	0	0	4.0	HO
2	20ECH02	DSP Processors and Architectures	-	4	0	0	4.0	HO
3	20ECH03	Information Theory and Coding	-	4	0	0	4.0	HO

Category II

4	20ECH04	Hardware Design using Verilog	-	4	0	0	4.0	HO
5	20ECH05	Advanced Digital Signal Processing	-	4	0	0	4.0	HO
6	20ECH06	Advanced Digital Communications	-	4	0	0	4.0	HO

Category III

7	20ECH07	Design of Digital Integrated Circuits	-	4	0	0	4.0	HO
8	20ECH08	Pattern Recognition	-	4	0	0	4.0	HO
9	20ECH09	Advanced 3G and 4G Mobile Communications	-	4	0	0	4.0	HO

Category IV

10	20ECH10	Simulation and Testing Methods for VLSI Design	-	4	0	0	4.0	HO
11	20ECH11	Digital Signal & Image Processing using MATLAB	-	4	0	0	4.0	HO
12	20ECH12	5G Mobile and Wireless Technology	-	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	Semiconductor Devices and Circuits	-	3	0	0	3.0	MI
6	20AIM01	Fundamentals of Neural Networks	-	3	0	0	3.0	MI
7	20DSM01	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	20SHM06	Journalism	-	3	0	0	3.0	MI
31	20SHM07	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	20ECS01	Printed Circuit Board Design	4	0	0	4	2.0	SC
35	20ECS02	Basics of Python Programming	1,5	0	0	4	2.0	SC
36	20ECS03	Fundamentals of Machine Learning	1,5	0	0	4	2.0	SC
Long Term Skill Oriented Courses (Industry Oriented)[10]								
37	20ICC01	Competitive Programming	-	2	0	8	6.0	ICC
38	20ICC02	Web Technologies – Transfering to Practice	-	2	0	8	6.0	ICC
39	20ICC03	Java and Spring boot	-	2	0	8	6.0	ICC
40	20ICC04	Robotics Process Automation	-	2	0	8	6.0	ICC
41	20ICC05	Information Security and Forensics	-	2	0	8	6.0	ICC
42	20ICC06	Battery System - Design Engineering	-	2	0	8	6.0	ICC
43	20ICC07	Blockchain Technology	-	2	0	8	6.0	ICC
44	20ICC08	Network Administration	-	2	0	8	6.0	ICC
45	20ICC09	Product Engineering	-	2	0	14	9.0	ICC
46	20ICC10	Machine Learning Engineer	-	2	0	8	6.0	ICC
47	20ICC11	Data Scientist	-	2	0	8	6.0	ICC
48	20ICC12	Industrial IOT	-	2	0	8	6.0	ICC

List of Honors offered by Electronics & Communication Engineering Program

1. VLSI System Design
2. Digital Signal & Image Processing
3. Advanced Communication Systems

List of Minor with Specialization offered by Electronics & Communication Engineering Program

1. Semiconductor Devices and Circuits
2. Digital Electronics
3. Analog Electronics Circuits

List of Minor's offered by the Freshman Engineering and Management studies such as

1. Liberal Arts
2. Statistics
3. General Management
4. Human Resource Management these will be implemented for the 2021 admitted students

[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 20BSX14 Complex Variables and Transforms 3 1 0 3

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

Code	Course Outcomes	Mapping with POs PO1	DoK
20BSX14.1	Apply C-R equations to complex functions to determine whether a given continuous function is analytic and find the integration of complex functions used in engineering problems	3	L1, L2, L3
20BSX14.2	Apply Cauchy residue theorem to evaluate certain integrals used in engineering problems	3	L1, L2, L3
20BSX14.3	Find Fourier series for certain functions used in engineering problems	3	L1, L2, L3
20BSX14.4	Apply the Laplace transform to solve ordinary differential equations with initial conditions.	3	L1, L2, L3
20BSX14.5	Solve engineering problems using Fourier transforms	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

Unit I: Functions of a Complex Variable and Complex Integration 11+1 Hours

Functions of a Complex Variable: Introduction– Differentiability – Analyticity – Properties – Cauchy - Riemann Equations in Cartesian and Polar Coordinates – Harmonic and Conjugate Harmonic Functions – Milne – Thompson Method.

Complex Integration: Line Integral – Cauchy's Integral Theorem – Cauchy's Integral Formula – Generalized Integral Formula (All Theorems Without Proofs).

Applications: Velocity Potential

Unit II: Series Expansions and Residue Theorem (All Theorems Without Proof) 11+1 Hours

Radius of Convergence – Expansion of Functions in Taylor's series- Maclaurin's Series and Laurent Series. Types of Singularities: Isolated – Pole of Order m – Essential – Residues – Residue Theorem.

Residue Theorem

Unit III: Fourier Series 11+1 Hours

Introduction - Periodic Functions – Dirichlet's Conditions – Even and Odd Functions -Fourier Series –Change of Interval - Half - Range Sine and Cosine Series.

Parseval's Formula

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.

Text Books

1. Grewal B. S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2018
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", 22nd Edition, Lakshmi Publications, 2018
3. Peter o'Neil, "Advanced Engineering Mathematics" 8th Edition, Cengage Publications, 2017
4. Dr. Iyenger T. K. V., Dr. Prasad, M. V. S. S. N., Ranganatham S. and Dr. Krishna Gandhi B., "EngineeringMathematics III", 2nd Edition, S. Chand Publications, 2020

Web References

1. https://nptel.ac.in/courses/111/103/111103070/
2. https://nptel.ac.in/courses/111/106/111106139/
3. https://nptel.ac.in/courses/111/102/111102129/
4. https://www.youtube.com/watch?v=LGxE_yZYigI

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

1. State Continuity of Complex function
2. Define Analytic function
3. Write Cauchy – Riemann's equations
4. Write types of Singularities
5. Define Pole and Residue

L2: Understand

6. Show that $f(z) = 2xy + i(x^2 - y^2)$ is analytic.
7. Show that the function $f(z) = z\bar{z}$ is differentiable but not analytic at $z = 0$.
8. Find the poles and Residues at each poles of $\frac{2z+1}{1-z^4}$
9. Expand f(x) =x as a Fourier series formula for f(x) in the interval (−,)
10. Using Convolution theorem, find $L^{-1}\left\{\frac{s^2}{(s^2+a^2)(s^2+b^2)}\right\}$

L3: Apply

11. Using Laplace Transform evaluate $\int_0^\infty \frac{\sin 2t}{t}\,dt$
12. Using Laplace Transform, Solve $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 5y = e^{-t}\sin t$ given that $y(0)=0, y'(0)=1$.
13. Find the Fourier transform of $f(x) = e^{-|x|}$ and hence deduce that $\int_0^\infty \frac{\cos st}{1+t^2}dt = \frac{\pi}{2}e^{-|s|}$.
14. Find the Fourier sine and cosine transform of $f(x) = \frac{e^{-ax}}{x}$ and deduce that $\int_0^\infty \frac{e^{-ax}-e^{-bx}}{x}\sin sx\,dx = \tan^{-1}\frac{s}{a} - \tan^{-1}\frac{s}{b}$
15. Apply Taylor's series to expansion of $\frac{1}{z^2+z-6}$ about $z = -1$

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Chairman Board of Studies(Mathematics)

PC 20EC302 Electronic Devices and Circuits 3 0 0 3

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

Code	Course Outcomes	Mapping with POs PO1	PO2	PO3	PSO1	DoK
20EC302.1	Explain the operation and characteristics of PN junction diode and special diodes	2	-	-	3	L1, L2
20EC302.2	Classify, Analyze and design different types of rectifiers	1	2	3	3	L2-L4
20EC302.3	Compute the flow of current in different configurations of the transistor	1	2	-	3	L1, L2
20EC302.4	Demonstrate the concept of DC biasing and transistor stabilization leading to the design of amplifiers	1	2	3	3	L2 – L4
20EC302.5	Design small signal low frequency transistoramplifiers	1	1	3	3	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: 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 wave forms 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 V_{BE}, I_C, 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

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

Reference Books

1. Salivahanan S, Suresh Kumar and 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 and C. Halkias, "Integrated Electronics", 2nd Edition, Tata Mc-Graw Hill, 2009
4. B.P. Singh 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	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

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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Chairman
Board of Studies (ECE)

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	PSO2	
20EC303.1	Define the mathematical model of continuous /discrete time signals and systems	2	3	3	L1, L2
20EC303.2	Determine and Analyze the output response of LTI systems	2	3	3	L1 - L3
20EC303.3	Derive the frequency domain representation of signals and systems	2	3	3	L2 - L4
20EC303.4	Analyze the characteristics of linear time invariant systems	2	3	3	L2 - L4
20EC303.5	Determine the output response of continuous time/ discrete time LTI systems	2	3	3	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

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?

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 $x(t) = e^{-3t}[u(t) - u(t-5)]$
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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Chairman
Board of Studies (ECE)

PC 20EC304 Random Variables and Stochastic Processes 3 1 0 3

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

Code	Course Outcomes	Mapping with POs PO1	PO2	DoK
20EC304.1	Understand the Formulation of Probability Theory & Random Variables	3	3	L1, L2
20EC304.2	Apply the Probability Models and function of Random Variables based on single variables	1	3	L2, L3
20EC304.3	Apply Probability models and function ofRandom Variables based on multiple random variables	1	3	L2, L3
20EC304.4	Determine the Spectral and temporal characteristics of Random Signals	1	3	L2 - L4
20EC304.5	Analyze the power spectral density of linearsystems for different noises	1	3	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: Probability & Random Variable 9+3 Hours

Probability introduced through sets and relative frequency: Experiments and sample spaces, Discrete and continuous sample spaces, Events, Probability definitions and axioms, Joint probability, Conditional probability, Total probability, Bay's theorem, Random variable- Definition, Conditions for a function to be a random variable, Discrete, Continuous and mixed random variable, Distribution and density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Methods of defining conditioning event, Conditional distribution, Conditional density and their properties.

Bernoulli trails independent events

Unit II: Operations On Single Variables - Expectations 9+3 Hours

Expected value of a random variable, Function of a random variable, Moments about the origin, Central moments, Variance and skew, Chebychev's inequality, Characteristic function, Moment generating function, Transformations of a random variable: Monotonic and non-monotonic transformations of continuous random variable, Transformation of a discrete random variable.

Markov inequality, Chernoff's inequality

Unit III: Multiple Random Variables 9+3 Hours

Vector random variables, Joint distribution function and its properties, Marginal distribution functions, Conditional distribution and density – Point conditioning, Conditional distribution and density – Interval conditioning, Statistical independence. random variables: Sum of two random variables, Sum of several random variables, Central limit theorem, (proof not expected). Unequal distribution, Equal distributions.

Operations on multiple random variables: Expected value of a function of random variables: Joint moments about the origin,Joint central moments, Joint characteristic functions, and Jointly gaussian random variables: Two random variables case, N random variable case, Properties, transformations of multiple random variables, Linear transformations of gaussian random variables.

Probability mass function, Conditional gaussian functions

Unit IV : Random Processes – Temporal Characteristics 9+3 Hours

The random process concept, Classification of processes, Deterministic and nondeterministic processes, Distribution and density functions, Concept of stationarity and statistical independence. First-order stationary processes, Second-order and wide-sense stationarity, Nth-order and strict-sense stationarity, Time averages and ergodicity, Autocorrelation function and its properties, Cross-correlation function and its properties, Covariance functions, Gaussian random processes, Poisson random process.

Spectral characteristics: The power density spectrum: Properties, Relationship between power density spectrum and autocorrelation function. The cross-power density spectrum, Properties, Relationship between cross-power density spectrum and cross-correlation function.

Independent random processes

Unit V : Linear Systems With Random Inputs **9+3 Hours**

Random signal response of linear systems: system response – Convolution, Mean and mean-squared value of system response, Autocorrelation function of response, Cross-correlation functions of input and output, Spectral characteristics of system response: Power density spectrum of response, Cross-power density spectra of input and output, band pass, Band-limited and narrowband processes, Properties, Modelling of noise sources: Resistive (thermal) noise source, Arbitrary noise sources, Effective noise temperature, Average noise figure, Average noise figure of cascaded networks.

Noise, Classification of noise

Textbooks

1. Peyton Z. Peebles, Probability, "Random Variables & Random Signal Principles", 4th Edition, Tata McGraw-Hill, 2001
2. Athanasios Papoulis and S.Unnikrisha, "Probability, Random Variables and Stochastic Processes", 4th Edition, Prentice Hall of India, 2002
3. Y.Mallikarjuna Reddy, "Probability theory and Stochastic processes", 4th Edition, Universities Press, 2013

Reference Books

1. B.P.Lathi, "An Introduction to Random Signals and Communication Theory", 1st Edition, Telesis business solutions Book Service Ltd, 1968
2. Henry Stark and John W. Woods, "Probability and Random Processes with Applications to Signal Processing", 3rd Edition, Pearson Education, 2002
3. P. Ramesh Babu, "Probability Theory and Random Processes", 1st Edition, McGraw Hill, 2015
4. B. Prabhakara Rao, "Probability Theory and Stochastic Processes", 1st Edition, Bright Sky Publications, 2014

Web Resources

1. http://www.nptelvideos.in/search?q=probability
2. http://www.nptelvideos.in/search?q=properties

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

1. Define Probability
2. What are the conditions for a function to be a random variable?
3. List the properties of conditional density functions
4. Define a random variable
5. When two random processes X (t)& Y(t) are said to be independent
6. Define a sample space
7. In the experiment of tossing a dice, what is the probability of face having 3 dots or 6 dots to appear
8. Define baye's theorem
9. Show that P (A∪B)=P(A)+P(B)-P(A∩B)
10. Define probability distribution function

L2: Understand

1. Show that $Var(kX)=k^2\, var(X)$, here k is a constant
2. Explain how probability can be considered as relative frequency
3. Prove that sum of two statistically independent random variables is equal to the convolution of their individual density functions
   Explain total probability theorem and baye's theorem with properties
4. Explain density function with four properties
5. If X and Y are two independent random variables, then $\phi_{X+Y}(\omega) = \phi_X(\omega)\phi_Y(\omega)$
6. Explain briefly about time average and Ergodicity
7. A man matches coin flips with a friend. He wins 2 Rs if coins match and loses 2 Rs if they do not match. Sketch a sample space showing possible outcomes for this experiment and illustrate how the points map onto the real line x that defines the values of the random variable X="dollars won on a trial". Show a second mapping for a random variable Y="dollars won by the friend on a trial
8. Explain how random processes are classified with neat sketches
9. A random processes $X(t)= A\sin(wt+\theta)$, where A , w are constants and θ is a uniformly distributed random variable on the interval (-π ,π) .find average power?
10. For the binomial density function, show that E[X] = Np and variance = Np(1-p)

L3: Apply

1. Given $\bar{x}=6$ and $R_{XX}(t,t+\tau)= 36+25\exp(-\tau)$ for a random process X(t) .indicate which of the following statements are true based on what is known with certainty: X(t). (i). is first order stationary (ii) has total average power of 61W
2. State and prove any four properties of cross covariance function
3. The joint characteristic function of two random variables is given by $\phi_{XY}(\omega_1, \omega_2) = \exp(-\omega_1^2 - 4\omega_2^2)$. Check whether X and Y are uncorrelated or not. b) X and Y are statistically independent random variables and W = X+Y obtain the pdf of W
4. Consider the random process $x(t)=A\cos(\omega_0 t+\theta)$ where A and ω_0 are real constants and θ is a uniformly distributed on the interval $(0, \frac{\pi}{2})$. Find the average power of X(t)
5. Let Y=2X+3. If the random variable is uniformly distributed over [-1, 2], determine $f_Y(y)$
6. If X and Y are independent then show that E[X, Y] = E[X] E[Y]
7. Let X and Y be defined by X = cos (θ) and Y = sin (θ) where θ is a random variable uniformly distributed over (0, 2π). Show that X and Y are not independent
8. State and explain the properties of joint density function
9. The joint p.d.f of a bi-variate (X, Y) is given by $f_{XY}(x, y) = kxy,\ \ 0 < x < y < 1$ where K is constant.
   (i) Find the value of K (ii) X and Y are independent

L4: Analyze

1. List the properties of of convolution
2. Derive the relationship between power spectral density and autocorrelation function
3. The power Spectral density of X (t) is given by $S_{XX}(w)=1+w2$ for w>0 Find the autocorrelation function
4. Derive the expression for effective noise temperature of cascaded system in terms of its individual input noise temperature
5. Let the auto correlation function of a certain random process X (t) be given by $R_X(\tau) = (A^2/2)(\cos(\omega\tau))$ Obtain an expression for its power spectral density $S_X(\omega)$
6. Derive the Wiener- Khintchine relationship
7. A wide sense stationary process X (t) has autocorrelation function $R_X(\tau) = Ae^{-b|\tau|}$ where b > 0. Derive the powerspectral density function
8. The power Spectral density of X(t) is given by $S_{xx}(w)=1/1+W^2$ for w>0 Find the autocorrelation function
9. Derive the relation between input PSD and output PSD of an LTI system

10. Derive the expression for average cross power between two random process X(t) and Y(t)

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Chairman
Board of Studies (ECE)

PC 20EC305 Digital System Design 3 0 0 3

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

Code	Course Outcomes	Mapping with Pos PO1	PO2	PO3	PSO2	DoK
20EC305.1	Understand the number systems and its logical operations	3	1	2	3	L1, L2
20EC305.2	Apply the properties of Boolean theorems forreducing the logical functions	3	2	1	3	L2, L3
20EC305.3	Classify and Design simple combinational logic circuits using logic gates and Design various programmable logic devices	3	2	2	3	L2, L3, L4
20EC305.4	Design various Registers and Counters using Flip-Flops and Analyze various Sequential Logic Circuits	3	2	2	3	L2, L3, L4
20EC305.5	Learn the IEEE standard Hardware Description Language	2	1	3	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).

12 Hours

UNIT -IV: Sequential Logic Circuits & Finite State Machines

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

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?
4. Name any two functions of encoders
5. What is Flip flop?
6. Define a finite state machine
7. List the three differences between Synchronous and asynchronous counter
8. What is mean by weighted code?
9. Define VHDL

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
4. Explain binary adder
5. Show the logic diagram of SR flip-flop with four NOR gate
6. Explain the operation of D-flip-flop
7. What are the elements of the VHDL

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
4. Solve the following Boolean functions, using four-variable maps: F(w, x, y, z) = $\sum$ (1, 4, 5, 6, 12, 14, 15)
5. Develop 4-bit ring counter using D flip-flop
6. Write the VHDL program for Universal Gates

L4: Analyze

1. Distinguish combinational logic circuits and sequential logic circuits
2. Compare mealy and Moore machine
3. Classify the counters
4. Analyze the characteristics of counters and registers
5. List out the statements of Boolean Theorems

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Board of Studies (ECE)

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		
		PO1	PO4	PSO1
20EC306.1	Identify and Demonstrate different semiconductor devices andmeasuring instruments	3	3	3
20EC306.2	Experiment with the semiconductor devices and observe the characteristics	3	3	3
20EC306.3	Design and analyze different types of rectifier circuits usingPN Junction Diodes and interpret the results	3	3	3
20EC306.4	Summarize the characteristics of BJT and FET	3	3	3
20EC306.5	Design different amplifiers and evaluate their frequencyresponses	3	3	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 CommunicationEngineering, NSRIT

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Board of Studies (ECE)

PCC 20EC307 Signals and Systems Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs			
		PO4	PO5	PO5	PSO2
20EC307.1	Understand the fundamental concept of signals using MAT Lab	2	1	2	1
20EC307.2	Find the frequency spectrum of periodic and aperiodic signals	2	1	2	2
20EC307.3	Develop a program for generation of discrete signals	3	1	2	2
20EC307.4	compare the performance of 1st order low pass and high pass filters	3	2	2	2
20EC307.5	Examine the operations on random sequences or random signals	3	2	2	2

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

List of Experiments

1. Write a program to generate the discrete sequences (i) unit step (ii) unit impulse (iii) ramp (iv) periodic sinusoidal sequences. Plot all the sequences
2. Find the Fourier transforms of a square pulse .Plot its amplitude and phase spectrum
3. Write a program to convolve two discrete time sequences. Plot all the sequences. Verify the result by analytical calculation
4. Write a program to find the trigonometric Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings
5. Write a program to find the trigonometric and exponential fourier series coefficients of a periodic rectangular signal. Plot the discrete spectrum of the signal
6. Generate a discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal
7. The signal x(t) is defined as below. The signal is sampled at a sampling rate of 1000 samples per second.Find the power content and power spectral density for this signal. X(t) = cos (2pi * 47t)+ cos(2pi* 219t), 0 < t < 10 X(t) = 0, otherwise
8. Write a program to find the magnitude and phase response of first order low pass and high pass filter. Plot the responses in logarithmic scale
9. Write a program to find the response of a low pass filter and high pass filter, when a speech signal is passed through these filters
10. Write a program to find the autocorrelation and cross correlation of sequences
11. Generate a uniformly distributed length 1000 random sequence in the range (0,1). Plot the histogram and the probability function for the sequence. Compute the mean and variance of the random signal
12. Generate a Gaussian distributed length 1000 random sequence . Compute the mean and variance of the random signal by a suitable method
13. Write a program to generate a random sinusoidal signal and plot four possible realizations of the random signal
14. Generate a discrete time sequence of N=1000 i.i.d uniformly distributed random numbers in the interval (-0.5,-0.5) and compute the autocorrelation of the sequence
15. Obtain and plot the power spectrum of the output process when a white random process is passed through a filter with specific impulse response

References

1. Lab Manual for Electronic Circuit Analysis Lab, Department of Electronics and Communication Engineering, NSRIT

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Board of Studies (ECE)

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	PO9	PSO1
20EC308.1	Identify and Verify the Logic Gates	3	2	1
20EC308.2	Design and Verify the Various Combinational Logic Circuits usingBasic Logic Gates	3	2	1
20EC308.3	Design Registers and Counters using Flip-Flops	3	2	2
20EC308.4	Develop Various Sequential Logic Circuits	3	2	3
20EC308.5	Simulate and Verify the Combinational and Sequential Logic Circuits	3	2	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 CommunicationEngineering, NSRIT

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Board of Studies (ECE)

SO 20ECS01 Printed Circuit Board Design 1 0 2 2

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

Code	Course Outcomes	Mapping with POs PO4
20ECS01.1	Understand basics of PCB designing	3
20ECS01.2	Apply advance techniques, skills and modern tools fordesigning and fabrication of PCBs	3
20ECS01.3	Apply the knowledge and techniques to fabricate Multilayer,SMT and HDI PCB	3
20ECS01.4	Understand concepts of Packaging	3
20ECS01.5	Test the Designed and fabricated PCB	3

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

List of Experiments

1. Introduction to PCB design, EDA tools and process of fabrication.
2. Develop a RLC schematic circuit using EDA tools(PROTEUS, ORCAD, and EAGLE).
3. Fabricate a RLC circuit on a PCB using Etching process.
4. Develop a LED's connected in Series and Parallel schematic circuit using EDA tools(PROTEUS,ORCAD, and EAGLE).
5. Fabricate a LED's connected in Series and Parallel circuit on a PCB using Etching process.
6. Develop a Transistor Amplifier (CE mode) schematic circuit using EDA tools(PROTEUS, ORCAD and EAGLE).
7. Fabricate a Transistor Amplifier (CE mode) circuit on a PCB using Etching process.
8. Develop a Rectifier schematic circuit using EDA tools(PROTEUS, ORCAD, and EAGLE).
9. Fabricate a Rectifier circuit on a PCB using Etching process.
10. Develop your own schematic of by using EDA tools(PROTEUS, ORCAD, and EAGLE) andfabricate the same circuit.

Textbooks

1. R. S. Khandpur, "Printed circuit board design, fabrication assembly and testing", Tata McGraw Hill 2006.

References

1. Lab Manual for Printed Circuit Board Design of Electronics and Communication Engineering,NSRIT.
2. Walter C. Bosshart , "Printed circuit Board Design and technology", Tata McGraw-Hill, 2008.
3. Clyde F. Coombs, Jr, Happy T, "Printed Circuits Handbook", McGraw-Hill Education Sixth Edition, 2016.
4. Rao R Tummala & Madhavan Swaminathan, b, "Introduction to System-on-Package", McGraw Hill, 2008.

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Board of Studies (ECE)

20MCX02 Constitution of India

2 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	Summarizing 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 themaking 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 AmbedkarDebate 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 Mehela 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 UniversityPress, 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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Board of Studies (BS & H)

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

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 makedecisions 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 to prepare final Accounts	3	1	L1,L2
20HSX03.4	Apply Financial planning techniques to make successful longterminvestment decisions.	3	1	L3,L4
20HSX03.5	Apply accounting concepts to analyze financial strength of business	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

Unit1: Introduction to Managerial Economics and Demand Analysis9 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 VariableProportion), 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 Final Accounts 9Hours

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.
Branches of Accounting

Unit IV: Introduction to CapitalPlanning 9 Hours

Concept of Capital – Types of Capital - Capital Budgeting -: Meaning of Capital-Capitalization-Meaning of Capital Budgeting- Time Value of Money-Methods of Appraising Project Profitability - Traditional Methods and Modern Methods.

Concept of Working Capital

Unit V: Financial Analysis through ratios 9 Hours

Computation, Analysis and Interpretation of Liquidity Ratios (CurrentRatio and Quick Ratio), Activity Ratios (Inventory Turnover Ratio and Debtor Turnover Ratio), Capital StructureRatios (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)

Text Books

1. AppaRao 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 PublishingHouse, 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. Varshita 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, OxfordUniversity 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 LevelsL1: 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
   Gross Profit Rs.40000 — Selling expences 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.95000
   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 Yearscalucalte 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 forthe project
3. A firm is considering two different investment options A & B detailes of both the options are given below (Rs,inLakhs)

	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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Chairman
Board of Studies (MBA)

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 blockdiagram algebra and signal flow graphs.	-	3	L1-L3
20EE403.2	Examine the time responses of various systems for variousinput standard signals.	-	3	L1-L4
20EE403.3	Demonstrate the stability of a system using Time DomainTechniques.	2	1	L1-L4
20EE403.4	Illustrate the Stability of a system using Frequency DomainTechniques.	3	1	L1-L4
20EE403.5	Apply the state space modelling for solving problemsrelated 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 - synchro, transmitter and receiver - block diagram algebra - representation by signal flow graph – 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 and error (static and dynamic) constants, P, PI, and PID controllers.

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

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, design of compensators using Bode plots.

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

Textbooks:

1. Nagarath I.J. and .Gopal M, "Control Systems Engineering", 2nd Edition, New age InternationalPublications, ,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 LevelsL1: 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?

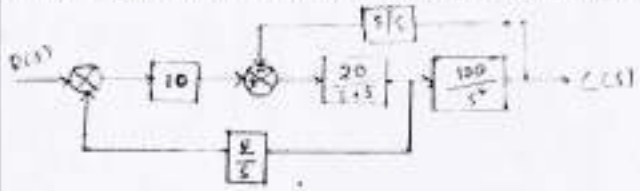
L3: Apply

1. The characteristic polynomial of a system is $s^5+2s^4+3s^3+s^4+5s^3+2s^2+s+7=0$. 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

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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Chairman
Board of Studies (EEE)

PC 20EC403 Pulse and Digital Circuits 3 0 0 3

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

Code	Course Outcomes	Mapping with POs PO1	PO2	PO3	PSO1	DoK
20EC403.1	Classify and Analyze the response of different signals for linear and Non linear wave shapingcircuits	3	3	2	1	L1,L2, L4
20EC403.2	Design Bistable Multivibrator by understandingthe switching characteristics of diode and transistor	3	3	3	2	L2, L4
20EC403.3	Analyze and Design Monostable and Astable Multivibrator	3	3	3	2	L2, L4
20EC403.4	Illustrate the working of voltage time base generators for generation of sweep waveforms	3	3	3	2	L1, L2
20EC403.5	Interpret the construction and operation of logicgates and sampling gates using diodes and transistors	3	2	2	2	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: Linear and Non-Linear Wave Shaping 12 Hours

Linear Wave Shaping: High pass, low pass RC circuits,Their response for sinusoidal, Step, Pulse, Square, Ramp and Exponential inputs. RC network as differentiator and integrator; Attenuators , its applications in CRO probe, RL and RLC circuits and their response for step input, Ringing circuit.

Non-Linear Wave Shaping: Diode clippers, Transistor clippers, Clipping at two independent levels, Transfer characteristics of clippers, Emitter coupled clipper, Clamping operation. Clamping circuits using diode with different inputs, Clamping circuit theorem, Practical clamping circuits, Effect of diode characteristics on clamping voltage, Transfer characteristics of clampers.

Synchronized Clamping

Unit II: Switching Characteristics of Devices & Bistable Multivibrator 12 Hours

Switching Characteristics of Devices: Diode as a switch, Piecewise linear diode characteristics, Design and analysis of transistor as a switch, Break down voltage consideration of transistor, Saturation parameters of transistor and their variation withtemperature, Design of transistor switch, Transistor-switching times.

Bistable Multivibrator: Analysis and design of fixed bias, Self bias bistable multi vibrator, Collector catching diodes, Commutating capacitors,Triggering of binary circuits, Emitter coupled bistable multivibrator (Schmitt trigger).

Collector coupled bistable multivibrator

Unit III: Monostable Multivibrator & Astable Multivibrator 12 Hours

Monostable Multivibrator: Analysis and design of collector coupled monostable multi vibrator, Triggering of monostablemultivibrator, Applications of monostable multivibrator.

Astable Multivibrator: Analysis and design of collector coupled astable multivibrator, Application of astable multivibrator as a voltage to frequency converter.

Emitter coupled monostable multivibrato

Unit IV: Voltage Time Base Generators 12 Hours

Voltage Time Base Generators: General features of a time base signal, Methods of generating time base waveform, Exponential sweep circuits, Negative resistance switches, Basic principles in miller and Bootstrap time base generators, Transistor miller time base generator, Transistor bootstrap time base generator.

Current time base generators

Unit V: Logic Families & Sampling Gates 12 Hours

Logic Families: Diode logic, Transistor logic, Diode-transistor logic, Transistor-transistor logic, Emitter coupled logic, AOI logic,Comparison of logic families.

Sampling Gates: Basic operating principles of sampling gates, Diode unidirectional sampling gate and Two-diode bidirectional sampling gate, Four-diode gates, Six-diode gates, Reduction of pedestal in sampling gates, Applications of sampling gates.

Logic gate circuits design using CMOS logic

Textbooks

1. J.Millman, H.Taub, Mothiki S Prakash Rao and Millman's, "Pulse Digital and Switching Waveforms", 2nd Edition, Tata McGraw-Hill, 2008
2. David A.Bell, "Solid State Pulse Circuits", 4th Edition, Prentice Hall of India, 2002

Reference Books

1. A.Anand Kumar, "Pulse and Digital Circuits", 2nd Edition, Prentice Hall of India, 2005
2. L.Strauss, "Wave Generation and Shaping", 2nd Edition,McGraw-Hill Companies, 1970
3. R.Venkataraman, "Pulse Digital Circuits and Computer Fundamentals", 1st Edition, Dhanpat Rai Publications, 1994

Web Resources

1. www.wikipedia.org/wiki/Digital electronics
2. http://nptel.ac.in/courses/117103063/6
3. http://nptel.ac.in/courses/117108107/Lecture%2031.pdf
4. http://nptel.ac.in/courses/117108107/Lecture%2001.pdf

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 rise time
2. List the other names for describing the bistable multivibrator
3. Write any two methods to eliminate the hysteresis in schmitt trigger
4. Write the expression of pulse time in mono stable multivibrator
5. Define settleing time and transistion time in bistable multivibrator

L2: Understand

1. Explain the response of RC high pass circuit for the following inputs (a)step (b)pulse
2. Draw the basic circuit diagram of positive peak of clamper circuit and explain its operation
3. Define the different switching times of a transistor with suitable collector current versus time characteristics
4. Write the differences between current and voltage time base generators?
5. Why collector catching diodes are used in multi vibrators?

L3: Apply

1. Illustrate the condition to be met for pulse synchronization
2. Mention the classification of saturated bipolar logic families
3. Draw the waveform at the base of the monostable relaxation circuit to show the frequency division
4. Give some merits and demerits of ECL
5. Identify the logic family for simple and most complex fabrication

L4: Analyze

1. Derive the expression for a %tilt of a square wave after passing through a high pass RC Circuit
2. Compare linear wave shaping and Non linear wave shaping
3. Analyze the diode comparator circuit and draw the response of the circuit to a ramp input Vi=t
4. Compare series diode clipper and shunt diode clipper

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Board of Studies (ECE)

PC 20EC404 Electromagnetic Waves and Transmission Lines 3 1 0 3

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

Code	Course Outcomes	Mapping with POs					DoK
		PO1	PO2	PO3	PO7	PSO 1	
20EC404.1	Build the expressions for input impedance of transmission lines	2	-	1	-	1	L1-L3
20EC404.2	Find and Analyze transmission line parameters for impedance matching purpose	2	-	1	-	1	L1, L4
20EC404.3	Demonstrate the concept of Electric and Magnetic fields using various laws	3	1	1	1	1	L1-L3
20EC404.4	Analyze the time varying behaviour of EM waves	3	1	1	1	1	L1-L3
20EC404.5	Understand the characteristics of uniform plane wave in various media	3	1	1	1	1	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: Transmission Lines – I 9+3 Hours

Transmission line parameters and equations, Primary & secondary constants, Expressions for characteristic impedance, Propagation constant, Phase and group velocities, Infinite line concepts, Input impedance relations, SC and OC lines, Reflection coefficient, VSWR, UHF lines as circuit elements, Problems.

Lossless line, Distortion less line

Unit II: Transmission Lines – II 9+3 Hours

Smith Chart- Configuration, Applications, Impedance transformation one-eighth, quarter, half wave transmission lines, Impedance matching- Single Stub Matching, Problems.

Double stub matching

Unit III: Electrostatics and Magnetostatics 9+3 Hours

Coulomb's law, Electric field intensity, Field due to a line charge, Electric flux density, Guass's law, Electric potential, Potential gradient, Energy stored, Continuity Equation, Laplace's and Poison's equations, Biot-Savart's law, Static magnetic field due to line current, Magnetic flux density, Ampere's circuital law, Lorentz force equation, Magnetic vector potential, Energy stored, Problems.

Capacitance – Parallel plate, Coaxial capacitors

Unit IV: Maxwell's Equations 9+3 Hours

Time varying fields, Faraday's law of electromagnetic induction, Displacement current, Maxwell's equations in point form and integral form, Boundary conditions of electromagnetic fields, Polarization, Problems.

Inconsistency of Ampere's law

Unit V: Uniform Plane Wave 9+3 Hours

Wave equation, Wave propagation in free space, Wave propagation in conductor and dielectrics, Skin depth, Poynting theorem, Skin effect, Wave polarization, Direction cosine, Reflection of uniform plane waves by perfect conductor – normal and oblique incidence, Standing wave ratio, Reflection and transmission of uniform plane waves by perfect dielectric – normal and oblique incidence, Problems.

Total internal Reflection, Brewester angle

Text Books

1. E. C. Jordan and K. G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd Edition, Prentice Hall of India,2000
2. Matthew N.O. Sadiku, "Elements of Electromagnetics", 3rd Edition, Oxford University Press", 2001
3. G. SasiBhushana Rao, "Electromagnetic Field Theory and Transmission Lines", 1st Edition, Wiley India, 2013

Reference Books

1. Nathan Ida, "Engineering Electromagnetics", Springer (India) Pvt. Ltd., New Delhi, 2005
2. John D. Ryder, Networks Lines and Fields, 2nd Edition, Prentice Hall of India, 1999
3. William H. Hayt Jr. and John A. Buck, " Engineering Electromagnetics", 7th Edition, Tata McGraw-hill, 2006
4. Umesh Sinha and Satya Prakashan, "Transmission Lines and Networks", 5th Edition, Tech. India Publications, New Delhi, 2001

Web Resources

1. https://ocw.mit.edu/resources/res-6-001-electromagnetic-fields-and-energy-spring-2008/index.htm 2. https://nptel.ac.in/courses/108/106/108106157/

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. List out any three types of transmission
2. Define the term characteristic impedance
3. What is Smith Chart?
4. State and explain Coulomb's law
5. Write Maxwell's equations in different final forms
6. Define Brewster angle and Critical angles
7. State Poynting theorem
8. What is Brewster angle?
9. Recall Relaxation Time
10. Where Gauss's law applicable

L2: Understand

1. Explain the principle of impedance matching with quarter wave transformer
2. Explain the transmission line parameters and also obtain the transmission line equations
3. A manufacturer produces a ferrite material with $\mu = 750\mu_0$, $\varepsilon = 5\varepsilon_0$, and ζ=10-6 S/m at 10MHz. i) Would you classifythe material as lossless, lossy, or conducting. ii) Calculate β and λ
4. Explain about Low loss radio frequency lines and UHF transmission lines in detail
5. Show that when a uniform plane wave propagating in particular direction, it does not contain any field components in that particular direction
6. Show that in a good conductor, the skin depth δ is approximately given by $\delta = 2\pi\lambda$
7. Find the relations between E and H in a uniform plane wave

8. Summarize the four Maxwell's equations with statements in Integral form
9. Relate Electric Potential and Electric Field Intensity
10. Show that E/H is equal to intrinsic Impedance

L3: Apply

1. Develop relation between Electric potential and Electric field intensity
2. Make use of Gauss's law, Derive the expressions for Electric field intensity and Electric flux density due to an infinitesheet of conductor of charge density ρ_s C/cm
3. The VSWR measured of UHF transmission line, working at a frequency of 300 MHz is found to be 2. If the distancebetween load and voltage minimum is 0.8 meter. Calculate the value of load impedance
4. Discuss the Maxwell's equations for electrostatic fields
5. Write about i) Equation of continuity for time varying fields. ii) Relaxation time
6. Derive an expression for the Electric field intensity due to a finite length line charge along the z-axis at an arbitrary point Q(x, y, z)
7. Find magnetic field strength, H, on the Z-axis at a point P (0, 0, h), due to a current carrying circular loop, $X^2 + y^2 = A^2$ in Z=0 plane
8. Show that when a uniform plane wave propagating in particular direction, it does not contain any field components in that particular direction
9. Build the relation between Zoc and Zsc
10. By Applying Equations of Transmission, derive the Input impedance of Transmission Line

L4: Analyze

1. Analyze magnetic field strength H on the Z-axis at a point P (0, 0, h) due to a current carrying circular loop $X^2 + Y^2 = A^2$ in Z=0 plane
2. Categorize the various charge Distributions
3. Analyse λ/8, λ/4 and λ/2 lines
4. Examine how the Zsc and Zoc lines are acting as Capacitor and Inductor with Varying Lengths
5. Discover the Relation between Zsc and Zoc
6. List the Maxwell's equation in integral and differential form
7. Conclude that the direction of EM wave is perpendicular to both E and H directions
8. Distinguish Magnetic vector potential and Scalar potential
9. What is Skin depth and derive its expression?

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Board of Studies (ECE)

PC 20EC405 Electronic Circuit Analysis 3 1 0 3

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PSO1	
20EC405.1	Design small signal high frequency transistor amplifiers	2	2	2	3	L2 – L4
20EC405.2	Classify, analyze and design different types of multistage amplifiers	1	2	3	3	L1 – L3
20EC405.3	Classify, analyze and design different types of feedback amplifiers	1	2	3	3	L2 - L4
20EC405.4	Design and analyze transistor oscillators for different frequencies	1	2	3	3	L2 - L4
20EC405.5	Design and explain operation of power amplifiers and tuned amplifiers	1	2	-	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: Small Signal High Frequency Transistor Amplifier models **10+2 Hours**

BJT: Transistor at high frequencies, Hybrid-π common emitter transistor model, Hybrid-π conductance's, Hybrid-π capacitances, validity of hybrid-π model, determination of high-frequency parameters in terms of low-frequency parameters, CE short circuit current gain, current gain with resistive load, cut-off frequencies, frequency response and gain bandwidth product.
FET: Analysis of self biased common source and common drain amplifier circuits at high frequencies.

Analysis of common source and common drain amplifier using potential divider method

Unit II: Multistage Amplifiers **10+2 Hours**

Classification of amplifiers, methods of coupling, cascaded transistor amplifier and its analysis, analysis of two stage RC coupled amplifier, high input resistance transistor amplifier circuits and their analysis-Darlington pair amplifier, Cascode amplifier, Boot-strap emitter follower, Differential amplifier using BJT.

Two stage RC coupled FET amplifier

Unit III: Feedback Amplifiers **10+2 Hours**

Feedback principle and concept, types of feedback, Classification of negative feedback amplifiers, feedback topologies, Characteristics of negative feedback amplifiers, Generalized analysis, Performance comparison, Method of analysis.

Common source configuration with source resistor R un-bypassed.

Unit IV: Oscillators **10+2 Hours**

Oscillator principle, Condition for oscillations, Types of oscillators, Analysis of RC-phase shift and Wein bridge oscillators with BJT and FET, Generalized analysis of LC Oscillators, Hartley and Colpitt's oscillators with BJT, Crystal oscillator, Frequency and amplitude stability of oscillators.

Heartly oscillator using FET, Colpits oscillator using FET

Unit V: Power Amplifiers and Tuned Amplifiers **10+2 Hours**

Power Amplifiers: Classification of amplifiers, Class-A power amplifiers, Harmonic distortions, Class-B Push-pull amplifiers, Complementary symmetry push pull amplifier, Class-AB power amplifier, Class-C power amplifier, Thermal stability and Heat sinks. **Tuned Amplifiers:** Introduction, Q-Factor, Single tuned amplifier, Double tuned amplifier, Staggered tuned amplifiers.

Class D power amplifier, Class S power amplifier

Textbooks 70

1. Salivahanan, N. Suresh Kumar, A. and Vallavaraj, "Electronic Devices and Circuits", 3rd Edition, Tata McGraw

Hill, 2013
2. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits Theory", 10th Edition, Prentice Hall of India, 2009
3. B.P. Singh and Rekha, "Electronic Devices and Integrated Circuits", 1st Edition, Pearson publications, 2006
4. J. Millman and C.C. Halkias, "Integrated Electronics", 2nd Edition, Tata Mc Graw-Hill, 2000

Reference Books

1. Adel. S. Sedra and Kenneth C. Smith, "Micro Electronic Circuits", 7th Edition, Oxford University press, 2014.
2. B. V. Rao, K. R. Rajeswari, P. C. R. Pantulu and K. B. R. Murthy, "Electronic Circuit Analysis", 6th Edition,Pearson Publications, 2013
3. Donald A. Neaman, "Electronic Circuit Analysis and Design", 3rd Edition, Tata Mc Graw-Hill, 2010
4. Paul Gray, Hurst, Lewis and Meyer, "Analysis and Design of Analog Integrated Circuits", 4th Edition, John Willey & Sons, 2005
5. D. Schilling and C. Belove, "Electronic Circuits", 3rd Edition, Tata Mc Graw-Hill, 1989

Web Resources

1. http://eostutorials.com/analog-electronics/high-frequency-hybrid-pi-model-or-giacoletto-model-of-bjt/
2. http://www.iitg.ac.in/apwajpey/ph218.html
3. http://cktse.eie.polyu.edu.hk/eie3100/8-FeedbackOscillator.pdf
4. http://www.electronics-tutorials.ws/amplifier/amp_1.html

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. What is cascade amplifier?
2. What is the need of blocking capacitor?
3. Write any three applications of cascode amplifiers
4. List the four types of power amplifiers
5. Define crossover distortion
6. Define tuned amplifier

L2: Understand

1. Explain various hybrid-pi capacitances and conductances of a BJT
2. Discuss the effect of a coupling and bypass capacitors on CE amplifier
3. Explain three types of coupling methods used in multistage amplifiers
4. With the help of a neat circuit diagram, describe the working of a cascade amplifier
5. Describe the effects of negative feedback on the various characteristics of the amplifier
6. Write the six differences between RC oscillators and LC oscillators
7. Draw and explain the circuit diagram of class A power amplifier
8. Describe the operation of single tuned amplifier
9. Describe the operation of double tuned amplifier
10. With neat circuit diagram explain stagger tuned amplifier

L3: Apply

4. With suitable expressions explain CE short circuit current gain
5. Obtain the expressions for f_β and f_α
6. Draw the circuit diagram and equivalent circuit of an emitter follower amplifier and derive the expression for A_v, A_i and input impedance
7. Find the expression for CMRR of a BJT based differential amplifier

8. Obtain the expression for output resistance of a voltage sampled circuit
9. Explain the principle of negative feedback in amplifiers. Show quantitatively the effect of negative feedback on (i) Gain (ii) Stability (iii) Noise (iv) Distortion
10. Establish the condition for frequency of oscillation in an RC phase shift oscillator
11. Show that the conversion efficiency of a transformer coupled power amplifier is 50%.
12. Prove the conversion efficiency of a class B power amplifier is 78.5%
13. With suitable expressions discuss about Thermal stability of power amplifier

L4: Analyze

1. Derive the expressions for the following hybrid Π conductance i) gm ii) gb'e iii) gb'c iv) gce
2. Derive the voltage gain equation for common source amplifier at high frequencies
3. A CE amplifier is drawn by a voltage source of internal resistance of 500 Ω and load impedance of 800 Ω. Thsh-parameters h_{ie} = 2kΩ, h_{re} = 2X10^{-4}, h_{fe} = 50, h_{oe} = 25μA/V and compute A_i, R_i, A_v and R_o using exact analysis
4. An amplifier has a gain of 50 with negative feedback. For a specified output voltage, if the input required is 0.1V without feedback and 0.8V with feedback, Compute β and open loop gain
5. Derive an expression for frequency of oscillations of a Wien bridge oscillator using BJT
6. Derive the expression for frequency of oscillation and condition for sustained oscillations of Colpitts oscillator
7. Derive the expression for frequency of oscillation and condition for sustained oscillations of Hartley oscillator

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Board of Studies (ECE)

PC 20EC406 Pulse and Digital 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	PO9	PSO1
20EC406.1	Design various linear circuits and analyze their response	3	2	3
20EC406.2	Design various non-linear circuits and analyze their response	3	2	3
20EC406.3	Design and generate various types of non-sinusoidal waveforms using multivibrators	3	2	3
20EC406.4	Design current and voltage sweep circuits based on given specifications	3	2	3
20EC406.5	Design and verify various digital logic circuits	3	2	3

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

List of Experiments

1. Linear wave shaping
2. Non Linear wave shaping – Clippers
3. Non Linear wave shaping – Clampers
4. Transistor as a switch
5. Study of Logic Gates & Some applications
6. Study of Flip-Flops & some applications
7. Sampling Gates
8. Astable Multivibrator
9. Monostable Multivibrator
10. Bistable Multivibrator
11. Schmitt Trigger
12. UJT Relaxation Oscillator
13. Bootstrap sweep circuit

References

1. Lab Manual for Pulse and Digital Circuits Lab, Department of Electronics and Communication Engineering, NSRIT.

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Board of Studies (ECE)

PC	20EC407 Electronic 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	PO5	PSO9	PSO1
20EC407.1	Using CRO (or) DSO to measure the frequency, and amplitude of any signal generated from Oscillator	3	3	2	2
20EC407.2	Understand the DC analysis and Transient analysis of amplifier.	3	3	2	2
20EC407.3	Understand the working of Power amplifiers	3	3	2	2
20EC407.4	Compare the frequency response of Various Tuned voltageamplifier	3	3	2	2
20EC407.5	Design and analyze different electronic circuits on Multisim tool	3	3	2	2

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

List of Experiments

1. Determination of h of a given transistor
2. Voltage-Series Feedback Amplifier
3. Current-Shunt Feedback Amplifier
4. RC Phase Shift/Wien Bridge Oscillator
5. Hartley/ Colpitt's Oscillator
6. Two Stage RC Coupled Amplifer
7. Darlington Pair Amplifer
8. Bootstrapped Emitter Follower
9. Class A Series-fed Power Amplifier
10. Transformer-coupled Class A Power Amplifier
11. Class B Push-Pull Power Amplifier
12. Complementary Symmetry Class B Push-Pull Power Amplifier
13. Single Tuned Voltage Amplifier
14. Double Tuned Voltage Amplifier

References

1. Lab Manual for Electronic Circuit Analysis Lab, Department of Electronics and Communication Engineering, NSRIT

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Chairman
Board of Studies (ECE)

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 PO's

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 AC 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., andGopal 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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Board of Studies (EEE)

20ECS02 Basics of Python Programming

1 0 2 2

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

Code	Course Outcomes	Mapping with POs PO1	DoK
20CS403.1	Demonstrate the basic programming in Python	3	L1, L2
20CS403.2	Demonstrate use of data structures and object-oriented programming in Python	3	L1, L2
20CS403.3	Build programs using packages like NumPy, Pandas, SciPy, Matplotlib	3	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

Introduction to Python - Input and Output operations – Comments – Variables – Operators – Expressions – Control Statements – Data Structures: List, Tuples, Sets, Dictionaries, Sequences – Strings: String Formatting, Accessing Character and Substring in Strings, Data Encryption – Functions: Defining functions, Simple programs with functions – Classes – Objects – Packages – Standard Packages: NumPy, Pandas, SciPy, Matplotlib

References

1. Kenneth A. Lambert, "Fundamentals of Python First Programs", 1st Edition, Cengage, 2017
2. Vamsi Kurama, "Python Programming: A Modern Approach", 1st Edition, Pearson, 2018
3. Mark Lutz, "Learning Python", 1st Edition, Oreilly, 2019

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Chairman Board of Studies
(CSE)

PC 20EC501 Analog & Digital Communications 3 1 0 3

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PSO1	
20EC501.1	Explain various Analog modulation and demodulation schemes and their spectral characteristics	2	1	2	2	L1, L2, L3
20EC501.2	Analyze noise characteristics of various analog modulation methods	2	2	2	2	L1, L2, L3
20EC501.3	Demonstrate understanding of various digital modulation and demodulation techniques	2	2	3	3	L1, L2, L3
20EC501.4	Determine the probability of error for various digital modulation schemes	2	2	3	3	L1, L2, L3
20EC501.5	Demonstrate the concept of entropy and different source coding techniques	2	1	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: Amplitude Modulation 11+1 Hours

Introduction to communication system, Need for modulation, Concept of modulation and demodulation of Continuous wave (CW) modulation: amplitude modulation (AM) - double sideband (DSB); double sideband suppressed carrier (DSBSC); single sideband suppressed carrier (SSBSC); Band width, power relations for Continuous wave (CW) modulation; Comparison of AM Techniques, Applications of different AM Systems.

Vestigial Sideband (VSB) Modulation

Unit II: Angle Modulation 11+1 Hours

phase modulation (PM) & frequency modulation (FM); narrow and wideband FM; Representation of narrowband noise; receiver model, signal to noise ratio (SNR), noise figure, noise temperature, noise in DSB-SC, SSB, AM & FM receivers, pre-emphasis and de-emphasis.

Zero Crossing Detector, Phase Locked Loop

Unit III: Pulse Digital Modulation 11+1 hours

Elements of digital communication systems, advantages of digital communication systems, Elements of PCM: Sampling, Quantization & Coding, Quantization error, Companding in PCM systems. Differential PCM systems (DPCM). Delta modulation, its draw backs, comparison of PCM and DM systems, noise in PCM and DM systems.

Adaptive Delta Modulation

Unit IV: Digital Modulation Techniques 11+1 Hours

Introduction, ASK, FSK, PSK, DPSK, DEPSK, QPSK, M-ary PSK, ASK, FSK.
DATA TRANSMISSION: Base band signal receiver, probability of error,, matched filter, probability of error using matched filter, coherent reception, non-coherent detection of FSK, calculation of error probability of ASK, BPSK, BFSK, QPSK.

Similarity of BFSK and BPSK, the Optimum Filter

Unit V: Information Theory 11+1 Hours

Discrete messages, concept of amount of information and its properties. Average information, Entropy and its properties. Information rate. **SOURCE CODING:** Introductions. Advantages, Shannon's theorem, Shanon-Fano coding, Huffman coding, efficiency calculations, channel capacity of discrete and analog Channels, capacity of a Gaussian channel, bandwidth –S/N trade off.

Mutual Information and its Properties

Textbooks

1. Simon Haykin, "Communication Systems", 5th Edition, John Wiley & Sons, 2009.
2. Taub H. & Schilling D., Gautam Saha, "Principles of Communication Systems" , 3rd Edition, Tata Mc-Graw Hill, 2007
3. Lathi B. P., Zhi Ding and Hari Mohan Gupta , "Modern Digital and Analog Communication Systems" , 4th Edition Oxford University Press, 2017

Reference Books

1. Sam Shanmugam, "Digital and Analog Communication Systems", John Wiley, 2005
2. Proakis J.G., "Digital Communications", 4th Edition, McGraw Hill, 2000
3. Singh and Sapre, "Communication Systems Analog and Digital", Tata McGraw Hill, 2004

Web References

1. https://nptel.ac.in/courses/117/102/117102059/
2. https://nptel.ac.in/courses/117/101/117101051/

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. What is Need for modulation?
2. Define pre-emphasis and de-emphasis
3. What is uniform quantization?
4. What are the advantages of M-ary Signalling Schemes?
5. Define source entropy

L2: Understand

1. Draw the Envelope detector and illustrate the process of detection of AM wave?
2. Derive the expression for the frequency modulated signal. Explain what is meant by narrowband FM and wideband FM using the expression
3. Explain the methods for demodulation of PAM signals
4. Explain the process of generating FSK signals
5. Explain the following
   i) Shannon's Source Coding Theorem ii) Channel Capacity

L3: Apply

1. An amplitude modulated signal represented in time domain as 4Cos (1800πt) +10Cos (2000πt) + 4Cos (2200πt). Sketch the spectrum and calculate the band width & total power
2. A cable has a power loss of 3 dB is connected to the input of an amplifier, which has a noise temperature of 100K. Calculate the overall noise temperature referred to the cable input
3. A DM system can handle message signals of bandwidth up to 5 kHz and has a sampling rate of 50 kHz. A sinusoidal signal of 1.5 volts peak amplitude and frequency 2 kHz is applied to the system. Determine the step-size Δ required to avoid slope overload
4. Find the Probability of error of Optimum Filter
5. A memory less source emits messages m1 and m2 with probabilities 0.8 and 0.2, respectively. Find the Huffman binary code for this source and determine the code efficiency

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PC 20EC502 Linear & Digital IC Applications 3 1 0 3

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PSO1	
20EC502.1	Understand the internal operation of Op-Amp and its specifications and Design circuit using operational Amplifier for various applications.	1	1	3	2	L1,L3
20EC502.2	Gain knowledge about PLL, and develop the skills to design the simple circuits using IC 555 timer and can solve problems related to it.	1	2	3	2	L1, L3
20EC502.3	Learn about various techniques to develop A/D and D/A converters.	1	2	3	2	L1,L3
20EC502.4	Understand the structure of commercially available digital integrated circuit families.	1	2	3	2	L1, L3
20EC502.5	Acquired the knowledge about the CMOS logic, combinational and sequential circuits.	1	1	3	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: Linear and Non-linear Applications of OP-Amp 11+1 Hours

Characteristics of OP-Amps - DC and AC characteristics, 741 op-amp & its features, Op-Amp parameters & Measurement, Frequency Compensation techniques, Inverting and Non-inverting amplifier, Integrator and differentiator, Difference amplifier, Instrumentation amplifier, AC amplifier, V to I, I to V converters, Buffers. Non- Linear function generation, Comparators, Multivibrators, Triangular and Square wave generators, Log and Anti log Amplifiers, Precision rectifiers.

Introduction to voltage regulators, Features of 723

Unit II: Timer and Phase Locked Loops 11+1 Hours

Introduction to IC 555 timer, description of functional diagram, monostable and astable operations and applications, Schmitt trigger, PLL - introduction, basic principle, voltage controlled oscillator (IC 566), monolithic PLL and applications of PLL.

Active Filters

Unit III:Data Converters 11+1 Hours

Introduction, Basic DAC techniques, Different types of DACs-Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R DAC, Different Types of ADCs - Parallel Comparator Type ADC, Counter Type ADC, Successive Approximation ADC and Dual Slope ADC.

IC Voltage Regulator

Unit IV: Digital Logic Families and Interfacing 11+1 Hours

Introduction to logic families, CMOS logic, CMOS steady state and dynamic electrical behaviour, CMOS logic families, Bipolar logic, Transistor-Transistor Logic, TTL families, CMOS/TTL interfacing, low voltage CMOS logic and interfacing.

CMOS logic levels, Emitter coupled logic

Unit V: Digital IC Applications 11+1 Hours

Combinational Circuits Using TTL 74XX ICS

Study of logic gates using 74XX ICs, Four-bit parallel adder(IC 7483), Comparator(IC 7485), Decoder(IC 74138), BCD-to-7-segment decoder(IC 7447), Encoder(IC 74148), Multiplexer(IC74151), Demultiplexer (IC 74154).

Sequential Circuits Using TTL 74XX ICS

D-Flip Flops (IC 7474), Shift Registers, Universal Shift Register(IC 74194), 4- bit asynchronous binary counter(IC 7493).

Full Adder(IC7483), T-Flip Flop (IC7473)

Text books

1. RamakanthA.Gayakwad,"Op-amps & linear ICs", 4thEdition, Prentice Hall of India, 2003
2. Floyd and Jain,"Digital Fundamentals",8thEdition,Pearson education, 2005
3. Roy Choudhury D., "Linear Integrated Circuits ", 2ndEdition, New Age International (Pvt) Ltd., 2003
4. John F. Walkerly, "Digital Design Principles & Practices", 3rdEdition, Prentice Hall of India/ Pearson Education Asia, 2005

Reference Books

1. James M. Fiore, "Op Amps and Linear Integrated Circuits Concepts and Applications",India Edition, 2009
2. Lal Kishore K., "Operational Amplifiers with Linear Integrated Circuits",1stEdition,Pearson, 2009
3. Salivahanan, " Linear Integrated Circuits and Applications",Mc Graw Hill Education, 2018
4. Jain RP., "Modern Digital Electronics", 4thEdition, Mc Graw Hill Education, 2010

Web Resources

1. https://www.rs-online.com/designspark/introduction-to-ideal-op-amp-circuit-characteristics
2. https://www.studyelectronics.in/linear-and-nonlinear-applications-of-op-amp/
3. https://www.analog.com/en/analog-dialogue/articles/phase-locked-loop-pll-fundamentals.html
4. https://www.sciencedirect.com/topics/computer-science/data-converter
5. https://www.iare.ac.in/sites/default/files/lecture_notes/DICA

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. Define an operational amplifier.
2. Define input offset voltage.
3. Mention the advantages of integrated circuits.
4. Define Combinational Circuits and Sequential Circuit.
5. what are the different logic levels in CMOS?
6. Define data converters.
7. Give the applications of data converters.
8. What is ECL logic?
9. what is the difference between Latch and Flip Flop?
10. Define the TTL and CMOS interfacing.

L2: Understand

1. Explain the following terms in an OP-AMP. 1. Input Bias current 2. Input offset voltage 3. Input offset current.
2. Explain practical integrator circuit using IC 741.
3. Explain pole zero compensation and frequency compensation in op-amp.
4. Explain various DC and AC characteristics of an op.amp.
5. Describe the Full adder using two Half adder.
6. Describe the 4-Bit Shift Register.
7. Explain triangular waveform generator using IC 741.
8. What you understand from the Logic Level?
9. Describe the TTL Logic.
10. Explain the operation of encoders.

L3: Apply

1. Design a square wave generator of frequency 100 Hz and duty cycle of 75% using 555 timer.
2. Design a wideband reject filter having fh=400 Hz and fl= 2 KHz having a pass band gain as 2.
3. Design a differentiator that differentiate an input signal with fmax=100Hz.
4. With suitable expressions explain about the working of a Weighted resistor D/A converter.
5. Obtain the expressions for successive approximation A/D converter.
6. Draw and explain about the working of a dual slope A/D converter.
7. Design IC74151 using IC74152.
8. Draw the Synchronous Counter IC7493 using IC7474.
9. Design 3-I/P NAND Gate using TTL Logic.
10. Obtain the T-Flip Flop from the JK-Flip Flop.

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PC 20EC503 Antennas & Wave Propagation 3 1 0 3

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

Code	Course Outcomes	Mapping with POs					DoK
		PO1	PO2	PO3	PO7	PSO1	
20EC503.1	Illustrate radiation mechanisms and basic characteristics of antennas	1	1	1	-	3	L1,L2
20EC503.2	Analyze mathematical expressions and their application for complete design of antennas	1	2	3	-	1	L1, L2, L3, L4
20EC503.3	Demonstrate the working of antenna using plane surface and curved surface	2	3	1	2	2	L1, L2, L3
20EC503.4	Illustrate feeding mechanism and techniques for antenna parameter measurements	2	2	2	2	1	L1, L2, L3, L4
20EC503.5	Demonstrate various modes of EM wave propagation	2	1	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:Antenna Basics 11+1 Hours

Introduction, Antenna Characteristics Radiation mechanism and current distribution, radiation pattern and its parameters (Main Lobe and Side Lobes, Beam widths), Polarization, Radiation Intensity, Directivity, Gain Antenna Apertures, Aperture Efficiency, Effective Height, effective aperture, vector effective length, antenna temperature, Friis transmission formula.

Patterns in Principal Planes

Unit II:Resonant Antennas and Antenna Arrays 11+1 Hours

Radiation Resistance, Directivity and other characteristics of Short Dipole, Monopole, Half-Wave Dipole, Small Loop Antenna. Linear array and Pattern Multiplication, Two-Element Array, Uniform Array, Binomial Array, Broadside and End-Fire Arrays, Yagi-Uda array, log-periodic Dipole Array.

Retarded Potential and Radiation from Small Electric Dipole

Unit III:Non-Resonant Antennas 11+1 Hours

Helical antenna - axial and normal modes, Spiral antenna,Slot antenna, Pyramidal and Conical horn antennas, reflector Antenna: flat plate, corner and paraboïc reflectors, common curved reflector shapes, Feed mechanisms.

Travelling wave radiator types

Unit IV:Micro-wave Antennas and Measurements 11+1 Hours

Basic characteristics, feeding methods, Design of Rectangular and Circular patch Antennas, Lens Antennas – Geometry, Features, Dielectric Lenses and Zoning, Applications. Introduction to Smart Antennas, Concept of adaptive beam forming, Measurement of Antenna Parameters (radiation pattern measurement, gain, directivity).

Radiation Resistance, Polarization measurement.

Unit V:Radio Wave Propagation 11+1 Hours

Ground wave propagation, free space propagation, sky waves, surface waves, diffraction, wave propagation in complex environments, Troposphere propagation, Troposphere scatter, Ionosphere propagation, electrical properties of the Ionosphere, effect of earth's magnetic field.

Duct propagation

Textbooks

1.Jordan E.C., and Balmain,"K. G. Electromagnetic Waves and Radiating Systems", 2nd Edition, Prentice-Hallpublications,1968
2.John D. Kraus,Ronald Marhefka J. and Ahmad Khan S., "Antennas and Wave Propagation",4thEdition, Tata McGraw Hill, 2010

3. Constantine Balanis A., "Antenna Theory-Analysis and Design", 4thEdition,Wiley Publication, 2005

Reference Books

1.Harish A.R. and Sachidananda M., "Antennas and Wave Propagation", Oxford University Press, 2007
2. CromptonR.E., "Adaptive Antennas", John Wiley Publication, 1988
3. PrasadK.D., "Antenna & Wave Propagation", 2nd Edition, Satya Prakashan, 2005

Web Resources

1. http://nptel.ac.in/courses/108101092/
2. http://www.antenna-theory.com/

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. DefineBeam efficiency
2. Write two differences between broadside array and endfire array
3. Listtwo applications of slot antenna
4. Define directivity
5. What is ground wave propagation?

L2: Understand

11. Draw the equivalent circuit of an antenna
12. With the help of neat diagrams explain the principle of radiation mechanism in antennas
13. Explain about FRIIS transmission formula and its significance
14. Demonstrate the way in which an oscillating dipole throws out its radiation
15. Describe the expressions for radiation resistance and directivity of monopole
16. Explainthe different operating modes of Helical Antenna with neat diagrams
17. Discuss about different feeding techniques used in antenna with neat diagrams
18. Illustrate different modes of Radio Wave Propagation with neat diagrams

L3: Apply

11. Build an expression for the Far field component of a Monopole, Half Wave Dipole Antenna
12. Develop the expression for total power radiated by a Monopole, Half Wave Dipole Antenna
13. Build the expression for gain of a Monopole, Half Wave Dipole Antenna
14. Develop the expression forfar field pattern of 2-element isotropic Array using various cases of excitations
15. Identify positions of maxima and minima of the radiation pattern for a broadside array of identical antennas consisting of isotropic radiators separated by a distance □ = □□
16. Develop the expression forradiation pattern of Broad side Array using various cases of excitations
17. Develop the expression for radiation pattern of End Fire Array using various cases of excitations
18. Identify the parameters to be considered for the design of a Helical Antenna
19. Build a Yagi-Uda Array antenna with 7 elements operating at a frequency of 500 MHz
20. Identify the length L,H –Plane aperture and flare angles in the E and H planes,beamwidth and directivity of a pyramidal horn for which the E-plane aperture a_e = 10λ .The horn is fed by a rectangular waveguide with TE10 mode. Let δ=0.2λ in the E-Plane and 0.375λ in the H plane

L4: Analyze

1. Compare the radiation parameters of a Monopole, Half Wave Dipole Antenna
2. Distinguish between End Fire Array and Broad side Array Antenna
3. Distinguish between Yagi-Uda array and log-periodic Dipole Array

4. Compare the feeding techniques of Microstrip Patch Antenna

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PC 20EC506 Linear & Digital IC Applications Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs			
		PO4	PO5	PO9	PSO2
20EC506.1	Demonstrate the Linear Applications and Non - Linear Applications using IC 741	2	3	2	3
20EC506.2	Model Monostable Operation circuits using IC555 timers	2	3	2	3
20EC506.3	sign various active filter applications of 1st order LPF & HPF	2	3	2	3
20EC506.4	dy of combinational and Sequential Circuits using Logic Gates	1	3	3	3
20EC506.5	strate Counter, Registers using Flip-Flops	1	3	3	3

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

List of Experiments

PART -A: To Verify the Following Functions

1. Adder, Subtractor, Comparator Circuits using IC 741 OP AMP
2. Integrator and Differentiator Circuits using IC 741 OP AMP
3. IC 555 Timers – Monostable Operation Circuits
4. Schmitt Trigger Circuits – using IC 741 and IC 555
5. Comparators using Op Amp
6. Active filter Applications-LPF, HPF (First Order)
7. Sample and Hold LF398 IC

PART -B: To Verify the Functionality of the Following 74 Series TTL IC's

1. D-Flip Flop (74LS74) and JK Master Slave Flip-flop(74LS73)
2. Decade counter (74LS90) and Up-down Counter (74LS192)
3. Universal shift Register(74LS194/195)
4. 3-8 Decoder using (74LS138)
5. 4 – bit comparator (74LS85)
6. 8x1 Multiplexer - 74LS151 and 2x4 DeMultiplexer-74155
7. RAM 16X4 -74189(read and write operation)

References

1. Lab Manual for Linear & digital integrated circuits Lab of Electronics and Communication Engineering, NSRIT.

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PC 20EC507 Analog & Digital Communications Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs				
		PO4	PO5	P09	PSO1	PSO2
20EC507.1	Design analog modulation circuits as amplitude and frequency modulation	3	3	1	2	2
20EC507.2	Perform the time and frequency domain analysis of the signals in a digital communication system	3	2	2	3	2
20EC507.3	sign various pulse modulation techniques as PAM, PPM, PWM	2	2	2	2	2
20EC507.4	alyze the Performance of digital design in the communication system	3	3	2	3	2
20EC507.5	Analyze digital modulation techniques	3	3	1	3	2

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

List of Experiments

1. Amplitude Modulation - Mod. &Demod.
2. AM - DSB SC - Mod. &Demod.
3. Pre-Emphasis & De-Emphasis
4. Frequency Modulation - Mod. &Demod.
5. RadioReceiverCharacteristic
6. Pulse Amplitude Modulation - Mod. &Demod.
7. Phase Locked Loop (PLL)
8. Time Division Multiplexing
9. Pulse Code Modulation
10. Differential Pulse Code Modulation
11. Delta Modulation
12. Frequency Shift Keying
13. Phase Shift Keying
14. Differential Phase Shift Keying

References

2. Lab Manual for Analog & Digital Communications Lab of Electronics and CommunicationEngineering, NSRIT

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SC 20ECS03 Fundamentals of Internet of Things

0 0 4 2

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

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO3	PO9	
20ECS03.1	Demonstrate the basics of IOT	3	2	1	L1, L2
20ECS03.2	Implement the state of the architecture of anIoT	3	3	3	L1, L6

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

Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects, Physical and MAC layers, Network Layer: IP versions, Constrained Nodes and Constrained Networks, IoT applications in security, Home appliances, other IoT electronic equipments.

Textbook

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals:Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017
2. Rajkamal, "Internet of Things: Architecture, Design Principles And Applications", McGraw Hill Higher Education

Reference Books

1. Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, "The Internet of Things – Key applications and Protocols", 2012
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand and David Boyle, "FromMachine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier Ltd., 2014

Web Resources

1. https://onlinecourses.nptel.ac.in/noc17_cs22/course
2. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

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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	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 Iproperty 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

Unit I: 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 ownershipissues, 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. Intellectua lproperty right,Deborah, E. Bouchoux ,cengage learning.
2. Intellectual property right - Unleashing the knowledge economy, Prabuddha Ganguli, TataMcGraw Hill Publishing CompanyLtd.
3. Cornish, WilliamRodolph & Llewelyn,David.Intellectual property:patents, copyright, trademarks and allied rights. Sweet & Maxwell, 8/e,2013.

Reference Books

1. Cornish,WilliamRodolph.Casesandmaterialsonintellectualproperty.Sweet&Maxwell, Ie,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 ownership 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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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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PC 20EC601 Microwave Engineering 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	PO7	PSO1	
20EC601.1	Derive field expressions for TE, TM modes.	3	3	2	1	1	L1, L2, L3
20EC601.2	Analyze Circular waveguides and Microstriplines	3	3	2	1	1	L1, L2, L3
20EC601.3	Demonstrate different Microwave Tubes working principle and its properties	1	1	2	1	1	L1, L3
20EC601.4	Distinguish between Helix TWTs, M-type Tubes and Microwave Solid State Devices	1	1	2	2	1	L1, L2, L3
20EC601.5	Calculate S-matrix for various waveguide components and measure microwave parameters using a Microwave test bench	3	3	2	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: Rectangular Waveguides 12Hours

Microwave Frequency Bands, Rectangular Waveguides – TE and TM Expressions for Fields, Characteristic Equation and Cut-off Frequencies, Dominant and Degenerate Modes, Mode Characteristics – Phase and Group Velocities, Wavelengths and Impedance Relations; Power Transmission and Power Losses in Rectangular Guide, Impossibility of TEM mode, Problems.

Microwave frequency applications, TE, TM mode analysis

Unit II:Circular Waveguides and Microstrip Lines 12 Hours

Introduction to circular waveguides, Nature of Fields, Characteristic Equation, Dominant and Degenerate Modes.Cavity Resonators– Introduction, Rectangular and Cylindrical Cavities, Dominant Modes and Resonant Frequencies, Q factor and Coupling Coefficients, related problems.Introduction Microstrip lines, Zo Relations, Effective Dielectric Constant, Losses, Q factor.

Applications of Circular waveguides and Microstrip lines, Comparison between Rectangular and Circular waveguides

Unit III: Microwave Tubes 12 Hours

Limitations and Losses of conventional tubes at microwave frequencies, O-type tubes :2 Cavity Klystrons – Velocity Modulation and Applegate Diagram, Bunching Process andExpressions for o/p Power and Efficiency, Reflex klystron: Structure, Principle of working.

Hellix's TWT: Types and Characteristics of Slow Wave Structures; Structure of TWT

M-Type Tubes:Cross-field effects, Types of Magnetrons, δ-Cavity Cylindrical Travelling Wave Magnetron – Hull Cut-off Condition, Modes of Resonance and PI-Mode Operation, Separation of PI-Mode, o/p characteristics.

Comparison between 2 cavity Klystron and Reflex Klystron

Unit IV:Microwave Solid State Devicesand Waveguide Components 12 Hours

Microwave Solid State Devices: Introduction,TEDs: Gunn Diode – Principle, RWH Theory, Characteristics, Basic Modes of Operation, Oscillation Modes. Avalanche Transit Time Devices:Working Principleand Characteristics of IMPATT and TRAPATT Diodes.

Waveguide Components: Scattering Matrix: Importance and Properties.S-Matrix for – 2 port Junction, E-plane and H-plane Tees, Magic Tee, Hybrid Ring;Ferrite Components: Faraday Rotation, S-Matrix Calculations for Gyrator, Isolator, Circulator, Problems.

Difference between Helix TWT & M-Type microwave tubes, Applications of Solid State devices

Unit V: Microwave Measurements 12 Hours

Microwave Measurements: Description of Microwave Bench – Different Blocks and their Features, Precautions; Microwave Power Measurement – Bolometer Method, Measurement of Attenuation, Frequency, Q- factor, Phase shift, VSWR, ImpedanceMeasurement.

Scattering matrix for Directional Coupler

Textbooks

5. Samuel Y. Liao, "Microwave Devices and Circuits", 3rdEdition,Prentice Hall India, 2016
6. CollinR.E., and John Wiley,"Foundations for Microwave Engineering",2ndEdition,IEEE Press, 2002
7. Kulakarni M., "Microwave and Radar Engineering", 3rd Edition, Umesh Publications, 2009

Reference Books

1. Herbert J. Reich, Skalnik J.G., Ordung P. F., and Krauss H. L., "Microwave Principles", CBS Publishers and Distributors Pvt. Ltd., New Delhi, 2004
2. Annapurna Das and Sisir K.Das, "Microwave Engineering", 3rd Edition, Mc Graw Hill Education, 2017
3. Raju G. S.N., "Microwave Engineering", I K International Publishing House Pvt, Ltd., 2008

Web Resources

1. https://www.youtube.com/watch?v=_SNwJknlSXA
2. https://nptel.ac.in/courses/108/103/108103141/

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

19. Define TE mode
20. What is scattering matrix?
21. Define Q factor
22. Define Hull cut off condition
23. What is TM mode?
24. Whatis TEM mode?
25. What is meant by TED?

L2: Understand

11. Draw and explain the Applegate Diagram of two cavity Klystron
12. Draw the microwave bench and explain each block in detail
13. Explain about Gunn diode
14. Explain about directional coupler
15. Write the difference between rectangular and circular wave guide
16. Explain the process to measure Attenuation use microwave bench
17. Explain about slow wave structure with neat diagrams

L3: Apply

5. Derive scattering matrix for E-plane TEE
6. Derive field expressions of TE,TM wave in rectangular waveguide
7. Derive field expressions of TE, TMwave in circular waveguide
8. Describe and Derive Scattering matrix for gyrator
9. Derive Scattering matrix for Circulator

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PC 20EC602 Digital Signal Processing

3 1 0 3

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PSO1	
20EC602.1	Apply the difference equations concept for analyzation of Discrete time systems	3	1	1	1	L1, L2, L3
20EC602.2	Apply the FFT algorithm for solving the DFT of a given signal	3	2	2	2	L1, L2, L3
20EC602.3	Design and realize the IIR Digital filter from the given specifications	3	2	3	3	L1, L2, L3
20EC602.4	Design and realize the FIR Digital filter from the given specifications	3	2	3	3	L1, L2, L3
20EC602.5	Apply the signal processing concepts on DSP Processor	1	2	2	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

Unit I: Introduction 11+1 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, Systemfunction.

Discrete time Fourier transform

Unit II:Discrete Fourier Transform 11+1 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:Designof IIR Digital Filters& Realizations 11+1 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 11+1 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 11+1 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

Textbooks

4. John G. Proakis and Dimitris G.Manolakis," Digital Signal Processing, Principles, Algorithms, and Applications",4th Edition, Pearson Education / Prentice Hall of India, 2009.
5. Oppenheim A V. and Schaffer R W.," Discrete Time Signal Processing",3rd Edition, Prentice Hall of India

6. VenkataramaniB. 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", OxfordUniversity Press,2014

Web Resources

3. https://nptel.ac.in/courses/117/102/117102060/
4. 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

6. What is the condition for stability of an LTI system?
7. What are the limitations of DSP?
8. Define DFT and IDFT
9. How FFT is more efficient to determine DFT of sequence?
10. Why IIR filters do not have linear phase?
11. What is meant by frequency warping effect?
12. Write twoadvantages of Kaiser widow
13. List the on-chip peripherals
14. List thespecial 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) = $x(n^2)$+ 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 filterwith the following specification
   (i) 3dB ripple in pass band $0 \le w \le 0.25\pi$
   (ii) 30 dB attenuation in stop band $0.35\pi \le w \le \pi$
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 cutoff frequency 1.2 radian and length $N = 7$. Use frequency sampling method
10. Design an ideal high pass filter with a frequency response

$Hd(e^{jw}) = 1$ for $\pi/4 \le |w| \le \pi$
$= 0$ for $|w| \le \pi/4$ Find the values of h(n) for N = 11 using Hamming window. Find H (z) and determine the magnitude response

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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	PO2	PO3	
20EC603.1	Describe the features and architecture of 8086 Microprocessor & the modes of operation	3	1	3	L1, L2
20EC603.2	Illustrate different instructions, addressing modes and write assembly programs	3	1	2	L1, L2, L3
20EC603.3	Illustrate how different peripherals are interfaced with Microprocessor	3	2	3	L1, L2, L3
20EC603.4	Describe the concepts of 8051 microcontroller's architecture, Addressing modes, interfacing and programs	3	2	3	L1, L2
20EC603.5	Differentiate the various ARM Processor architectures, functions and interfaces	3	1	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

11+1Hours

UNIT I:Introduction to 8086 Microprocessor

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, Databus,ALE,Interrupts

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

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

Textbooks

8. Douglas V. Hall, Rao S. S. S. P., "Microprocessors and Interfacing – Programming and Hardware ", Tata McGraw Hill Education Private Limited, 3rd Edition,1994
9. Prof Bhurchandi K. M.,and Prof RayA. K., "Advanced Microprocessors and Peripherals: With ARM and an Introduction to Microcontrollers and Interfacing", 3rd Edition,2010
10. Muhammad AliMazidi, Janice GillespieMazidiand Rollin D. McKinlay,"The 8051 Microcontrollers and Embedded systems Using Assembly and C", 2nd Edition,Pearson Publications, 2011
11. JosephYiu," The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors", 3rd Edition,Newnes,2013

Reference Books

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

Web Resources

3. https://www.youtube.com/watch?v=GapjiO_8Kuk
4. https://www.tutorialspoint.com/microprocessor/microprocessor_8086_overview.html
5. https://www.javatpoint.com/8086-microprocessor
6. http://www.digimat.in/nptel/courses/video/108105102/L31.html
7. 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 outany 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

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 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	PO5	PO9	PSO2
20EC606.1	Develop assembly language programs to perform arithmetic, logical operations,string operations using TASM and 8086 Microprocessor boards	3	2	2	2
20EC606.2	Design interfacing circuits using 8086 Microprocessor	2	2	3	2
20EC606.3	Construct different waveforms using 8086 Microprocessor and 8051 Microcontroller	3	2	3	2
20EC606.4	Develop and implement assembly language programs to perform real time interfacing using 8051Microcontrollers	3	2	3	2
20EC606.5	Implement assembly language programs to perform arithmetic operations using ARM Processors	3	2	3	2

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 anarray
5. Interfacing ADC to 8086
6. Interfacing DAC to8086
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 binarynumbers
13. Write an assembly program to find the sum of first 10 integersnumbers
14. Write a program to toggle LED every second using timerinterrupt

References

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

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PC 20EC607 Digital Signal Processing Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs		
		PO4	PO5	PSO2
20EC607.1	Develop various DSP Algorithms using MATLAB Software	3	2	3
20EC607.2	Analyze and Observe Magnitude and phase characteristics (Frequency response Characteristics) of digital IIR-Butterworth, Chebyshev filters	3	2	3
20EC607.3	Analyze and Observe Frequency response Characteristics of digital FIR filters using window techniques	3	2	3
20EC607.4	Develop and Implement DSP algorithms in software using a computer language such as C with TMS320C6713 Processor	3	3	3

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

List of Experiments

1. Generation of discrete time signals for discrete signals
2. To verify the Linear Convolution
   a. Using MATLAB
   b. b) Using Code Composer Studio(CCS)
3. To verify the Circular Convolution for discrete signals
   a. Using MATLAB
   b. b) Using Code Composer Studio(CCS)
4. To Find the addition of Sinusoidal Signals
5. To verify Discrete Fourier Transform(DFT) and Inverse Discrete Fourier Transform(IDFT)
   a. Using MATLAB
   b. b) Using Code Composer Studio(CCS)
6. Transfer Function Stability Analysis: using pole-zero plot, bode plot, Nyquist plot, z-plane plot.
7. Frequency Response of IIR low pass Butterworth Filter
8. Frequency Response of IIR high pass Butterworth Filter
9. Frequency Response of IIR low pass Chebyshev Filter
10. Frequency Response of IIR high pass Chebyshev Filter
11. Frequency Response of FIR low pass Filter using Rectangle Window
12. Frequency Response of FIR low pass Filter using Triangle Window

References

1. Lab Manual for Digital Signal Processing Lab of Electronics and CommunicationEngineering, NSRIT

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PC 20EC608 Microwave and Radiating Systems Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs				
		PO4	PO5	PO6	PSO1	PSO2
20EC608.1	Characterize different microwave components	1	3	1	2	2
20EC608.2	Measuring the VSWR, Wavelength and frequency	1	3	2	2	2
20EC608.3	Determine scattering parameters of Circulator, Isolator and Magic TEE	2	3	2	2	2
20EC608.4	ermine the characteristics of LASER and LED	2	3	2	2	2
20EC608.5	asuring Numerical Aperture and losses of optical link	2	3	1	2	2

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

List of Experiments

1. Reflex Klystron Characteristics
2. GUNN diode characteristics
3. Directional Coupler characteristics
4. VSWR measurement
5. Wavelength and frequency measurement
6. Scattering parameters of Circulator & Isolator
7. Scattering parameters of Magic TEE
8. Characterization of LED
9. Characterization of LASER diode
10. Intensity modulation of LASER output through an Optical link
11. Measurement of data rate for Optical link
12. Measurement of Numerical Aperture
13. Measurement of losses for Analog optical link

References

1. Lab Manual for Microwave and Radiating System lab,Department of Electronics and Communication Engineering, NSRIT

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SC **20ECS04 Fundamentals of Machine Learning** 1 0 2 2

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO3	
20ECS04.1	Demonstrate the basic theory underlying machine learning	3	2	L1, L2
20ECS04.2	Formulate machine learning problems corresponding to different application	3	2	L1, L2
20ECS04.3	Demonstrate a range of machine learning algorithms along with their strengths and weaknesses	3	3	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

Introduction to machine learning- Classification - Regression - Learning Associations - Learning Applications, Supervised Learning - Vapnik - Chervonenkis (VC) Dimension - Probably Approximately Correct (PAC) Learning - Noise - Learning Multiple Classes - Regression - Model Selection and Generalization, Dimensionality Reduction - Introduction - Subset Selection - Isomap - Factor Analysis - Locally Linear Embedding, Clustering - Introduction, Mixture Densities, K-Means Clustering - Mixture of Latent Variable Models - Hierarchical Clustering, Decision Trees - Introduction, Univariate Trees- Pruning, Rule Extraction from Tress- Multivariante Trees. Programs on Linear Regression, Decision Trees using C/C++.

Reference Books

1. Alpaydin Ethem, "Introduction to machine learning", Prentice Hall India Learning Private Limited, 2nd Edition, 2010
2. Thomas P. Trappenberg, "Introduction to machine learning", Oxford University Press, 2019

Web Resources

1. https://onlinecourses.nptel.ac.in/noc22_cs29/course

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20MCX04 Indian Traditional Knowledge

2 0 0 2

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO6	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/

PE 20EC001 Computer Hardware Description Language 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20EC001.1	Demonstrate the concepts of different logics and implementations using Integrated circuits		L1, L2
20EC001.2	Design and analyze any Digital design in real time applications		L2, L4
20EC001.3	Extend the digital operations to any width by connecting the ICs and can also design, simulate their results using hardware description language		L1, L2
20EC001.4	Explain the concepts of MSI Registers, Modes of Operation of Shift Registers and Universal Shift Registers		L1, 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: Introduction to HDL **12 Hours**

Design flow, Program structure, History of VHDL, VHDL requirements, Elements of VHDL, VHDL Fundamentals, Levels of Abstraction, Entity and Architecture Representations, Dataflow Modeling, Behavioural Modeling, Structural Modeling, Timing and Delay Modeling.

Subprograms

Unit II: Digital Design Using VHDL **12 Hours**

VHDL Data Types, Variables, Signals, Constants, Packages, Libraries and Bindings, Objects and Classes, Arrays, Subprograms, Comparison of VHDL and Verilog HDL.

Data Operator

Unit III: VHDL Modelling **12 Hours**

Logic Simulation, Logic Synthesis, Inside a logic Synthesizer, Constraints, Technology Libraries, Functional Gate-Level verification, Place and Route, Post Layout Timing Simulation, Static Timing, Major Netlist formats for design representation.

VHDL Synthesis-Programming Approach

Unit IV: Combinational Circuits **12 Hours**

Combinational Circuit Analysis, Combinational Circuit Design, , Comparators, Decoders, Encoders, Multiplexers, Parity Generators and Checkers, Applications on Combinational Circuits.

Adders, Subtractor

Unit V: Sequential Circuits **12 Hours**

Sequential Circuit Analysis, Register, Shift Registers, Counter, Synchronous Counter, Asynchronous Counter, Memory, Read-Only Memory, Random Access Memory, Application on Data Storage Elements, Sequential Circuit Design, Applications on Sequential Circuits.

Latches, Flip-Flops

Textbooks

1. John F. Wakerly, "Digital Design Principles & Practices", 3rd Edition, Pearson Education Asia, 2005
2. Padmanabhan T. R., and Bala Tripura Sundari B., "Design through Verilog HDL", 2nd Edition, IEEE Press, 2004

References

1. Stephen Brown & Zvonko Vranesic, "Fundamentals of Digital logic design with VHDL", 2nd Edition, Tata McGraw Hill, 2005
2. Bhasker J., "VHDL Primer", 3rd Edition, Prentice Hall of India /Pearson Education, 2007

Web Resources or Links

1. http://www.downloadpdffree.com/digital-systems-principles-and-designrajkamal.pdf
2. http://www.getbookee.org/morris-mano-digital-design-4th-edition
3. http://nptel.iitm.ac.in
4. http://cmrtc.ac.in/EBooks/Digital%20Systems%20Design%20Using%20 VHDL.pdf

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define HDL Fundamental
2. What is VHDL?
3. What are the Data types and operators in VHDL?
4. Define Combinational circuits
5. Define Sequential circuits

L2: Understand

1. Explain the Design flow diagram
2. Explain the elements of VHDL
3. Write a VHDL program for Combinational Circuit
4. Write a VHDL program for Sequential Circuit
5. Write a VHDL program for RAM

L3: Apply

1. Give the comparison of synchronous and asynchronous counters
2. With the help of diagram explain 32 X 1 Mux by using 3 to 8 and 2 to 4 decoder
3. Give the comparison of VHDL and Verilog HDL
4. Obtain the 8-Bit Shift register by using D-Flip Flop

L4: Analyze

1. Determine VHDL program for the data storage elements
2. Discuss RAM and ROM with neat Diagrams
3. Analyze the Combinational circuits analysis with neat examples
4. Analyze the Sequential circuits analysis with neat examples

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PE 20EC002 Communication Systems 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20EC002.1	Classify and analyze the Block codes, cyclic codes and convolution codes		L1, L2, L3
20EC002.2	Demonstrate the properties of optical fibers, operation of LEDs, laser diodes, and PIN photo detectors		L1, L2, L3
20EC002.3	Demonstrate the method of interconnecting of two separate digital switches		L1, L2
20EC002.4	Demonstrate the basic cellular concepts and the different types of interferences influencing cellular communication		L1, L2, L3
20EC002.5	Identify traffic channels for call processing and explain the concepts of navigational aids		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: Linear and Convolution Codes — 12 Hours

Linear Block Codes: Introduction, Matrix description of Linear Block codes, Error detection and error correction capabilities of Linear block codes, Hamming codes, Binary cyclic codes, Algebraic structure, encoding, syndrome calculation.
Convolution Codes: Introduction, Encoding of convolution codes, Time domain approach, Transform domain approach. Graphical approach- State, Tree and Trellis diagram decoding using Viterbi algorithm.

BCH Codes

Unit II: Optical Fiber Communication — 12 Hours

Advantages of optical fiber communications, Total Internal reflection, Acceptance angle, Numerical aperture step index fibers, Graded index fibers, Single mode fibers- Cut off wavelength, Mode field diameter, Effective refractive index, Laser diodes, Optical detectors- Physical principles of PIN and APD, Detector response time, Temperature effect on avalanche gain.

Comparison of Photo detectors

Unit III: Digital Networks — 12 Hours

Introduction: Evolution of Telecommunications, Simple telephone communication, Basics of Switching system, Manual Switching system, Major Telecommunication networks.
Integrated Services Digital Network: Motivation for ISDN, New Services, Network and Protocol architecture, Transmission channels, User-Network interfaces, Signalling, Numbering and Addressing, Service characterization, ISDN Standards, Expert systems in ISDN, Broadband ISDN.

Voice Data Integration, Interworking

Unit IV: Cellular Communication — 12 Hours

Cellular Concepts: Evolution of Cellular systems, Concept of frequency reuse, frequency reuse ratio, Number of channels in a cellular system, Cellular traffic: Trunking and blocking, Grade of Service; Cellular structures: Macro, Micro, Pico and Femto cells
Interference: Types of interferences, Introduction to Co-Channel Interference, Real time Co-Channel interference, Co-Channel measurement, Co-channel interference reduction factor.

Cell splitting, Cell sectoring

Unit V: Digital Cellular Networks and Navigational Aids — 12 Hours

Digital Cellular Networks: GSM architecture, GSM channels, Multiple access schemes; TDMA, CDMA, OFDMA.
Navigational Aids: Principles of Direction finders, Aircraft homing and ILS, Radio altimeter, LORAN, DECCA, OMEGA, Inland Shipping Aids.

Operation of DECTRA, Salient features of Precision approach Radar

Textbooks

1. Simon Haykin, "Digital communications",4th Edition, John Wiley, 2005
2. Gerd Keiser, "Optical Fiber Communications"", 3rd Edition, Mc Graw-Hill International Edition, 2000
3. Thiagarajan Viswanathan, "Telecommunication Switching Systems and Networks", Prentice Hall India, 2000
4. Aditya K. Jagannathan, "Principles of Modern Wireless Communication Systems', Mc Graw Hill publishers, 2017
5. Raju G. S. N., "Radar Engineering and Fundamentals of Navigational Aids", IK International Publishers, 2008

Reference Books

1. Taub H. and Schilling D., "Principles of Communication Systems", Tata Mc-Graw Hill, 2003
2. John Proakis, "Digital Communications", Tata Mc-Graw Hill, 1983
3. Mynbaev D.K., Gupta S.C., and Lowell L. Scheiner., "Fiber Optic Communications", Pearson Education, 2005
4. Bellamy J., 'Digital Telephony", 2nd Edition, John Wiley, 2001
5. Vijay K. Garg and Morgan Kaufmann, " Wireless Communications and Networking", 2007
6. Gottapu Sasi Bhushana Rao, "Microwave and Radar Engineering", Pearson Education Chennai, 2013

Web Resources

1. https://nptel.ac.in/courses/117/106/117106031/
2. https://nptel.ac.in/courses/117/104/117104127/
3. https://nptel.ac.in/courses/117/105/117105076/
4. https://nptel.ac.in/content/syllabus_pdf/106106167.pdf
5. https://nptel.ac.in/courses/101/108/101108056/

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is encoding?
2. Write two difference between time domain approach and transform domain approach
3. Define Acceptance angle
4. Define effective refractive index of a fiber
5. List all types of switching systems
6. What is the use of signalling?
7. What is handoff?
8. List two types of interferences
9. What is direction finder?
10. What is ILS?

L2: Understand

1. Discuss about Error detection and error correction capabilities of Linear block codes
2. Explain the operation of p-i-n photo detector with neat sketches
3. Write Advantages and Disadvantages of Optical Fibers Communication
4. Briefly discuss about Broadband ISDN
5. With neat sketch, explain the concept of frequency reuse
6. Describe about Co-Channel measurement and Co-channel Interference Reduction Factor
7. Explain the working of DECCA receiver in brief
8. Describe the operation and typical applications of LORAN

L3: Apply

1. Consider a (7,4) linear block code with the parity-check matrix H given by:

$$H = \begin{bmatrix} 1 & 0 & 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$$

   Construct code words for this (7, 4) code and show that this code is a Hamming code
2. With an example, explain the decoding using Viterbi algorithm
3. Analytically compare the error performance of a block coded system with other codes
4. A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.50 and a cladding refractive index of 1.47. Determine: (i) the critical angle at the core-cladding interface;(ii) the NA for the fiber; (iii) the that the efficiency of full acceptance angle in air for the fiber
5. With suitable expressions show that the significance of total internal reflection and numerical aperture of an optical fiber

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PE 20EC003 Artificial Intelligence 3 1 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20EC003.1	Enumerate the history and foundations of Artificial Intelligence		L1, L2
20EC003.2	Apply the basic principles of AI in problem solving		L2, L3
20EC003.3	Formulate and solve given problem using Propositional and First order logic		L1, L2, L3
20EC003.4	Choose the appropriate representation of knowledge		L2
20EC003.5	Solve problems with uncertain information using Bayesian approaches and understand Fuzzy Logics		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 AI — 10+2 Hours

What Is AI? The Foundations of Artificial Intelligence, The History of Artificial Intelligence, Applications, The State of the Art, Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents, Current trends.

Cognitive Science, Basic Programming skills

Unit II: Problem Solving — 10+2 Hours

Introduction, general problem solving, characteristics of problem, Problem-Solving Agents, Example Problems, searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Problem Reduction: Introduction, Problem Reduction, Alpha-Beta Pruning.

BFS, DFS, Basic understand of Complex Algorithms

Unit III: Logic Concepts — 10+2 Hours

Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic, predicate logic.

Proportional Logic, First Order Logic, Clauses

Unit IV: Knowledge Representation — 10+2 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, Expert Systems.

Predicate Logic, Conversion of statements into predicate logic

Unit V: Uncertainty Measure — 10+2 Hours

Probability theory: Introduction, probability theory, Bayesian belief networks, certainty factor theory, dempster-shafer theory Fuzzy sets and fuzzy logic: Introduction, fuzzy sets, fuzzy set operations, types of membership functions, multi valued logic, fuzzy logic, linguistic variables and hedges, fuzzy propositions, inference rules for fuzzy propositions, fuzzy systems

Basics of Probability and Statistics

Text Books

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall
2. Saroj Kaushik, "Artificial Intelligence", CENGAGE Learning

Reference Books

1. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill
2. David Poole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University Press 2010
3. Trivedi, M.C., "A Classical Approach to Artificial Intelligence", Khanna Publishing House, Delhi
4. Ivan Bratko, "Prolog Programming for Artificial Intelligence", 2nd Edition Addison Wesley, 1440
5. Eugene, Charniak and Drew Mcdermott: "Introduction to Artificial Intelligence.", Addison Wesley

Web Resources

1. https://nptel.ac.in/courses/106105077
2. http://aima.cs.berkeley.edu/
3. https://nptel.ac.in/courses/106106126

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. Define AI
2. Define Intelligence
3. Define propositional logic
4. What are the four categories of AI?
5. Define Fuzzy Logic
6. State Uncertainty
7. What are the characteristics of problem?
8. Define Alpha-Beta Pruning

L2: Understand

1. Explain the four categories of AI
2. List out the four categories of AI system
3. What are the three components of AI?
4. Describe Axiomatic System with an example
5. Explain Resolution Refutation of propositional logic
6. Explain Dempster-Shafter theory
7. Describe Fuzzy Logic operations

L3: Apply

1. Solve water-jug problem using production rules
2. Write the BFS and DFS using heuristic search technique
3. Apply the possible heuristics for travelling salesman problem
4. Design heuristic function for 8-puzzle problem

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PE 20EC004 Computer Architecture and organization 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20EC004.1	Describe the fundamental organization of computer system		L1, L2
20EC004.2	Explain the concepts of design of basic components of the system		L1, L2
20EC004.3	Explain the functional units of a processor and addressing modes, Instruction format, program control statement		L1, L2
20EC004.4	Illustrate various algorithms to perform arithmetic operations		L1, L2
20EC004.5	Distinguish the organization of various parts of system memory hierarchy		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: Digital Logic Circuits and Data Representation — 12 Hours

Digital components: Integrated Circuits, Decoders, Multiplexers, Registers, Shift Registers, Binary Counters, Memory Unit.
Data Representation: Data types, Complements, Fixed Point Representation, Floating - Point Representation, Other Binary Codes, Error Detection codes.

Computer Types. Generation of Computers

Unit II: Register Transfer Language and Micro operations — 12 Hours

Register Transfer Language and Micro operations: Register Transfer language, Register Transfer Bus and memory transfers, Arithmetic Micro operations, logic micro operations, shift micro operations, Arithmetic logic shift unit.
Basic Computer Organization and Design: Instruction codes, Computer Register Computer Instructions, Timing and control, Instruction cycle, Memory - Reference Instructions, Input - Output and Interrupt.

Assembly Language, Design of basic computer

Unit III: Central Processing Unit and Micro Programmed Control — 12 Hours

Central Processing Unit: Stack organization, Instruction formats, Addressing modes, Data Transfer and manipulation, Program control, Reduced Instruction set computer.
Micro Programmed Control: Control memory, Address sequencing, Micro program example, Design of control unit.

General Register Organization, RISC Vs CISC Architecture.

Unit IV: Computer Arithmetic — 12 Hours

Addition and subtraction with Signed Magnitude Data - Hardware Implementation - Multiplication - Hardware Implementation for Signed Magnitude Data - Division - Hardware Implementation for Signed Magnitude Data - Divide Overflow - Floating Point Arithmetic operations.

BCD Adder-BCD Subtraction

Unit V: The Memory System and Input-Output Organization — 12 Hours

The Memory System: Main memory, Auxiliary memory, Associative Memory, Cache Memory, Virtual Memory.
Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupts, Direct memory Access.

Synchronous data transfer, Memory Hierarchy.

Textbooks

1. Morris Mano M., "Computer System Architecture", Revised 3rd Edition, Pearson, 2017
2. John P. Hayes, "Computer Architecture and Organization", 3rd Edition, McGraw Hill, 2002

Reference Books

1. Hamacher Carl, Zvonko Vranesic and safwatZaky, "Computer Organization", 5th Edition, McGraw Hill, 2011
2. William Stallings, "Computer Organization and Architecture", 6th Edition, Pearson, 2010

Web Resources

1. https://nptel.ac.in/courses/106/105/106105163/
2. https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/ 3.
3. https://www.javatpoint.com/computer-organization-and-architecture-tutorial

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 instruction cycle?
2. Define Cache memory. Mention any two advantages
3. List any five addressing modes
4. What is asynchronous serial transfer?
5. What is an interrupt?
6. Write about auxiliary memory
7. What is LIFO?
8. What is a mapping function?
9. List any three types of computers
10. Define Hit ratio and Miss ratio
11. What is circular shift micro operation?
12. What are peripherals?

L2: Understand

1. Compare RISC over CISC
2. Explain the structure of a basic computer system
3. Explain the concept of virtual memory. Why it is significant?
4. Explain the steps involved in the complete execution of an instruction
5. Differentiate between hardwired control and micro programmed control
6. Explain the functions of typical input-output interface
7. Explain the functional architecture of the computer system
8. Discuss about set-associative mapping
9. Explain the method of DMA transfer
10. Explain about the error detection codes
11. Explain the design of basic computer

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PE 20EC005 Advanced Electromagnetics 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20EC005.1	Make use of the fundamental relations of the electromagnetic field		L1, L2, L3
20EC005.2	Apply theorems to solve complex engineering problems		L1, L2, L3
20EC005.3	Demonstrate the working of waveguides and EM field configurations of different modes		L1, L2, L3
20EC005.4	Explain the properties of waveguide cavities and measure the electrical properties of material		L1, L2, L3
20EC005.5	Describe various modes of EM wave propagation		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: Auxiliary Vector Potentials 12 Hours

Introduction, vector potential F, vector potentials A and F, construction of solutions, solution of inhomogeneous vector potential wave equation, far-field radiation.

Radiation and scattering equations

Unit II: Electromagnetic Theorems and Principles 12 Hours

Duality theorem, uniqueness theorem, image theory, reaction theorem, volume equivalence theorem, huygen's principle, induction theorem.

Reciprocity theorem

Unit III: Rectangular Cross-section Waveguides and Cavities 12 Hours

Introduction, rectangular resonant cavities, hybrid modes, partially filled waveguide, transverse resonance method, dielectric waveguide, stripline and microstrip lines, ridged waveguide.

Rectangular waveguide

Unit IV: Circular Cross-section Waveguides and Cavities 12 Hours

Introduction, circular cavity, radial waveguides, dielectric waveguides and resonators.

Circular waveguides

Unit V: Spherical Transmission Lines and Cavities 12 Hours

Introduction, construction of solutions, bi-conical transmission line.

Spherical cavity

Textbooks

1. Harrington R. F., "Time Harmonic Electromagnetics", McGraw Hill, 1961
2. Harrington R. F., "Field Computation by Moment Methods", New York: MacMillan, 1968
3. Jordan E. C. and Balmain K. G., "Electromagnetic Waves and Radiating Systems", 2nd Edition, Prentice Hall India, Pvt. Ltd., New Delhi
4. Kraus J. D. and Fleisch D. A., "Electromagnetics with Applications", McGraw-Hill, 1999

Reference Books

1. William Hayt H. and John Buck, "Engineering Electromagnetics", 8th Edition, McGraw Hill, 2010
2. C.A. Balanis, "Advanced Engineering Electromagnetics", Wiley India, Pvt. Ltd., 2005

Web Resource

1. https://nptel.ac.in/courses/115/104/115104088/
2. https://nptel.ac.in/courses/115/104/115104088/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	16	-
L2	50	60
L3	34	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define vector potential
2. What is the significance of Image theory?
3. What is the significance of Hybrid modes?
4. What is Radial waveguide?
5. State Huygen's principle
6. What is circular cavity?

L2: Understand

1. Explain Polarization characteristics on Reflection
2. Explain Volume equivalence theorem
3. Discuss the Oblique incidence - lossless media
4. Describe the importance of radiation and scattering equations
5. Explain Induction theorem
6. Explain the features of Rectangular waveguide
7. Explain Dielectric Waveguides
8. Explain the concept of cavity resonator along with appropriate equations

L3: Apply

1. Find the cut-off frequency of TE_{21} mode in a circular waveguide of radius 4cms (take $\rho_{21}=3.054$)
2. Construct and explain the geometry of wave reflection in dielectric sheet wave guide for permitted angles of reflection
3. A standing wave has a maximum field of 150 μv/m and minimum field of 30 μv/m find
   i) VSWR ii) the reflection coefficient for wave
4. Develop the equations for Hybrid modes and explain
5. Derive the equation for vector potential A for an Electric current source J
6. Derive an expression for energy density in a magnetic field

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PE 20EC006 Electronic Measurements & Instrumentation 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20EC006.1	Identify the various parameters that are measurable in electronic instrumentation		L1, L2
20EC006.2	Classify and analyze different signal generators and analyzers		L1, L2, L3
20EC006.3	Explain construction and working principle of different oscilloscopes		L1, L2
20EC006.4	Implement the Bridge measurements for parameters like R, L, C, F		L1, L2, L3, L4
20EC006.5	Demonstrate how different types of Transducers used for measurement of physical parameters		L1, 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: Introduction to Measuring Instruments 12 Hours

Performance characteristics of instruments, Static characteristics, Accuracy, Resolution, Precision, Expected value, Error, Sensitivity. Errors in measurement, Dynamic characteristics-speed of response, Fidelity, Lag and Dynamic error, Errors in measurement, Design of multi range AC, DC meters (Voltmeters & Ammeters), Ohmmeters series type, Shunt type, Multi-meter for voltage, Current and resistance measurements.

True RMS meter

Unit II: Signal Generator And Signal Analyzers 12 Hours

Signal Generator- fixed and variable, Standard and AF sine and square wave signal generators, Function generators, Random noise, sweep, Arbitrary waveform, Wave analyzers, Harmonic distortion Analyzers, Spectrum analyzers, Digital fourier analyzers.

AF oscillators, Square pulse generators

Unit III: Oscilloscope 12 Hours

Oscilloscopes CRT features, Vertical amplifiers, Horizontal deflection system, Sweep, Trigger pulse, Delay line, Sync selector circuits, Triggered sweep CRO, Standard specifications of CRO, Probes for CRO- active & passive, Lissajous method of frequency measurement.
Special purpose CROs : Sampling oscilloscope ,Analog storage oscilloscope, Digital storage oscilloscope

Simple CRO

Unit IV: AC and DC Bridges 12 Hours

Measurements using DC and AC bridges: Wheat stone bridge, Kelvin bridge , Maxwell, Schering, Wien, Anderson bridges, Errors and precautions in using bridges, Q-meter

Hay bridge

Unit V: Transducers 12 Hours

Active & passive transducers : Resistance, Capacitance, Inductance; Strain gauges, LVDT, Piezo electric transducers Measurement of physical parameters force, Pressure, Velocity, Humidity and displacement.

Thermistors

Textbooks

1. Kalsi H. S., "Electronic instrumentation", 2nd Edition, Tata McGraw Hill, 2004
2. Helfrick A. D., and Cooper. W. D., "Modern Electronic Instrumentation and Measurement Techniques", 5th Edition, Prentice Hall of India, 2002
3. Bell, D. L., " Electronic Instrumentation and Measurements", 3rdEdition, Oxford University Press, 2013

Reference Books

1. LalKishore K., "Electronic Measurements and Instrumentation ", 2nd Edition, Pearson Education, 2010
2. Robert A., "Electronic Test Instruments, Analog and Digital Measurements", 2nd Edition, Pearson Education, 2010

Web Resources

1. https://www.scribd.com/
2. https://www.worldcat.org/
3. https://www.infibeam.com/
4. https://www.abebooks.co.uk

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	50	50
L3	20	20
L4	-	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define measuring system
2. Define precision and accuracy
3. Recall operation principle of frequency counter
4. Define the basic elements of function generator
5. Define the dynamic range of a spectrum analyser

L2: Understand

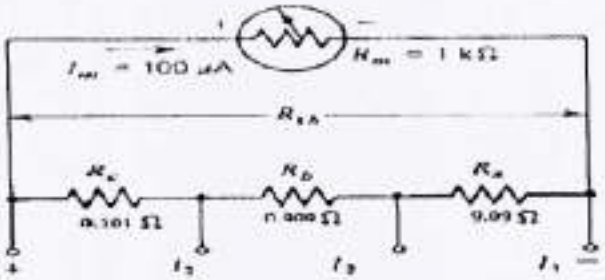
1. Describe the basic performance characteristics of a system? Explain in detail about it
2. Explain the constructional details and difference between Ohmmeter series type and shunt type
3. Describe the function of DC voltmeter and multirange voltmeter with neat operation explanation?
4. Explain the major parts of CRO with a block diagram
5. Draw the block diagram of a function generator and explain its operation
6. Explain how Wien's bridge can be used for experimental determination of frequency. Derive the expression for frequency in terms of bridge parameters

L3: Apply

1. Determine the Multiplier resistance on the 50V range of a DC Voltmeter, which uses 300mA meter movement having internal resistance of 1.2Ω.Show that the efficiency of full wave rectifier is 81.2%
2. If a basic DC bridge arms are connected with R1 = 2.2 K, R2 = 3.9 K, R3 = 10 K, find R4
3. A Maxwell bridge is used to measure inductive impedance. The bridge constants at balance are C1=0.01μF, R1=520k Ω, R2=6.2k Ω and R3=200k Ω
4. In a Wien bridge oscillator R1 = R2 =75k, C1=C.2= 400pf with usual notation. Determine the frequency of oscillations?
5. An unbalanced Wheatstone bridge has the following standard arms: R1=1K Ω, R2=2K Ω, R3=3K Ω, R4=4K Ω, Rg=300 Ω and E=5V. Calculate the current through the galvanometer

L4: Analyze

1. Identify the bridge used for measurement of inductance and explain the construction and operation of this bridge
2. Find the different ranges of currents can be measured by using multi-range ammeter shown in the figure



3. Simplify the equation for the gauge factor of a resistive strain gauge in terms of Poisson's ratio

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PE 20EC007 VLSI Design

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20EC007.1	Demonstrate a clear understanding of CMOS fabrication flow and technology scaling	-	L1, L2
20EC007.2	Apply the design Rules and draw layout of a given logic circuit		L1, L2, L3, L4
20EC007.3	Design MOSFET based logic circuit and basic building blocks in Analog IC design		L1, L2, L4
20EC007.4	Design various CMOS logic circuits for design of Combinational logic circuits		L1, L2, L3, L4
20EC007.5	Design & Analyze MOSFET based logic circuits using various logic styles like static and dynamic CMOS logic gates		L1, 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: Introduction — 12 Hours

Introduction to IC technology, The IC era, MOS and related VLSI technology, Basic MOS transistors, Enhancement and depletion modes of transistor action, IC production process, NMOS and CMOS fabrication process, Comparison between CMOS and BiCMOS technology

PMOS fabrication process, P-Well Process of CMOS fabrication process

Unit II: Basic Electrical Properties of MOS and CMOS Circuits — 12 Hours

Ids vs Vds relationships, Aspects of MOS transistor Threshold voltage, MOS Trans and output conductance and Figure of merit, The nMOS inverter, Determination of pull- up to pull-down ratio for nMOS inverter driven by another nMOS inverter, and through one or more pass Transistors, Alternative forms of pull up, MOS transistor Circuit model, The CMOS Inverter

nMOS Inverters

Unit III: MOS and CMOS Circuit Design Processes and Basic Circuit Concepts — 12 Hours

MOS layers, Stick diagrams, Design rules and layout diagrams for MOS circuits, Sheet resistance, Sheet resistance concept applied to MOS transistor and inverters, Area capacitance of layers, Standard unit of capacitance, Some area capacitance calculations, The delay unit, Driving large capacitive loads, Propagations Delays, Wiring Capacitance

Layout diagrams of NAND and NOR gates, Inverter delays, Choice of layers

Unit IV: Scaling of MOS Circuit and Basic Building Blocks of Analog IC Design — 12 Hours

Scaling models and scaling factors, Scaling factors for device parameters, Limitations of scaling, Limits due to sub threshold currents, Limits on logic level and supply voltage due to noise and to current density, Regions of operation of MOSFET, Modelling of transistor, body bias effect, biasing styles, single stage amplifier with resistive load Common Source amplifier, Common Drain amplifier, Common Gate amplifier

Introduction to switch logic and gate logic, single stage amplifier with diode connected load

Unit V: FPGA Design and Introduction to Advanced Technologies — 12 Hours

FPGA design flow, Basic FPGA architecture, FPGA Technologies, Introduction to FPGA Families, Giga-scale dilemma, Short channel effects, High-k, Metal Gate Technology, FinFET, and TFET

Textbooks

1. Kamran Eshraghian, Douglas, Pucknell A. and Sholeh Eshraghian, "Essentials of VLSI Circuits and Systems", 1st Edition, Prentice Hall of India Private Limited, 2005
2. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", 1st Edition McGraw Hill, 2003
3. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, "Digital Integrated Circuits", 2nd Edition, Pearson Publications, 2016

References

1. John P. Uyemura, John Wiley and Sons, "Introduction to VLSI Circuits and Systems", Wiley India Edition, 2009
2. Vinod Kumar Khanna, "Integrated Nanoelectronics: Nanoscale CMOS, Post-CMOS and Allied Nanotechnologies", 1st Edition, Springer India, 2016
3. Colinge J. P., "FinFET and other multi-gate transistors", Springer, 2008

Web Resources

1. https://www.tutorialspoint.com/vlsi_design/vlsi_design_digital_system.htm
2. http://cmrtc.ac.in/EBooks/Digital%20Systems%20Design%20Using%20 VHDL.pdf
3. http://nptel.iitm.ac.in

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List two advantages of ICs
2. Describe Short Channel devices
3. What are design rules?
4. Define Combinational circuits
5. Define Sequential circuits

L2: Understand

1. Explain different fabrication process of CMOS transistor
2. Explain clearly the CMOS Design style with neat sketches
3. Write the relationship between Ids versus Vds of MOSFET
4. Explain the Transmission gate and tri state inverter briefly
5. Write the comparison of synchronous and asynchronous counters

L3: Apply

1. Derive the expression for Ids vs Vds
2. Derive the expression for time delay Tsd in case of MOSFET
3. Derive the threshold voltage for NMOS enhancement transistor
4. Explain clearly the nMOS Design style with neat sketches
5. Write the applications of FPGA

L4: Analyze

1. Sketch the transistor level diagram for the expression Y=AB+CD and also get the corresponding Stick diagram representation using CMOS logic
2. Analyze the Combinational circuits analysis with neat examples
3. Analyze the Sequential circuits analysis with neat examples
4. Sketch stick diagram for nMOS inverter

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PE 20EC008 Wireless Communications and Networks 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20EC008.1	Demonstrate the functioning of wireless communication systems		L1, L2
20EC008.2	Classify different technologies used for wireless communication systems		L1, L2
20EC008.3	Explain the architecture, functioning, protocols, capabilities and application of various wireless communication networks		L1, L2, L3
20EC008.4	Demonstrate the ability to explain multiple access techniques for Wireless Communication		L1, L2
20EC008.5	Demonstrate the design challenges, constraints and security issues associated with Ad-hoc wireless networks		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: Overview of Wireless Communication — 12 Hours

Cellular communication, different generations and standards in cellular communication system, GPS, wireless local loop, cordless phone, paging systems, RFID.

Basics of satellite communications

Unit II: Recent Wireless Technologies — 12 Hours

Multicarrier modulation, OFDM, MIMO system, MIMO-OFDM system, smart-antenna; beamforming and MIMO, cognitive radio, software defined radio, communication relays, spectrum sharing.

Diversity multiplexing trade-off

Unit III: Multiple Access Techniques in Wireless Communication — 12 Hours

Contention-free multiple access schemes (FDMA, SDMA and Hybrid), Contention-based multiple access schemes (ALOHA and CSMA).

TDMA, CDMA

Unit IV: Wireless Personal Area Networks — 12 Hours

Bluetooth, UWB and ZigBee, wireless local area networks (IEEE 802.11, network architecture, WLAN standards), wireless metropolitan area networks (WiMAX).

Medium Access Methods

Unit V: Ad-Hoc Wireless Networks — 12 Hours

Design challenges in Ad-hoc wireless networks, concept of cross layer design, security in wireless networks, energy constrained networks, MANET and WSN.
Wireless system protocols: mobile network layer protocol (mobile IP, IPv6, dynamic host configuration protocol), mobile transport layer protocol (traditional TCP, classical TCP improvements), support for mobility (wireless application protocol).

MANET

Textbooks

1. Goldsmith Andrea, "Wireless Communications", Cambridge University Press, 2005
2. Sanjay Kumar, "Wireless Communication the Fundamental and Advanced Concepts", River Publishers, Denmark, 2015

Reference Books

1. Garg Vijay K., "Wireless Communications and Networks", Morgan Kaufmann Publishers an Imprint of Elsevier, USA, 2009
2. Schiller J., "Mobile Communication" 2nd Edition, Pearson Education, 2012
3. Saha Misra Iti., "Wireless Communication and Networks: 3G and Beyond", 2nd Edition, McGraw Hill Education (India) Private Ltd., New Delhi, 2013

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	50	20
L2	40	40
L3	10	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are cordless telephone systems?
2. Write two differences between GSM and GPRS
3. List any three types of small-scale fading
4. What is WLAN?
5. List any two propagating models

L2: Understand

1. Explain briefly about parameters of mobile multipath channels
2. Write the comparisons of common wireless communication systems
3. Explain the physical layer specifications of IEEE802.11 using infrared
4. Explain the similarities between HYPERLAN 1 and HYPERLAN 2
5. Compare IEEE 802.11 a, b, g and n standards
6. Draw the configuration of IEEE802.11 architecture
7. Demonstrate Two-Ray Rayleigh fading model

L3: Apply

1. Derive the Impulse response model of a Multipath channel
2. Derive the expression for Maximal Ratio Combining Improvement
3. Develop the relation between ALOHA and CSMA
4. Develop the Hybrid model of multiple access schemes

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PE 20EC009 Speech Processing 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20EC009.1	Summarize the mechanism of human speech production and articulation	-	L1, L2
20EC009.2	Differentiate time and frequency domain methods of speech processing		L1, L2
20EC009.3	Attribute linear predictive analysis for speech signals		L1, L2, L3
20EC009.4	Implement the different algorithms and models involved for speaker and speech recognition systems		L1, L2
20EC009.5	Explain the solutions for LPC equations		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: Mechanics of Speech 12 Hours

Speech production: Mechanism of speech production, Acoustic phonetics, The Acoustic Theory of Speech Production: Uniform lossless tube, Effects of losses in the vocal tract, Digital models for speech signals: Vocal tract, Radiation, Excitation, Auditory perception: psycho acoustics.

Representations of speech waveform: Sampling of speech signals, Quantization

Unit II: Time and Frequency Domain Methods for Speech Processing 12 Hours

Time domain parameters of Speech signal: Short-Time Energy, Average Magnitude, Average Zero Crossing Rate, Silence Discrimination using ZCR and energy, Short Time Auto Correlation Function, Pitch period estimation using Auto Correlation Function.

Short Time Fourier analysis: Fourier transform and linear filtering interpretations, Sampling rates in time and frequency, Pitch detection, Analysis by Synthesis, Analysis synthesis systems: Phase vocoder, Channel Vocoder, Median Smoothing, Spectrographic displays.

Fourier Transform interpretation

Unit III: Linear Predictive Analysis of Speech 12 Hours

Basic Principles of linear predictive analysis: Auto correlation method, Covariance method, Solution of LPC equations: Cholesky method, Durbin's Recursive algorithm, Application of LPC parameters: Pitch detection using LPC parameters, Formant analysis using LPC parameters, VELP. Relations Between the Various Speech Parameters, CELP.

Synthesis of speech from various linear predictive parameters

Unit IV: Speech Recognition Systems 12 Hours

Isolated digit recognition system, Continuous digit recognition system. Typical applications of computer voice response systems: Wiring communication equipment, Information retrieval systems.

A 3-Mode Speech Communication System

Unit V: Application of Speech Processing 12 Hours

Voice response systems: General considerations in the design of voice response systems, A multiple output digital voice response system, Speaker recognition systems: Speaker verification system, Speaker identification system.

Speech Synthesis by Concatenation of Formant-Coded Words

Textbooks

1. Rabiner L. R and Schaffer R. W., "Digital Processing of Speech signals", Prentice Hall, 2004
2. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing", John Wiley and Sons Inc., Singapore

Reference Books

1. Quatieri, "Discrete-time Speech Signal Processing", Prentice Hall, 2001
2. Rabiner L. R and Juang B. H., "Fundamentals of Speech Recognition", Prentice Hall, 1999

Web Resources

1. https://nptel.ac.in/courses/117/105/117105145/

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. What is Excitation?
2. Define zero crossing rate
3. Define STFT
4. What is pitch detection?
5. What is HMM?

L2: Understand

1. Explain the human speech production system with the help of a schematic representation of its physiological mechanism
2. Explain the concept of short-time speech processing with suitable general block diagram
3. Explain basic principles of linear predictive analysis
4. What is the concept of speaker verification system? explain with a related block diagrams
5. Explain Typical applications of computer voice response systems

L3: Apply

1. Discuss briefly about Digital modelling of Speech Signals
2. Explain Levinson -Durbin recursive algorithm for calculation of predictor coefficients
3. Discuss the Cholesky Decomposition Solution for Covariance Method for LPC Analysis
4. Draw and Explain Speaker Identification system. Also explain different performance measurement parameters used for speaker recognition

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PE 20EC010 Computer Networks

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20EC010.1	Describe the functions of each layer in OSI mode		L1, L2
20EC010.2	Describe the functions of data link layer and the protocols		L1, L2
20EC010.3	Explain the functions of network layer and its protocols		L1, L2
20EC010.4	Illustrate the session layer issues and transport layer services		L1, L2
20EC010.5	Exemplify the functions of application layer and presentation layer and their protocols		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 Networks — 12 Hours

Network Topologies, Network Hardware, Network Software. Reference models-OSI Reference Model- TCP/IP Reference Model - Physical Layer: Guided Transmission Media, Digital Modulation and Multiplexing, Public Switched Telephone Network.

Network Devices, Mobile Telephone System.

Unit II: Data Link Layer — 12 Hours

Data Link Layer Design issues, Error Detection &Correction, Elementary Data Link protocols, Sliding window protocols, Medium Access control sublayer: Multiple access protocols, Wireless LANS.

Bluetooth, Data Link layer switching.

Unit III: Network Layer — 12 Hours

Design Issues- Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, Quality of service, Network Layer in the Internet.

Routing for mobile hosts, Routing in Ad Hoc Networks.

Unit IV: Transport Layer — 12 Hours

Transport service, Elements of Transport protocols, Internet Transport Protocols: UDP, Internet Transport Protocols: TCP, Performance issues.

Delay-Tolerant Networking: DTN Architecture, Bundle protocols

Unit V: Application Layer — 12 Hours

Domain Name System: DNS Name Space, Resource Records, Name Servers, Electronic Mail: Architecture and Services, User Agent, Message Formats, Message Transfer, Final Delivery.

World Wide Web; Streaming Audio &Video.

Textbooks

1. Tanenbaum and David Wetherall J., "Computer Networks", 5th Edition, Pearson Education, 2010
2. Behrouz Forouzan A. and Firoz Musharraf, "Computer Networks: A Top-Down Approach", 1st Edition, McGraw Hill, 2012
3. Gary Donahue A., "Network Warrior", 2nd Edition, O'Reilly Media, Inc., 2011

Reference Books

1. Peterson L. L., Davie B. S. and Morgan-Kauffman, "Computer Networks: A Systems Approach", 5th Edition, 2011
2. Kurose J. F., Ross J. W. and Addison-Wesley, "Computer Networking: A Top-Down Approach", 5th Edition, 2009

3. William Stallings., "Data and Computer Communications" , Pearson Prentice Hall, 8th Edition, 2007.

Web Resources

1. http://1.https//nptel.ac.in/courses/106/105/106105183/
2. https://www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_network_pdf_version.htm
3. https://www.javatpoint.com/computer-network-tutorial

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 two advantages and disadvantages of mesh topology
2. Define Maximum Data rate of a channel
3. Define Ethernet and Fast Ethernet
4. Define Congestion.
5. Write the general principles of congestion
6. Define TCP and UDP
7. What are the problems with Congestion?
8. What are the design issues of data link layer?
9. What is the significance of DNS?

L2: Understand

1. Explain the structure of UDP Header format
2. Illustrate Routing of Packets within Virtual Circuit Subnet
3. Explain Traffic Aware Routing
4. Compare the throughput of pure aloha and slotted aloha
5. Explain Channel Aware Routing
6. Explain Simplex Stop & Wait Protocol
7. Compare synchronous time division multiplexing and statistical time division multiplexing
8. Explain different Network Topologies

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PE 20EC011 RF Components and Circuit Design

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20EC011.1	Identify and Analyze DC and low AC signals		L1, L2, L3
20EC011.2	Classify and Analyze different types of smith charts, RF & Microwave circuit design		L1, L2, L3, L4
20EC011.3	Construct Multi stage small signal amplifier Generator-tuning networks		L1, L2, L3, L4
20EC011.4	Demonstrate the normalized impedance-admittance		L1, L2, L3
20EC011.5	Explain the Signal distortion due to inter modulation products		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 RF and Microwave concepts — 12 Hours

Introduction, reasons for using rf/microwaves, RF/microwave applications, RF and microwave circuit design, the unchanging fundamentals versus the ever-evolving structure, general active circuit block diagrams.

Radio frequency waves

Unit II: RF Electronics Concepts — 12 Hours

Introduction, RF/Microwaves versus DC or low AC signals, introduction to component basics, resonant circuits, analysis of a simple circuit in phasor domain, impedance transformers, RF impedance matching, three element matching.

EM spectrum, wave length and frequency

Unit III: Smith Chart and its Applications — 12 Hours

Introduction, a valuable graphical aid the smith chart, derivation of smith chart, smith charts circular scales, smith charts radial scales, the normalized impedance-admittance (ZY) smith chart introduction, applications of the smith chart, distributed circuit applications, lumped element circuit applications.

Description of two types of smith charts

Unit IV: RF and Microwave Amplifiers — 12 Hours

Introduction, types of amplifiers, small signal amplifiers, multistage small signal amplifier design, high-power amplifiers, large signal amplifier design, microwave power combining/dividing techniques, signal distortion due to inter modulation products, multistage amplifiers, large signal design.

Design of different types of amplifiers

Unit V: RF and Microwave Oscillator Design — 12 Hours

Introduction, oscillation conditions: Two port NR oscillators, a special case: One port NR oscillator, condition of stable oscillation, design of transistor oscillators, generator-tuning networks: Fixed frequency oscillators, frequency tunable oscillators.

Oscillator versus amplifier design

Textbooks

1. Radmanesh Mathew M., "Radio Frequency and Microwave Electronics", Prentice Hall of India, 2001
2. Helszain Joseph, "Microwave Engineering, Active and Non-Reciprocal Circuits", McGraw Hill International Edition, 1992

Reference Books

1. Hagen, "Radio Frequency Electronics, Circuits and Applications", Cambridge University Press, 1996

2. Bowick, "RF Circuit Design", 2nd Edition, Newnes, 2007
3. Reinhold Ludwig and Gene Bogdanov, "RF Circuit Design: Theory and Applications", 2nd Edition, Prentice Hall, 2000

Web Resources

1. https://nptel.ac.in/courses/117/105/117105138/
2. https://nptel.ac.in/courses/108/101/108101112/
3. https://www.coursera.org/learn/rf-mmwave-circuit-design
4. https://www.udemy.com/course/basics-of-rf-components-matching-networks-and-filter-design/

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

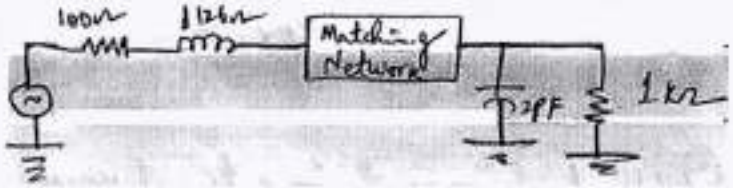
1. What are the pre-requisites for any general system design?
2. What is RF impedance matching?
3. Write three applications of smith charts
4. Draw the equivalent circuit of a real capacitor
5. Define power gain
6. Write three advantages fixed frequency oscillators

L2: Understand

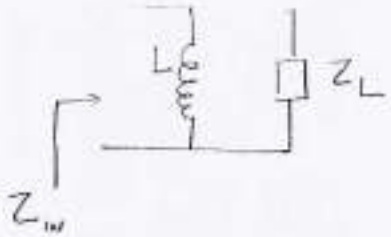
1. Explain how a two-conductor transmission line behaves at low and high frequencies
2. Draw and explain the operation of amplifier and detector circuits of a general communication system
3. Demonstrate the analysis of a simple circuit in phasor domain
4. Discuss about distributed & Lumped element circuit applications with examples
5. Explain the steps in design procedure of class A large-signal amplifier
6. Differentiate between Oscillator and amplifier design
7. Explain the principle of operation/working of a) YIG-tuned oscillator circuits b) Dielectric resonator circuits
8. Draw an experimental set-up for measuring SP and LP and explain the procedure for measurement

L3: Apply

1. Using KVL and KCL derive the relationship between voltage and current in a transmission line at: i) Low frequencies ii) High frequencies
2. Give a neat sketch for a smith chart and explain clearly, step by step, how would you use smith chart to: i) Calculate the complex reflection coefficient ii) Transfer impedance from one point to other along the line iii) Determine the length and location of a short-circuited stub line for impedance matching purpose
3. Using the tapped-C method, design a resonant circuit with a loaded Q of 40 at a centre frequency of 100 Mhz that operates between a source resistance of 100 Ω and a load resistance of 3000 Ω. Assume lossless capacitors and the inductor has a φ of 100 at 100 Mhz
4. Use the absorption method to match the source (100+j126Ω) to a load (1000//-j795.8Ω) at 100 Mhz, as shown in figure below



5. Use Smith chart to calculate the total input admittance of a combination of a load $Z_L = 50+j50\Omega$ with a shunt inductor of L= 8nH at f_0 = 1GHz as shown in figure below. Assume a 50 Ω system



6. A power amplifier uses a Gats FET transistor that has the following large - signal S-parameters at 3GHz in a 50Ω system S11 = 0.62∠140°, S12 = 0.06∠10°, S21 = 2.58∠20°, S22 = 0.53∠120° P1dB = 30dBm. Design a class A amplifier for maximum output power

L4: Analyze

1. A lossless transmission line is connected to a load ZR LR = 100+j 100Ω. Using a Smith chart determine reflection coefficient at the load, the return loss and the reflection coefficient and the input impedance λ/8 away from the load
2. A lossless line of 300 Ω is terminated by a load of Z_R. If the VSWR at 200 MHz is 4.48, and the first V_{max} is located at 6cm from the load. Calculate the reflection coefficient and Z_R
3. The reflection coefficient at load is 0.5 $\underline{|30^0}$. The characteristic impedance is 100. At 200MHz, calculate-i) The position of V_{min} nearest to the load ii) The ratio of voltage to current at the load iii) The value of the load, and VSWR
4. A lossless transmission line is connected to a load Z_L=100+j 100Ω. Using a Smith chart Determine reflection coefficient at the load, the return loss and the reflection coefficient and the input impedance λ/8 away from the load
5. Find impedance of a device having reflection coefficient of 2.23 with an angle of 26.5 degree

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PE 20EC012 Bio-Medical Instrumentation 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20EC012.1	Explain the various sources of bio-electric potentials in man-instrumentation system		L1, L2
20EC012.2	Outline the anatomy of Cardiovascular and respiratory system and their measuring instruments		L1, L2, L3
20EC012.3	Summarize the functionality of patient care & monitoring equipment's used to identify the malfunction of human body		L1, L2, L3
20EC012.4	Demonstrate various bio telemetry instruments in the clinical laboratory		L1, L2, L3
20EC012.5	Identify the different diagnostic imaging techniques and monitors, recorders and electrical accident prevention method		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: Sources of Bioelectric Potentials and Electrodes **12 Hours**

Resisting and action potentials, Propagation of action potentials, The bioelectric potentials. Electrodes: Electrode theory, Bio potential electrodes, Biochemical transducers.

Introduction to bio-medical signals

Unit II: The Cardiovascular System **12 Hours**

The heart and cardiovascular system, The heart, blood pressure, Characteristics of blood flow, Heart sounds, Cardiovascular measurements, Electrocardiography, Measurement of blood pressure, Measurement of blood flow and cardiac output, Plethysmography, Measurement of heart sounds, Event detection, PQRS & T-Waves in ECG, The first & second heart beats, ECG rhythm analysis, The di-crotic notch in the carotid pulse detection of events and waves, Analysis of exercise ECG, Analysis of event related potentials, Correlation analysis of EEG channels.

Correlation of muscular contraction

Unit III: Patient Care & Monitory and Measurements in Respiratory System **12 Hours**

The elements of intensive care monitory, Diagnosis, Calibration and reparability of patient monitoring equipment, Other instrumentation for monitoring patients, Pace makers, defibrillators, the physiology of respiratory system, tests and instrumentation for mechanics of breathing, respiratory theory equipment.

Analysis of respiration

Unit IV: Bio Telemetry and Instrumentation for the Clinical Laboratory **12 Hours**

Introduction to biotelemetry, Physiological parameters adaptable to biotelemetry, The components of biotelemetry system, Implantable units, Applications of telemetry in patient care - The blood, tests on blood cells, chemical test.

Automation of chemical tests

Unit V: X-ray and Radioisotope Instrumentation and Electrical Safety of Medical Equipment **12 Hours**

Generation of lonizing radiation, Instrumentation for diagnostic X-rays, Special techniques, Instrumentation for the medical use of radioisotopes, Radiation therapy - physiological effects of electrical current, Shock hazards from electrical equipment, Methods of accident prevention.

Modern Imaging Systems: Tomography, Magnetic resonance imaging system, Ultrasonic imaging system.

Medical thermography

Textbooks

1. Leslie Cromwell, Fred Weibell J. and Erich Pfeiffer A., "Biomedical Instrumentation and Measurements", 2nd Edition, Prentice Hall, New Delhi, 1998
2. Geddes L. A. and Baker L. E., "Principles of Applied Biomedical Instrumentation", 3rd Edition, John Wiley, New York, 1989
3. Bell A. B., " Electronic Instrumentation and Measurements", 3rd Edition, Oxford University Press, 2013

Reference Books

1. John. G. Webster, "Medical Instrumentation, Application and Design", 2nd Edition, John Wiley, New York, 1998
2. Richard Aston, "Principles of Bio-medical Instrumentation and Measurement", 3rd Edition, Merril Publishing Company, New York, 1999

Web Resources

1. http://www.bio12.com/ch17/Notes.pdf
2. http://highered.mcgraw
3. https://www.infibeam.com/
4. http://fourier.eng.hmc.edu/e84/lectures/ch4/node3.html

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 are resisting and action potentials?
2. Define EEG and ECG
3. What are the methods involved in direct blood pressure measurement?
4. What are the elements of biotelemetry system?
5. Write three applications of MRI

L2: Understand

1. Describe in detail about the clinical significance, lead configuration, recording methods and waveforms of ECG
2. Explain the concepts of ultrasonography and mention its types
3. Discuss in detail about bio medical signals
4. Explain the different elements involved in biotelemetry circuits
5. With neat sketches explain bio chemical transducers

L3: Apply

1. List the modes of ultrasonic imaging system and explain any one
2. Compare ultrasonic diagnosis with x ray diagnosis
3. List the instrument used in clinical laboratory, explain any one in details
4. Discuss the elements of intensive care monitory

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PE 20EC013 Digital VLSI **3 0 0 3**

Pre- Requisite Electronic devices and circuits, Digital Logic Design, VLSI Design

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

Code	Course Outcomes	Mapping with POs	DoK
20EC013.1	Illustrate concepts of CMOS Inverter logic and Pseudo NMOS Logic using basic inverter circuit		L1, L2, L3,L4
20EC013.2	Design and analyse combinational MOS logic circuits		L1, L2, L3
20EC013.3	Design different types of sequential MOS logic circuits		L1, L2, L3
20EC013.4	Identify different types of interconnects		L1, L2, L3
20EC013.5	Understand the concepts and types of semiconductor memory		L1, 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: MOS Design — 9 Hours

Pseudo NMOS Logic - Inverter, Inverter threshold voltage, output high voltage, Output Low voltage, gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

CMOS Inverter - Static Characteristics, Dynamic Characteristics.

Unit II: Combinational MOS Logic Circuits — 9 Hours

MOS logic circuits with NMOS loads, Primitive CMOS logic gates - NOR & NAND gate, Complex Logic circuits design - Realizing Boolean expressions using NMOS gates and CMOS gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates

AOI and OIA gates

Unit III: Sequential MOS Logic Circuits — 9 Hours

Behaviour of bistable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop.
Dynamic Logic Circuits: Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOS transmission gate logic, High performance Dynamic CMOS circuits.

Nonbistable Sequential Circuits

Unit IV: Interconnect and Clocking Strategies — 9 Hours

Interconnect Parameters - Capacitance, Resistance, and Inductance, Advanced Interconnect Techniques, Timing classification of Digital Systems, Synchronous Design, Self-Timed Circuit Design.

Electrical Wire Models, Clock gating

Unit V: Semiconductor Memories — 9 Hours

Memory Types, RAM array organization, DRAM - Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory- NOR flash and NAND flash.

In-Memory Technology

Text Books

1. Rabaey, M., Anantha Chandrakasan and Borivoje Nikolic, "Digital Integrated Circuits - A Design Perspective", 2nd Edition, Prentice Hall International, 2016.
2. Ken Martin, "Digital Integrated Circuit Design", Oxford University Press, 2011.

Reference Books

1. Sung-Mo Kang and Yusuf Leblebici, "CMOS Digital Integrated Circuits Analysis and Design", 3rd Edition, Tata McGraw Hill 2011.
2. Neil, H. E. Weste, David harris and Ayan Banerjee, "CMOS VLSI Design", 3rd Edition, Pearson Publications, 2006.

Web References

1. https://www.youtube.com/watch?v=juN82_ifNA0
2. https://www.youtube.com/watch?v=wPs9hjrQd08
3. https://www.ee.iitb.ac.in/~intel/vlsi.html

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 inverter threshold voltage?
2. What is transmission gates?
3. What is dynamic Logic circuit?
4. Write the three types of Electrical Wire Models.

L2: Understand

1. Explain the concept of transient response in MOS circuits.
2. Explain about different Dynamic Logic Circuits.
3. Describe the concept of Advanced interconnect Techniques.
4. Illustrate about DRAM and SRAM Leakage currents.

L3: Apply

1. Design and explain the concepts of CMOS D-Latch and edge triggered Flipflop.
2. Design a basic inverter using Pseudo NMOS logic.
3. Design full adder using CMOS and Transmission Gate technology.
4. Write about formation of capacitive and inductive parasites in MOS circuits.

L4: Analyse

1. Sketch the NAND gate using Pseido NMOS logic and explain its operation.
2. Analyse the difference in design of circuits using CMOS logic and Psedo NMOS Logic.
3. Analyse CMOS inverter Logic.
4. Analyse about different types of Flash memory.

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PE 20EC014 Satellite Communications 3 0 0 3

Pre- Requisite Antenna Wave Propagation, Radar Systems

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

Code	Course Outcomes	Mapping with POs	DoK
20EC014.1	Understand the basic concepts, applications and Future Trends in satellite communications		L1, L2
20EC014.2	Demonstrate the concepts on Orbital Mechanics and Launcher systems		L1, L2, L3
20EC014.3	Analyze the expression for G/T ratio and some analytical problems on satellite link design		L1, L2, L3
20EC014.4	Demonstrate the satellite Transmitters, Receivers, LEO and NGSO Systems		L1, L2, L3
20EC014.5	Identify the concepts of Navigational Aids, GPS and its architecture		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 — 9 Hours

Origin and History of Satellite Communications, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications.

PSLV, GSLV, SSLV

Unit II: Orbital Mechanics and Launchers — 9 Hours

Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbit determination, launches and launch vehicles, Orbital effects in communication systems performance.

Apogee, Perigee

Unit III: Satellite Subsystems — 9 Hours

Attitude and orbit control system, telemetry, tracking, Command and monitoring, power systems, communication subsystems, Satellite antenna Equipment reliability and Space qualification. Satellite Link Design: Basic transmission theory, system noise temperature and G/T ratio, Design of down links and up links.

Design of satellite links for specified C/N, System design example

Unit IV: Multiple Access Techniques — 9 Hours

CDMA and DAMA Inter-modulation, Calculation of C/N, Spread spectrum transmission and reception. Low Earth Orbit and Geo-Stationary Satellite systems: Orbit consideration, coverage and frequency considerations, Delay& Throughput considerations, System considerations, Operational NGSO constellation Designs.

FDMA, TDMA

Unit V: Satellite Navigation & the Global Positioning system — 9 Hours

Radio and Satellite Navigation, GPS Position Location principles, GPS Receivers and codes, Satellite signal acquisition, GPS Navigation Message, GPS signal levels, GPS receiver operation, GPS C/A code accuracy.

GLONAS, Differential GPS

Text Books

1. Timothy Pratt, Charles Bostian, and Jeremy Allnutt, "Satellite Communications", 2nd Edition, John Wiley Publications, 2003
2. Pritchard, L., Robert, A. Nelson and Henri, G. Suyderhoud, "Satellite Communications Engineering" 2nd Edition, Pearson Publications, 2003

3. Tri, T. Ha., "Digital Satellite Communications" 2nd Edition, McGraw Hill, 2000
4. Raju. G. S. N., "Radar Engineering and Fundamentals of Navigational Aids", IK International Publishers, 2008

Reference Books

1. Dennis Roddy, "Satellite Communications", 2nd Edition, McGraw Hill, 1996
2. Richharia, M., "Satellite Communications: Design Principles", 2nd Edition, BS Publications, 2003
3. Agarwal, D. C., "Satellite Communication", 5th Edition, Khanna Publications, 2008
4. Raja Rao, K. N., "Fundamentals of Satellite Communications", Prentice Hall of India, 2004
5. Gottapu Sasi Bhushana Rao, "Microwave and Radar Engineering", Pearson Education Chennai, 2013

Web Resources

1. https://blog.oureducation.in/satellite-launching-mechanism/
2. https://www.slideshare.net/ManikantaswamySeerip/satellite-orbit-and-constellationdesign
3. https://www.elprocus.com/how-gps-system-works

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	35	35
L2	35	35
L3	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Satellite?
2. Give the frequency ranges of VHF, UHF, L and S
3. What is meant by transponder?
4. Give the two segments of basic satellite communication
5. List two types of CDMA
6. Define noise factor
7. Write three major sources of error in a GPS receiver

L2: Understand

1. Discuss the various satellite services in brief
2. Draw a basic block diagram of satellite communication system and explain each block in detail
3. Explain in detail about of Orbit perturbations
4. Explain the TDMA frame structure
5. Draw describe the working of transmitter and receiver block diagrams of an earth station
6. Explain the function of the non-coherent delay lock loop in GPS receiver

L3: Apply

1. State and derive the expressions for the look angles with help of necessary diagrams
2. State the Kepler's laws. Discuss its importance in satellite communications
3. Calculate the C/N with inter modulation
4. How to determine the optimum orbital altitude? Explain in detail
5. Describe the technology of range error budget used to provide accuracy in GPS C/A code receiver

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PE 20EC015 Digital Image Processing Techniques 3 0 0 3

Pre- Requisite Digital Signal Processing

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

Code	Course Outcomes	Mapping with POs	DoK
20EC015.1	Defining the digital image, representation of digital image, importance of image resolution, applications in image processing and Know the advantages of representation of digital images in transform domain		L1, L2, L3, L4
20EC015.2	How an image can be enhanced by using histogram techniques, filtering techniques and understand image degradation, image restoration techniques using spatial filters and frequency domain		L1, L2, L3, L4
20EC015.3	Analyze pseudo and full color image processing techniques		L1, L2, L3
20EC015.4	Know the detection of point, line and edges in images, edge linking through local processing, global processing, Understand the redundancy in images, various image compression techniques		L1, L2, L3, L4
20EC015.5	Know the video technology from analog color TV systems to digital video systems, how video signal is sampled and filtering operations in video processing		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:Fundamentals of Image Processing and Image Transforms 9 Hours

Introduction to Image Processing, Fundamental steps in digital image processing, components of an image processing system, image sampling and quantization, some basic relationships between pixels, Need for transform, image transforms, Walsh transform, Hadamard transform, Haar transform, slant transform, Discrete cosine transform, KL transform.

Fourier transform, Discrete Fourier transform

Unit II: Image Enhancement and Image Restoration 9 Hours

Histogram processing, Fundamentals of Spatial filtering, smoothing spatial filters, sharpening spatial filters, Selective filtering, A model of the image degradation / Restoration process, Noise models, restoration in the presence of noise only-Spatial Filtering, Estimating the degradation function, Inverse filtering, Minimum mean square error (Wiener) filtering.

Basics of filtering in frequency domain

Unit III: Color image processing 9 Hours

Color fundamentals, color models, pseudo color image processing, basics of full color image processing, color transformations, smoothing and sharpening, Image segmentation based on color.

Noise in color images, color image compression,

Unit IV: Image Segmentation and Image Compression 9 Hours

Introduction to image segmentation, Point, Line and Edge Detection, Region based segmentation, Image segmentation based on thresholding, Introduction to compression, Classification of image compression schemes, Fundamentals of information theory, Run length coding, Shannon - Fano coding, Huffman coding, Arithmetic coding, LZW coding.

Need for image compression

Unit V: Basic Steps of Video Processing 9 Hours

Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, filtering operations.

Sampling of Video signals

Textbooks

1. Gonzalez and Woods R. E., "Digital Image Processing", 3rdEdition, Pearson, 2008.
2. Tekalp M., "Digital Video Processing", 2ndEdition, Prentice Hall International, 2015.

Reference Books

1. Jayaraman S., Esakkirajan S. and Veera Kumar T., "Digital Image Processing" Tata McGraw Hill, 2009.
2. Yao Wang, JoemOstermann and Ya-quin Zhang, "Video Processing and Communication", 1st Edition, Prentice Hall International,2017.
3. ScotteUmbaugh, "Digital Image Processing and Analysis-Human and Computer Vision Application with CVIP Tools" 2nd Edition, CRC Press, 2011.

Web Resources or Links

1. https://www.imageprocessingplace.com/
2. https://onlinecourses.nptel.ac.in/noc19_ee55/preview

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. What is meant by pixel?
2. Define Digital Image
3. What do you mean by color models?
4. What is Image transform?
5. What is Image enhancement?

L2: Understand

1. Explain Image Restoration Models
2. Explain Image Compression techniques.
3. Explain Analog Video and Digital Video.
4. Explain Line based segmentation.
5. Explain Selective Filtering.

L3: Apply

1. Draw The Basic block diagram of the Image Processing.
2. How the order statistics filters are remove the Impulse Noise.
3. Draw the Image Restoration and degradation diagram and apply to estimation of degradation function.
4. How to classify the Image compression.

L4: Analyze

1. Discuss Shannon-Fano coding with neat example.
2. Describe Huffman coding Arithmetic coding
3. Discuss Arithmetic coding with neat example.
4. Describe spatial filtering and frequency filtering techniques.
5. Discuss Color image processing techniques.

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PE 20EC016 Embedded System Design 3 0 0 3

Pre- Requisite Electronic Devices & Circuits , Microprocessor and Microcontroller

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

Code	Course Outcomes	Mapping with POs	DoK
20EC016.1	Understand the basic concepts of an embedded system		L1, L2
20EC016.2	Describe the Hardware components required for an embedded system and understand the design approach of an embedded hardware		L1, L2
20EC016.3	Discuss the various embedded firmware design approaches on embedded environment		L2, L3, L4
20EC016.4	Understand how to integrate hardware and firmware of an embedded system using real time operating system.		L2, L3, L4
20EC016.5	Understand and apply hardware & software architectures		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 Embedded Systems 9 Hours

What is embedded system, embedded systems vs.general computing systems, history of embedded systems, and classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, the typical embedded system-core of the embedded system, Sensors and Actuators, Communication Interface,Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

Memory

Unit II: Embedded Hardware Design 9 Hours

Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Watchdog timer, Real time clock

Reset circuit, brownout protection circuit

Unit III: Embedded Firmware Design 9 Hours

Embedded Firmware design approaches, Embedded Firmware development languages, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming

Concepts of C versus Embedded C and Compiler versusCross-compiler.

Unit IV: RTOS and Hardware& software Co-design 9 Hours

Operating system basics, Types of operatingsystems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronization, Device Drivers, Fundamental Issues in Hardware Software Co-Design, Hardware Software Tradeoffs.

Integration of Hardware andFirmware

Unit V: Embedded System Development, Implementation And Testing 9 Hours

The integrated development environment, Types of files generated on cross-compilation, Deassembler/Decompiler, Simulators, Emulators and Debugging, Target hardware debugging, Embedded Software development process and tools, Compilers and Linkers, Debugging tools, Quality assurance and testing of the design, Testing on host machine, Simulators, Laboratory Tools.

Interpreters

Text Books

1. Shibu K V., "Introduction to Embedded Systems", 2nd Edition, McGraw Hill Education,2017
2. Raj Kamal, "Embedded Systems: Architecture, Programming and Design", 3rd Edition, McGraw Hill Education, 2017.

Reference Books

1. Frank Vahid, Tony Givargis., "Embedded System Design", John Wiley Publications, 2013.
2. Lyla B. Das., "Embedded Systems", Pearson Publications, 2013.

Web References

1. http://nptel.ac.in/courses/108102045/
2. http://www.embedded.com

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define embedded system.
2. List the types of files generated on cross-compilation
3. What are Timer and counting devices?
4. List the different applications of embedded systems.

L2: Understand

1. Explain the various purposes of embedded systems in detail with illustrative examples.
2. Illustrate the different onboard communication interface in brief.
3. Classify the different approaches available for embedded firmware development.
4. Explain the different characteristics of embedded systems in detail.

L3: Apply

1. Compare general purpose processor and application specific instruction set processors with an example.
2. Explain the sequence of operation for communicating with an I2C slave device.
3. Explain various I/o devices in detail ? Mention the signals used by I/o devices for interrupting.
4. List and describe the three types of ROM and RAM.
5. Give examples for small scale embedded systems.

L4: Analyze

1. Analyze how threads and process are related.
2. Discuss the role of Real Time Clock in embedded system.
3. Discuss the role of Watch dog Timer in embedded system.
4. Compare PLD and ASIC.
5. Compare RISC and CISC processors.

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PE 20EC017 Smart Antennas

3 0 0 3

Pre-Requisite Electromagnetic Waves & Transmission Lines, Antennas & Wave Propagation

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

Code	Course Outcomes	Mapping with POs	DoK
20EC017.1	Understand the fundamentals of Smart Antennas and its configurations		L1, L2, L3
20EC017.2	Understand the architecture and arrays of Smart Antennas		L1, L2, L3
20EC017.3	Understand the different techniques involved in Smart Antennas		L1, L2, L3
20EC017.4	Understand the techniques of CDMA for spatial processingin Smart Antenna Systems		L1, L2, L3
20EC017.5	Understand the performance analysis of CDMA system using Spatial Filtering		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

Unitl: Introduction to Smart Antennas — 9 Hours

Performance Improvement, Feasibility, and System Considerations, BeamForming and Direction-of-Arrival Considerations.Spatial Processing for Wireless Systems, Key Benefits of Smart Antennas , Smart antenna introduction ,smart antenna configuration.

Application of Antenna Arrays to Mobile Communications

Unit II: Smart Antenna Architecture and Arrays — 9 Hours

SDMA, architecture of smart antenna systems, The Vector Channel Impulse Response and the Spatial Signature, Spatial Processing Receivers, Fixed Beam forming Networks, Switched Beam Systems.

Beam forming Networks

Unit III: Smart Antenna Systems — 9 Hours

Adaptive Antenna Systems, Wideband Smart Antennas, Spatial Diversity, Diversity Combining, and Sectoring, Digital Radio Receiver Techniques and Software Defined Radios for Smart Antennas, Transmission Beam forming.

Spatial Diversity

Unit IV: Smart Antennas Techniques for CDMA — 9 Hours

Non-Coherent CDMA Spatial Processors, Coherent CDMA Spatial Processors and the Spatial Processing Rake Receiver, Multi-User Spatial Processing, Dynamic Re-sectoring Using Smart Antennas, Downlink Beam forming for CDMA.

Spatial Processing

Unit V: CDMA System Improvement Using Spatial Filtering — 9 Hours

Range Extension in CDMA, Single Cell Systems with Spatial Filtering at the IS-95 Base Station, Reverse Channel Performance of Multi-cell Systems with Spatial Filtering at the Base Station, Range and Capacity Analysis Using Smart Antennas - A Vector Based Approach.

Reverse Channel Spatial Filtering at the WLL Subscriber Unit

Text Books

1. T.S. Rappaport and J.C. Liberti, "Smart Antennas for Wireless Communications", Prentice Hall, 1999
2. Tapan K. Sarkar ,"SmartAntennas",IEEE Press, John Wiley & Sons Publications,2003
3. L.C.Godara, "Applications of antenna arrays to mobile communications, Part I: Performance improvement, feasibility, and system considerations", Proc. IEEE, vol. 85, no.7, pp.1031-1060, 1997.

Reference Books

1. C. A. Balanis and P. I. Ioannides, "Introduction to Smart Antennas", Morgan & Claypool Publication , 2014
2. Frank Gross, "Smart Antennas with MATLAB", McGraw-Hill Professional , 2015
3. Lal Chand Godara, "Smart Antennas", CRC Press

Web References

1. https://www.youtube.com/watch?v=Hq_JBLgGr4E
2. https://www.ll.mit.edu/outreach/adaptive-antennas-and-phased-arrays-online-course

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 are the features of a smart antenna system? Write benefits of smart antennas. Alsomention few applications of smart antennas in wireless systems
2. What are the principles of Rake receiver in detail?
3. What is switched beam system?

L2: Understand

1. Discuss the concept of Antenna beam forming
2. How mutual coupling between the antennas in an array affect the desired reception of thearray? Explain this by considering an array of two antennas.Illustrate the difference between raft foundation and shallow foundation
3. Differentiate Fixed Beam forming Networks and Switched Beam Systems
4. Illustrate the principle of Multi-User Spatial Processing

L3: Apply

1. Demonstrate the concept of adaptive antenna system by considering the case of beam forming
2. Describe how the weight vectorsof adaptive array are adjusted by constant modulus algorithm
3. Apply Vector Based ApproachAnalysistoenhanceRange and Capacity Using Smart Antennas
4. Illustrate the Software Defined Radios for Smart Antennas

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PE 20EC018 Process Control Instrumentation **3 0 0 3**

Pre-Requisite Control Systems

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

Code	Course Outcomes	Mapping with POs	DoK
20EC018.1	Understand various process variables and dynamics of parameters		L1, L2, L3
20EC018.2	Analyze various process charecteristics and control modes		L1, L2, L3
20EC018.3	Demonstrate controller settings and methods for tuning of controllers		L1, L2, L3
20EC018.4	Illustrate different pneumatic, electric and hydraulic actuators		L1, L2, L3
20EC018.5	Design of different control systems		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: Process Dynamics — 9 Hours

Process variables, Load variables, Dynamics of simple pressure, flow, level and temperature process, interacting and non,interacting systems, continuous and batch process, self regulation, Servo and Regulator operation.

Single variable, independent variable, interactive single variable, compound variable, multivariable control systems

Unit II: Controller Principles — 9 Hours

Process characteristics: process equation, process load, process lag, self regulation, control system parameters, Controller Modes: Discontinuous control modes, two position mode, multiposition mode, Continuous controller modes: Proportional control modes, Integral control mode, Derivative control mode, Composite control modes: PI, PD, PID.

Process characteristics: process equation, process load, process lag

Unit III: Controller Settings and Tuning of Controllers — 9 Hours

Evaluation criteria 1/4th decay ratio, IAE, ISE, ITSE, ITAE , determination of optimum settings for mathematically described process using time response and frequency response, tuning of controllers, process curve reaction method, continuous oscillation method.

Damped oscillation method

Unit IV: Final Control Elements and Control Valves — 9 Hours

I/P Converter, P/I converter , pneumatic, electric and hydraulic actuators, valve Positioned , Control valves, characteristic of control valves, valve body, Globe, Butterfly, diaphragm, Ball valves, Control valve sizing, Cavitation, flashing.

Different types of the Actuators,Pneumatic, Hydraulic

Unit V: Multiloop Control System — 9 Hours

Feed forward control, Feed Forward Feedback Controller (FFFBC), Ratio control, Cascade control, Split range, multivariable control and examples from distillation column, Boiler system and heat exchanger.

Adaptive control systems

Text Books

1. Eckman, D. P. , "Automatic Process Control", Wiley Eastern Ltd., New Delhi, 1993.
2. Curtis, D. Johnson, "Process Control Instrumentation technology", 8th Edition Prentice Hall of International Publishers.

Reference Books

1. Krishna Kant, "Computer based Industrial Control", Prentice Hall of India Pvt., Ltd. 2002.

2. Stephanopoulos, "Chemical Process Control: An introduction to Theory and Practice", Prentice Hall, New Delhi,1999.
3. Liptak, B. G, "Process Control", 3rd Edition, Chilton Book Company, Pennsylvania, 1995.

Web References

1. http://www.pc-education.mcmaster.ca/Instrumentation/go_inst.htm
2. https://instrumentationtools.com/what-is-process-control/
3. https://www.youtube.com/watch?v=kG0htehHEGA

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 are different process variables?
2. What is feed forward feedback controller?
3. List three types of discontinuous control modes.
4. Write two characteristics of control valves.

L2: Understand

1. Illustrate different controller mode operations.
2. Explain the operation of PID controller.
3. Describe I/P Converter and P/I converter.
4. Discuss about continuous oscillation method & damped oscillation method.

L3: Apply

1. Design a PID control and explain its operation.
2. Design interfacing and non interfacing systems.
3. Design a multivariable control system for Boiler system.

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PE **20EC019 Analog VLSI** 3 0 0 3

Pre-Requisite VLSI Design

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

Code	Course Outcomes	Mapping with POs	DoK
20EC019.1	Draw the equivalent circuits of MOS based Analog VLSI and analyse their performance		L1, L2, L3
20EC019.2	Analyze different current mirrors and the frequency response used to bias IC amplifiers	-	L1, L2, L3, L4
20EC019.3	Design single and multi-stage amplifiers for desired gain, bandwidth		L1, L2, L3
20EC019.4	Analyze different Data Converters		L1, L2, L3, L4
20EC019.5	Design different noise amplifiers and Power Amplifiers		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: MOS Devices and Signal Models **9 Hours**

MOS Device Operation,Small signal models,Single State Amplifiers,Differential Amplifiers.

Characteristics of MOS Devices

Unit II: Frequency Response and Compensation 9 Hours

Current Sources and Mirrors,High frequency response of Analog circuits,Design of Operational Amplifiers Stability Compensation

Frequency Compensation

Unit III: Bandgap References 9 Hours

CMOS Processing Technology:Layout and Packaging, Bandgap References:Supply independent,temperature independent references,constant Gm biasing

Gm/Id methodology

Unit IV: Mied Signal Circuit Design 9 Hours

Switched Capacitor Circuits,Data Convereter Fundamentals,Nyquist Rate D/A and A/D Converters

Oversampling Converters

Unit V: RF IC Design 9 Hours

Concepts in RF Design,Trancseiver Architectures, Low noise Amplifiers,Oscillators,Phase Locked Loops, Power Amplifiers

Mixer Design

Text Books

1. Shih Chii Liu and Rodney Douglas "Analog VLSI - Circuits & Principles: Circuits and Principles", MIT Press ,New Delhi, 2002.
2. J. P. Rabaey, A. P. Chandrakasan, B. Nikolic, "Digital Integrated circuits: A design perspective", 2nd Edition, Prentice Hall electronics and VLSI series.
3. Behzad Razavi , "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2007.

Reference Books

1. Phillip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", 3rd Edition, Oxford.
2. Kang, S. and Leblebici, Y., "CMOS Digital Integrated Circuits, Analysis and Design", 3rdEdition, Tata McGraw Hill.
3. Pucknell, D. A. and Eshraghian, K., "Basic VLSI Design", 3rd Edition, Prentice Hall International.

Web References

1. nptel.ac.in/content/storage2/courses/117101106/downloads/L15.PDF
2. nptel.ac.in/content/storage2/courses/117101106/downloads/L17.PDF

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is a differential amplifier?
2. Draw the small signal model of MOSFET
3. Define switched capacitor circuits
4. What are different Noise Amplifiers?
5. Define phase locked loop

L2: Understand

1. Differentiate small signal model characteristics of MOSFETS
2. Illustrate the characteristics of current mirror circuits
3. Describe the frequency compensation techniques of CMOS circuits
4. Differentiate sampling converters
5. Compare A/D and D/A Converters

L3: Apply

1. Derive the gain for common source amplifier with current mirror load
2. Define the equation for resolution in A/D Converters and explain
3. Derive an expression for drain current ID for NMOS in different regions of operation

L4: Analyze

1. Discuss Different data convertors
2. Discuss Low noise amplifiers
3. Describe switched capacitor circuits

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PE 20EC020 Radar Engineering 3 0 0 3

Pre- Requisite Analog and Digital Communication, Antenna Wave Propagation

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

Code	Course Outcomes	Mapping with POs	DoK
20EC020.1	Demonstrate the basic principles of the RADAR System and also analyze the radar range equation		L1, L2, L3
20EC020.2	Understand the working principle and applications of CW & FMCW Radar		L1, L2, L3
20EC020.3	Classify and demonstrate the principles of operation of MTI Radar		L1, L2, L3
20EC020.4	Classify and understand the working principle of tracking Radar		L1, L2
20EC020.5	Compute and demonstrate the Matched filter, displays and phase array antennas		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: Basics of Radar and Radar Equation — 9 Hours

Basics of Radar: Introduction, Maximum Unambiguous Range, simple Radar range Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Illustrative Problems. Radar Equation: Modified Radar Range Equation, SNR, probability of detection, probability of False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Creeping Wave, Transmitter Power, PRF and Range Ambiguities, System Losses (Illustrative Problems).

Antenna Parameters, Cross-Section Fluctuations

Unit II: CW and FM-CW Radar — 9 Hours

CW and Frequency Modulated Radar : Doppler Effect, CW Radar - Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar. Illustrative Problems FM-CW Radar: Range and Doppler Measurement, Block Diagram and Characteristics, FM-CW altimeter, Multiple Frequency CW Radar.

Matched filter detection, Airborne Doppler Navigation

Unit III: MTI and Pulse Doppler Radar — 9 Hours

Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers - Filter Characteristics, Blind Speeds, Double Cancellation, N th Cancellation Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler Radar.

Digital signal Processing, MTI Radar Processor

Unit IV: Tracking Radars — 9 Hours

Tracking with Radar, Types of Tracking Radars, Sequential Lobing, Conical Scan, Mono pulse Tracking Radar - Amplitude Comparison Mono pulse (one- and two- coordinates), Phase Comparison Mono pulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

Servo System, High-Range-Resolution monopulse, Tracking with Surveillance Radar

Unit V: Detection of Radar Signals in Noise — 9 Hours

Introduction, Matched Filter Receiver - Response Characteristics and Derivation, Correlation detection and Cross-correlation Receiver, Efficiency of Non-matched Filters, Matched Filter with Non-white Noise, Noise Figure and Noise Temperature. Radar Receivers -Displays - types. Duplexers - Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas - Basic Concepts, Radiation Pattern, Series versus parallel feeds, Applications, Advantages and Limitations.

Beam Steering and Beam Width changes, Radomes

Text Books

1. Merrill, I. Skolnik., "Introduction to Radar Systems", 2nd Edition, Tata Mc-Graw Hill Special Indian Edition, 2007.
2. Raju, G. S. N., "Radar Engineering and Fundamentals of Navigational Aids", I.K. Int. Publishing house pvt. Ltd, 2008.

Reference Books

1. Skolnik, M. I., "Introduction to Radar Systems", 3rd Edition, Tata Mc-Graw Hill, 2005.
2. Byron Edde., "Radar Principles, Technology, Applications", Pearson Education, 2004.
3. Peyton, Z. Peebles, Jr,. "Radar Principles", Wiley Publishers, New York, 1998.
4. Mark, A. Richards, James, A. Scheer, William, A. Holm and Yesdee., "Principles of Modern Radar: Basic Principles", Scitech Publishers, 2010.

Web Resources

1. https://nptel.ac.in/courses/108105154
2. https://nptel.ac.in/courses/117107035
3. https://freevideolectures.com/course/4438/nptel-analysis-design-principles-microwave-antennas/17

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 signal to noise ratio
2. What is maximum unambiguous range
3. What is Doppler effect?
4. Mention two salient features of FMCW radar
5. What is delay line canceller?
6. Give two applications of MTI radar
7. What is single target tracking radar?
8. Write two comparisons of trackers
9. Define noise temperature
10. Give three salient features of matched filter

L2: Understand

1. Describe the operation of radar block diagram
2. Draw and explain CW radar with nonzero IF receiver
3. Write the applications and merits of continuous wave radar
4. Explain, how the various unwanted signals causes errors in FM altimeter
5. Describe the operation of MTI Radar with power oscillator transmitter
6. Draw and explain three pulse canceller
7. Describe the operation of conical scanning method
8. Draw and explain the block diagram of one-coordinate amplitude-comparison mono pulse tracking radar
9. Draw and explain Balanced duplexer
10. Explain the merits and limitations of phased array antennas

L3: Apply

1. Derive simple radar range equation
2. Derive modified radar range equation
3. The pulse Radar has a maximum ranging capacity of 90 km for targets having cross section of 20 m^2.If the peak transmitter power is increased 15 times, the antenna gain increases 3 times, determine the new maximum range detection capability of the Radar whose Radar cross section is 4 m^2.
4. With suitable expressions discuss about multiple frequency CW radar
5. Determine the first three blind speeds of MTI operating at 9 GHz with a PRF of 975 Hz

6. In mono pulse radar two antennas are used to produce a phase difference of 25° between the echo signals. It operates at frequency of 1.5 GHz. Find the spacing between the antennas if the angle θ=15°
7. Derive an expression for noise figure of N networks in cascade
8. Derive the equation for matched filter response characteristics
9. Analyze the Radiation pattern of Phased array antennas
10. With suitable expressions discuss about beam steering and beam width changes

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PE 20EC021 Video Processing And Application 3 0 0 3

Pre- Requisite Digital Image Processing

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

Code	Course Outcomes	Mapping with POs	DoK
20EC021.1	Understand the Steps involved in Video Processing.		L1, L2, L3
20EC021.2	Estimate the 2-D Motion		L1, L2, L3
20EC021.3	Analyse the coding.		L1, L2, L3
20EC021.4	Understand the concept of Object Detection.		L1, L2, L3
20EC021.5	Understand the concept of FrameDiffererencing.		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

Unitl: Introduction 9 Hours

Basic Steps of Video Processing, Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals.

Filtering operations

Unit II: 2-D Motion Estimation 9 Hours

Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation.

Region based motion estimation.

Unit III: 2-D Motion Estimation 9 Hours

Multi resolution motion estimation. Waveform based coding, Block based transform coding, Application of motion estimation in video coding.

Predictive coding

Unit IV: Applications-I 9 Hours

Object detection: Moving camera,Object detection approaches,Thresholding,Multigrid identification of regions of interest,Edge-based detection (spatial differentiation).

Space signature

Unit V: Applications-II 9 Hours

Frame differencing: Background frame differencing,Inter-frame differencing,Feature aggregation and object tracking,Object recognition with deep learning,Face detection and tracking

Conclusion & Future Scope

Text Books

1. Yao wang, Joem Ostarmann and Ya - quin Zhang, "Video processing and communication ",1st Edition , Prenteice Hall India
2. Thomas. B. Moeslund, "Introduction to Video and Image Processing", Springer, 2012.
3. John Woods, "Multidimentional Signal, Image and Video Processing and Coding", 2ndEdition, Elsevier

Reference Books

1. W. Tomasi, "Advanced Electronic Communication Systems", 4th Edition., Pearson Education, 1998.
2. Keith Jack, "Video Demystified" A Hand Book for the Digital Engineer, 5thEdition., Elsevier
3. M. Tekalp, "Digital Video Processing", Prentice Hall International

Web References

1. https://archive.nptel.ac.in/courses/117/104/117104020/
2. https://www.mooc-list.com/tags/video-processing

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 analog video?
2. What is MPEG & H.26X standards?
3. What is Multi resolution motion estimation?

L2: Understand

1. Explain the predictive coding for Video.
2. Explain the basic steps of video processing with the help of block diagram.
3. Discuss the sampling of Video signals.
4. Compare wave form based coding and block based transform coding techniques.

L3: Apply

1. Application of motion estimation in video coding.
2. Build Block based transform coding.
3. Make use of any four methods of 2-D motion estimation techniques in video processing.

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PE **20EC022 Embedded Internet of Things** 3 0 0 3

Pre-Requisite Embedded Systems, IoT

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

Code	Course Outcomes	Mapping with POs	DoK
20EC022.1	Understand the significance and applications of IoT		L1, L2
20EC022.2	Design and Understand IoT based systems for Inter-disciplines		L1, L2, L3
20EC022.3	Demonstrate IoT based solutions using Raspberry Pi development board		L1, L2,L3
20EC022.4	Design different types of control systems with Arduino board		L1, L2,L3
20EC022.5	Classify and analyze Different Programs using open-source tools		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 IoT 9 Hours

Definition and characteristics, Evolution of IoT, IoT Architectures, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, Applications of IoT, Introduction to Protocols.

Physical design, Logic Design

Unit II:IoT Networking 9 Hours

Introduction to M2M, Difference between IoT and M2M, Types of IOT Networks-LPWAN,Cellular 3G/4G/5G),WIFI, RFID Software Defined Networking, Need for IoT Systems Management, Network Operator Requirements.

Network Function Virtualization

Unit III: IoT Logical Design and Physical Design 9 Hours

IoT Logical Design: Data types, Data structures, Control flow, Functions, Modules, Packages, File Handling, Date and time operation, Classes, Python packages of IoT.
IoT Physical Design: Basic building blocks, Raspberry Pi, Linux on Raspberry Pi, Interfaces, Programming on Raspberry Pi with Python.

IoT design methodology

Unit IV: Raspberry Pi for Project Development 9 Hours

Raspberry Pi for Project Development: Raspberry Pi platform, GPIO, Establishment and setting of Raspberry Pi software, LAMP project, home temperature monitoring system.

Webcam and Raspberry Pi camera project

Unit V: Arduino for Project Development 9 Hours

Internet enabled Arduino powered garage door opener, Irrigation control system, Light controller, Message controller and cloud Services.

Beaglebone black for Project development

Text Books

1. ArshdeepBahga, Vijay Madisetti, "Internet of Things: A Hands-On Approach", University Press (India) Pvt. Limited, 2015.
2. Donald Norris, "The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black", 1st Edition, McGraw Hill, 2015.
3. SaiYamanoor, SrihariYamanoor, "Python Programming with Raspberry Pi", 1st Edition, Packt Publishing Limited, Mumbai 2017.

Reference Books

1. Donald Norris, "Raspberry Pi Projects for the Evil Genius", Tata McGraw Hill Professional, 2014.
2. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", 1stEdition, John Wiley and sons", 2014.
3. CunoPfister, "Getting started with the Internet of Things", 1st Edition, O'Reilly Media Inc, 2011.

Web Resources

1. http://www.tutorialspoint.com/internet_of_things/
2. https://www.codeproject.com/Learn/IoT/
3. https://swayam.gov.in/nd1_noc20_cs22/
4. https://swayam.gov.in/nd1_noc20_cs24

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 the need of Network?
2. What is meant by Wide Area Network?
3. List outthree Features of IoT
4. Define Arduino
5. What are the functions used to read analog and digital data from a sensor in Arduino?
6. List three available models in Raspberry Pi

L2: Understand

1. How to program Arduino?
2. How to install a new library in Arduino?
3. Classify and explain various types of embedded Internet of things.
4. Describe the different components of IOT.
5. How does IoT influence the development of smart cities?
6. Explain Bluetooth Low Energy protocol for an IOT

L3: Apply

1. Design the process of IOT
2. How did you use Python to control the Arduino?
3. How did you install the updated Arduino library?
4. How might wireless communications have an effect on the development and implementation of the internet of things (IoT)? Explain.

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PE 20EC023 Micro Electro Mechanical System (MEMS) 3 0 0 3

Pre- Requisite: Basics of Microelectronics and mechanics

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

Code	Course Outcomes	Mapping with POs	DoK
20EC023.1	Understand the basic concepts of MEMS Technology		L1, L2
20EC023.2	Demonstrate the different materials used for MEMS		L1, L2
20EC023.3	Understand the Different microfabrication processes		L1, L2
20EC023.4	Evaluate the basic MEMS Design process		L1, L2
20EC023.5	Identify the basic MEMS Devices		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 Microelectromechanical System (MEMS) 9 Hours

Introduction to MEMS, Classification of MEMS, Difference between sensor, actuator and transducer, Multidisciplinary nature of MEMS, Market survey, Miniaturization and scaling in MEMS and Applications of MEMS.

Evolution of MEMS, Scaling Laws

Unit II: Materials for MEMS 9 Hours

Introduction to Materials used for MEMS, Silicon as the ideal material for MEMS, Single crystal silicon wafers, Miller indices, Silicon compounds, Silicon dioxide, silicon carbide, silicon nitride and polycrystalline silicon, silicon piezoresistor and polymers.

Silicon as the promising material, Polymers MEMS.

Unit III: Micromachining 9 Hours

Review of Microelectronics processes used for MEMS, SOI wafer, Bulk micromachining, Isotropic and Anisotropic etching, Dry versus wet etching, Description of surface micromachining and problems associated with this, LIGA process.

SOI Wafer, Deep-Reactive ion Etching.

Unit IV: MEMS Design 9 Hours

Basic design flow in MEMS, Design constraints, Selection of material and fabrication processes, Types of signal transduction and packaging considerations, Importance of numerical simulation in MEMS, Finite element analysis (Practical approach only) and a brief introduction to the commercial software available for MEMS design.

Practical Finite Element Analysis, Meshing

Unit V: Case Study of Basics MEMS Devices 9 Hours

Microcantilever, RF Switch, Pressure Sensor and Accelerometer.

Gyroscope, MEMS based bio sesors

Text Books

1. Stephen D. Senturia, " Microsystem Design" Springer New York, NY, 2001.
2. Gabriel, M. Rebeiz, "Rf MEMS: Theory, Design, and Technology" Kluwer academic publishers, 2001.
3. Gad-El-Hak, "MEMS Introduction and Fundamentals" CRC Press, 2005.

Reference Books

1. Tai-Ran Hsu, "MEMS and Microsystems: Design and Manufacture" McGraw-Hill, 2002.
2. Eun Sok Kim, "Fundamentals of Microelectromechanical Systems (MEMS)" by McGraw-Hill, 2021

Web References

1. https://nptel.ac.in/courses/117105082
2. https://nptel.ac.in/courses/108108113

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 MEMS and basic classification?
2. What is the difference between sensor, actuator and transducer?
3. What are the basic materials used in MEMS?

L2: Understand

1. Explain is the difference between isotrophic and anisotrophic etching.
2. Write the differences between bulk and surface micromachinging.
3. Explain the basic MEMS design flow.
4. Why numerical simulation is necessary in MEMS ? Explain in brief.
5. Describe the development of MEMS based Accelerometer.

L3: Apply

1. Design a MEMS based microcantilever.
2. Design and explain MEMS based RF switch.
3. Explain MEMS based pressure sensor.

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PE 20EC024 Modern Industrial Automation 3 0 0 3

Pre- Requisite Basics of Automation and control system

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

Code	Course Outcomes	Mapping with POs	DoK
20EC024.1	Understand the basics of Modern Industrial Automation		L1, L2
20EC024.2	Understand the types of automation system		L1, L2
20EC024.3	Demonstrate Basics of the PLC Structure and programming		L1, L2, L3
20EC024.4	Classify and demonstrate different electric drives		L1, L2
20EC024.5	Understand the SCADA with PLC for different 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 Modern Industrial Automation 9 Hours

Requirements and advantages of Industrial Automation. Components of automation system, Classification of automation system, fixed, programmable and flexible. Levels of automations, automated flow lines and transfer mechanism.

Integrated automation system

Unit II: PLC Essentials 9 Hours

Basic structure of PLC, Input output modules, Power supply, CPU and memory organization. Fixed and Modular PLC, its types and Redundancy in PLC module. Selection criteria for input-output module, interfacing in I/O devices.

Virtual Instrumentation

Unit III: Programming in PLC 9 Hours

Functional block diagram (FBD), Sequential function chart (SFC), Relay type and timer instruction, arithmetic and handling instructions, Instruction list, Ladder programming, Applications of PLC.

Graphical Programming platform

Unit IV: Electric Drives 9 Hours

Types of electric drives, working principle, specification, four quadrant operation, its functions and characteristics. AC and DC drive V/F controls, parameters, direct torque control, Speed control of motor (AC/DC).

Integrated motor drives, stepper motors

Unit V: Administrative control and Data Acquisition system 9 Hours

SCADA, classic block diagram and benefits of SCADA, Various SCADA editors, Interfacing of PLC and SCADA with required connections, OPC (Object linking and embedding for Process Control), Step by step creation of SCADA screen for interfacing with PLC, Applications of SCADA.

Integration of SCADA with Manufacturing Execution System (MES)

Text Books

1. Groover, M. P.,"Automation, Production Systems and Computer Integrated Manufacturing", 5th Edition, Pearson Education, 2009.
2. John, W. Webb and Ronald, A. Reis, "Programmable Logic Controllers: Principles and Applications", 5th Edition, Prentice Hall Inc., New Jersey, 2003.
3. Krishna Kant, "Computer - Based Industrial Control", 2nd Edition, Prentice Hall, New Delhi, 2011.
4. Frank, D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York, 2016.
5. Lingfeng Wang and Kay Chen Tan, " Modern Industrial software Design" IEEE Press 2006.

Reference Books

1. Curtis, D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson New International, 2013.

2. Lukas, M. P, "Distributed Control Systems", Van Nostrand Reinhold Co., New York, 1986.
3. Viswanandham, N. and Y. Narahari, "Performance Modeling of Automated Manufacturing Systems", 1st Edition, 2009.

Web References

1. https://nptel.ac.in/courses/108105063
2. https://nptel.ac.in/syllabus/108108098

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 LevelsL1:

Remember

1. What is Industrial Automation System?
2. Write three application of Industrial Automation Systems.
3. What is PLC?
4. What is OPC ?

L2: Understand

1. Discuss redundancy in PLC module
2. Explain the functional block diagram of PLC
3. Discuss the relay type and timer instruction in PLC programming
4. Discussion the applications of PLC
5. What is the working principal of electric drives and discuss its four quadrant operation ?
6. Discuss speed control mechanism of Motor.
7. Discuss SCADA and its benefits with block diagram.

L3: Apply

1. Interface the PLC with SCADA by taking an simple example.
2. Basic examples using visual and graphical programming platforms.
3. Expore the concept of virtual instrumentation (A practical Approach).

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OE 20CEO01 Urban Environment and Health 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20CEO01.1	Identify urban - health relationships		L1, L2
20CEO01.2	Demonstrates the connection between urban built form and healthoutcomes		L1, L2
20CEO01.3	Discuss the distribution of health risks of urban transportation grid	-	L1, L2
20CEO01.4	Assess and plan for community needs in health-care infrastructure		L1, L2
20CEO01.5	Identify preliminary opportunities for advancing urban health outcomes		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 Pedestrians 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 Behavior, Access andMortality.

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/32006565.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 LevelsL1: 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 studyauthors 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

Unit III: Trees and Graphs 9 hours

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

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 learning's		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 - LinearSeparability - 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 - Geneticalgorithms - 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 Alpaydın. "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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20DSC01 Introduction to Database Management Systems 3 0 0 3

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, Naïve 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,

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 Navate, "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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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 Eventanalysis		L1, L2, L3
20ECO01.5	Demonstrate the Industrial Internet of Thingsand 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 09 Hours

What Is IoT?, Applications , Architectures , Wireless Networks, Devices, Security and Privacy , Event-Driven Systems.

Ethernet

Unit II: IoT System Architectures 09 Hours

Introduction, Protocols Concepts, IoT-Oriented Protocols, Databases, Time Bases, Security.

Message Queuing Telemetrtransport (MQTT)

Unit III: IoT Devices 09 Hours

The IoT Device Design Space, Cost of Ownership and Power Consumption, Cost per Transistor and Chip Size, Duty Cycle andPower Consumption.

Platform Design

Unit IV: Event-Driven System Analysis 09 Hours

IoT Network Model - Events, Networks, Devices and Hubs, Single-Hub Networks, Multi-hub Networks, Network Models andPhysical Networks.
IoT Event Analysis - Event Populations, Stochastic Event Populations, Environmental Interaction Modeling.

Event Transport and Migration

Unit V: Industrial Internet of Things 09 Hours

Introduction, Industrie 4.0, Industrial Internet of Things (IIoT), IIoT Architecture, Basic Technologies, Applications and Challenges.

Integrated NoT

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

Reference Books

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and Sons Ltd, UK, 2014
2. Olivier 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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OE 20EEO01 Introduction to Renewable Energy Sources 3 0 0 3

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

Code	Course Outcomes	Mapping with PO's	DoK
20EEO01.1	Understand the significance of solar energy		L1, L2
20EEO01.2	Provide the importance of Wind Energy		L1, L2
20EEO01.3	Understand the role of ocean energy in the Energy Generation		L1, L2
20EEO01.4	Explain the utilization of Biogas plants and geothermal energy		L1, L2
20EEO01.5	Explain the concept of energy Conservation		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 09 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 09 Hours

Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Wind Turbine Generator

Betz Criteria

Unit III: Ocean Energy 09 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 09 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 09 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

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

CognitiveLevel	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	40	30
L2	60	70
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive LevelsL1: 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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OE 20MEO01 Nano Technology

3 0 0 3

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

Code	Course Outcomes	Mapping with PO's	DoK
20MEO01.1	Describe the fundamental science of nano materials		L2
20MEO01.2	Demonstrate the preparation of nano materials		L1,L2
20MEO01.3	Explain of the challenges on safe nano technology	-	L1,L2
20MEO01.4	Develop knowledge in characteristic nano material		L1,L2,L3
20MEO01.5	Apply Nano science 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 — 09 Hours

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nano structured 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 — 09 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 — 09 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 — 09 Hours

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy includinghigh-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA.

SIMS-Nano-indentation

Unit V: Applications — 09 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 OfPhysics 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 Edition, Springer Publications,2013
4. Louis Hornyak and Tibbals H F, " Introduction to Nanoscience and NanoTechnology" , 1st Edition,Tailor 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/PSE/links.html
3.http://nptel.ac.in/courses/112105182/9
4.IOPSCIENCE–Nanotechnology

Internal Assessment Pattern

CognitiveLevel	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	40	20
L2	60	40
L3		40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive LevelsL1: Remember

1. What is Nano technology?
2. How does Nano Technology Works?
3. 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, And 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.

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(ME)

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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
20CEO02.1	Discuss the role that humans play in affecting the characteristics ofthe environment		L1, L2
20CEO02.2	Understand the interrelationships between land, sea, theatmosphere and the living things that occupy these environments		L1, L2
20CEO02.3	Distinguish between economic growth and economic developmentand outline the nature of a sustainable economy		L1, L2
20CEO02.4	Identify the environmental attributes to be considered for the EIAstudy		L1, L2
20CEO02.5	Develop a thorough understanding of Environmental Policies andlegislationspracticed in India		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. Structure and Function. Flow of material, Ecological Succession. Tropic 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 9 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 Statemention 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_Polic y_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 LevelsL1: 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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OE 20CSO02 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

Internal Assessment Pattern

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

L1: Remembering

1. Define IoT
2. What are the Enhanced objects for IoT?
3. What is a Prototype?
4. Define Sketching
5. Define DNS

L2: Understanding

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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20AIO02 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

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 LevelsL1: 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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20DSO02 Introduction to Data Science 3 0 0 3

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/

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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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 infrastructureand AMI protocols		L1, L2, L3
20ECO02.5	Identify suitable communication networks forSmart 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 **09 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 **09 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 **09 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 **09 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 **09 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

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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20EEO02 Electrical Safety and Management 3 0 0 3

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 09 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 09 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 09 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 09 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 09 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

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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(EEE)

20MEO02 Fundamentals of Automobile Engineering 3 0 0 3

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

Code	Course Outcomes	Mapping with PO's	DoK
20ME302.1	Introduction to fundamentals of automobiles, lubrication, Tres 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 09 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 09 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 09 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 09 Hours

SUSPENSION SYSTEM: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

BRAKINGSYSTEM:Mechanicalbrakesystem,hydraulicbrakesystem,mastercylinder,wheelcylindertandemmastercylinderrequire ment of brake fluid

ELECTRICAL SYSTEM: Charging circuit, generator, current – voltage regulator – starting system, bendixdrivemechanismsolenoidswitch,lightingsystems,horn,wiper,fuelgauge–oilpressuregauge,enginetemperatureindicatoretc.

Pneumatic and vacuumbrakes.

Unit V: ENGINESPECIFICATION AND MAINTENANCE 09 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, concentrationmeasurement,methodsofcontrolling-enginemodification,exhaustgastreatment-thermalandcatalyticconverters-useof alternative fuels for emission control

National and International pollution standards.

Text Books

1. AutomotiveMechanics–Vol.1&Vol.2/KirpalSinghvstandardpublishers
2. AutomobileEngineering/WilliamCrouse/TMHDistributors
3. AutomobileEngineering/P.SGill/S.K.Kataria&Sons/NewDelhi.
4. AutomobileEngineering/CSrinivasan/McGrawHill

Reference Books

1. Automotive EnginesTheoryandServiceJamesD.HaldermanandChaseD.MitchellJr.,/Pearso neducationinc.
2. Automotive Engineering/KNewton,W.Steeds&TKGarrett/SAE
3. Automotive Mechanics: PrinciplesandPractices/ JosephHeitner/VanNostrandReinhold

Web References

1. https://nptel.ac.in/noc

Internal Assessment Pattern

CognitiveLevel	InternalAssessment#1(%)	InternalAssessment#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 of 1.5Mpa ,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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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	Identifyvarioustypesofdisasters,theircauses,effects&mitigationmeasures	-	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

UnitII: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, predisasterstage(mitigation),Effecttomitigatenatural 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, StrategiesSustainable 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 ",NewIndia PublishingAgency, New Delhi, 2005
2. Edwards,B.," NaturalHazards",Cambridge UniversityPress,U.K., 2005
3. Chakraborty,S.C.,"NaturalHazardsandDisasterManagement",PargatishilProkashak,Kolkata, 2007

Reference Books

1. Sahni,P., "DisasterMitigationExperiencesandReflections",PrenticeHallofIndia,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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OE 20CS404 Operating Systems 3 0 0 3

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, Multi process 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, Hard disk Drives, Volatile Memory, HDD Scheduling-FCFS Scheduling, SCAN Scheduling of a Disk-Scheduling Algorithm.

Buddy System, Preparing

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", TenthEdition,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, McGrawHill 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.unf.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 SJFscheduling: (i) Draw Gantt chart
   (ii) Calculate average waiting time.
8. Why semaphores are important? Suggest the solution for bounded bufferproblem with semaphores
9. Explain the steps involved in handling a page fault with aneat sketch

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OE 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 Map Reduce 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, Name Node, Data Node, Secondary Name Node, 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 Map Reduce — 9 Hours

Hadoop Map Reduce Framework, Architecure, Phases, Map reduce Job Types, Uses of Map Reduce, Techniques to Optimize Map Reduce Jobs, Limitations of Map Reduce.

Map Reduce Phases

Unit V: Introduction to Spark and RDD — 9 Hours

Introduction to Spark, Data frames - Data frames role in Spark, Introduction to RDD, RDD operations, Creating RDDs, RDD Operations, Working with Key/Value Pairs.

Data frames

Text Books

1. DT Editorial Services, "Big Data - Hadoop2, Map Reduce, Hive, YARN, Pig, R and Data Visualization", Black Book, Dream Tech Press, 2019.
2. Sridhar Alla, "Big Data Analytics with Hadoop 3" - Packt Publications, 2018.
3. Holden Karau, Andy Konwinski, Patrick Wendell &Mate iZaharia, "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 Applicaations		L1, L2, L3
20ECO03.3	Understand the Attacks against IoT system		L1, L2, L3
20ECO03.4	Explain Secure Bootstrapping for IoT Sytem		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

Unitl: Introduction to Cryptography and Network Securitys **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) ,Aattacks against IoT network protocols ,Attacks against industry IoT

Attacks against Web systems

Unit IV: Secure Bootstrapping for secure IoT system 9 Hours

Ttrustedboot,Secureboot,TPM and its usages,Remote attestation ,tamper resistant-proof-response hardware and its usage

Bootatraping 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 " 1stEdtion ,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" ,1stEdtion ,Chapman & Hall, 2019
2. Vijay Madisetti, ArshdeepBahga, 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

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 iscryptography ?
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 Aattacks 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 PO's	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 IntegratedManufacturing", 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.

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(EEE)

03 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

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 20SHO03 Design Innovations 3 0 0 3

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

Code	Course Outcomes	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

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

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,Shrrutin 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

Web References

1. https://nptel.ac.in/courses/110106124
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

CognitiveLevel	InternalAssessment#1(%)	InternalAssessment#2(%)
L1	20	20
L2	50	50
L3	30	30
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive LevelsL1:

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 **20ECH01 Low Power VLSI Design** 4 0 0 4

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

Code	Course Outcomes	Mapping with POs	DoK
20ECH01.1	Identify the sources of power dissipation in digital IC systems		L1, L2
20ECH01.2	Demonstrate the impact of power on system performance and reliability.		L1, L2, L3,L4
20ECH01.3	Extend the Low Power Design to Different Applications		L1, L2
20ECH01.4	Design and analysis of Low-Voltage Low-Power Circuits		L1, L2, L3
20ECH01.5	Realize the leakage sources and reduction techniques		L1, 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:Fundamentals of Low Power VLSI Design **12 Hours**

Need for Low Power Circuit Design, Sources of Power Dissipation - Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation.

Short-Channel Effects

Unit II: Low-Power Design Approaches **12 Hours**

Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach -Pipelining and Parallel Processing Approaches.

Combining Parallelism with Pipelining

Unit III: Power estimation and analysis **12 Hours**

SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power and gate level capacitance estimation.

Gate level logic simulation

Unit IV: Low-Voltage Low-Power Adders **12 Hours**

Introduction, Standard Adder Cells, CMOS Adder's Architectures - Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques.

Carry Skip Adder

Unit V: Low-Voltage Low-Power Multipliers **12 Hours**

Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh-Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

Parallel Multiplier

Textbooks

1. Kiat-Seng Yeo and Kaushik Roy, "Low-Voltage, Low-Power VLSI Subsystems", 2nd Edition, Technische Hochschule Mittelhessen publications, 2017
2. Chandrakasan A. and Brodersen R., "CMOS Low Power Digital Design", Kluwer Academic Publications, 1995

Reference Books

1. Kaushik Roy and Sharat C. Prasad, "Low Power CMOS VLSI Circuit Design", 2nd Edition, John Wiley & Sons, 2000
2. Gary K. Yeap, "Practical Low Power Digital VLSI Design", 3rd Edition, Kluwer Academic Press, 2002

Web Resources

1. http://www.eeherald.com/section/design-guide/Low-Power-VLSI-Design.html
2. https://nptel.ac.in/courses/106/105/106105034/
3. https://www.intechopen.com/chapters/59358

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the various issues involved in low power VLSI Design?
2. What is short channel effect?
3. What is SPICE?
4. Define DIBL
5. What is the need for low power circuit design?

L2: Understand

1. Explain about Sub-threshold leakage in a MOS transistor
2. Explain about gate level logic simulation
3. Describe about Braun multiplier with help of neat Schematics
4. Describe the basic concepts of supply voltage scaling
5. Clarify the VTCOMS and MTCMOS in low power VLSI design

L3: Apply

1. Draw the basic architecture of Ripple Carry Adder and explain its operation
2. Draw and Explain the MOSFET model for estimating
3. Draw and explain different configurations of full adder schematic
4. Draw the basic architecture of Carry Save Adder and explain its working
5. Draw the basic architecture of Typical SRAM and explain its operation
6. Construct Baugh-Wooley Multiplier and explain its operation

L4: Analyze

1. Compare Carry Select and Ripple Carry Adders in terms of delay and area
2. Compare EPROM and Flash memory w.r.t functionality and cost of the design
3. Discuss about future trends and Development of DRAM
4. Discuss the features of a six transistor CMOS memory cell
5. Explain8 bit architecture of CSA with an example

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HO 20ECH02 DSP Processors and Architectures 4 0 0 4

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

Code	Course Outcomes	Mapping with POs	DoK
20ECH01.1	Demonstrate the basic concepts of Digital Signal Processing		L1, L2
20ECH01.2	Differentiate the architectural features of General-purpose processors and DSP processors		L1, L2
20ECH01.3	Understand the architectures of TMS320C54xx devices and ADSP 2100 DSP devices		L1, L2
20ECH01.4	Write the simple assembly language programs by using instruction set of TMS320C54xx		L1, L2, L3
20ECH01.5	Interface the various devices to DSP Processors		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 Digital Signal Processing 12 Hours

Introduction, a Digital signal-processing system, discrete time sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation.

Computational Accuracy in DSP Implementations

Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

Sampling Process

Unit II: Architectures for Programmable DSP Devices 12 Hours

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Features for External interfacing.

Speed Issues

Unit III: Programmable Digital Signal Processors 12 Hours

Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX Instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX Processors, Pipeline Operation of TMS320C54XX Processors.

Commercial Digital signal-processing Devices

Unit IV: Analog Devices Family of DSP Devices 12 Hours

Analog Devices Family of DSP Devices - ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100. Introduction to Black fin Processor - The Black fin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.

ADSP-2181 high performance Processor

Unit V: Interfacing Memory and I/O Peripherals to Programmable DSP Devices 12 Hours

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O.

Direct memory access (DMA)

Textbooks

1. Avtar Singh and S. Srinivasan, "Digital Signal Processing", Thomson Publications, 2004
2. Padmanabhan K, Vijayarajeswaran R. and Ananthi S., "A Practical Approach to Digital Signal Processing", New Age International, 2009

3. Woon-Seng Gan and Sen M.Kuo, "Embedded Signal Processing with the Micro Signal Architecture", Wiley-IEEE Press, 2007

Reference Books

1. Venkataramani B and Bhaskar M., "Digital Signal Processors, Architecture, Prog and Applications", Tata Mc Graw Hill, 2002
2. Amy Mar, "Digital Signal Processing App Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices", DSP Division, Prentice Hall of India
3. Lapsley et al, "DSP Processor Fundamentals, Architectures & Features", S. Chand &Co, 2000

Web Resources or Links

1. https://cds.cern.ch/record/1100536/files/p167.pdf
2. https://people.eecs.berkeley.edu/~pattrsn/252S98/Lec08-dsp.pdf

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 Decimation and Interpolation
2. What are the sources of error in DSP Implementations?
3. What are the Features for External interfacing?
4. Write any four Interrupts of TMS320C54XX Processors
5. What are the I/O Peripherals to Programmable DSP Devices?

L2: Understand

1. What are the different number formats that are used to represent signals and coefficients in DSP systems? Explain any two of them
2. Describe the following on-chip peripherals of TMS320C54xx processors.
    a) Hardware Timer
    b) Host port interface
4. Discuss in brief about the basic peripherals in analog devices family of DSP devices.
5. Explain the Data Addressing modes of TMS320C54XX DSPs
6. Explain the Bus Architecture of Black fin Processor
7. Write short notes on the following
    a) Basic peripherals
    b) DMA

L3: Apply

1. Find DFT of a sequence x(n) = { 0,1,2,4.,6,8,7,3} using DIFFFT algorithm
2. How does DMA help in increasing the processing speed of a DSP processor?

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Dept. of Electronics & Communication Engineering
N.S. Raju Institute of Technology
Sontyam, Visakhapatnam - 531173

HO 20ECH03 Information Theory and Coding 4 0 0 4

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

Code	Course Outcomes	Mapping with POs	DoK
20ECH03.1	Design an Application with Error-Control coding		L1, L2, L3, L4
20ECH03.2	Classify and demonstrate Compression and Decompression Techniques		L1, L2
20ECH03.3	Perform source coding and channel coding		L1, L2
20ECH03.4	Design Encoding and Decoding of Digital DataStream		L1, L2, L3
20ECH03.5	Demonstrate the Entropy, source coding channel and its capacity		L1, 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:Information Theory and Source Coding 12 Hours

Uncertainty, information, entropy and its properties, entropy of binary memory less source and its extension to discrete memory less source, source coding theorem, data compression, prefix coding, Lempel-Ziv coding, Source with memory and itsentropy.

Huffman coding

Unit II: Discrete Channels 12 Hours

Binary Symmetric Channel, mutual information & its properties, Channel capacity, channel coding theorem and its application to BSC, Shannon's theorem on channel capacity, capacity of a channel of infinite bandwidth, bandwidth - S/N trade off, Fading channel, channels with memory.

Practical communication systems in light of Shannon's theorem

Unit III: Groups, Fields and Linear Block Codes 12 Hours

Galois field and its construction in GF(2m) and its basic properties, vector spaces and matrices in GF(2), Linear block codes, systematic codes and its encoding circuit, syndrome and error detection, minimum distance, error detecting and correcting capabilities of block code, probability of undetected error for linear block code in BSC, Hamming code and their applications.

Decoding circuit

Unit IV: Cyclic Codes and BCH Codes 12 Hours

Basic properties of Cyclic codes, Generator and parity check matrix of cyclic codes, encoding and decoding circuits, syndrome computation and error detection, encoding and decoding of BCH codes, error location and correction.

Cyclic Hamming codes

Unit V: Convolutional Codes 12 Hours

Introduction to convolution code, its construction and Viterbi algorithm for maximum likelihood decoding, Automatic repeat request strategies and their throughput efficiency considerations.

Convolution codes with examples

Textbooks

1. Sklar, "Digital Communication", 2nd Edition, Pearson Education Asia, 2001
2. Shu Lin and Costello, "Error Control Coding: Fundamentals and Applications", 2nd Edition, Pearson, 2004

Reference Books

1. Haykin Simon,"Digital Communication", Wiley Publications,2013
2. ChithodeJ. S., "Information theory and coding", 1st Edition, Technical publishers, 2014

Web Resources

1. https://www.cl.cam.ac.uk/teaching/0809/InfoTheory/InfoTheoryLectures.pdf
2. https://nptel.ac.in/courses/117/101/117101053/
3. http://www.nitjsr.ac.in/course_assignment/EC23EC4211ITC_PPT.pdf

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is prefix coding?
2. Define channel capacity of the discrete memoryless channel
3. Define mutual information
4. What is the efficiency of the source encoder?
5. What is mean by code redundancy?

L2: Understand

1. Explain channel capacity theorem
2. Write the properties of information theory coding
3. What do you understand from adaptive coding? Explain in details
4. Explain the Properties of entropy
5. State and explain the sampling theorem

L3: Apply

1. Construct Shannon's theorem on channel capacity
2. With suitable expressions explain a source coding theorem
3. Construct the Lempel - Ziv encoding algorithm over Huffman coding
4. Discuss about linear block codes in BSC

L4: Analyze

1. Compare encoding and decoding BCH codes
2. Compare Huffman coding Forward and backward with neat example
3. Discuss about Convolution codes with examples
4. Discuss about Hamming codes with neat examples
5. Draw the diagram of encoder and syndrome calculator generated by polynomial g(x)
6. Verify whether g(x) = 1+x+x2+x3+x4 is a valid generator polynomial for generating a cyclic code for message [111]

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20ECS05 Android App Development

1 0 2 2

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

Code	Course Outcomes	Mapping with POs and PSOs PO1	PO5	DoK
20ECS05.1	To illustrate the different components of Android OS in detail	3	3	L1, L2
20ECS05.2	To develop a mobile application using different components of Android	3	3	L1, L2
20ECS05.3	To choose appropriate controls to design the GUI to meet desired needs	3	3	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

Android SDK Features, The Dalvik Virtual Machine, Downloading and Installing the Android SDK, Developing with Eclipse, Application Manifest File, Creating resources, Drawables, Layouts, Animations, Menus, Building user Interfaces-Assigning user interfaces to Activities, Layouts-Linear, Relative and Grid Layout, Working with fragments, Android widget Toolbox-Creating New Views, Introducing adapters, Intents and Broadcast receivers, Databases and content providers-SQLite Databases and content Providers, Introducing services, Using background threads, using alarms, Customizing toasts, Introducing Notifications, Maps

References

1. Reto Meier, "Professional Android 4 Application Development", Wrox,2018
2. Dave MacLean, Satya Komatineni, Grant Allen, "Pro Android 5", Apress 2015
3. John Horton, "Android Programming for Beginners", PACKT 2015
4. Wallace Jackson, "Android Apps for Absolute Beginners", Apress, 2013

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HO 20ECH04 Hardware Design Using Verilog 4 0 0 4

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

Code	Course Outcomes
20ECH04.1	Understand the Verilog fundamentals and tools used in modelling of digital design.
20ECH04.2	Analyze and design basic digital circuits with combinatorial and sequential logic circuits using Verilog HDL.
20ECH04.3	Model complex digital systems at several levels of abstractions.
20ECH04.4	Design real time applications such as vending machine and washing machines etc.
20ECH04.5	Understand the various applications for Digital interface.

Unit I:Introduction **12 Hours**

Digital Circuit Design Flow, Hardware Description Languages, Verilog Fundamentals, Module Representation, Timing and Delays in Modelling, Hierarchical Module Representation.

Unit II: Verilog Data Types and Operators 12 Hours

Data Types in Verilog, Net and Variable Data Types, Defining Constants and Parameters, Defining Vectors, Operators in Verilog

Unit III: Combinational Circuits 12 Hours

Combinational Circuit Analysis, Combinational Circuit Implementation, Combinational Circuit Design, Adders in Verilog, Comparators in Verilog, Decoders in Verilog, Encoders in Verilog, Multiplexers in Verilog, Applications on Combinational Circuit.

Unit IV: Sequential Circuits 12 Hours

Sequential Circuit Analysis, Sequential Circuit Implementation, Sequential Circuit Design, Latches in Verilog, Flip-Flops in Verilog, Shift Registers in Verilog, Counters in Verilog, Applications on Sequential Circuits.

Unit V: Digital Interfacing 12 Hours

Universal Asynchronous Receiver/Transmitter (UART) in Verilog, Serial Peripheral Interface (SPI) in Verilog, Inter- Integrated Circuit (I2C) in Verilog, *Universal Serial Bus (USB) Receiving Module in Verilog* Video Graphics Array (VGA) in Verilog, Applications on Digital Interfacing.

Textbooks

1. CemUnsalan and BoraTar, "Digital System Design with FPGA Implementation Using Verilog and VHDL" McGraw-Hill Education,2017
2. PadmanabhanR. andBala Tripura Sundari B., "Design through Verilog HDL", WSE, IEEE Press,2004.

Reference Books

1. MichaelD. Ciletti, "Advanced Digital Design with Verilog HDL", Prentices Hall International,2005.
2. Stephen Brown andZvonkoVranesic, "Fundamentals of Logic Design with Verilog", Tata McGraw Hill,2005.

Web Resources or Links

1. https://onlinecourses.nptel.ac.in/noc22_cs94/preview
2. https://www.classcentral.com/course/swayam-hardware-modeling-using-verilog-14103

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HO 20ECH05 Advanced Digital Signal Processing 4 0 0 4

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

Code	Course Outcomes
20ECH05.1	Study the modern digital signal processing algorithms andapplications and Comprehend the DFT, FFT and IIRfiltersand
20ECH05.2	Acquire the basics of multi rate digital signal processing and apply the algorithms for wide area of recentapplications.
20ECH05.3	Analyze the power spectrum estimation
20ECH05.4	Understand theory of different filters andalgorithms
20ECH05.5	Comprehend the Finite word length effects in Fixed point DSPSystems

Unit I: Review of DFT, FFT, IIR Filters and FIR Filters **12 Hours**

Multi Rate Signal Processing: Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Multistage Implementation of Sampling Rate Conversion.

Unit II: Applications of Multi Rate Signal Processing **12 Hours**

Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Narrow Band Low Pass Filters, Implementation of Digital Filter Banks,Trans-multiplexers, Over Sampling A/D and D/A Conversion.

Unit III: Non-Parametric Methods of Power Spectral Estimation **12 Hours**

Estimation of spectra from finite duration observation of signals, Non-parametric Methods: Bartlett, Welch & Blackman-Tukey methods.

Unit IV: Implementation of Digital Filters 12 Hours

Introduction to filter structures (IIR & FIR), Frequency sampling structures of FIR, Lattice structures, Forward prediction error, Backward prediction error, Reflection coefficients for lattice realization, Advantages of lattice structures.

Unit V: Parametric Methods of Power Spectrum Estimation **12 Hours**

Autocorrelation & Its Properties,Relationbetween auto correlation & model parameters, AR Models - Yule-Walker & Burg Methods, MA &ARMA models for power spectrum estimation, Finite word length effect in IIR digital Filters - Finite word-length effects in FFT algorithms.

Text Books

1. Proakis, J.G. andManolakisPunmia, D.G.,"Digital Signal Processing: Principles, Algorithms &Applications",PrenticeHall International, 4th Edition,2008
2. Alan, V. Oppenheim & Ronald, W. Schaffer, "Discrete Time signal processing ",PrenticeHall International. 2nd Edition,1999
3. Emmanuel, C. Ifeacher, Barrie, W. Jervis,"DSP - A Practical Approach", 2nd Edition, PearsonEducation,2000.

Reference Books

1. Kay, S. M ., "Modern spectral Estimation: Theory & Application ",Prentice Hall International, 1988.
2. Kaluri, V. Rangarao andRanjan, K. Mallik,"Digital Signal Processing: A Practitioner's Approach", ISBN: 978-0-470-01769-2, 210 pages, November JohnWeley 2006
3. Vaidyanathan, P.P., "Multi Rate Systems and Filter Banks", PearsonEducation.

Web References

1. https://nptel.ac.in/courses/117101001
2. https://onlinecourses.nptel.ac.in/noc21_ee20/preview

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HS 20ECH06 Advanced Digital Communication 4 0 0 4

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

Code	Course Outcomes
20ECH06.1	Understand the mathematical model for channels and can represent digitally modulated signals.
20ECH06.2	Design slabs with different boundary conditions and RC Staircases
20ECH06.3	Estimate signal parameters.
20ECH06.4	Understand under Band-Limited Channels
20ECH06.5	Understand the concept of parallel Transmission.

Unit I: Introduction **12 Hours**

Introduction Elements of Digital Communication System: Communication channels and their characteristics, mathematical modelsfor channels, representation of Band pass signals and Systems,Gram-Schmidt orthogonalization procedure, representation of digitally modulated signals, signalling schemes with memory - CPFSK - CPM.

Unit II: Optimum Receiver for Additive White Gaussian Noise Channel **12 Hours**

Channel Coherent and noncoherent demodulation: Matched filter,Correlator demodulator, square-law, and envelope detection, Detector: Optimum rule for ML and MAP detection Performance: Bit-error-rate, symbol error rate for coherent and noncoherent schemes.

Unit III: Carrier and Symbol Synchronization 12 Hours

Signal Parameter Estimation: Carrier phase estimation, symbol timing estimation, joint estimation of carrier phase, performance characteristics of ML estimators.

Unit IV: Band-Limited Channels 12 Hours

Band-Limited Channels Pulse shape design for channels with ISI: Nyquist pulse, Partial response signaling (duobinary and modified duobinary pulses), demodulation, Channel with distortion. Equalization: MLSE, linear equalization, decision feedback equalization, adaptive linear equalizer - adaptive decision feedback equalization.

Unit V: Concept of parallel transmission 12 Hours

Concept of parallel transmission, Multichannel and multicarrier CDMA Systems, fading, multi-path channel, OFDM.

Text Books

1. John, G.Proakis, "Digital Communication" , McGraw Hill
2. Stephen, G. Wilson, "Digital Modulation and Coding", Pearson Education (Asia) Pvt. Ltd, 2003.
3. Andrew, J. Viterbi, "CDMA: Principles of spread spectrum communications",Prentice Hall International, USA, 1995.

Reference Books

1. Proakis, J. G. and M. Salehi, "Fundamentals of Communication Systems", Pearson Education, 2005.
2. SimonHaykins, "Communication Systems", 5th Edition, John wiley, 2008.
3. Simon, M. K., Hinedi, S. M. and Lindsey, W. C.,"Digital Communication Techniques: Signaling and detection", Prentice Hall India, N. Delhi, 1995.
4. Tomasi, W. "Advanced Electronic Communication Systems", 4th Edition., Pearson Education, 1998.

Web References

1. https://nptel.ac.in/courses/117105144
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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HO 20ECH07 Design of Digital Integrated Circuits 4 0 0 4

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

Code	Course Outcomes
20ECH07.1	Describe any algorithm to efficient architecture mapping
20ECH07.2	Construct various adder architecture
20ECH07.3	Construct various multiplier architecture
20ECH07.4	Describe CORDIC architecture with any applications
20ECH07.5	Illustrate the timing issues in VLSI

Unit I: Algorithm to Efficient Architecture Mapping **12 Hours**

One bitincrementer, four bit incrementer, n-bit incrementer, ones' complement, two's complement, sum of N -natural numbers, prioritization, greatest common divisor (GCD)

Unit II: Adder Architecture **12 Hours**

Single bit addition, Carry - Ripple adder, Carry - Skip adder, Carry-Look ahead adder, Carry -Select adder, Carry - Increment adder, Tree adder

Unit III: : Multiplier Architecture 12 Hours

Tree multiplication, Array multiplication, signed multi-operand addition, squaring, shift and add multiplier, synchronous shift and add multiplier, Booth algorithm

Unit IV: Cordic Architecture 12 Hours

CORDIC method, rotation and vectoring mode, convergence, precision and range, scaling factor and compensation, implementations: word-serial and pipelined, New techniques - Micro rotation to Angel Recoding (MAR), Binary to Bipolar Recoding (BBR)

Unit V: Issues in Timing Closure 12 Hours

Static and Dynamic timing analysis, System Considerations - edge triggered, clock skew, handling asynchronous inputs, sequential machine, clock cycle time, Violation - maximum propagation delay, race through, Re-timings

Text Books

1. BehroozParhami, "Computer Arithmetic Algorithms and Hardware Designs", 2nd Edition, Oxford University Press, 2010
2. MErcegovac, D. and T. Lang, "Digital Arithmetic", Elsevier Science (USA), 2003

Reference Books

1. Ulrich, W. Kulisch, "Advanced Arithmetic for the Digital Computer", Springer-Verlag Wien, 2002
2. Rabaey, M., Anantha Chandrakasan and BorivojeNikolic, "Digital Integrated Circuits - A Design Perspective", 2nd Edition, Prentice Hall International, 2016

Web Resource

1. https://www.youtube.com/watch?v=iQHmtEtEggY
2. https://onlinecourses.nptel.ac.in/noc22_ee58/preview
3. https://onlinecourses.nptel.ac.in/noc20_ee37/preview

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HO 20ECH08 Pattern Recognition 4 0 0 4

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

Code	Course Outcomes
20ECH08.1	Understand and recollect the basics of Baye's Theorem, Auto Correlation and Cross Correlation Techniques
20ECH08.2	Illustrate the Bayes Decision Theory and Parameter Estimation Methods
20ECH08.3	Demonstrate the Criterion and Clustering Techniques
20ECH08.4	Demonstrate the Sequential Pattern Recognition Techniques like HMMs, Parzen-Window Method
20ECH08.5	Understand the principles involved in Dimensionality Reduction using Non-metric methods for pattern classification

Unit I: Basics of Probability, Random Processes and Linear Algebra **12 Hours**

Probability: independence of events, Baye's theorem; Random Processes: Stationary and non stationary processes, Expectation, Autocorrelation, Cross-Correlation, spectra; Linear Algebra: inner product, outer product, inverses, Eigen values, Eigen vectors

Unit II: Baye's Decision Theory **12 Hours**

Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, discriminant functions, discrete features.

Parameter Estimation Methods: Maximum-Likelihood estimation: Gaussian case; Maximum a Posteriori estimation; Bayesian estimation: Gaussian case.

Unit III: Unsupervised learning and clustering **12 Hours**

Criterion functions for clustering; Algorithms for clustering: K-Means, Hierarchical and other methods; Cluster validation, Expectation-Maximization method for parameter estimation; Maximum entropy estimation

Unit IV: Sequential Pattern Recognition 12 Hours

Hidden Markov Models (HMMs); Discrete HMMs; Continuous HMMs, Nonparametric techniques for density estimation: Parzen-window method.

Unit V: : Dimensionality Reduction 12 Hours

Fisher discriminant analysis; Principal component analysis;Linear discriminant functions: Gradient descent procedures; Perceptron, Support vector machinesm, Non-metric methods for pattern classification: Non-numeric data or nominal data; Decision trees: CART.

Text Books

1. R.O.Duda, P.E.Hart and D.G.Stork, "Pattern Classification", John Wiley, 2001.
2. S.Theodoridis and K.Koutroumbas,"Pattern Recognition",4th Edition, Academic Press, 2009.
3. C.M.Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

Reference Books

1. Earl Gose, Richard Johnsonbaugh and Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India, 2002.

Web Resource

1. https://onlinecourses.nptel.ac.in/noc19_ee56/preview
2. https://www.ll.mit.edu/outreach/adaptive-antennas-and-phased-arrays-online-course

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HO 20ECH09 Advanced 3G and 4G Mobile Communications 4 0 0 4

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

Code	Course Outcomes
20ECH09.1	Understand the concept of cellular systems, cell structures, cell sectoring.
20ECH09.2	Design of Antenna system, Types of interferences.
20ECH09.3	Understand the channel assignments, formula for mobile propagation over water and flat open area.
20ECH09.4	Classify and analyse types of hand-off strategies, vehicle locating methods, and dropped call rates.
20ECH09.5	Understand GSM Architecture, Multiple Access Schemes

Unit I: The Cellular Mobile Radio Systems **12 Hours**

Introduction, uniqueness of mobile radio environment, cellular system operation, components of Cellular system, Hexagonal shaped cells, Analog and Digital Cellular systems .Evolution of Cellular systems, frequency reuse and it's ratio, Number of channels in a cellular system, Trunking and Blocking, Grade of Service, macro, micro, pico and femto cell structures, Cell splitting, Cell sectoring.

Unit II: Interference 12 Hours

Types of interferences, Introduction to Co-Channel Interference, real time Co-Channel interference, Co-Channel measurement, Co-channel Interference Reduction Factor, desired C/I from a normal case in a omni-directional Antenna system, design of Antenna system, antenna parameters and their effects, diversity receiver, non-co-channel interference-different types.

Unit III: Frequency Management and Assignments of Channels **12 Hours**

Numbering and grouping, setup access and paging channels, channel assignments to cell sites and mobile units, channel sharing and borrowing, overlaid cells. Cell coverage for signal and traffic: Signal reflections in flat and hilly terrain,effect of human made structures, mobile propagation over water and flat open area, near and long-distance propagation, antenna height gain, form of a point-to-point model

Unit IV: Handoff Strategies 12 Hours

Concept of Handoff, types of handoffs, handoff initiation, delaying handoff, forced handoff, mobile assigned handoff, intersystem handoff, soft and hard handoffs, vehicle locating methods, dropped call rates and their evaluation

Unit V: : Digital Cellular Networks 12 Hours

GSM architecture, GSM channels, multiple access schemes; TDMA, CDMA, OFDMA.3G and 4G Wireless Standards GSM,GPRS, WCDMA, LTE, Wi-MAX, Introduction to 5G standards..

Text Books

1. Lee W.C.Y.,"Mobile Cellular Telecommunications", Tata McGraw Hill, 2nd Edition, 2006
2. Gordon L. Stuber.," Principles of Mobile Communications", Springer International, 2nd Edition, 2007.
3. Savo G. Glisic," Advanced Wireless Communications-4G", John Wiley & Sons Publication, 2nd Edition

Reference Books

1. Theodore, S. Rapport.," Wireless Communications", Pearson education, 2nd Edition,2002.
2. David Tse and Pramod Viswanath," Fundamentals of Wireless Communication", Cambridge University Press

Web Resource

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/
3. http://ieeexplore.ieee.org

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HO 20ECH10 Simulation and Testing Methods for VLSI Design 4 0 0 4

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

Code	Course Outcomes
20ECH10.1	Identify the significance of testable design and specify Fabrication defects, Errors and Faults
20ECH10.2	Analyze various Simulation Methods in Modeling circuits
20ECH10.3	Understand the importance of Design verification
20ECH10.4	Implement the test methods for static and dynamic CMOS circuits
20ECH10.5	Analyze the BIST techniques to improve testability

Unit I : Introduction to Testing 12 Hours

Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends affecting Testing, Types of Testing, FaultModeling: Defects, Errors and Faults, Functional Versus Structural Testing, Levels of Fault Models, Single Stuck-at Fault.

Unit II : Logic and Fault Simulation 12 Hours

Simulation for Design Verification and Test Evaluation, Modeling Circuits for Simulation, Algorithms for True-value Simulation, Algorithms for Fault Simulation, ATPG

Unit III : Testability Measures 12 Hours

SCOAP Controllability and Observability, High Level Testability Measures, Digital DFT and Scan Design: Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design, Variations of Scan.

UNIT IV : CMOS Testing 12 Hours

CMOS testing: Testing of static and dynamic circuits. Fault diagnosis: Fault models for diagnosis, Cause- effect diagnosis, Effect-cause diagnosis.

UNITV : Built-In Self-Test 12 Hours

The Economic Case for BIST, Random Logic BIST: Definitions, BIST Process, Pattern Generation, Response Compaction, Built-In Logic Block Observers, Test-Per-Clock, Test-Per Scan BIST Systems, Circular Self Test Path System, Memory BIST, Delay Fault BIST.

Text Books

1. WenW. W., "VLSI Test Principles and Architectures Design for Testability", Morgan Kaufmann Publishers, 2006.
2. AbramoviciM., BreuerM. and FriedmanA.,"Digital Systems Testing and Testable Design", IEEE Press, 1990
3. William K. Lam "Hardware Design Verification: Simulation and Formal Method based Approaches", Prentice Hall, 2008

Reference Books

1. Stroud and Kluwer,"A Designer's Guide to Built-in Self-Test", Academic Publishers, 2002
2. BushnellM. and AgrawalV. and Kluwer, "Essentials of Electronic Testing for Digital, Memory &MixedSignal VLSI Circuits", Academic Publishers, 2000
3. AgrawalV. and SethS.C.,"Test Generation for VLSI Chips", Computer Society Press.1989.
4. LalaP. K., "Digital Circuit Testing and Testability", Academic Press.

Web References

1. https://www.semanticscholar.org/paper/Advanced-simulation-and-test-methodologies-for-VLSI-Russell-Sayers/c97ef40cf7a38b27bc3ec0496f9d0943dc29fdd4
2. nptel.ac.in/content/storage2/courses/106103116/handout/mod1.pdf

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using MATLAB | Approved in 4th BOS & 5th AC | Applicable to the students admitted from 2022-23 and onwards

20ECH11 Digital Signal Processing and Image ProcessingUsing MATLAB 4 0 0 4

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

Code	Course Outcomes
20ECH11.1	Understand the mathematical functions , operations and programming
20ECH11.2	Derive the frequency domain representation of signals and systems
20ECH11.3	Design and realization of IIR and FIR filters from the given specifications
20ECH11.4	Demonstrate the basic operations and processing techniques of digital Image processing
20ECH11.5	Understand the algorithms and Develop some applications of digital image processing

UnitI: Introduction to MATLAB 12 Hours

Variables ,Operations and Functions, Matrix operations, Matrix functions, Logical operators on Boolean variables, Graphically displaying results, Program writing.

Unit II: Operations on Signals and Systems 12 Hours

Concept of signal, Concept of System, Sampling Theorem, Plotting a signal as a function of time, Specral representation, Discrete -Time Fourier Transform, Discrete Fourier Transform

Unit III: Linear Filters 12 Hours

Transforming and Linear Filtering,Connection between gain and poles /zeros, Filter Design methods: Continuous to Discrete time Filter, FIR filter design using the window method, IIR filter design .

Unit IV: Image Processing 12 Hours

Introduction: Image display, Arithmetical and logical operations, Geometric transformations of an image, Linear Filtering, Other operations on images, Median filtering, Morphological filtering of binary images.

Unit V: Applications of Digital Signal Processing and Digital Image Processing 12 Hours

Speech Processing: A speech signal Model,Principal Component Analysis(PCA),Matched Filetrs in radar telemetry, Kalman filtering.

Text Books

1. Gerard Blanchet Maurice Charbit,"Digital Signal and Image Processing using MATLAB", Wiley, 2006.
2. Sanjit K. Mitra," Digital Signal Processing , A Computer Based Approach " Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

Reference Books

1. Steven, L. Eddins, Rafael C. GONZALES, Richard, E. Woods ,"Digital Image Processing Using MATLAB , Tata McGraw Hill Education (India)2010
2. Chris Solomon, Toby Breckon,P.C., "Fundamentals of Digital Image Processing - A Practical Approach with Examples in Matlab"Wiley, 2011
3. Robert, J. Schilling and Sadra,L.Haris," Fundamentals of Digital Signal Processing using MATLAB" Thomson, 2007

Web References

1. https://nptel.ac.in/courses/117/102/117102060/
2. https://nptel.ac.in/courses/108106168/
3. http://nptel.ac.in/courses/122106033/

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Board of Studies
(ECE)

HO 20ECH12 5G Mobile & Wireless Technology 4 0 0 4

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

Code	Course Outcomes
20ECH12.1	Understand the basics of wireless technology
20ECH12.2	Demonstrate the fundamentals of cellular system
20ECH12.3	Classify and Understand the various Digital standards for wireless communication
20ECH12.4	Understand the requirements and advantages of CDMA
20ECH12.5	Demonstrate the 5G Technlogy

Unitl: Introduction to Wireless Technology 12 Hours

Radio wave propagation, Block diagram of wireless communication system, Wireless network generations, mobile wireless system, cordless telephone system, cellular telephone system, and wireless local loop (WLL) and Local Multipcint Distribution System (LMDS), Mobile Standards.

Unit II: Elementary Cellular Systems 12 Hours

Basic of Cellular fundamentals, cell structure, cluster, minimum reuse distance, basics of cellular systems, mobile station, basestation, traffic channel and control channel, frequency reuse, concept of Handoffs, Types of Handoffs (Hard, soft, queued, delayed and Mobile assisted Handoffs) and channel interference.

Unit III: Digital Cellular Standards 12 Hours

Global system for mobile communication (GSM), Architecture, features, channel types and security and call routing. IS-95/CDMA One, Comparison with GSM features. Signaling system, network services part (NSP), Message transfer part (MTP), Signaling correction control part (SCCP) and its performance. Need of 3G & 4G technology.

Unit IV: Advanced Cellular Standards 12 Hours

IMT-2000 global standards, its vision, spectrum requirements, services and compatibility, Architecture, features of UMTS standard. Features and advantages of CDMA-2000 over 3G. Features and architecture of 802.15.1, Basics of RFID, frequency band andclassification of RFID tags, WMAN, MANET.

Unit V: Introduction to 5G 12 Hours

Review of 4G, 4G LTE, VoLTE, 4.5G. Introduction advantages of 5G, its challenges and applications, Basics of 5G channels access methods, radio access network requirements for 5G, 5G &IoT. - 5G for Massive Machine Type Communication and Massive IoT- V2X Communication.

Text Books

1. Lin Yi-Bang, Clamtaclmrich, "Wireless and mobile network architecture" John Wiley & sons, 2001.
2. William, Y.,"Mobile cellular telecommunications system" McGraw Hill Education, New Delhi, 2017.
3. SaadZ. Asif, "5G Mobile Communications Concepts and Technologies",1st Edition, CRC Press, 2019.
4. Jonathan Rodriguez, "Fundamentals 5G Mobile Networks", 1st Edition John Wiley& Sons, 2015.

Reference Books

1. Rappaport, S., Theodore, "Wireless communications principles and practice" Pearson publication, New Delhi, 2005.
2. Singal, T.L., " Wireless communications" McGraw Hill Education Private Limited, 2010.
3. Erik Dahlman, Stefan Parkvall, Johan Skold, "5G NR: The Next Generation Wireless Access Technology",1st Edition,Academic Press, 2018.
4. AfifOsseiran, Jose F., Monserrat and Patrick Marsch, "5G Mobile and Wireless Technology", Cambridge press, 2016.

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1. https://nptel.ac.in/courses/108105134
2. https://www.researchgate.net/publication/337224719_Mobile_and_Wireless_Technology_MWT

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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	Mapping with POs	DoK
20CEM01.1	Identify different types of pollution and their sources		L1,L2
20CEM01.2	Identify the meteorological components		L1,L2
20CEM01.3	Outline the impact on local and global effects of air pollution on human, materials, properties and vegetation		L1,L2
20CEM01.4	Explain various types of air pollution control equipment and their working principles		L1,L2
20CEM01.5	Understand sampling methods and monitoring of air pollution		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

Definition of air pollution, Sources and causes of air pollution, Types and classification of air pollution - Natural contaminents,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 andstack 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

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. Mention various sources of air pollution.
2. Define Atmospheric stability
3. Write a note on Ozone depletion
4. What are Filters & Electrostatic precipitators?

L2: Understand

1. What are Primary and secondary air pollutants?
2. Write the effect of effect of meteorology on Plume dispersion
3. Explain briefly about effects of air pollution on human beings, plants and animals and properties

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20CSM01 E-Commerce

3 0 0 3.0

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

Code	Course Outcomes	Mapping withPOs	DoK
20CSM01.1	Explain the role of new internet economy in E-Commerce		L1,L2
20CSM01.2	Explain the architecture of World Wide Web		L1,L2
20CSM01.3	Describe the E-Commerce process models and E-Payment System		L1,L2
20CSM01.4	Illustrate the network models in customization and internal commerce		L1,L2
20CSM01.5	Explain the E-commerce models in advertising and marketing of business		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

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, Technologybehind 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 Intraorganizational 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- commerce 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 LevelsL1: 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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Studies (CSE)

VI 20MEM01 Biomaterials 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20MEM01.1	Classify various biomaterials		L1,L2
20MEM01.2	Identify the Metallic implant materials		L1,L2, L3
20MEM01.3	Describe the failure modes of implant materials		L1,L2
20MEM01.4	Apply Ceramic implant materials		L1,L2, L3
20MEM01.5	Develop the Biocompatibility & Toxicological properties in of biomaterials		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 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.

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 Karihalo, ElsevierAcademic Press, 2003.

Reference Text 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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Chairman
Board of Studies(ME)

Head of the Department
Dept. of Electronics & Communication Engg.
M.S.Raju Institute of Technology
Sontyam, Visakhapatnam-531 173

20EEM01 Basic Control Systems 3 0 0 3

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

Code	Course Outcomes	Mapping with PO's	DoK
20EEM01.1	Determine time response specifications of second order systems		L1-L2
20EEM01.2	Determine error Constants for different types of input signals		L1-L2
20EEM01.3	Understand various levels of illuminosity produced by differentilluminating sources.		L1-L3
20EEM01.4	Design different lighting systems by taking inputs and constraints in view for different layouts.		L1-L3
20EEM01.5	Understand the speedtime characteristics of different types oftraction motors.		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: 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

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 LevelsL1: 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 $s^5+2s^4+3s^3+s^2+5s^1+2s^0+s+7=0$. Determine the the stability of thesystem 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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(EEE)

20ECM01 Semiconductor Devices and Circuits 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20ECM01.1	Classify different types of semiconductors with energy band diagrams		L1, L2
20ECM01.2	Explain the operation and characteristics of PN junction diode and special diodes		L1, L2
20ECM01.3	Classify and Analyze different types of rectifiers	-	L1, L2, L3
20ECM01.4	Demonstrate the flow of current in different configurations of the transistor & the concept of DC biasing and transistor stabilization		L1, L2, L3
20ECM01.5	Analyze and Design the small signal low frequency amplifiers		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: 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 bies 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 (C_e) 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

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 amplifier

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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	Mapping with POs	DoK
20AIM01.1	Describe the concepts of artificial neural networks	-	L1, L2
20AIM01.2	Compare functions of biological and artificial neural networks		L1, L2
20AIM01.3	Explain the architecture and functioning of Single Layer feed forward networks		L1, L2
20AIM01.4	Describe architecture and functioning of Multi-layer networks		L1, L2
20AIM01.5	Explain associative memory networks		L1, L2

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

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

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(CSE)

	20DSO03 Introduction to R Programming	3	0	0	3.0

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

Code	Course Outcomes	Mapping with POs	DoK
20DSO03.1	Understand the basic concepts of R programming		L1, L2
20DSO03.2	Understand about Scalars and Vectors		L1, L2,
20DSO03.3	Implement Lists and data Frames		L1, L2, L3
20DSO03.4	Implement Tables and Statistical Distributions		L1, L2 , L3
20DSO03.5	Implement Functions in R programming		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**

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-Like 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

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 Grolemund, 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 LevelsL1: 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 RL3: 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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MI 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

Web References

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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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, 1996
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

Web References

1. https://onlinecourses.nptel.ac.in/noc21_ma74/preview
2. https://archive.nptel.ac.in/cour ses/111/105/111105077/
3. http://www.nitttrc.edu.in/nptel/courses/video/111105077/L10.html

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MI 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 10 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 10 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 10 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 10 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 10 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

Web References

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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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 10 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 10 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 10 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 10 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 10 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. Mammoria 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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MT 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

Unitl: 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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ChairmanBoard 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 Un-supervisory 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 I ", Tata McGraw - Hill Edition, 35th Reprint 2016.
2. K.P. Soman, ShyamDiwakar and V. Ajay, " Insight into Data Mining Theory and Practice II ", Eastern Economy Edition, Prentice Hall of India, 2006.
3. Ian H.Witten, Elbe Frank, " Data Mining: Practical Machine Learning Tools and Techniques", Second Edition, Elsevier.

Web Resources

1. https://www.tutorialspoint.com/
2. https://www.coursera.org/learn/

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(CSE)

20MEM02 Micro Electro mechanical Systems 3 0 0 3.0

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

Code	Course Outcomes	DoK
20MEM02.1	Acquire the operation of micro devices, micro systems and their applications	L1, L2
20MEM02.2	Ability to design the micro devices, micro systems using the MEMS fabrication process.	L2
20MEM02.3	Acquire basic approaches for various sensor design	L2
20MEM02.4	Acquire basic approaches for various actuator design	L2
20MEM02.5	Gain the technical knowledge required for computer-aided design, fabrication, analysis and characterization of nano-structured materials, micro- and nano-scale devices.	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: Basic Concepts 11+1Hours

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 11+1Hours

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 11+1 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 11+1Hours

Applications, considerations on micro scale fluid, fluid actuation methods, dielectrophoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, microfluid dispenser, micro needle, molecular gate, micro pumps. RADIO FREQUENCY (RF) MEMS:RF - based communication systems, RF MEMS, MEMS inductors, varactors, tunerifilter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

Unit V: Chemical And Bio Medical Micro Systems 11+1Hours

Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemoresistors, chemocapacitors, chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluorescence detection, calorimetric spectroscopy

Text Books

1. NitaigourPremchandMahalik, "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.

Web References

1. https://nptel.ac.in/courses/117/105/117105082/

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Board of Studies(ME)

VII **20EEM02 Basics of Electrical Machines and Drives** 3 0 0 3.0

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 9Hours

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 9Hours

Types of D.C Motor starters - Typical control circuits for shunt and series motors - Three phase squirrel cage and slipring induction motors

Unit IV: Conventional and Solid State Speed Control of D.C. Drives 9Hours

Speed control of DC series and shunt motors - Armature and field control, Ward-Leonard control system - Using controlled rectifiersand 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. VedamSubrahmaniam, "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.

Web References

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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Board of Studies (EEE)

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 forBasic 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 InternationalLearning, 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

Web Resource

1. https://onlinecourses.nptel.ac.in/noc19_ee51/preview
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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Chairman
Board of Studies (ECE)

PC	**20DSM02 Data Management and Analysis**	3	0	0	3.0

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

Code	Course Outcomes	Mapping with POs	DoK
20DSM02.1	Understand database and be familiar with relational database concepts		L1, L2
20DSM02.2	Demonstrate knowledge of terms, methods of ER Modelling		L1, L2
20DSM02.3	Demonstrate knowledge of trends in data management in Entity Clustering		L1, L2
20DSM02.4	Demonstrate how to acquire, transform, analyse in SQL		L1, L2, L3
20DSM02.5	Demonstrate how to solve problems in accounting using Transactions		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: 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 Entities, 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 Manipulation 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

Web Resources

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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Chairman Board
of Studies
(CSE-DS)

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, 1998
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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Chairman
Board of Studies

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 Edition, 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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Chairman
Board of Studies

Head of the Department
Dept. of Electronics & Communication Engg.
N.S.Raju Institute of Technology
Sontyam, Visakhapatnam-531 173

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 atwork, 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

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8. https://nptel.ac.in/courses/105/102/105102012/
9. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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Board of Studies

ACM

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)

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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

20CEM03 Sustainability and pollution prevention practices 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20CEM03.1	Concept of sustainability and its goals		L1,L2
20CEM03.2	Sources and effects of environmental pollution		L1, L2
20CEM03.3	Identify the prevention measures for environmental protection		L2,L3
20CEM03.4	Approach for analysis and assessment of developmental activities and their impacts on environment		L2, L3
20CEM03.5	Objectives and components of environmental management		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 -1 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 -2 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 controlof air, water, soil Pollution (Physicochemical and bacteriological sampling and analysis); effects of pollution on plants, animals and Human beings.

Unit-3 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 planningand land-use pattern

Unit-4 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-5 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,2009,Improving the Sustainable Development Goals: Strategies and the Governance Challenge
2. Herman KorenBest Practices for Environmental Health: Environmental Pollution, Protection, Quality and Sustainability, 21 April 2017
3. McCully, P. 1996. Rivers no more: the environmental effects of dams (pp. 29-64). Zed Books.
4. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

Reference Books

1. Environmental Chemistry - A.K. De, New Age Int. Pub. Co., New Delhi, 1990
2. Toxic Chemicals, health and the Environment, Lave, L.B and Upton, A.C. 1987. The Hopkins Press Ltd., London.
3. Pepper, I.L., Gerba, C.P. &Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.

Web References

1. http://mcic.ca
2. https://www.drishtiias.com
3. https://www.jica.go.jp

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, and Hala S. El-Sayed, "Multilevel Security for Relational Databases", ISBN 978-1-4822- 0539-8, CRC Press, 2014.

Reference Books

1. BhavaniThuraisingham, "Database and Applications Security: Integrating Information Security and Data Management", CRC Press, Taylor & Francis Group, 2005.
2. Elmasrinavrate, "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.

Web Resources

1. http://www.nptelvideos.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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Board of Studies (CSE)

MI 20MEM03 Surface Engineering 3 0 0 3

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

Code	Course Outcomes	DoK
20MEM03.1	Decide the surface preparation methods suitable for different substrate materials.	L2
20MEM03.2	Apply knowledge on properties offered by different Coatings based on the application requirement.	L3
20MEM03.3	Interpret the testing &evaluation of metallic coatings.	L2
20MEM03.4	Explain the effect of process parameters on the properties & microstructure of the surface coating processes.	L3
20MEM03.5	Explain the importance & role of surface modifications to achieve several technological properties.	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 Surface Engineering 11+1 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 11+1 Hours

Chromating, Phosphating, Anodizing, Thermochemical processes: Methodology used, mechanisms, important reactions involved, Process parameters and applications.

Unit III: Coating from Vapor Phase 11+1 Hours

PVD, and CVD: Various Methods used, mechanisms, important reactions involved, Process parameters and applications.

Unit IV: Metallic coating 11+1 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 11+1 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 Edison, 1997
2. George J. Rudzki -Surface Finishing Systems. metal and non-metal finishing handbook-guide, 1st Edison 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 Edison., ASM, Metals Park, 1987

Reference Books

1. Friction Stir Welding and Processing, Rajiv Sharan Mishra, Partha Sarathi De, Nilesh Kumar, ASM 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

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)

20EEM03 Electrical Engineering Material Science 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	DoK
20EEM03.1	Understand the phenomena of metal conductivity	2	L2
20EEM03.2	Explain the properties of di-electric properties	2	L2
20EEM03.3	Understand the magnetic properties of materials	2	L2
20EEM03.4	Explain the types of semi conductors	2	L2
20EEM03.5	Understand the modern techniques used for studying the material science	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: 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", 4thEdition, PHI, 2011
3. John Matthews, "Introduction to the Design and Analysis of Building Electrical Systems", 2ndEdition,Springer, 2013.

Reference Books

1. M.A. Cayless, "Lamps and Lighting", 5thEdition, Routledge, 2016.
2. Leopold Bloch, "Science of Illumination: An Outline Of The Principles Of Artificial Lighting", Kessinger Pub, 2018.

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1. https://nptel.ac.in/courses/108/105/108105060/

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Board of Studies
(EEE)

MD 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. Neeman, "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 Willey &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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Board of Studies
(ECE)

Head of the Department
Dept. of Electronics & Communication Engg.,
N.S.Raju Institute of Technology
Sontyam, Visakhapatnam-531 173

VI	20AIM03 Interpretable Machine Learning	3	0	0	3.0

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

Code	Course Outcomes	Mapping with POs	DoK
20AIM03.1	Introduction to interpretability		L1,L2
20AIM03.2	Different interpretable models		L1,L2
20AIM03.3	Explain the software's for interpretable models.		L1,L2
20AIM03.4	Illustrate plotting of prediction changes.		L1,L2
20AIM03.5	Explains individual predictions of any black box classification model.		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

Importance of Interpretability, Taxonomy of Interpretability Methods, Scope and evaluation of Interpretability, Properties ofExplanations, Human-friendly 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) - NonlinearEffects, 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.

Local Surrogate

Unit V: Local Model Agnostic Methods 9 hours

Individual Conditional Expectation (ICE), Local Surrogate (LIME), Counterfactual Explanations, Scoped Rules (Anchors),Shapley Values.

SH Additive explanations (SHAP)

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 SergMasis - 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

WebReferences

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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Chairma
n Board of
Studies(CSE)

Head of the Department
Dept. of Electronics & Communication Engg.
N.S.Raju Institute of Technology
Sontyam, Visakhapatnam-531 173

	20DSM03 Data Governance	3	1	0	3.0

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

Code	Course Outcomes	Mapping with POs	DoK
20DSM03.1	Understanding of the role computation can play in solving problems and optimization techniques		L1, L2
20DSM03.2	Understanding the usage of computational techniques.		L1, L2
20DSM03.3	Understanding Stochastic programming and statistical thinking		L1, L2, L3
20DSM03.4	Identify the problem using Monte Carlo simulations		L1, L2, L3
20DSM03.5	Plotting with the pylab package		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, Data Literacy and Concepts **9 + 3 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 + 3 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 + 3 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 + 3 hours**
Types of approaches, The data governance delivery framework, Process overview, Engegement, Strategy, Architecture and design, Implementation, Operation, and changes

Unit V:Engagement 9 + 3 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. EvrenEryuek, 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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Board of Studies (CSE)

20SHM06 Journalism

3 0 0 3

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

Code	Course Outcomes
20SHM01.1	Understand the concepts of mass communication in general and journalism in particular
20SHM01.2	Impact fundamentals of journalism, evolutionary process, basics concepts, practices and recent trends
20SHM01.3	Get exposed to different faces of journalism
20SHM01.4	Get trained to develop inquisitive and analytical skills to be successful in media
20SHM01.5	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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Board of Studies

20SHM07 Statistical Quality Control

3 0 0 3

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

Code	Course Outcomes
20SHM08.1	Identify application of various Statistical quality tools
20SHM08.2	Use control chart techniques for quality improvement
20SHM08.3	planning, establishing, and operating SQC procedures
20SHM08.4	Design a procedure testing incoming batches
20SHM08.5	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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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

Web References

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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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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ChairmanBoard of Studies

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

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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Board of Studies

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

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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

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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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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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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Board of Studies

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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Board of Studies

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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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

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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Board of Studies

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

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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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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Board of Studies

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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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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