ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

ELECTRONICS AND COMMUNICATION ENGINEERING

FOR

B.TECH FOUR YEAR DEGREE COURSE

(Applicable for the batches admitted from 2022-23)

G. NARAYANAMMA INSTITUTE OF TECHNOLOGY & SCIENCE

(AUTONOMOUS) (For Women)

Shaikpet, Hyderabad –500104.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

DEPARTMENT VISION

ECE dept envisions to develop high quality and technically competent women engineers who can address the growing challenges in the modern world with a keen sense of social responsibility.

DEPARTMENT MISSION

To provide:

- Knowledge Based Engineering Education
- Analysis and Design Skills with Modelling Potential, Technical Competence
- Industry Compatibility and Women Empowerment with Societal Commitment
- Professional Career Growth with Values and Ethics

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ACADEMIC REGULATIONS (R22)

For CBCS Based B.Tech. Degree Programmes

(Applicable for the students admitted into I year from the Academic Year **2022-23** and onwards)

1.0 Under-Graduate Degree Programme (UGDP) in Engineering & Technology (E&T)

G. Narayanamma Institute of Technology & Science (GNITS) - for Women, Hyderabad, an Autonomous College approved by AICTE, New Delhi, and affiliated to Jawaharlal Nehru Technological University Hyderabad (JNTUH), Hyderabad, offers 4 Year (8 Semesters) Bachelor of Technology (B.Tech.) Degree Programme under Choice Based Credit System (CBCS) with effect from the Academic Year 2022 – 23 onwards in the following Branches of Engineering & Technology (Table 1.0):

S.No.	*Programme*
I.	Computer Science & Engineering **(CSE)**
II.	Electrical & Electronics Engineering **(EEE)**
III.	Electronics & Communication Engineering **(ECE)**
IV.	Electronics & Telematics Engineering **(ETE)**
V.	Information Technology **(IT)**
VI.	Computer Science & Engineering (Artificial Intelligence & Machine Learning) **(CSM)**
VII.	Computer Science & Engineering (Data Science) **(CSD)**
VIII.	Computer Science & Technology **(CST)**

Table 1.0

2.0 Eligibility for Admission

2.1 The Admission to the UGDP shall be made either on the basis of the merit rank obtained by the qualifying candidate at an Entrance Test conducted by the Telangana State Government (TSEAMCET), OR the University, OR on the basis of any other order of merit approved by the University, subject to the reservations as prescribed by the Government from time to time.

2.2 The medium of instruction for the entire UG Degree Programme in E&T shall be ENGLISH only.

3.0 B.Tech. Degree Programme Structure

3.1 The B.Tech. Degree Programmes at GNITS are of Semester Pattern, with 8 Semesters constituting 4 Academic Years and each Academic Year is of TWO Semesters (First/Odd and Second/Even Semesters). Each Semester shall be of 22 Weeks duration (inclusive of Examinations), with a minimum of 90 Instructional Days per Semester.

3.2 UGC/AICTE specified Definitions/Descriptions areadopted appropriately for various terms and abbreviations used in these Academic Regulations/ Norms, which are listed under Clauses **3.2.1 to 3.2.4**. The Course Structure is organized based on the AICTE Model Curriculum for Under-Graduate Degree Courses in Engineering & Technology (Jan. 2018).

3.2.1 Semester Scheme:

Each UGDP is of 4 Academic Years (8 Semesters), with each academic year divided into two semesters of 22 weeks (≥90 working days) each. Each semester has 2 components of evaluation - 'Continuous Internal Evaluation (CIE)' and 'End Semester Examination or Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as denoted by UGC, and Course Structure/Curriculum as suggested by AICTE are followed. The terms 'SUBJECT' or 'COURSE' imply the same meaning here, and refer to 'Theory Subject', or 'Lab/Practical Course', or 'Design/ Drawing Subject', or 'Elective', or 'Open Elective", or 'Seminar', or 'Project', or 'Mini-Project', or 'Online Course', as the case may be.

3.2.2 All the Subjects/ Courses are to be registered by a student in a Semester to earn Credits. Credits shall be assigned to each Subject/ Course in a **L: T: P: C** (**L**ecture Periods: **T**utorial Periods: **P**ractical Periods: **C**redits) Structure based on the following general pattern:

- One Credit - for One hour/ Week/ Semester for Theory/ Lecture (L) Courses, and Tutorials (T); and,
- One Credit - for Two hours/ Week/ Semester for Laboratory/ Practical (P) Courses.
- Mandatory Courses (MC) will not carry Credits.

3.2.3 Subject/ Course Classification

All the Subjects/ Courses offered for the UGDP are broadly classified as: (a) Foundation Courses (FnC), (b) Core Courses (CoC), and (c) Elective Courses (EℓC).

- Foundation Courses (FnC) are further categorized as:
  - i) HS (Humanities and Social Sciences including Management Courses),
  - ii) BS (Basic Sciences Courses), and
  - iii) ES (Engineering Sciences Courses);
- Core Courses (CoC) and Elective Courses (EℓC) are categorized as PS (Professional Subjects), which are further subdivided as:
  - i) PC (Professional/ Departmental Core) Courses
  - ii) PE (Professional/ Departmental Electives) Courses
  - iii) OE (Open Electives) Courses; and
  - iv) Project Works (PW);

- Additional Courses:
  - ONLINE Courses (OL - offered on MOOCS platform by NPTEL/ IITs) approved by JNTUH;
  - MC - No Credits allocated.

3.2.4 Course Nomenclature:

The Curriculum Nomenclature or Course Structure Grouping for each UG Degree Programme (or B.Tech. Degree Course) is as listed below (along with AICTE specified % Range of Credits) in Table 3.2.4:

S. No.	*Broad Course Classification*	*Course Group/ Category*	*Course Description*	*Range of Credits (AICTE Model)*	*R22 Regulations at GNITS*
1)	**Foundation Courses (FnC)**	**BS – Basic Sciences**	Include - Mathematics, Physics, Chemistry, Biology Subjects	**15% - 20%**	**22.5 C (14.06 %)**
2)		**ES - Engineering Sciences**	Include fundamental engineering subjects	**15% - 20%**	**25 C (15.63 %)**
3)		**HS – Humanities & Social Sciences**	Include subjects related to Humanities, Social Sciences and Management	**5% - 10%**	**12 C (7.5 %)**
4)	**Core Courses (CoC)**	**PC – Professional Core**	Include core subjects related to the Parent Department/ Branch of Engg.	**30% - 40%**	**54.5 C (34.06 %)**
5)	**Elective Courses (EℓC)**	**PE – Professional Electives**	Include Elective subjects related to the Parent Department/ Branch of Engg.	**10% - 15%**	**18 C (11.25 %)**
6)		**OE – Open Electives**	Elective subjects include subjects from other Technical and/ or Emerging Subject Areas	**5% - 10%**	**9 C (5.62 %)**

7)	**Projects Related Courses (PW)**	**Project Work**	B.Tech. Project or UG Project or UG Major Project	**10% - 15%**	**19 C (11.88 %)**
8)		**Mini-Project**	Mini-Project/ Industrial Training / Internship/ UG Mini-Project		
9)		**Seminar**	Seminar based on core contents related to Parent Department/ Branch of Engg.		
10)	**Mandatory Courses**	**MC**	Mandatory Courses	**No Credits**	-
11)	**Additional Courses**	**ONLINE Courses (OL)**	Offered on MOOCS platform by NPTEL/ IITs	ADDI-TIONALs	24 C
Total Credits for UG (B. Tech.) Degree Programme				**160 (100%)**	**160 (100%)**

Table 3.2.4

4.0 Course Work

4.1 A student after securing admission, shall pursue the B.Tech. UG Degree Programme in a minimum period of 4 Academic Years, and a maximum period of 8 Academic Years (with effect from the Date of Commencement of I Year).

4.2 As suggested by AICTE, a 3-week 'Mandatory Induction Programme' shall be offered for all the Branches of Engineering at the start of the I Year UGDP, to enable the newly admitted students get acquainted with the new professional environment, to develop awareness and understanding of the engineering education requirements, and to get them prepared for the academic schedules ahead. The features, activities and pattern of the Induction Programme shall be as per the guidelines suggested in the Model Curriculum. Conventional class work shall commence only after the completion of the Induction Programme.

4.3 Each student shall Register for and secure the specified number of Credits (160 Credits) required for the completion of the UGDP and Award of the B.Tech. Degree in the respective Branch of Engineering.

4.4 Each Semester is structured to provide 20 Credits (20 C), totaling to 160 Credits (160 C) for the entire B.Tech. Programme.

5.0 Course Registration

5.1 A 'Faculty Advisor or Counselor' shall be assigned to each B.Tech. student and the Faculty Advisor assigned shall advise/counsel the student about the UGDP, its Course Structure and Curriculum, Choice/ Option for Subjects/Courses, based on the competence, progress, pre-requisites and interest of the student.

5.2 The Academic/Examination Section of the College invites 'Registration Forms' from the students apriori (before the beginning of the Semester) through 'ONLINE SUBMISSIONS', ensuring 'DATE and TIME Stamping'. The ONLINE Registration Requests for any 'CURRENT SEMESTER' shall be completed BEFORE the commencement of SEEs (Semester End Examinations) of the 'PRECEDING SEMESTER'.

5.3 Every individual student is advised to register for all the number of credits (20 Credits) indicated in that semester workload of the respective UGDP Course Structure - this is termed as the 'Normal Work Load' (NWL).

5.4 A student can apply for ONLINE Registration, ONLY AFTER obtaining the 'WRITTEN APPROVAL' from her assigned Faculty Advisor, which should be submitted to the College Academic/ Examination Section through the Head of the Department. (a copy of the same is to be retained by the Head of the Department, Faculty Advisor and the student).

5.5 A student may be permitted to register for the Subjects/ Courses of her choice with the typical work load (20 Credits) suggested in the respective semester credit load allocation of that UGDP Course Structure as the Normal Work Load (NWL), and the Maximum Work Load per semester (MWL) – with permissible additional courses within the Course Structure (subject to a maximum of 2 Theory Courses and 1 Lab Course) of her choice, is limited to a total work load of 28 Credits, based on her PROGRESS and SGPA/ CGPA, and completion of the 'PRE-REQUISITES' as indicated for various Subjects/ Courses in the Department Course Structure and Syllabus contents.

5.6 The choice for the 'additional/extra' Subjects/Courses to reach the Maximum Work Load (MWL) of 28 Credits (above the NWL specified) in each semester must be clearly indicated on a request letter, which needs the specific approvals and signatures of the Faculty Advisor/ Counselor and the HoD on the hardcopy.

5.7 If the student submits ambiguous choices or multiple options or erroneous entries during ONLINE Registration for the Subject(s) / Course(s) under a given/ specified Course Group/ Category as listed in the Course Structure, only the first correctly mentioned Subject/ Course in that category shall be taken into consideration, as applicable.

5.8 The Subject/Course Options exercised through ONLINE Registration are final and CANNOT be changed, and CANNOT be inter-changed; further, alternate choices shall also be not considered. However, if the Subject/ Course that has already been listed for Registration (by the Head of the Department) in a semester could not be offered on account of any unforeseen or unavoidable reasons, then the student shall be allowed to have alternate choice - either for a new Subject (subject to offering of such a Subject), or for another existing Subject (subject to availability of seats), which may be considered. Such alternate arrangements shall be made by the Head of the Department, with due notification and time-framed schedule, within the FIRST WEEK from the commencement of class-work for that semester.

5.9 Dropping of the Subjects/ Courses may be permitted ONLY AFTER obtaining the prior approval from the Faculty Advisor assigned (subject to the retaining of the NWL), 'within 15 Days of Time' from the beginning of the current semester.

5.10 For the Mandatory Courses, a 'Satisfactory Participation Certificate' from the concerned authorities of the relevant semester is essential. No Marks or Grades or Credits shall be awarded for the Mandatory Courses.

6.0 Subjects/ Courses to be offered

6.1 A typical Section strength (or Class strength) for each semester shall be 60.

6.2 A Subject/ Course may be offered to the students, ONLY IF a Minimum of 30 Students opt for the same. The Maximum Class Strength of a Section is limited to 80.

6.3 More than ONE TEACHER may offer the SAME SUBJECT (Theory/ Tutorials/Lab./Practicals) in any semester. However, selection choice for students will be based on - 'FIRST COME FIRST SERVE Basis and CGPA Criterion' (ie., the first focus shall be on the earliest stamping of ONLINE ENTRY from the student for Registration in that semester, and the second focus, if needed, shall be on the existing CGPA of the student).

6.4 If more entries for the Registration of a Subject come into picture, then the Head of the Department concerned shall take necessary action, whether to offer such a Subject/ Course for TWO (or multiple) SECTIONS or NOT .

6.5 In case of the options coming from the students of the other Departments/ Branches/ Disciplines also (not considering OPEN ELECTIVES), PRIORITY shall be given to the student of the 'Parent Department/Branch' first.

7.0 Attendance Requirements

7.1 A student shall be eligible to appear for the End Semester Examinations if she acquires a minimum of 75% of attendance in aggregate of all the Subjects/Courses (including Mandatory or Non-Credit Courses) for that semester. Two periods of attendance for each theory subject shall be considered, if the student appears for the mid-term examination of that subject.

7.2 Condoning of shortage of attendance in aggregate up to 10% (65% and above, and below 75%) in each semester may be granted by the College Academic Committee (CAC) on genuine and valid grounds based on the student's representation with supporting evidence.

7.3 A stipulated fee shall be payable towards condoning of shortage of attendance.

7.4 Shortage of Attendance below 65% in aggregate shall in NO CASE be condoned.

7.5 A student, whose shortage of attendance is not condoned in a semester is not eligible to take her End Examinations of that semester; she gets detained and her registration for that semester shall stand cancelled. She will not be promoted to the next semester. She may seek re-registration for all those Subjects registered in that semester in which she got detained, by seeking re-admission for that semester as and when offered; in case if there are any Professional Electives and/ or Open Electives, the same may also be re-registered if offered, however, if those Electives are not offered in later semesters, then alternate Electives may be chosen from the same set of Elective Subjects available under that Elective category.

8.0 Academic Requirements

The following Academic Requirements have to be satisfied in addition to the Attendance Requirements mentioned under Clause 7.0.

8.1 A student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to each Subject/ Course (except for Seminar and Mini-Projects), if she secures not less than 35% (14 marks out of 40 marks) in CIE (Continuous Internal Evaluation), not less than 35% (21 marks out of 60 marks) in SEE (Semester End Examination), and a minimum of 40% (40 marks out of 100 marks) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of Letter Grades, this implies securing **'C'** grade or above in that subject/ course.

8.2 A student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to the Seminar (IV Year II Semester) and the Mini-Projects (II Year II Semester, and III Year II Semester), if she secures not less than 40% of the total marks (that is, 40 out of

100 marks allotted) for each of them. The student would be treated as failed, if she - (i) does not submit a report on her Mini-Projects, or does not make a presentation of the same before the Evaluation Committee as per specified schedule, or (ii) does not present the Seminar as required in the IV year II Semester, or (iii) secures less than 40% of marks (that is, 40 marks) in the Mini-Projects/ Seminar evaluations. She may reappear once for each of the Mini-Projects/ Seminar evaluations, as and when they are scheduled again; if she fails in such 'one reappearance' evaluation also, she has to reappear for the same in the next subsequent semester, as and when they are scheduled, as supplementary candidate.

8.3 A student will not be promoted from the I Year to the II Year, unless she fulfills the Attendance and Academic Requirements and secures a total of 20 Credits out of 40 Credits specified for the I Year, from all the relevant regular and supplementary examinations, whether she takes those examinations or not.

8.4 A student will not be promoted from the II Year to the III Year, unless she fulfills the Attendance and Academic Requirements and secures a total of 48 Credits out of 80 Credits specified up to and inclusive of the II Year II Semester, from all the relevant regular and supplementary examinations, whether she takes those examinations or not.

8.5 A student will not be promoted from the III Year to the IV Year, unless she fulfils the Attendance and Academic Requirements and secures a total of 72 Credits out of 120 Credits specified up to and inclusive of the III Year II Semester, from all the relevant regular and supplementary examinations, whether she takes those examinations or not.

8.6 A student - (i) shall register for all the Subjects covering 160 Credits as specified and listed (with the relevant Course/ Subject Classifications as mentioned) in the Course Structure, (ii) puts up all the Attendance and Academic requirements for 160 Credits securing a minimum of C Grade (Pass Grade) or above in each Subject, (iii) earns ALL 160 Credits securing SGPA $\geq$ 5.0 (in each semester), and CGPA (at the end of each successive semester) $\geq$5.0, and (iv) satisfactorily completes all Mandatory Courses; to successfully complete the UG Degree Programme. **THERE IS NO EXEMPTION OF CREDITS IN ANY CASE**

8.7 **B.Tech. Degree Programme with HONORS/ MINOR DEGREE in EMERGING AREAS as per AICTE Norms and JNTUH Specifications (with effect from 2022-23 Academic Year):**

a) GNITS offers B.Tech. Degree Programme with HONORS in CSE Branch of CSE Department, with the JNTUH stipulated Regulations and Eligibility Conditions. Accordingly, students need to acquire

20 additional Credits in specified subjects offered from identified Emerging Areas during III Year and IV Year, for HONORS specialization in the same Major Discipline/Branch of Engineering.

The Academic Regulations, Eligibility Conditions, Registration and other details are listed in Annexure-H (enclosed).

b) GNITS offers B.Tech. Degree Programmes with MINOR DEGREE in the following Emerging Areas – (i) Artificial Intelligence & Machine Learning (AI & ML), (ii) Cyber Security (CS), (iii) Data Science (DS), (iv) Internet of Things (IoT), v) Advanced Web Development (AWD – under AICTE-LITE Programme - Online), with the JNTUH specified Regulations and Eligibility Conditions. Accordingly, students need to acquire 18 additional Credits in specified subjects offered from identified Emerging Areas, during III Year and IV Year, for MINOR DEGREE specialization from other Departments/Branches of Engineering.

The Academic Regulations, Eligibility Conditions, Registration and other details are listed in Annexure-M (enclosed).

c) Students who opt for the above HONORS/ MINOR DEGREE Programmes should not have any backlogs, as per JNTUH stipulations (details listed in Annexures - H and M).

d) If the student fails to get the JNTUH stipulated number of Credits (18 for Minor Degree and 20 for Honors) within 4 years from the date of commencement of their UGDP, then they shall get only the B.Tech. Degree with the Major Engineering Branch Specialization in which they were admitted in I Year, subject to completion of the required 160 C (as per NWL). All the other Credits they have acquired (beyond this 160 C) shall only be listed as ‘Additional Subjects/ Courses chosen’ in the Marks Memo along with the Grade obtained. The performances in these ‘Additional Subjects’ shall not be taken into account while calculating the SGPA and CGPA of the B.Tech. Degree Programme.

e) If a student takes prior permission and registers for any ‘Additional Subjects’ (in the parent Department or other Departments/Branches of Engg.) other than those listed Subjects totaling to 160 Credits as specified in the Course Structure of her Department, without HONORS/ MINOR DEGREE considerations (as listed above), the performances in those ‘Additional Subjects’ (although evaluated and graded) shall not be taken into account while calculating the SGPA and CGPA of the B.Tech. Degree Programme. For such ‘Additional Subjects’ registered, the % of marks and/or the Letter Grade alone may be indicated in the Marks Memo as a performance measure, subject to the completion of the Attendance and Academic Requirements as stated under Clauses 7.0 and 8.1 – 8.6.

8.8 Students who fail to earn 160 Credits as per the Course Structure, and as indicated above, within 8 Academic Years from the Date of the Commencement of their I Year, shall forfeit their seats in B.Tech. Programme and their admissions shall stand cancelled.

8.9 When a student is detained due to the shortage of attendance in any semester, she may be re-admitted into that semester as and when offered, along with the Academic Regulations of the Batch into which she gets readmitted. However, no Grade Allotments or SGPA/ CGPA calculations shall be done for that entire semester in which she got detained.

8.10 When a student is detained due to lack of Credits in any year, she may be readmitted in the next year(s), after the fulfilment of the Academic Requirements, along with the Academic Regulations of the Batch into which she gets readmitted.

8.11 A student who is eligible to appear for the End Semester Examination in any Subject/ Course, but is absent for a particular Subject/Course or has failed (failing to secure C Grade or above), may reappear for that Subject/ Course at the supplementary examination (SEE) as and when conducted. In such cases, her Internal Marks (CIE) assessed earlier for that Subject/Course shall be retained and carried over, and added to the marks to be obtained in the SEE supplementary examination for evaluating her performance in that Subject.

9.0 Evaluation - Distribution and Weightage of Marks

9.1 The performance of a student in each semester shall be evaluated Subject-wise (irrespective of the Credits assigned) with a maximum of 100 marks for Theory, or Labs/ Practicals, or Engineering Graphics/ Engineering Drawing, or Elective Course, or Mini-Projects, or Seminar, or Project – I (Phase – I), or Project – II (Phase – II) etc. These evaluations shall be based on 40% CIE (Continuous Internal Evaluation) and 60% SEE (Semester End Examination) basis, and a Letter Grade corresponding to the % of marks obtained shall be given.

9.2 For all the Subjects/ Courses as mentioned under **9.1**, the distribution shall be: 40 Marks for the CIE and 60 Marks for the SEE for the entire UG Degree Programme.

9.3 **a)** For the Theory Subjects during the semester, the CIE assessment for 40 marks includes two Mid-Term Examinations. Each Mid-Term Examination is conducted for 30 marks, for a duration of 120 minutes, and it shall have two parts: i) Part-A (Objective/Quiz Paper) for 10 marks, and ii) Part-B (Descriptive Paper) for 20 marks. Average of these two Mid-Term Examinations is assessed for 30 marks.

The Objective/Quiz Paper is set with ten multiple choice/ fill-in the blanks/ match the following … type of questions for a total of 10 marks. The Descriptive Paper (for 20 marks) shall contain 6 full questions, out of which, the student has to answer 4 questions, each carrying 5 marks.

The remaining 10 marks of CIE are distributed as - i) 5 marks for Assignment (average of 2 Assignments submitted, each for 5 marks), and ii) 5 marks for - Subject Viva-voce/ PPT/ Poster Presentation/ Case Study on a topic in the concerned subject.

b) The first mid-term examination shall be conducted in the middle of the semester for the first 50% of the syllabus, and the second mid-term examination shall be conducted at the end of the semester for the remaining 50% of the syllabus.

c) There shall be 2 Assignments per semester, and 5 marks are allocated for each Assignment. The First Assignment should be submitted before the conduct of the first mid-term examination, and the Second Assignment should be submitted before the conduct of the second mid-term examination. The Assignments shall be as specified by the concerned subject teacher, and the Average of these two Assignments shall be taken into account for 5 marks.

d) Assessment (for 5 marks) for the Subject Viva-voce/ Poster Presentation/ Case Study on a topic in the subject concerned shall be carried out before the commencement of II Mid-Term Examinations.

e) Sum of these three components of marks - (i) Average of the two Mid-Term Examinations marks (for 30 marks), (ii) Average of the two Assignments marks (for 5 marks), and (iii) the Assessment for the Subject Viva-voce/ Poster Presentation/ Case Study on a topic in the subject concerned (for 5 marks) – shall be the final marks secured towards the CIE (40 marks) in that Subject/ Course. The student has to earn a minimum of 35 % (14 marks) out of these 40 marks allocated.

- The Student, in each subject, shall have to earn 35% of marks (i.e. 14 marks out of 40 marks) in CIE, 35% of marks (i.e. 21 marks out of 60) in SEE and Over all 40% of marks (i.e. 40 marks out of 100 marks) both CIE and SEE marks put together.
- *The student is eligible to write Semester End Examination of the concerned subject, if the student scores ≥ 35% (14 marks) of 40 Continuous Internal Examination (CIE) marks.*
- *In case, the student appears for Semester End Examination (SEE) of the concerned subject but not scored minimum 35% of CIE marks (14 marks out of 40 internal marks), his performance in that subject in SEE shall stand cancelled inspite of appearing the SEE*

- ***Special internal(Mid) examinations will not be conducted for the absent students in R22 academic regulations***

f) 60 marks are allocated for Semester End Examination (SEE), which is of 3 hours duration. The SEE Question Paper will have two parts: i) Part-A is for 10 marks and is compulsory - it consists of 10 questions of 1 marks each (Two questions from each unit) and ii) Part-B is for 50 marks – it consists of 5 questions of 10 marks each (one question from each unit, it may contain sub-questions); for each question there will be 'either/ or' choice, which means that there will be two questions from each unit and the student should answer one of these two.

9.4 For the Lab/Practical Subjects also, the Continuous Internal Evaluation (CIE) during the semester shall be for 40 Marks, and the End Semester Examination (SEE) shall be for 60 Marks. Out of the 40 Marks for internals (CIE), day-to-day assessment of the lab work shall be judged for 20 Marks; and one internal lab exam shall be conducted by the laboratory teacher concerned for 20 Marks, out of which 10 Marks are allocated for the viva-voce. The Semester End Examination (SEE) for Lab/Practical's shall be conducted at the end of the semester by Two Examiners nominated by the Head of the Department and approved by the Principal.

- The Student, in each subject, shall have to earn 35% of marks (i.e. 14 marks out of 40 marks) in CIE, 35% of marks (i.e. 21 marks out of 60) in SEE and Over all 40%of marks (i.e. 40 marks out of 100 marks) both CIE and SEE marks put together.
- *The student is eligible to write Semester End Examination of the concerned subject, if the student scores ≥ 35% (14 marks) of 40 Continuous Internal Examination (CIE) marks.*
- *In case, the student appears for Semester End Examination (SEE) of the concerned subject but not scored minimum 35% of CIE marks (14 marks out of 40 internal marks), his performance in that subject in SEE shall stand cancelled inspite of appearing the SEE*

9.5 For the Subjects with Design and/or Drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing, Production Drawing Practice, and Estimation etc.), the distribution shall be: 40 Marks for CIE (20 Marks for the day-to-day work and 20 Marks for the internal test) and 60 Marks for SEE. There shall be TWO internal tests in a semester and the AVERAGE of the two shall be taken into consideration for the award of Marks from the internal tests for CIE. In case of Drawing SEE (*Semester End Examination) question paper there is no compulsory part(Part-A). Drawing will have only one part with either or type pattern. Two questions from each unit will be given,* *students has to answer one question from each unit and carries 12 marks.*

9.6 Open Electives (OE): 3 Open Elective Courses shall be offered in the 8 Semester UG Degree Programme. Students are to choose each Open Elective, from the set of options given, in 3 different semesters (in III and IV Years). The students have to choose three Open Electives (OE1, OE2, OE3) from the list of Open Electives given by other departments. However, the student can opt for an Open Elective subject offered by her own (parent) department, if she has not registered that subject under any category (Professional Core, Professional Electives, Mandatory Courses etc.) offered by parent department in any semester. Open Elective subjects already studied should not repeat/should not match with any category (Professional Core, Professional Electives, Mandatory Courses etc.) of subjects even in the forthcoming semesters.

9.7 There shall be a Seminar Presentation in the IV Year II Semester. For the Seminar, the student shall collect the information on a technical topic, prepare a Technical Report and submit the Technical Report to the Department at the time of Seminar Presentation. The Seminar Presentation (along with the Technical Report submitted) shall be evaluated for 100 marks by Two Faculty Members assigned by the Head of the Department. There shall be no SEE or external examination for the Seminar.

9.8 **a)** There shall be two Mini-Projects – first one (Mini-Project 1 or MP1) will be during II Year II Semester (also termed Real Time Project, based on Laboratory Experiments and Teachers' advice); and the second one (Mini-Project 2 or MP2) is preferably in collaboration with an Industry with the relevant specialization (Industry Oriented Mini-Project), to be registered immediately after II Year II Semester examinations, and taken up during the summer vacation (between II and III Years) for about eight weeks duration. Students also have an option to choose Industry Internship (instead of Industry Oriented Mini-Project) for MP2, if they secure selection at any reputed Industry.

b) The Mini-Project Work shall be submitted in a Report form, and a presentation of the same shall be made before a Committee, which is evaluated for 100 marks by the Committee. The Committee shall consist of - 1) Head of the Department (for MP2) / a Professor of the Department (for MP1), 2) the Supervisor of Mini-Project, and 3) External Examiner (for MP2) / a Senior Faculty Member of the Department (for MP1). There shall be no internal marks for Mini-Projects. Performance evaluation of MP1 and MP2 shall be included in the II Year II Semester Grade Card and III Year II Semester Grade Card, respectively. The External Examiner for MP2 shall be nominated by the Principal from the panel of 3 names of external faculty members (Professors or Associate Professors outside the College) submitted by the Head of Department. Performance Evaluations of MP1 and MP2 Mini-Projects will be included in the II Year – II Semester, and III Year – II Semester Grade Cards, respectively.

c) Industry Internship (for MP2, in place of collaborative Mini-Project) is exclusively meant for those students who have been considered eligible and selected accordingly by the Industry. Based on such selection letters from Industry, approvals will be given to students by the Principal of the Institution to carry out the Industry Internship for the specified period. The work performed during the Internship and the outcomes shall be reported in a Report form, which will also be evaluated in the same format (same as that of MP2 as stated in 9.8 b above).

9.9 Each student shall start the Project Work during the IV Year I Semester as per the instructions of the Project Guide/ Project Supervisor assigned by the Head of the Department.

a) The Project Work shall be divided and carried out in 2 phases: Phase – I (Project - I) during IV Year I Semester, and Phase – II (Project - II) during IV Year II Semester, and the student has to prepare two independent Project Work Reports – *one each during each phase*. First Report shall include the Project Work carried out under Phase – I, and the Second Report (Final Report) shall include the Project Work carried out under Phase – I and Phase – II put together. Phase – I and Phase – II of the Project Work shall be evaluated for 100 marks each.

b) Out of the total 100 marks allotted for each Phase of the Project Work, 40 marks shall be for the CIE (Continuous Internal Evaluation/CIE), and 60 marks shall be for the End Semester Viva-voce Examination (SEE). The marks earned under CIE for both Phases of the Project shall be awarded by the Project Guide/ Supervisor, based on the continuous evaluation of student's performance and her presentations at the Project Review Committee (PRC) Meetings in the Department, during the two Project Work Phases/periods. The PRC shall be constituted by the Head of the Department, and shall consist of the Head of the Department (HoD), Project Supervisor, and a Senior Faculty Member of the Department. The PRC shall monitor and review the progress of the Project Work, based on the PRC presentations and performance evaluations. The marks earned under SEE shall be awarded by the Project Viva-voce Committee/ Board (based on the work carried out, report prepared and the presentation made by the student at the time of Viva-voce Examination).

c) For the Project Phase - I, the Viva-voce shall be conducted at the end of the IV Year I Semester, before the commencement of the Semester End Examinations, at the Department Level by the Project (Phase – I) Evaluation Committee comprising of HoD or One Professor (nominated by the HoD), Supervisor (no External Examiner).

d) For the Project Phase – II Viva-voce (or Final Project Viva-voce) shall be conducted by a Project (Phase -II) Evaluation Committee comprising of an External Examiner, HoD and the Project Supervisor at the end of the IV Year II Semester, before the commencement of the Semester End Examinations. The External Examiner shall be nominated by the Principal from the panel of 3 names of external faculty members (Professors or Associate Professors outside the College) submitted by the HoD.

e) The student would be treated as failed, if she - (i) does not submit a Report on her Projects (Phase – I or Phase – II), or does not make a presentation of the same before the Evaluation Committee as per specified schedule, or (ii) secures less than 40% of marks (that is, 40 marks) in the sum total of the CIE and SEE taken together, in her Projects evaluations. She may reappear once for each of the Projects evaluations, as and when they are scheduled again; if she fails in such 'one reappearance' evaluation also, she has to reappear for the same in the next subsequent semester, as and when they are scheduled, as supplementary candidate.

9.10 For the Mandatory Non-Credit Course offered in a semester, a 'Satisfactory grade letter(s)" will be awarded in Grade Memo only after securing ≥ 75% attendance in the Course.

9.11 ONLINE Courses (OL) – offered on MOOCs platform (by NPTEL/IITs): Provision is made to offer some identified Courses, PEs and OEs (or their nearest equivalent courses, along with the number of credits and period of duration, as notified by the HoD) over 'ONLINE' mode, in addition to the conventional 'OFFLINE' mode (regular class-room teaching), from III Year onwards. Students may choose any mode out of these two, within one week from the commencement of the current semester; however, for ONLINE mode choice, prior intimation and approval from the Head of the Department and Principal is necessary. If any student wishes to discontinue the ONLINE mode, she can switch back to OFFLINE mode with prior intimation to the Head of Department, preferably within 2 weeks from the beginning of the current semester. Prior to Registration of these ONLINE Courses (on MOOCS platform – offered by NPTEL/IITs), formal approval of the Courses by JNTUH is essential. On successful completion of the

ONLINE Course, the performance Grade – based on the certification from the 'MOOCS Course Conducting Authorities' (NPTEL/IITs), will be appropriately awarded to the student and the same will be recorded on her Grade Card.

9.12 a) student can re-register for subjects in a semester:

- ***If the internal marks secured by a student in the Continuous Internal Evaluation marks for 40 (Sum of average of two mid-term examinations consisting of Objective & descriptive parts, Average of two Assignments & Subject Vivavoce/PPT/ Poster presentation/ Case Study on a topic in the concerned subject) are less than 35% and failed in those subjects.***

  They may seek re-registration for all those subjects registered in that semester in which the student is failed. The student has to re-appear for CIE and SEE as and when offered.

  A student must re-register for the failed subject(s) for 40 marks within four weeks of commencement of the classwork in next academic year. His Continuous Internal Evaluation marks for 40 obtained in the previous attempt stand cancelled. The student has to obtain fresh set of marks for 40 allotted for CIE (Sum of average of two mid-term examinations consisting of Objective & descriptive parts, Average of two Assignments & Subject Viva-voce/PPT/ Poster presentation/ Case Study on a topic in the concerned subject). Head of the Dept. will take care of this

10.0 Grading Procedure

10.1 Marks shall be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practical, or Workshop/Drawing, or Elective Course, or Seminar, or Project, or Mini-Project, etc., and, based on the % of marks obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified under 9.0, a corresponding Letter Grade shall be given.

10.2 As a measure of the student's performance, a 10-point Absolute Grading System using the following (Table 10.2) 'Letter Grades and corresponding percentage of marks' shall be followed:

% of Marks Secured	*Letter Grade (Class Intervals)*	*Grade Points (UGC Guidelines)*
90% and above ($\geq 90\%$, $\leq 100\%$)	O (Outstanding)	10
Below 90% but not less than 80% ($\geq 80\%$, $< 90\%$)	A^+ (Excellent)	9
Below 80% but not less than 70% ($\geq 70\%$, $< 80\%$)	A (Very Good)	8

Below 70% but not less than 60% (≥ 60% , < 70%)	B^+ (Good)	7
Below 60% but not less than 50% (≥ 50% , < 60%)	B (above Average)	6
Below 50% but not less than 40% (≥ 40% , < 50%)	C (Pass)	5
Below 40% (< 40%)	F (FAIL)	0

Table 10.2

10.3 The Grade Designations include 7 categories, namely … O, A+, A, B+, B, C and F.

10.3.1 A student obtaining F Grade in any Subject shall be considered 'FAILED' and will be required to reappear as 'Supplementary Candidate' in the End Semester Examination (SEE), as and when conducted later. In such cases, her Internal Marks (CIE Marks) in those Subject(s) will remain the same as those obtained earlier.

10.3.2 If a student fails to appear for SEE of any Subject (s) for any reason whatsoever, she is deemed to have 'failed', and she will get F Grade in all such failed Subject (s). She will be required to reappear as 'Supplementary Candidate' in the End Semester Examination (SEE), as and when conducted later. In these cases also, her Internal Marks (CIE Marks) in those Subject(s) will remain the same as those obtained earlier.

10.4 A Letter Grade does not imply any specific % of marks.

10.5 In general, a student shall not be permitted to repeat any Subject/ Course (s) for the sake of 'Grade Improvement' or 'SGPA/ CGPA Improvement'. However, she has to repeat all the Subjects/Courses pertaining to that semester, when she is detained (as listed under Clauses 8.9- 8.10).

10.6 A student earns Grade Points (GP) in each Subject/ Course on the basis of the Letter Grade obtained by her in that Subject/Course (excluding Mandatory non-credit Courses). Then the corresponding 'Credit Points' (CP) are computed by multiplying the Grade Point with Credits for that particular Subject/Course.

Credit Points (CP) = Grade Points (GP) x Credits - for a Course

10.7 The student passes the Subject/ Course only when she gets GP ≥ 5 (C Grade or above).

10.8 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points (SCP) secured from ALL Subjects/ Courses registered in a semester by the Total Number of Credits registered during that semester. SGPA is rounded off to TWO Decimal Places. SGPA is thus computed as

SGPA = $\{\sum_{i=1}^{N} C_i\, G_i\} \,/\, \{\sum_{i=1}^{N} C_i\}$ **.... for each semester**

where 'i' is the Subject indicator index (takes into account all Subjects in a semester), 'N' is the no. of Subjects 'REGISTERED' for the semester (as specifically required and listed under the Course Structure of the parent Department), C_i is the no. of Credits allotted to the ith Subject, and G_i represents the Grade Points (GP) corresponding to the Letter Grade awarded for that ith Subject.

10.9 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student over all the semesters considered for registration. The CGPA is the ratio of the Total Credit Points secured by a student in ALL the registered Courses in ALL the semesters, and the Total Number of Credits registered in ALL the semesters. CGPA is rounded off to TWO Decimal Places. CGPA is thus computed from the I Year Second Semester onwards at the end of each semester as per the formula

CGPA = $\{\sum_{j=1}^{M} C_j\, G_j\} \,/\, \{\sum_{j=1}^{M} C_j\}$ **... for all S semesters registered**

(ie., upto and inclusive of S semesters, S ^{3} 2),

where 'M' is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of the parent Department) the student has 'REGISTERED' from the 1st Semester onwards upto and inclusive of the semester S (obviously M > N), 'j' is the Subject indicator index (takes into account all Subjects from 1 to S semesters), C_j is the no. of Credits allotted to the jth Subject, and G_j represents the Grade Points (GP) corresponding to the Letter Grade awarded for that jth Subject. After the registration and completion of I Year I Semester however, the SGPA of that semester itself may be taken as the CGPA, as there are no cumulative effects.

10.10 For the Merit Ranking or Comparison Purposes or any other listing, ONLY the 'ROUNDED OFF' values of the CGPAs shall be used.

10.11 SGPA of a semester will be mentioned in the Semester Grade Card or Grades Memorandum, if all the subjects of that semester are passed in first attempt. Otherwise, the SGPA shall be mentioned on the Grade Card, only when the student passes all subjects of that semester.

10.12 Passing Standards

10.12.1 A student shall be declared successful or 'passed' in a semester, only when she gets a SGPA $\geq$ 5.00 (at the end of that particular semester); and a student shall be declared successful or 'passed' in the entire UG Degree Course, only when she gets a CGPA $\geq$ 5.00; subject to the condition that she secures a GP $\geq$ 5 (C Grade or above) in every registered Subject/ Course in each semester (during the entire UG Degree Course) for the Award of the Degree, as required.

10.12.2 A student shall be declared successful or 'passed' in any Non-Credit Subject/ Course, if she secures a 'Satisfactory grade' for that Mandatory Course.

10.13 After the completion of each semester, a Grade Card or Grade Sheet (or Transcript) shall be issued to all the Registered Students of that semester indicating the Letter Grades and the Credits earned. The Grade Card or the Grade Sheet shall show the details of the Courses Registered (Course Code, Title, No. of Credits, Grade Earned etc.), Credits earned, SGPA.

11.0 Declaration of Results

a. Computation of SGPA and CGPA are done using the procedure listed under Clauses 10.6 – 10.10.

b. CGPA is NOT indicative of the % of marks secured. However, in case if % of marks equivalent to the FINAL CGPA (computed at the end of UG Degree Programme) is required, then the following formula may be used as an estimate.

% of Marks = (final CGPA – 0.5) x 10

12.0 Award of Degree

12.1 **a)** A student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes all the examinations prescribed in the entire UG Degree Programme, and secures the required number of 160 Credits (with Final CGPA $\geq$ 5.0), within 8 Academic Years from the Date of Commencement of the First Academic Year, shall be declared to have 'QUALIFIED' for the Award of the B.Tech. Degree in the chosen Branch of Engineering as selected at the time of Admission.

b) B.Tech. with Honors/ Minor Degree shall be awarded by JNTUH to those successful and acquired 20 Credits (for Honors) and 18 Credits (for Minors) in addition to the stipulated 160 Credits for B.Tech. Degree, as per norms listed Clause 8.7 and Annexures H-M.

12.2 A student who qualifies for the Award of the Degree as listed under Clause 12.1, shall be placed in the following Classes (Table 12.2):

AWARD OF CLASS BASED ON FINAL CGPA
(at the end of the UG Degree Programme)

First Class with Distinction	Final CGPA 8.00 or more ##
First Class	Final CGPA below 8.00 but not less than 7.00
Second Class	Final CGPA below 7.00 but not less than 6.00
Pass Class	Final CGPA below 6.00 but not less than 5.00

Table 12.2

Note:

a) A student with Final CGPA (at the end of the UG Degree Programme) ≥ 8.00, and fulfilling the following conditions -

i) should have passed all the Subjects/ Courses within the first 4 Academic Years (or 8 Sequential Semesters) from the Date of Commencement of her First Academic Year,

ii) should not have been detained or prevented from writing the End Semester Examinations in any semester due to shortage of attendance or any other reason, shall be placed in 'FIRST CLASS with DISTINCTION'.

A student fulfilling the conditions listed under (a) above,alone will be the eligible candidate for the 'University/College Rank' and/or 'Gold Medal' considerations.

b) A student with Final CGPA (at the end of UG Degree Programme) ≥ 8.00, but not fulfilling the above conditions, shall be placed in 'FIRST CLASS'.

c) A student with Final CGPA (at the end of the UG Degree Programme) < 5.00 will not be eligible for the Award of the Degree.

12.3 Award of 2-Year Diploma Certificate

1. A student is awarded 2-Year UG Diploma Certificate in the concerned engineering branch on completion of all the academic requirements and earned all the 80 credits (within 4 years from the date of admission) upto B.Tech. II Year II Semester, if the student want to exit the 4-Year B.Tech. program and requests for the 2 -Year B. Tech. (UG) Diploma Certificate.

2. The student once opted and awarded 2-Year UG Diploma Certificate, the student will be permitted to join in B. Tech. III Year I Semester and continue for completion of remaining years of study for 4-Year B. Tech. Degree ONLY in the next academic year along with next batch students. However, if any student wishes to continue the study after opting for exit, he/she should register for the subjects/courses in III Year I Semester before commencement of classwork for that semester.

3. The students, who exit the 4-Year B. Tech. program after II Year of study and wish to re-join the B.Tech. program, must submit the 2 -Year B. Tech. (UG) Diploma Certificate awarded to him, subject to the eligibility for completion of Course/Degree.

4. A student may be permitted to take one year break after completion of II Year II Semester or B. Tech. III Year II Semester (with university permission through the principal of the college well in advance) and can re-enter the course in next Academic Year in the same college and complete the course on fulfilling all the academic credentials within a stipulated duration i.e. double the duration of the course (Ex. within 8 Years for 4-Year program)

13.0 Withholding of Results

13.1 If the student has not paid fees to the University/ College at any stage, or has pending dues against her name due to any reason whatsoever, or if any case of indiscipline is pending against her, the result of the student may be withheld, and she shall not be allowed to go into the next higher semester. The award or issue of the Degree may also be withheld in such cases.

14.0 Transitory Regulations

A. For students detained due to shortage of attendance:

1. A student who has been detained in any semester of I, II, III and IV years of R18 regulations for want of attendance, shall be permitted to join the corresponding semester of R22 Regulations and is required to complete the study of B.Tech. within the stipulated period of eight academic years from the date of first admission in I Year. The R22 Academic Regulations under which a student has been readmitted shall be applicable to that student from thatsemester. See rule (C) for further Transitory Regulations.

B. For students detained due to shortage of credits:

1. A student of R18 Regulations who has been detained due to lack of credits, shall be promoted to the next semester of R22 Regulations only after acquiring the required number of credits as per the corresponding regulations of his/her first admission. The total credits required are 160 including both R18 & R22 regulations. The student is required to complete the study of B.Tech. within the stipulated period of eight academic years from the year of first admission. The R22 Academic Regulations are applicable to a student from the year of readmission. See rule (C) for further Transitory Regulations.

C. For readmitted students in R22 Regulations:

1. A student who has failed in any subject under any regulation has to pass those subjects in the same regulations.
2. The maximum credits that a student acquires for the award of degree, shall be the sum of the total number of credits secured in all the regulations of his/her study including R22 Regulations. There is NO exemption of credits in any case.
3. If a student is readmitted to R22 Regulations and has any subject with 80% of syllabus common with his/her previous regulations, that particular subject in R22 Regulations will be substituted by another subject to be suggested by the University.

Note: If a student readmitted to R22 Regulations and has not studied any subjects/topics in his/her earlier regulations of study which is prerequisite for further subjects in R22 Regulations, the College Principals concerned shall conduct remedial classes to cover those subjects/topics for the benefit of the students.

15.0 Student Transfers

15.1 There shall be no Branch transfers after the completion of the Admission Process.

16.0 Scope

i) Where the words "Subject" or "Subjects", occur in these regulations, they also imply "Course" or "Courses".

ii) The Academic Regulations should be read as a whole, for the purpose of any interpretation.

iii) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.

iv) The College may change or amend the Academic Regulations, Course Structure or Syllabi at any time, and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the College Authorities.

ANNEXURE - H:

H1) JNTUH stipulated Regulations for B.Tech. Degree Course with Honors:

H1.1 Academic Regulations:

a) The weekly instruction hours, internal & external evaluation and award of grades are on par with regular 4-Years B. Tech. program.

b) For B. Tech with Honors program, a student needs to earn additional 20 credits (over and above the required 160 credits for B. Tech degree). The broad guidelines for the courses of Honors program, their respective credits weightage and semester-wise break-up of the course are enclosed below in Clause H1.4. All these 20 credits need to be completed in III year and IV year only.

c) After registering for the Honors program, if a student is unable to pass all courses in first attempt and earn the required 20 credits, she shall not be awarded Honors degree. However, if the student earns all the required 160 credits of B. Tech., she will be awarded only B. Tech degree in the concerned branch.

d) There is no transfer of credits from courses of Honors program to regular B. Tech. degree course & vice versa.

e) These 20 credits are to be earned from the additional courses offered by the host department in the college or from a closely related departments in the college as well as from the MOOCS platform.

f) For the courses selected under MOOCS platform following guidelines may be followed:

i) Prior to registration of MOOCS courses, formal approval of the courses, by the University is essential. University before the issue of approval considers the parameters like the institute / agency which is offering the course, syllabus, credits, duration of the programme and mode of evaluation etc.

ii) Minimum credits for a MOOCS course must be equal to or more than the credits specified in the Honors course structure provided by the University.

iii) Only Pass-grade/marks or above shall be considered for inclusion of grades in the Honors grade memo.

iv) Any expenses incurred for the MOOCS courses are to be met by the students only.

g) The choice to opt/take the Honors program is purely on the choice of the students.

h) The student shall be given a choice of withdrawing all the courses registered and/or the credits earned for Honors program at any time; and in that case the student will be awarded only B. Tech. degree in the concerned branch on earning the required credits of 160.

i) The students of every branch can choose Honors program in their respective branches if they are eligible for the Honors program. A student who chooses an Honors program is not eligible to choose a Minor program and vice-versa.

j) The B. Tech. with Honors program shall be offered at GNITS (W) from the AY 2022-23 onwards. The students who are pursuing their III year I semester in the current academic year can register for the Honors program if they fulfil the eligibility criteria.

k) A student can graduate with Honors if she fulfils the requirements for her regular B. Tech. program as well as fulfils the requirements for Honors program.

l) The institute shall maintain a record of students registered and pursuing their Honors programs branch-wise. The same report needs to be sent to the University once the enrolment process is complete.

m) The department shall prepare the time-tables for each Honors program offered at their respective departments without any overlap/clash with other courses of study in the respective semesters.

H1.2 Eligibility conditions of the students for the Honors degree:

a) A student can opt for B.Tech. degree with Honors, if she passed all subjects in first attempt in all the semesters till the results announced and maintaining 7.5 or more CGPA.

b) If a student fails in any registered course of either B. Tech. or Honors in any semester of four years program, she will not be eligible for obtaining Honors Degree. She will be eligible for only B. Tech. degree.

c) Prior approval of mentor and Head of the Department for the enrolment into Honors program, before commencement of III year I Semester (V Semester), is mandatory.

d) If more than 30% of the students in a branch fulfil the eligibility criteria (as stated above), the number of students given eligibility should be limited to 30%. The criteria to be followed for choosing 30% candidates in a branch may be the CGPA secured by the students till II year I semester.

e) The department concerned should be preferably NBA accredited and shall offer at least one M. Tech. Program.

f) Successful completion of 20 credits earmarked for Honors program with atleast 7.5 CGPA along with successful completion of 160 credits earmarked for regular B. Tech. Program with at least 7.5 CGPA and passing all subjects in first attempt gives the eligibility for the award of B. Tech. (Honors) degree.

g) For CGPA calculation of B. Tech. course, the 20 credits of Honors program will not be considered.

H1.3 Registration for the course in Honors Program:

a) At the beginning of each semester, just before the commencement of classes, students shall register for the courses which they wish to take in that semester.

b) The students should choose a course from the list against each semester (from Honors course structure) other than the courses they have studied/registered for regular B.Tech. programme. No course should be identical to that of the regular B. Tech. course. The students should take the advice of faculty mentors while registering for a course at the beginning of semester.

c) The maximum No. of courses for the Honors is limited to two (three in case of inclusion of lab) in a semester along with regular semester courses.

d) The registration fee to be collected from the students by the College is Rs. 1000/- per one credit.

e) A fee for late registration may be imposed as per the norms.

H1.4 Academic Regulations/ Course Structure for Honors degree in B. Tech. Programs (Table H1.4):

S. No.	*Year/ Semester*	*Course to be Chosen From/ Studied*	*Mode of Learning*	*No. of Credits*
1	III-1	PE1 OR PE2	Blended/ Conventional	3
2	III-2	Research Methodologies	Conventional	3
3	III-2	PE3	Conventional	3
4	IV-1	PE4	Conventional	3
5	IV-1	PE5	Conventional	3
6	IV-2	Technical Paper Writing	Under the Mentorship of a Supervisor	2
7	IV-2	PE6 or an Inter-disciplinary Subject as suggested by University	MOOCS	3
		TOTAL CREDITS		20

Table: H1.4

Notes:

A) Professional Elective (PE) course should be selected (which is not studied) from each Professional Electives list provided in regular B. Tech. course.

B) Courses can be chosen as in above table.

C) **Technical paper writing:**

a) The student shall take up a problem/topic of engineering branches (inter-disciplinary nature) and apply the knowledge which she acquired while pursuing their engineering branch. It is expected to analyse, design and develop an application for the identified problem and write a technical paper/document.

Alternatively, the student - i) shall identify a research topic, analyse the problem, carryout the experiments, write a technical paper and publish in /communicate for a Scopus indexed journal/any journal with decent reputation, or ii) demonstrate a talent/an idea/ development of an innovative product.

b) The evaluation shall be done by the same committee which is constituted for project evaluation, along with the final semester project work.

c) The students should start exploration for the Technical Paper Writing immediately after the semester exams of III-II semester. Only the evaluation part shall be carried in IV-II semester.

D) The institute shall offer a course on Research Methodologies by combining the students of all branches (if the number of students is more, multiple parallel sessions may be conducted). The time slots in the time-tables of respective branches should be aligned. The external evaluation of Research Methodologies course shall be done by the University.

E) If the blended course option is chosen, for the subject in III-I semester, the learning should be partially in online mode and partially in offline mode. The external evaluation shall be done by the University; however, for the internal evaluation component, online assessment should also be taken into account while finalising the internal marks by the course teacher.

ANNEXURE - M:

M1) JNTUH stipulated Regulations for B.Tech. Degree Course with Minors:

M1.1 Minor Courses and the Offering Departments (Table M1.1):

S. No.	*Minor Programme*	*Eligible Branches of Students*	*Offering Depart-ments @*	*Award of Degree*
1	Artificial Intelligence & Machine Learning	All Branches, except B.Tech. in CSE (AI & ML)/ B.Tech. (AI & ML)/B.Tech. (AI) / B.Tech. CSE (AI)	CSE	B.Tech. in Branch Name with Minor in Artificial Intelligence & Machine Learning
2	Cyber Security	All Branches, except B.Tech. in CSE (Cyber Security)/ B.Tech. (Cyber Security)	CSE	B.Tech. in Branch Name with Minor in Cyber Security
3	Data Science	All Branches, except B.Tech. in CSE (Data Science)/ B.Tech. (Data Science)	CSE	B.Tech. in Branch Name with Minor in Data Science
4	IOT	All Branches, except B.Tech. in CSE (IOT)/ B.Tech. (IOT)	ECE	B.Tech. in Branch Name with Minor in IOT
5	Innovation and Entrepre-neurship	All Branches	Manage-ment Science/ MBA	B.Tech. in Branch Name with Minor in Innovation and Entrepreneurship

@ as per AICTE guidelines.

Table: M1.1

M1.2 Academic Regulations for B. Tech. Degree with Minor Programs:

a) The weekly instruction hours, internal & external evaluation and award of grades are on par with regular 4-Years B. Tech. program.

b) For B. Tech. with Minor, a student needs to earn additional 18 credits (over and above the required 160 credits for B. Tech degree). The list of courses of each Minor program, their respective credits weightage and semester-wise break-up of the courses are as specified by JNTUH authorities. All these 18 credits need to be completed in III year and IV year only.

c) After registering for the Minor programme, if a student is unable to earn all the required 18 credits in a specified duration (twice the duration of the course), she shall not be awarded Minor degree. However, if the student earns all the required 160 credits of

B.Tech., he/she will be awarded only B. Tech degree in the concerned branch.

d) There is no transfer of credits from Minor program courses to regular B. Tech. degree course & vice versa.

e) These 18 credits are to be earned from the additional Courses offered by the host department in the college as well as from the MOOCS platform.

f) For the course selected under MOOCS platform following guidelines may be followed:

i) **Prior to registration of MOOCS courses, formal approval of the courses, by the University is essential.** University, before the issue of approval, considers the parameters like the Institute / Agency which is offering the course, syllabus, credits, duration of the programme and mode of evaluation etc.

ii) Minimum credits for MOOCS course must be equal to or more than the credits specified in the Minor course structure provided by the University.

iii) Only Pass-grade/marks or above shall be considered for inclusion of grades in Minor grade memo.

iv) Any expenses incurred for the MOOCS courses are to be met by the students only.

g) The choice to opt/take a Minor program is purely on the choice of the students.

h) The student shall be given a choice of withdrawing all the courses registered and/or the credits earned for Minor program at any time; and in that case the student will be awarded only B. Tech. degree in the concerned branch on earning the required credits of 160.

i) The student can choose only one Minor program along with her basic engineering degree. A student who chooses an Honors program is not eligible to choose a Minor program and vice-versa.

j) The B. Tech. with a Minor program shall be offered from the AY 2021-22 onwards. The students who are pursuing their III year I semester in the current academic year can register for the Minor program if they fulfil the eligibility criteria.

k) A student can graduate with a Minor if she fulfils the requirements for her regular B. Tech. program as well as fulfils the requirements for Minor program.

l) The Institute shall maintain a record of students registered and pursuing their Minor programs, minor program-wise and parent branch-wise. The same report needs to be sent to the University once the enrolment process is complete.

m) The Institute / Department shall prepare the time-tables for each Minor course offered at their respective institutes without any overlap/clash with other courses of study in the respective semesters.

M1.3 Eligibility conditions for the student to register for Minor Course:

a) A student can opt for B.Tech. degree with Minor program if she/he has no active backlogs till II Year I Semester (III semester) at the time of entering into III year I semester.

b) Prior approval of mentor and Head of the Department for the enrolment into Minor program, before commencement of III year I Semester (V Semester), is mandatory.

c) If more than 50% of the students in a branch fulfil the eligibility criteria (as stated above), the number of students given eligibility should be limited to 50%.

M1.4 Registration for the courses in Minor Program:

a) At the beginning of each semester, just before the commencement of classes, students shall register for the courses which they wish to take in that semester.

b) The students should choose a course from the list against each semester (from Minors course structure) other than the courses they have studied/registered for regular B.Tech. programme. No course should be identical to that of the regular B.Tech course. The students should take the advice of faculty mentors while registering for a course at the beginning of semester.

c) The maximum No. of courses for the Minor is limited to two (three in case of inclusion of lab) in a semester along with regular semester courses.

d) The registration fee to be collected from the students by the College is Rs. 1000/- per one credit.

e) A fee for late registration may be imposed as per norms.

ACADEMIC REGULATIONS (R22)

For CBCS Based B.Tech. Degree Programmes for Students Admitted under Lateral Entry Scheme (LES)

(Applicable for the students admitted into II year from the Academic Year **2023-24** and onwards)

A) Eligibility for Admission ~

A.1 The Admission to the B.Tech. Programme (UG Degree Programme) shall be made either on the basis of the merit rank obtained by the qualifying candidate at an Entrance Test conducted by the Telangana State Government (TSECET), OR the University, OR on the basis of any other order of merit approved by the University, subject to the reservations as prescribed by the Government from time to time.

B) B.Tech. Degree Course Structure for LES Students ~

B.1 Regular Full Time B.Tech. Degree Courses at GNITS are of Semester Pattern, with 8 Semesters constituting 4 Academic Years and each Academic Year is of TWO Semesters (First/Odd and Second/Even Semesters). Students admitted under LES shall join - the II Year stream of the Regular B.Tech. students in the relevant branch of engineering (admitted for 4 Year UG Degree Programme in the previous year); and their UGDP period therefore shall be 3 Years (II, III and IV Years) or 6 Semesters of the Regular Full Time B.Tech. Programme (commencing from II Year I Semester).

B.2 The LES Students, after securing admission, shall pursue their UG Degree Programme of study for not less than 3 years and not more than 6 years, from the year of admission.

B.3 Each student shall Register for and secure the specified number of Credits (120 Credits) required for the completion of the UGDP and the Award of the B.Tech. Degree in the respective Branch of Engineering.

C) Academic Requirements ~

C.1 A student will not be promoted from the II Year to the III Year, unless she fulfills the Attendance and Academic Requirements and secures a total of 24 Credits out of 40 Credits specified up to and inclusive of the II Year II Semester, from all the relevant regular and supplementary examinations, whether she takes those examinations or not.

C.2 A student will not be promoted from the III Year to the IV Year, unless she fulfils the Attendance and Academic Requirements and secures a total of 48 Credits out of 80 Credits specified up to and inclusive of the III Year II Semester, from all the relevant regular and supplementary examinations, whether she takes those examinations or not.

C.3 A student shall register for all the Subjects covering 120 Credits as specified and listed (with the relevant Course/ Subject Classifications as mentioned) in the Course Structure, puts up all the Attendance and Academic requirements for 120 Credits securing a minimum of C Grade (Pass Grade) or above in each Subject, and earns ALL 120 Credits securing SGPA $\geq$ 5.0 (in each semester), and CGPA (at the end of each successive semester) $\geq$ 5.0, to successfully complete the B.Tech. Degree Programme.

C.4 A student who fails to earn 120 Credits specified as per the Course Structure, and as indicated above, within 6 Academic Years from the year of admission (that corresponds to the II Year I Semester of the Regular Full Time B.Tech. Degree Programme), shall forfeit their seat in B.Tech. Programme and their admission shall stand cancelled.

D) Award of Degree

D.1 A student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes all the examinations prescribed in the entire UG Degree Programme, and secures the required number of 120 Credits (with final CGPA $\geq$ 5.0), within 6 Academic Years from the year of admission, shall be declared to have 'QUALIFIED' for the Award of the B.Tech. Degree in the chosen Branch of Engineering as selected at the time of Admission.

D.2 A student who qualifies for the Award of the Degree as listed under Clause **D.1**, shall be placed in the following Classes (Table D.2):

AWARD OF CLASS BASED ON FINAL CGPA
(at the end of the UG Degree Programme)

First Class with Distinction	Final CGPA 8.00 or more ##
First Class	Final CGPA below 8.00 but not less than 7.00
Second Class	Final CGPA below 7.00 but not less than 6.00
Pass Class	Final CGPA below 6.00 but not less than 5.00

Table: D.2

Note:

a) A student with Final CGPA (at the end of the UG Degree Programme) $\geq$ 8.00, and fulfilling the following conditions -

i) should have passed all the Subjects/ Courses within the first 3 Academic Years (or 6 Sequential Semesters) from the Year of Admission,

ii) should not have been detained or prevented from writing the End

Semester Examinations in any semester due to shortage of attendance or any other reason, shall be placed in 'FIRST CLASS with DISTINCTION'.

A student fulfilling the conditions listed under (a) above,alone will be the eligible candidate for the 'University/College Rank' and/or 'Gold Medal' considerations.

b) A student with Final CGPA (at the end of UG Degree Programme) $\geq$ 8.00, but not fulfilling the above conditions, shall be placed in 'FIRST CLASS'.

c) A student with Final CGPA (at the end of the UG Degree Programme) < 5.00 will not be eligible for the Award of the Degree.

E) Other Regulations ~

All the Academic Regulations as applicable for the B.Tech. 4 Year (Regular) Degree Programme students shall hold good for the B.Tech. Lateral Entry Scheme students also, but for the variations as described above, under Clauses A, B, C and D for LES students.

F) LES Students are not eligible for the 2-Year UG Diploma Certificate (that provision is available for the Regular 4 Year B.Tech. Course Students only).

B.Tech. 4 Year (8 semesters) Regular Programme in MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	Punishment
	If the student:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which student is appearing but has not made use of (material shall include any marks on the body of the student which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other student orally or by any other body language methods or communicates through cell phones with any student or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the students involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the student is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year.
3.	Impersonates any other student in connection with the examination	The student who has impersonated shall beexpelled from examination hall. The student isalso debarred and forfeits the seat. The performance of the original student who has been

		impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him
4.	Smuggles in the answer book, takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.

6.	Refuses to obey the orders of the chiefsuperintendent/assistant – superintendent / any officer on duty or misbehaves or creates disturbance of anykind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, eitherspoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the student(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/ year. The students also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking awayanswer script or intentionally tears of the script or any part there of inside oroutside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject andall the other subjects the student has already appeared including practical examinations andproject work and shall not be permitted for theremaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work andall university examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat.

8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall andcancellation of the performance in that subjectand all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.The student is also debarred and forfeits the seat.
9.	If student of the college, who is not a student for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeits the seat.Person(s) who do not belong to the college will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the student has appeared including practical examinations and project work of that semester/ year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the university for further action to award suitable punishment.	

B.Tech. 4 Year (8 Semesters) Regular Programme in
ELECTRONICS & COMMUNICATION ENGINEERING
COURSE STRUCTURE
(Applicable for the Batches admitted from the Academic Year 2022-23)

I YEAR **I SEMESTER**

S. No.	Group	Subject Code	Subject	L	T	P	Credits
1	BS	121AB	Applied Physics	3	0	0	3
2	BS	121AA	Applied Chemistry	3	0	0	3
3	BS	121AG	Linear Algebra and Multivariable Calculus	3	1	0	4
4	ES	121AH	Programming for Problem Solving	3	0	0	3
5	HS	121AF	English for Skill Enhancement	2	0	0	2
6	BS	12102	Applied Physics Lab	0	0	3	1.5
7	BS	12101	Applied Chemistry Lab	0	0	2	1
8	ES	12108	Programming Lab	0	0	3	1.5
9	HS	12105	English Language and Communication Skills Lab	0	0	2	1
10	MC	12107	Gender Sensitization	0	0	2	-
			TOTAL	**14**	**1**	**12**	**20**

I YEAR **II SEMESTER**

S. No.	Group	Subject Code	Subject	L	T	P	Credits
1	BS	122AK	Numerical Techniques and Transform Calculus	3	1	0	4
2	ES	122AJ	Data Structures	3	0	0	3
3	ES	122AC	Basic Electrical Engineering	3	0	0	3
4	ES	122AE	Engineering Graphics	1	0	3	2.5
5	ES	12204	Engineering Workshop	1	0	3	2.5
6	ES	12209	Data Structures Lab	0	0	3	1.5
7	ES	12203	Basic Electrical Engineering Lab	0	0	3	1.5
8	ES	122AD	Design Thinking	2	0	0	2
9	MC	12206	Environmental Science and Technology	2	0	0	-
			TOTAL	**15**	**1**	**12**	**20**

B.Tech. 4 Year (8 Semesters) Regular Programme in
ELECTRONICS & COMMUNICATION ENGINEERING
COURSE STRUCTURE
(Applicable for the Batches admitted from the Academic Year 2022-23)

II YEAR **I SEMESTER**

S. No.	Group	Subject Code	Subject	L	T	P	Credits
1	BS	123AX	Special Functions and Complex Variable Theory	3	0	0	3
2	ES	123AV	Python Programming	2	0	0	2
3	PC	123AR	Electronic Devices and Circuits	3	1	0	4
4	PC	123AW	Signals and Systems	3	1	0	4
5	PC	123AT	Network Theory and Analysis	3	0	0	3
6	ES	12311	Basic Simulation Lab	0	0	3	1.5
7	ES	12317	Python Programming Lab	0	0	2	1
8	PC	12315	Electronic Devices and Circuits Lab	0	0	3	1.5
9	MC	12312	Constitution of India	2	0	0	-
			TOTAL	**16**	**2**	**8**	**20**

II YEAR **II SEMESTER**

S. No.	Group	Subject Code	Subject	L	T	P	Credits
1	BS	124BN	Probability Theory and Stochastic Processes	3	0	0	3
2	PC	124BJ	Electromagnetic Theory and Transmission Lines	3	0	0	3
3	PC	124AZ	Analog Circuits	3	0	0	3
4	PC	124BE	Digital Electronics and Logic Design	3	0	0	3
5	PC	124BC	Control Systems Engineering	3	0	0	3
6	PC	12418	Analog Circuits Lab	0	0	3	1.5
7	PC	12419	Digital Electronics and Logic Design Lab	0	0	3	1.5
8	PW	12424	Mini Project -1 (Real Time Project)	0	0	4	2
9	MC	12422	Human Values and Professional Ethics	2	0	0	-
			TOTAL	**17**	**0**	**10**	**20**

B.Tech. 4 Year (8 Semesters) Regular Programme in
ELECTRONICS & COMMUNICATION ENGINEERING
COURSE STRUCTURE
(Applicable for the Batches admitted from the Academic Year 2022-23)

III YEAR **I SEMESTER**

S. No.	Group	Subject Code	Subject	L	T	P	Credits
1	PC	125BU	Analog and Digital Communications	3	1	0	4
2	PC	125BV	Antennas and Wave Propagation	3	0	0	3
3	PC	125CY	Microprocessors and Microcontrollers	3	1	0	4
4	PE1	**Professional Elective - 1** (Offline/Online)		3	0	0	3
		125CB	Computer Architecture and Organization				
		125CK	Electronic Measuring Instruments and Sensors				
		125BY	Bio-Medical Electronics				
		125CW	Data Science				
5	PE2	**Professional Elective - 2** (Offline/Online)		3	0	0	3
		125CH	Programming with Verilog HDL				
		125BK	Object Oriented Programming Through Java				
		125ED	Internet of Things				
		125BA	Artificial Intelligence				
6	PC	12529	Analog and Digital Communications Lab	0	0	2	1
7	PC	12535	Microprocessors and Microcontrollers Lab	0	0	2	1
8	HS	12528	Advanced Communication Skills Lab	0	0	2	1
			TOTAL	**15**	**2**	**6**	**20**

III YEAR **II SEMESTER**

S. No.	Group	Subject Code	Subject	L	T	P	Credits
1	HS	126EG	Managerial Economics and Financial Analysis	3	0	0	3
2	PC	126DV	Digital Signal Processing	3	0	0	3
3	PC	126ES	VLSI Design	3	1	0	4
4	PE3	**Professional Elective - 3 (Offline/Online)**		3	0	0	3
		126DT	Data Communications and Computer Networks				
		126EB	Information Theory and Coding				
		126CF	Design for Testability				
		126DK	Green Communications				
5	OE1	**Open Elective - 1 (Offline/Online)**		3	0	0	3
6	PC	12640	Digital Signal Processing Lab	0	0	2	1
7	PC	12647	VLSI Design Lab	0	0	2	1
8	PW	12644	Mini Project-2(Industry Oriented Mini Project/ Industry Internship : during Summer between 2^{nd} and 3^{rd} years)	0	0	4	2
			TOTAL	**15**	**1**	**8**	**20**

B.Tech. 4 Year (8 Semesters) Regular Programme in
ELECTRONICS & COMMUNICATION ENGINEERING
COURSE STRUCTURE
(Applicable for the Batches admitted from the Academic Year 2022-23)

IV YEAR **I SEMESTER**

S. No.	Group	Subject Code	Subject	L	T	P	Credits
1	HS	127FN	Fundamentals of Management	3	0	0	3
2	PC	127GH	Wireless Communications and Networks	3	0	0	3
3	PE4	**Professional Elective - 4**		3	0	0	3
		127FR	Microwave Engineering and Optical Communications				
		127FH	Embedded System Design				
		127CX	Machine Learning				
4	PE5	**Professional Elective - 5(Offline/Online)**		3	0	0	3
		127FD	Digital Image and Video Processing				
		127GD	Voice Over Internet Protocol				
		127GK	Wireless Sensor Networks				
		127FQ	Low Power VLSI Design				
5	OE2	**Open Elective - 2 (Offline/Online)**		3	0	0	3
6	PC	12768	Wireless Communications and Networks Lab	0	0	2	1
7	PC		Lab (Linked to PE4)	0	0	2	1
		12759	Microwave and Optical Communications Lab				
		12756	Embedded System Design Lab				
		12734	Machine Learning Lab				
8	PW1	12763	PROJECT WORK (Phase – I)	0	0	6	3
			TOTAL	**15**	**0**	**10**	**20**

IV YEAR **II SEMESTER**

S. No.	Group	Subject Code	Subject	L	T	P	Credits
1	HS	128GW	Entrepreneurship and Project Management (Offline/Online)	2	0	0	2
2	PE6	**Professional Elective - 6 (Offline/Online)**		3	0	0	3
		128HF	Radar Systems				
		128HA	5G Communication Technologies				
		128GY	Static Timing Analysis				
		128HH	Satellite Communications and Navigation Systems				
3	OE3	**Open Elective - 3 (Offline/Online)**		3	0	0	3
4	PW	12870	Technical Seminar (Presentation with Report before 1st Mid Exams)	1	0	2	2
5	PW2	12869	PROJECT WORK (Phase – II)	0	0	20	10
			TOTAL	**9**	**0**	**22**	**20**

List of Open Elective offered by various Departments for B.Tech. Programme

(Applicable for the Batches admitted from the Academic year 2022-23 onwards)

S. No.	Name of the Department Offering	Open Elective-1 (B. Tech. III Year II Semester)	Open Elective-2 (B. Tech. IV Year I Semester)	Open Elective-3 (B.Tech. IV Year II Semester)
1	CSE/ IT/ CST	• Fundamentals of Data Structures (126KF) • Fundamentals of Database Management Systems(126KG) • Operating Systems (126KK) • Software Engineering (126KQ)	• Internet of Things(127KY) • Cyber Security (127KT)	• Cloud Computing(128LE) • Blockchain Technologies (128LD)
2	CSE (AI & ML)	• Fundamentals of Artificial Intelligence (126KD)	• Machine Learning Basics (127KZ)	• Introduction to Natural Language Processing (128LL)
3	CSE (Data Science)	• Fundamentals of Data Science(126KE) • R Programming (126KP)	• Data Visualization using Python (127KU)	• Data Mining (128LF)
4	ECE	• Biomedical Electronics and Applications (126KA) • Principles of Communication Technologies (126KN) • Verilog HDL(126KR)	• Sensors and Actuators (127KV) • Elements of Satellite Communications (127KW)	• Wearable Devices and its Applications (128LP) • Systems Engineering (128LG)
5	ETM	• Principles of Communications (126KM)	• Telecommunication Switching Systems (127LC)	-
6	EEE	• Engineering Materials (126KC)	• Renewable Energy Sources(127LA)	• Waste Management Techniques and Power Generation (128LN)
7	Mech. Engg.	• Operations Research (126KL)	• Research Methodology (127LB)	-
8	H&M	• Introduction to Data Analytics(126KJ) • Intellectural Property Rights(126KH)	• Industrial Management (127KX) • Behavioral Skills and Professional Communication (127KS)	• Marketing Management (128LM)
9	BS	• Disaster Management (126KB)	-	• Environmental Impact Assessment (128LH)

I Year B.Tech. ECE I-Semester **L T P C**

Course Code: 121AB **3 0 0 3**

APPLIED PHYSICS

(Common to EEE, ECE, ETE, CST)

Prerequisites: -Nil-

Course Objectives:

Through this course the student is to:

1. Understand the fundamentals of quantum mechanics and study the behaviour of a particle quantum mechanically.
2. Analyze the semiconductors and semiconductor devices.
3. Be able to classify the types and properties of dielectric and magnetic materials
4. Understand the construction and working principle of different types of lasers and light propagation through optical fiber.
5. Learn the fundamentals of nano material synthesis and characterizations.

UNIT 1: Quantum Mechanics (~9 Lecture Hours)

Introduction to quantum physics, de-Broglie's hypothesis, Wave-particle duality, Davisson and Germer experiment, Heisenberg's Uncertainty principle, Born's interpretation of the wave function, Schrodinger's time independent wave equation, Particle in one dimensional box.

Kronig-Penny model (using Bloch theorem, qualitative analysis and conclusions), Energy bands in solids. E-k diagram, classification of materials: Metals, Semiconductors and Insulators. Density of states (Qualitative) and electron occupation probability (Fermi-Dirac Distribution function analysis)

UNIT 2: Semiconductor Physics (~9 Lecture Hours)

Intrinsic and Extrinsic semiconductors, Carrier concentrations of Intrinsic and Extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature, Carrier generation and recombination (Qualitative), Hall effect and calculation of Hall Coefficient (R_H).

Semiconductor Devices

Radiative and non-radiative recombination in semiconductors (Qualitative), Direct and Indirect band gap semiconductors, Diffusion and Drift currents , p-n junction diode, Zener diode and their V-I Characteristics, LED and Solar cell :construction, principle of operation and characteristics.

UNIT 3: Dielectric and Magnetic materials (~9 Lecture Hours)

Dielectric materials: Electric dipole, Dipole moment, Oscillating dipole, Dielectric constant, Polarizability, Electric susceptibility, Displacement vector, Polarization Vector, Qualitative study of electronic, ionic and orientation polarizations, Local field (Qualitative treatment) and Clausius-Mossotti equation; Ferro-electricity –Behaviour of $BaTiO_3$, Piezoelectricity, Pyro-electricity.

Magnetic materials: Permeability, field intensity, magnetic field induction, magnetization, magnetic susceptibility, origin of magnetic moment: Bohr magneton, classification of dia, para and ferro magnetic materials on the basis of magnetic moment, Domain theory(Qualitative), Hysteresis curve based on domain theory, soft and hard magnetic materials, properties of antiferro and ferri magnetic materials.

UNIT 4: Lasers and Fibre Optics (~9 Lecture Hours)

Lasers**:** Characteristics of Lasers, Absorption, Spontaneous and stimulated emission process, Pumping, Population inversion, Lasing action, Einstein's Coefficients and their relations. Types of Lasers: Ruby laser, Carbon dioxide (CO_2) laser, Semiconductor diode laser, Applications of laser.

Fibre Optics: Introduction, Optical fiber as a dielectric wave guide, Total internal reflection, Acceptance angle, Acceptance cone and Numerical aperture, Types of Optical fibers, Losses associated with optical fibers, Applications of optical fibers (communication system, sensors).

UNIT 5: Nanomaterials: (~8 Lecture Hours)

Origin of Nanotechnology, Nano Scale, Surface to Volume Ratio, Quantum Confinement, Bottom-up Fabrication: Sol-Gel, Precipitation, Combustion Methods; Top-Down Fabrication: Ball milling method, Chemical Vapor Deposition, Physical Vapor Deposition, Characterization Techniques (XRD, SEM & TEM) and Applications.

Text Books:

1. M.N.Avadhanulu, P.G.Kshirsagar & T.V. S.Arun Murthy, "A Text book of Engineering Physics"-S.Chand Publications, 11th Edition, 2019.
2. J.P Srivastava, "Elements of Solid state physics", second edition, Prentice Hall India Publishers.
3 Donald A, Neamen, "Semiconductor Physics and Devices-Basic Principle", McGraw Hill, 4th Edition, 2021.
4. Palani Swamy, "Applied Physics", Scitech Publications.
5. Narasimha Reddy Katta, "Essentials of Nano science& Nanotechnology", Typical Creatives NANO DIGEST, 1st Edition, 2021.

Reference Books:

1. H.C.Verma, "Quantum Physics", TBS Publication, 2nd Edition 2012.
2. Halliday, Resnick and Walker, "Fundamentals of Physics", John Wiley & Sons, 11th Edition, 2018.
3. Charles Kittel, "Introduction to Solid State Physics", Wiley Eastern, 2019.
4. S.L.Gupta and V.Kumar, "Elementary Solid State Physics", Pragathi Prakashan, 2019.

5. A.K. Bhandhopadhya, “Nano Materials”, New Age International, 1^{st} Edition, 2007.
6. Aliaksandr S. Bandarenka, “Energy Materials a Short Introduction to Functional Materials for Energy Conversion and Storage” CRC Press Taylor & Francis Group.
7. M.C.Narayan, “International encyclopedia of Nanotechnology, Science and Physics”

Online Resources:

1. https://www.youtube.com/channel/UCNNlt5I3Z-Qbswfo_7KAzNA/videos

Course Outcomes:

After completion of the course, student will be able to

CO1 Explain the quantum mechanical aspects of physics and apply the same in differentiating the conducting properties of solids.

CO2 Asses and modify the carrier concentration of different types of semiconductors and also be able to understand the working of semiconducting devices.

CO3 Choose materials on the basis of their electric and magnetic behavior for different engineering applications.

CO4 Differentiate different types of Lasers, optical fibers and realize their application in engineering fields. Understand the underlying principles of Lasers and fiber optics.

CO5 Appreciate the importance of nano materials and their applicability in modern engineering applications

CO6 The student will be able to apply the tools and principles of modern physics to comprehend engineering applications.

* * *

I Year B.Tech. ECE I-Semester **L T P C**
Course Code: 121AA **3 0 0 3**

APPLIED CHEMISTRY

(Common to EEE, ECE, ETE, CST)

Prerequisites: -Nil-

COURSE OBJECTIVES:

1. To bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfect engineer.
2. To acquire the knowledge of water treatment, electrochemistry and corrosion which are essential for the engineers and in industry.
3. To acquire the skills pertaining to Polymers and Energy sources to apply them for various engineering fields etc.
4. To impart the knowledge of engineering materials and their aspects useful for understanding material chemistry.

UNIT-1: (~8 Lecture Hours)

Water and its treatment: Introduction to hardness of water: Causes of hardness and its units . Estimation of hardness of water by complexometric method and related numerical problems. Potable water and its specifications: Steps involved in the treatment of potable water, Disinfection of potable water by chlorination and break-point chlorination. Boiler troubles: Sludges, Scales and Caustic embrittlement. Internal treatment of boiler feed water: Calgon conditioning, Phosphate conditioning, Colloidal conditioning. External treatment methods :Softening of water by Ion exchange process. Desalination of Brackish water–Reverse osmosis.

UNIT-2: (~12 Lecture Hours)

Electrochemistry and corrosion: Electrochemistry: Electrochemical cells,Electrode potential, Standard electrode potential. Nernst equation: derivation and significance. Electrochemical series and its applications. Construction and functioning of Hydrogen and Calomel electrode. pH determination using Calomel electrode. Batteries :Primary and Secondary batteries. Construction, working of Lithium Cell and Lithium-ion battery and its applications to electrical vehicles. Fuel cells: Construction and applications of Methanol Oxygen fuel cell. **Corrosion:** Causes and effects of corrosion. Theories of chemical and electrochemical corrosion. Mechanism of electrochemical corrosion. Types of corrosion: Galvanic corrosion, Concentration cell corrosion, Waterline and Pitting corrosion. Factors affecting rate of corrosion. Corrosion control methods-Cathodic protection: Sacrificial anodic protection and Impressed current cathodic methods. Surface coatings: Metallic coatings – Methods of coatings:Hot dipping, galvanization, tinning.

UNIT– 3: (~8 Lecture Hours)

Polymeric materials: Definition of polymers,Classification of polymers with examples.Types of polymerization: Addition Polymerization (free radical mechanism) and condensation polymerization with examples – Nylon 6:6, Terylene. **Plastics:** Definition and characteristics. Plastics:thermosetting and thermoplastics. Preparation, properties and engineering applications of PVC , Bakelite, Teflon . **Rubbers:** Natural rubber and its vulcanization. **Elastomers:** Characteristics,preparation, properties and applications of Buna-S, Butyl and Thiokol rubber. **Conducting polymers:** Characteristics and Classification with examples, mechanism of conduction in trans-polyacetylene and applications of conducting polymers.**Biodegradable polymers:** Concept and advantages of biodegradable polymers. Preparation of Polylactic acid and poly vinyl alcohol and their applications.

UNIT – 4: (~8 Lecture Hours)

Energy sources: Fuels-Introduction, Calorific value of fuel: HCV,LCV,Dulong's formula. Classification of fuels: Solid fuels: coal ,analysis of coal – proximate and ultimate analysis and their significance. Liquid fuels :Petroleum and its refining. Cracking types: Moving bed catalytic cracking. Knocking: Octane and Cetane rating. Synthetic petrol - Fischer-Tropsch's process. Gaseous fuels: Composition and uses of natural gas, LPG and CNG. Combustion: Definition, Calculation of air required for the combustion of fuel, numerical problems related to calorific value and combustion. Solar cells: Introduction and applications of Solar cells. Biodiesel: Transesterification and applications.2G-Ethanol:Synthesis and applications.

UNIT-5: (~8 Lecture Hours)

Engineering Materials: Cement: Portland cement, its composition, setting and hardening of Portland cement. Special cement: Properties and uses of High alumina cement, White cement, and Waterproof cement. **Refractories:** Classification and Characteristics of a good refractory. Properties-Refractoriness and RUL**. Lubricants:** Functions and Classification of lubricants with examples. Characteristics of good lubricants. Mechanism of Lubrication: Thick film, thin film, and extreme pressure. Properties: Viscosity, Cloud and pour point, Flash and fire point.

Text Books:

1. Engineering Chemistry by P.C.Jain and M.Jain, Dhanpatrai Publishing Company, 2010
2. Engineering Chemistry by RamaDevi, and Rath, Cengage learning, 2022.
3. A text book of Engineering Chemistry by M. Thirumala Chary, E. Laxminarayana and K.Shashikala, Pearson Publications,2021.
4. A Textbook of Engineering Chemistry by Y. Bharathi kumari, VGS publications

Reference Books:

1. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi (2015)
2. Engineering Chemistry by Shashi Chawla, Dhanpatrai and Company(P) Ltd. Delhi (2011)

Online Resources:

1. https://archive.nptel.ac.in/courses/108/106/108106170/
2. https://nptel.ac.in/courses/113105028
3. https://nptel.ac.in/courses/115107116

Course Outcomes:

After completion of the course students will be able to:

1. Understand the concepts, to identify and analyse the hardness of water and its softening techniques in industry and daily usage.
2. Apply the working principles of batteries and their applications in automobile field , corrosion and its prevention.
3. Learn the concepts of various types of polymers, conducting polymers, biodegradable polymers and their applications in industrial and medical fields.
4. Identify different types of energy sources and their applications in various engineering fields.
5. Analyse the usage and applications of various types of cements, lubricants and refractories in engineering field.
6. Learn the potential applications of chemistry in practical utility to become good engineers and entrepreneurs.

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I Year B.Tech. ECE I-Semester **L T P C**
Course Code: 121AG **3 1 0 4**

LINEAR ALGEBRA AND MULTIVARIABLE CALCULUS

(Common to EEE, ECE, CSE, IT, ETE, CST, CSM & CSD)

Prerequisites: Nil

Course Objectives:

1. To learn the concepts of rank of a matrix and applying it to understand the consistency of the system of equations.
2. To solve a system of linear equations.
3. To study properties of Eigen values and Eigen vectors.
4. To find extreme values for functions of several variables.
5. To find the solutions of first and higher order ODE.
6. To evaluate the double and triple integrals for functions of several variables.

UNIT1: Linear System of Equations (~ 8 Lecture Hours)

Types of real matrices and complex matrices, rank, echelon form, normal form, consistency and solution of linear systems (Homogeneous and Non-homogeneous), LU decomposition method.

UNIT 2: Eigen values and Eigen Vectors (~8 Lecture Hours)

Eigen values, Eigen vectors and their properties. Cayley - Hamilton theorem (only statement), Inverse and powers of a matrix using Cayley - Hamilton theorem, Diagonalization.

UNIT 3: Functions of Several Variables (~10 Lecture Hours)

Limit & Continuity (Definitions), Partial derivatives, Chain rules, Total derivative, Differentiation of implicit functions, Jacobian, functional dependency. Maxima and Minima of functions of two variables (with and without constraints) and Lagrange's method of undetermined multipliers.

UNIT 4: Ordinary Differential Equations (~12 Lecture Hours)

First Order ODE – Exact Differential Equations, Differential Equations reducible to exact, Orthogonal trajectories, Law of natural growth & decay.

Linear differential equations of higher order with constant coefficients: Non-homogeneous differential equations with RHS term of the type , polynomials in, Method of variation of parameters, Applications to Electrical circuits.

UNIT 5: Multiple Integrals and its Applications (~10 Lecture Hours)

Multiple Integrals - Double and Triple integrals, Change of variables, Change of order of integration. Applications: Finding area as double integrals and volume as triple integrals.

Text Books:

1. Dr. B. S. Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. N. P. Bali, Engineering Mathematics, 1st Edition, Lakshmi Publications.

Reference Books:

1. B.V.Ramana, Higher Engineering Mathematics, 1st Edition, Tata McGraw-Hill Publications.
2. E.Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley and Sons Publisher.
3. Srimanta Pal, SubodhC.Bhunia, Engineering Mathematics, 1st Edition, Oxford Higher Education.
4. R K Jain & S R K Iyengar, Advanced Engineering Mathematics, 5th Edition, Narosa Publishers.

Online Resources:

1) https://nptel.ac.in/courses/111106051
2) https://www.youtube.com/watch?v=mIeeVrv447s

Course Outcomes:

After completion of the course, students will be able to

1. Solve and analyse the solution for the system of equations.
2. Compute the Eigen values and Eigen vectors which come across under linear transformations.
3. Determine the extreme values of functions of two variables with/ without constraints.
4. Find the solutions of ordinary differential equations.
5. Evaluate double and triple integrals.
6. Apply the knowledge of mathematics for real situations.

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I Year B.Tech. ECE I-Semester **L T P C**
Course Code: 121AH **3 0 0 3**

PROGRAMMING FOR PROBLEM SOLVING

(Common to EEE, ECE, CSE, IT, ETE, CST, CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. To learn the fundamentals of computers.
2. To understand the various steps in program development.
3. To use the syntax and semantics of C Programming Language.
4. To decompose a problem into functions and to develop modular reusable code.
5. To implement C programs in structured programming approach to solve problems.

UNIT 1: (~10 Lecture Hours)

Introduction to Computers: Computer systems, computing environments, computer languages, creating and running programs, program development, algorithms and flowcharts, number systems - binary, decimal, hexadecimal and conversions. **Introduction to C Language**: Background, C programs, identifiers, types, variables, constants, input / output, operators (arithmetic, relational, logical, bitwise etc.), expressions, precedence and associativity, expression evaluation, type conversions.

Statements: Selection statements (making decisions) – if and switch statements.

UNIT 2: (~9 Lecture Hours)

Repetition Statements (Loops):while, for, do-while statements, Loop examples, other statements related to looping – break, continue.

Functions: Designing structured programs, functions, user defined functions, inter function communication, standard functions, scope, storage classes - auto, register, static, extern, scope rules, type qualifiers, recursion- recursive functions, limitations of recursion.

UNIT 3: (~10 Lecture Hours)

Arrays: Concepts, using arrays in C - declaration and definition, accessing elements in array, storing values in arrays, array applications- linear search, binary search and bubble sort, two dimensional arrays, multi-dimensional arrays.

Pointers: Introduction (basic concepts), pointers for inter function communication, pointers to pointers, compatibility, pointer applications - arrays and pointers, pointer arithmetic and arrays, passing an array to a function, memory allocation functions, array of pointers, pointers to void, strings - concepts, C strings, string input / output functions, arrays of strings, string manipulation functions.

UNIT 4: (~9 Lecture Hours)

Enumerated, Structure and Union Types: The type definition (typedef), enumerated types, structures - declaration, initialization, accessing structures, operations on structures, complex structures - nested structures, structures containing arrays, structures containing pointers, arrays of structures, structures and functions, passing structures through pointers, self-referential structures, unions, bit fields.

UNIT 5: (~8 Lecture Hours)

Introduction to files, using files in C, reading data from files- fscanf(), fgets(), fgetc(), fread(), writing data to files- fprintf(), fputs(), fputc(), fwrite(), detecting the end-of-file, error handling during file operations, random access to files, command line arguments, preprocessor commands.

Text Books:

1. B.A.Forouzan and R.F.Gilberg, Computer Science: A Structured Programming Approach Using C, 3rd Edition, Cengage learning.
2. Reema Thareja, Introduction to C Programming, 2nd Edition, Oxford University Press.

Reference Books:

1. Byron Gottfried, Schaum's Outline of Programming with C, 2nd Edition, McGraw-Hill.
2. E.Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill.
3. B.W.Kernighan and Dennis Ritchie, C Programming Language, 2nd Edition, PHI.

Online Resources:

1. https://drive.google.com/file/d/1Yvq27-sSPOxjJakf1cXpWq76L0F0cu_/view
2. https://cs50.harvard.edu/college/2022/spring/

Course Outcomes:

After completion of the course, students will be able to

1. Relate various computing environments and formulate solutions to problems using algorithms and flowcharts.
2. Understand data types and control structures to solve problems.
3. Divide a problem into functions and synthesize a complete program.
4. Use arrays, pointers and strings to formulate programs.
5. Apply user defined data types to model real world data.
6. Develop solutions to problems using file handling functions.

I Year B.Tech. ECE I-Semester **L T P C**
Course Code: 121AF **2 0 0 2**

ENGLISH FOR SKILL ENHANCEMENT
(Common to EEE, ECE, ETE, CST)

Prerequisites: NIL

Course Objectives:

This course will enable the students to:

1. Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
2. Develop study skills and communication skills in various professional situations.
3. Equip students to study engineering subjects more effectively and critically using the theoretical and practical components of the syllabus.

UNIT – I (~7 Lecture Hours)

Chapter entitled **'Toasted English'** by R.K.Narayan from *"English: Language, Context and Culture"* published by Orient Blackswan, Hyderabad.

Vocabulary: The Concept of Word Formation -The Use of Prefixes and Suffixes - Acquaintance with Prefixes and Suffixes from Foreign Languages to form Derivatives - Synonyms and Antonyms

Grammar: Identifying Common Errors in Writing with Reference to Articles and Prepositions.

Reading: Reading and Its Importance- Techniques for Effective Reading.

Writing: Sentence Structures -Use of Phrases and Clauses in Sentences- Importance of Proper Punctuation- Techniques for Writing precisely – Paragraph Writing – Types, Structures and Features of a Paragraph - Creating Coherence-Organizing Principles of Paragraphs in Documents.

UNIT – II (~7 Lecture Hours)

Chapter entitled **'Appro JRD'** by Sudha Murthy from "*English: Language, Context and Culture"* published by Orient Blackswan, Hyderabad.

Vocabulary: Words Often Misspelt - Homophones, Homonyms and Homographs

Grammar: Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement.

Reading: Sub-Skills of Reading – Skimming and Scanning – Exercises for Practice

Writing: Nature and Style of Writing- Defining /Describing People, Objects, Places and Events – Classifying- Providing Examples or Evidence.

UNIT – III (~6 Lecture Hours)

Chapter entitled **'Lessons from Online Learning'** by F.HaiderAlvi, Deborah Hurst et al from *"English: Language, Context and Culture"* published by Orient Blackswan, Hyderabad.

Vocabulary: Words Often Confused - Words from Foreign Languages and their Use in English. **Grammar:** Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses **Reading:** Sub-Skills of Reading – Intensive Reading and Extensive Reading – Exercises for Practice.

Writing: Format of a Formal Letter-Writing Formal Letters E.g.., Letter of Complaint, Letter of Requisition, Email Etiquette, Job Application with CV/ Resume.

UNIT – IV (~6 Lecture Hours)

Chapter entitled **'Art and Literature' by Abdul Kalam** from *"English: Language, Context and Culture"*

published by Orient Blackswan, Hyderabad.

Vocabulary: Standard Abbreviations in English

Grammar: Redundancies and Clichés in Oral and Written Communication.

Reading: Survey, Question, Read, Recite and Review (SQ3R Method) - Exercises for Practice

Writing: Writing Practices- Essay Writing-Writing Introduction and Conclusion -Précis Writing.

UNIT – V (~6 Lecture Hours)

Chapter entitled **'Go, Kiss the World'** by Subroto Bagchifrom *"English: Language, Context and Culture"*

published by Orient Blackswan, Hyderabad.

Vocabulary: Technical Vocabulary and their Usage

Grammar: Common Errors in English (*Covering all the other aspects of grammar which were not covered in the previous units*)

Reading: Reading Comprehension-Exercises for Practice

Writing: Technical Reports- Introduction – Characteristics of a Report – Categories of Reports Formats- Structure of Reports (Manuscript Format) - Types of Reports - Writing a Report.

Note: ***Listening and Speaking Skills which are given under Unit-6 in AICTE Model Curriculum are covered in the syllabus of ELCS Lab Course.***

Note: 1. As the syllabus of English given in AICTE *Model Curriculum-2018 for B.Tech First Year is **Open- ended**,* besides following the prescribed textbook, it is required to prepare teaching/learning materials **by the teachers collectively** in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning in the class.

Note: **2**. Based on the recommendations of NEP2020, teachers are requested to be flexible to adopt Blended Learning in dealing with the course contents. They are advised to teach 40 percent of each topic from the syllabus in blended mode.

Text Books:

1. "English: Language, Context and Culture" published by Orient BlackSwan Pvt. Ltd, Hyderabad. 2023 Print.
2. Fusion: Integrated Reading & Writing by Kepler published by CENGAGE [e-Book].

Reference Books:

1. Effective Academic Writing by Liss and Davis (OUP)
2. Richards, Jack C. (2022) Interchange Series. Introduction, 1,2,3. Cambridge University Press
3. Wood,F.T. (2007). Remedial English Grammar. Macmillan.
4. Chaudhuri, Santanu Sinha. (2018). Learn English: A Fun Book of Functional Language, Grammar and Vocabulary. (2^{nd} ed.,). Sage Publications India Pvt. Ltd.
5. (2019). Technical Communication. Wiley India Pvt. Ltd.
6. Vishwamohan, Aysha. (2013). English for Technical Communication for Engineering Students. Mc Graw- Hill Education India Pvt. Ltd.
7. Swan, Michael. (2016). Practical English Usage. Oxford University Press. Fourth Edition.

Online Resources:

1. https://nptel.ac.in/courses/109106116 [English Language for Competitive Exams by Prof.Aysha Iqbal, IIT Madras.]
2. https://onlinecourses.nptel.ac.in/noc22_hs77/preview [Developing Soft skills and Personality by Prof.T.Ravichandran, IIT Kanpur.]

Course Outcomes (COs)

1. After learning the contents of this course, the students will be able to Understand the importance of vocabulary and sentence structures
2. Choose appropriate vocabulary and sentence structures for their oral and written communication.
3. Demonstrate their understanding of the rules of functional grammar.
4. Develop comprehension skills from the known and unknown passages.
5. Take an active part in drafting paragraphs, letters, essays, abstracts, précis and reports in various contexts.
6. Acquire basic proficiency in reading and writing modules of English.

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I Year B.Tech. ECE I-Semester **L T P C**
Course Code: 12102 **0 0 3 1.5**

APPLIED PHYSICS LAB

(Common to EEE, ECE, ETE& CST)

Prerequisites: -Nil-

Course Objectives:

Through this course the student is to

1. Determine and classify magnetic materials and electro-magnetization.
2. Determine the type of semiconductor and Study the temperature dependence of resistivity.
3. Bring out the basic characteristics of semiconductor devices.
4. Construct basic electrical circuits and understand the effect of different components of the circuit on the electric parameters.
5. Learn the fundamentals of fiber optics and apply diffraction phenomenon.

Any of the following Ten experiments to be performed:

List of Experiments :

1. Biot – Savart's law to verify Magnetic field along the axis of current carrying coil – Stewart and Gees method.
2. Study B-H curve of a magnetic material.
3. To determine Energy gap of a material taken in the form of p-n junction diode.
4. Determination of Hall co-efficient and carrier concentration of a given semiconductor.
5. To study V-I characteristics of a solar cell.
6. V-I characteristics of a p-n junction diode and Zener diode.
7. Measurement of Time constant of an R-C circuit (Charging and Discharging).
8. Resonance Phenomena & Q-factor of L-C-R circuit (Series/Parallel).
9. Evaluation of numerical aperture of a given optical fiber.
10. Bending and attenuation losses of fibers.
11. Dispersive power of the material of a prism – Spectrometer.
12. Wavelength of light and determining the LPI of unknown grating of a diffraction grating using laser.
13. To find Rigidity modulus of given material using Torsional pendulum experiment.
14. Melde's experiment – Transverse and longitudinal modes.
15. Quantum dots.
16. Polarimeter-Polarization of light

Text books:

1. Laboratory Manual of Engineering Physics by Dr.Y.Aparna & Dr.K.Venkateswara Rao (V.G.S Publishers)
2. Engineering Physics - 2nd Edition NEW AGE Publications by M R Srinivasan.

Reference books:

1. Experiments In Engineering Physics (A Lab. Manual & W.B) - M.N.Avadhanulu, A.A.Dani & P.M.Pokley. Publisher, S. Chand Limited.
2. Science and Technology of PHOTOVOLTAICS - 2nd Edition- BS Publications by P.Jayarama Reddy.

Online Resources:

1. https://www.vlab.co.in/broad-area-physical-sciences
2. http://www.bsauniv.ac.in/UploadImages/Downloads/PHYSICS-LAB-MANUAL2017-(new-regulation).pdf
3. http://jnec.org/Lab-manuals/FE/Physics.pdf
4. https://www.myphysicslab.com/**(simple simulations)**
5. https://www.iist.ac.in/departments/physics-lab
6. https://wci.llnl.gov/simulation

Course Outcomes:

After completion of the course, students will be able to

1. Students are introduced to handling different instruments, interpret the data and correlate the same with their understanding of its theory.
2. Study the electro-magnetization characteristics and determine hysteresis loss
3. Determine hall coefficient and energy gap of the semiconductor (taken as a diode)
4. Differentiate Zener and p-n junction diode and to determine fill factor of a semiconductor solar cell
5. Determine the time constant, resonance and quality of the circuit consisting of R, C &/ L components.
6. Determine wavelength of laser light and differentiate different types of lasers, optical fibers losses

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I Year B.Tech. ECE I-Semester **L T P C**
Course Code: 12101 **0 0 2 1**

APPLIED CHEMISTRY LAB

(Common to EEE, ECE, CSE, IT, ETE, CSM, CSD & CST)

Prerequisites: -Nil-

Course Objectives:

The course consists of experiments related to the principles of chemistry required for engineering student. The student will learn:

1. Estimation of hardness of water to check its suitability for drinking purpose.
2. Perform estimations of acids and bases using conductometry, potentiometry and pH metry methods.
3. Prepare polymers such as Bakelite and nylon-6 in the laboratory.
4. Skills related to the lubricant properties such as saponification value, surface tension and viscosity of oils.

List of Experiments:

i. Volumetric Analysis:

1. Estimation of hardness of water complexometric titration by using EDTA
2. Estimation of ferrous iron by Dichrometry.
3. Estimation of ferrous iron by Permanganometry.

ii. Conductometry:

Estimation of the amount of given acid by Conductometry.

iii. Potentiometry:

1. Estimation of the amount of given acid by Potentiometry.
2. Estimation of the amount of Fe^{2+} by Potentiometry using Potassium dichromate.

iv. pH Metry:

Determination of an acid concentration using pH meter.

v. Colorimetry:

Estimation of Copper using Colorimetry.

vi. Preparations:

1. Preparation of Bakelite.
2. Preparation Nylon–6

vii. Lubricants:

1. Estimation of saponification value of a given lubricant oil.
2. Estimation of Viscosity of lubricant oil using Ostwald's Viscometer

viii. Virtual lab experiments

1. Batteries for electrical vehicles.
2. Functioning of solar cell and its applications.

Text books:

1. Lab manual for Engineering chemistry by B. Ramadevi and P. Aparna, S Chand Publications, New Delhi (2022)
2. College Practical Chemistry by V.K. Ahluwalia, Narosa Publications Ltd. New Delhi (2007)

Reference books:

1. Vogel's text book of practical organic chemistry 5th edition.
2. Inorganic Quantitative analysis by A.I. Vogel, ELBS Publications.

Online Resources:

1. https://www.youtube.com/watch?v=EGV9MBzqdoA
2. http://www.titrations.info/EDTA-titration-water-hardness
3. https://www.youtube.com/watch?v=_0MteudoAqA
4. https://archive.nptel.ac.in/content/storage2/courses/104103071/pdf/mod16.pdf

Course Outcomes:

After completion of the course, students will be able to

1. Understand the concepts of error, its analysis and also to develop the skills to tabulate the experimental data and derive valid conclusions.
2. Have hands on experience in performing the electro-analytical techniques such as Conductometry, Potentiometry and pHmetry.
3. Gain the ability to prepare polymeric materials like Bakelite and Nylon-6.
4. Estimate the Saponification value and viscosity of Lubricant oil.
5. Compare the experimental results with those introduced in lecture, draw relevant conclusions and substantiate.
6. Apply theoretical knowledge to real world situations, emphasizing the practical applications of chemical principles.

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I Year B.Tech. ECE I-Semester **L T P C**
Course Code: 12108 **0 0 3 1.5**

PROGRAMMING LAB

(Common to EEE, ECE, CSE, IT, ETE, CST, CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. To gain familiarity with the programming environment to edit, compile, run and debug programs.
2. To apply the syntax and semantics of C Programming Language.
3. To develop modular, reusable and readable C programs using the concepts like arrays, functions etc.
4. To implement programs using file handling functions.

List of Experiments:

Week 1: Familiarization with programming environment

Introduction to the working environment, compiling, running and debugging c programs, simple C programs.

Week 2: Simple computational problems using arithmetic expressions

a. Write a C program which reads time required (in hours and minutes) to complete two tasks and then print the total time in hours and minutes.
b. Write a C program which reads five students marks in a test and then prints average mark of passed students (assume that a minimum of 35 is needed to pass) using operators.
c. Assume an object is thrown upwards with some initial velocity, u (in m/sec). Write a C program to find the maximum height which it can reach. Assume acceleration due to gravity is 9.8m^2 /sec.
   Hint: Maximum height, h=u^2/2g.

Week 3:Problems involving if-then-else structures and switch statement

a. Write a C program to check whether a given number is even or odd using bitwise operator.
b. Write a C program to find the roots of a quadratic equation.
c. Write a C program to carry out the arithmetic operations addition, subtraction, multiplication, division and modulus using switch statement.

Week 4:Iterative problems

a. Write a C program to find whether a given number is Armstrong or not.
b. Write a C program to determine if the given number is a prime number or not.

c. Write a C program to calculate the following Series: Sum=1-x^2/2! +x^4/4!-x^6/6!+x^8/8!-x^{10}/10!

d. Write a C program to find the number of even and odd digits in a given number.

Week 5:Simple functions

a. The least common multiple (LCM) of two positive integers a and b is the smallest integer that is evenly divisible by both a and b. Write a C program that reads two integers and calls LCM (a, b) function that takes two integer arguments and returns their LCM. The LCM (a, b) function should calculate the least common multiple by calling the GCD (a, b) function and using the following relation: LCM (a, b) = ab / GCD (a, b).

b. Write a function to find the factorial of a positive integer.

c. Write a menu-driven C program that allows a user to enter 3 numbers and then choose between finding the smallest, largest, sum, or average. Use a switch statement to determine what action to take. Display an error message if an invalid choice is entered.

d. Write a C program that reads two integers and calls a factorial function to compute ${}^{\mathbf{n}}\mathbf{C}_{\mathbf{r}}$ value.

Week 6:Recursive functions

a. Write a C program that reads two integers x and n and calls a recursive function to compute x^n.

b. Write a C program that uses a recursive function to solve the Towers of Hanoi problem.

c. Write a C program that uses a recursive function to generate Pascal's triangle.

d. A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program which calls a recursive function to generate the first n terms of the sequence.

Week 7:Applications of 1D Array

a. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user using Sieve of Eratosthenes algorithm.

b. Write a C program to implement linear search on a list of integers.

c. Write a C program to implement binary search on a list of integers.

d. Write a C program to implement Bubble sort to sort a given list of integers in ascending order.

Week 8:Applications of 2D arrays

a. Write a C program that reads two matrices and performs Addition of two matrices using functions.

b. Write a C program that reads two matrices and performs Multiplication of two matrices using functions.

Week 9:Applications of Strings

a. Write a C program to perform the following
   i) To insert a sub-string into a main string at a given position.
   ii) To delete n characters from a given position in a string.
b. Write a C program to determine whether the given string is a palindrome or not.
c. Write a C program to replace a substring with another in a given line of text.
d. Write a C program to Sort Array of Strings.

Week 10:Pointers and Dynamic Memory Allocation

a. Write a C program to find the number of times a given word (i.e., a short string) occurs in a sentence. (i.e., a long string).
b. Using pointers, write a function that receives a character string and a character as argument and deletes all occurrences of this character in the string. Function should return the corrected string with no spaces.
c. Write a C program to find the maximum element from a set of elements. The number of elements will be decided during the execution of the program.

Week 11:Structures

a. Write a menu-based program in C that uses a set of functions to perform the following Operations:
   i) Reading a Complex number
   ii) Writing a complex number
   iii) Addition of two complex numbers
   iv) Subtraction of two complex numbers
   v) Multiplication of two complex numbers Represent the complex number using a structure
b. Declare a structure to store the following information of an employee: Employee code, Employee name, Salary, Department number, Date of joining (it is itself a structure consisting of day, month and year). Write a C program to store the data of N employees where N is given by the user (Use dynamic memory allocation). Include a Menu that allows user to select any of the following features:
   i) Use a function to display the employee information who are drawing the maximum and minimum salary.
   ii) Use a function to display the employee records in ascending order according to their date of joining.

Week 12: File Handling

a. Write a C program to display the contents of a file to standard output device.

b. Write a C program which copies one file to another, replacing all lowercase characters with their uppercase equivalents.

c. Write a C program to count the number of times a character occurs in a text file. The file name and the character are supplied as command-line arguments.

d. Write a C program to reverse the first n characters in a file. The file name and n are specified on the command line. Use fseek function.

Text Books:

1. B.A.Forouzan and R.F.Gilberg, Computer Science: A Structured Programming Approach Using C, 3rd Edition, Cengage learning.

Reference Books:

1. Byron Gottfried, Schaum's Outline of Programming with C, 2nd Edition, McGraw-Hill.
2. Yashavant P. Kanetkar, Let Us C, 13th Edition, Bpb Publications.
3. B.W.Kernighan & Dennis Ritchie, C Programming Language, 2nd Edition, PHI.
4. E.Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill.

Online Resources:

1. https://drive.google.com/file/d/1Yvq27-qsSPOxjJakf1cXpWq76L0F0cu_/view
2. https://cs50.harvard.edu/college/2022/spring/

Course Outcomes:

After completion of the course, students will be able to

1. Use tools to compile, debug, run and test the program.
2. Translate algorithms into executable programs.
3. Implement programs using control structures and arrays.
4. Develop modular and reusable code using functions.
5. Demonstrate usage of pointers, strings and structures.
6. Solve problems using file concepts.

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I Year B.Tech. ECE I-Semester **L T P C**
Course Code: 12105 **0 0 2 1**

ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB
(Common to EEE, ECE, ETE, CST)

Prerequisites: -Nil-

The **English Language and Communication Skills (ELCS) Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Course Objectives:
To facilitate computer assisted multimedia instruction enabling individualized and independent language learning.
1. To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm.
2. To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking.
3. To improve the fluency of students in spoken English and neutralize the impact of dialects.
4. To train students to use language appropriately for public speaking, group discussions and interviews.

Syllabus: English Language and Communication Skills Lab (ELCS) shall have two parts:
a. Computer Assisted Language Learning (CALL) Lab
b. Interactive Communication Skills (ICS) Lab

Listening Skills: Objectives
1. To enable students develop their listening skills so that they may appreciate the role in the LSRW skills approach to language and improve their pronunciation.
2. To equip students with necessary training in listening, so that they can comprehend the speech of people of different backgrounds and regions

Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.
- Listening for general content
- Listening to fill up information
- Intensive listening
- Listening for specific information

Speaking Skills: Objectives

1. To involve students in speaking activities in various contexts
2. To enable students express themselves fluently and appropriately in social and professional contexts
   - Oral practice
   - Describing objects/situations/people
   - Role play – Individual/Group activities
   - Just A Minute (JAM) Sessions

The following course content is prescribed for the **English Language and Communication Skills Lab**.

Exercise 1: CALL Lab:

Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers- Effective Listening. *Practice*: Introduction to Phonetics – Speech Sounds – Vowels and Consonants – Minimal Pairs- Consonant Clusters- Past Tense Marker and Plural Marker- *Testing Exercises*

ICS Lab:

Understand: Spoken vs. Written language- Formal and Informal English.

Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing

Oneself and Others.

Exercise 2: CALL Lab:

Understand: Structure of Syllables – Word Stress– Weak Forms and Strong Forms – Stress pattern in sentences – Intonation.

Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms- Stress pattern in sentences – Intonation - *Testing Exercises*

ICS Lab:

Understand: Features of Good Conversation – Strategies for Effective Communication.

Practice: Situational Dialogues – Role Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

Exercise 3: CALL Lab:

Understand: Errors in Pronunciation-Neutralising Mother Tongue Interference (MTI).

Practice: Common Indian Variants in Pronunciation – Differences between British and American

Pronunciation -*Testing Exercises*

ICS Lab:

Understand: Descriptions- Narrations- Giving Directions and Guidelines – Blog Writing

Practice: Giving Instructions – Seeking Clarifications – Asking for and Giving Directions – Thanking and Responding – Agreeing and Disagreeing – Seeking and Giving Advice – Making Suggestions.

Exercise 4: CALL Lab:
Understand: Listening for General Details.
Practice: Listening Comprehension Tests - *Testing Exercises*
ICS Lab:
Understand: Public Speaking – Exposure to Structured Talks- Non-verbal Communication- Presentation Skills.
Practice: Making a Short Speech – Extempore- Making a Presentation.

Exercise 5: CALL Lab:
Understand: Listening for Specific Details.
Practice: Listening Comprehension Tests -*Testing Exercises*
ICS Lab:
Understand: Group Discussion
Practice: Group Discussion

Minimum Requirement of infrastructural facilities for ELCS Lab:

1. **Computer Assisted Language Learning (CALL) Lab:**
   The Computer Assisted Language Learning Lab has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.
   System Requirement (Hardware component):
   Computer *network with LAN facility (minimum 40 systems with multimedia) with the following specifications:*
   i) Computers with Suitable Configuration ii) High Fidelity Headphones

2. **Interactive Communication Skills (ICS) Lab:**
   The Interactive Communication Skills Lab: A Spacious room with movable chairs and audio- visual aids with a Public Address System, a T. V. or LCD, a digital stereo –audio & video system and camcorder etc.
   Source of Material (Master Copy):
   Exercises in Spoken English. Part 1,2,3. CIEFL and Oxford University Press

Note: *Teachers are requested to make use of the master copy and get it tailor-made to suit the contents of the syllabus.*

Suggested Software:

1. Cambridge Advanced Learners' English Dictionary with CD.
2. Grammar Made Easy by Darling Kindersley.
3. Punctuation Made Easy by Darling Kindersley.
4. Oxford Advanced Learner's Compass, 10th Edition.
5. English in Mind (Series 1-4), Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.

6. English Pronunciation in Use (Elementary, Intermediate, Advanced) Cambridge University Press.
7. English Vocabulary in Use (Elementary, Intermediate, Advanced) Cambridge University Press.
8. TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS).
9. Digital All Orell Digital Language Lab (Licensed Version)

Referred Lab Manual: English Language Communication Skills – Manual cum Workbook published by CENGAGE, 2022

Reference Books:

1. *English Language Communication Skills – Lab Manual cum Workbook,* Cengage Learning India Pvt. Ltd, 2022.
2. Shobha KN & Rayen J. Lourdes, *Communicative English – A workbook,* Cambridge University Press, 2019.
3. Kumar Sanjay & Lata Pushp, *Communication Skills: A Workbook,* Oxford University Press, 2019.
4. Board of Editors, *ELCS Lab Manual: A Workbook for CALL and ICS Lab Activities,* Orient Black Swan Pvt. Ltd, 2016.
5. Mishra, Veerendra et al, *English Language Skills: A Practical Approach,* Cambridge University Press, 2020.

Online Resources:

1. https://nptel.ac.in/courses/109103183 [Phonetics and Phonology: A broad overview by Prof. Shakuntala Mahanta, IIT Guwahati]
2. https://nptel.ac.in/courses/109104031 [Communication Skills by Dr.T.Ravichandran, IIT Kanpur]

Course Outcomes:

After completion of the course, students will be able to

1. Differentiate between the letters of the alphabet and the phonetic symbols.
2. Demonstrate the right pronunciation of the words in English using phonetic transcription and word stress.
3. Speak with proper intonation, voice modulation and tonal groups.
4. Maximize the listening comprehension skills through various language modules.
5. Develop Speaking skills with clarity and confidence individually and in groups to discuss and present the topics chosen and understand the nuances of team dynamics.
6. Work individually and discuss in teams to present the topics and demonstrate their public speaking skills and presentation skills through various aids like posters, PPTs etc.,

I Year B.Tech. ECE I-Semester **L T P C**
Course Code: 12107 **0 0 2 -**

GENDER SENSITIZATION

(Mandatory Course) (Common to EEE, ECE, ETE, CST)

Prerequisites: NIL

Course Objectives:

1. To develop students' sensibility with regard to issues of gender in contemporary India.
2. To provide a critical perspective on the socialization of men and women.
3. To introduce students to information about some key biological aspects of genders.
4. To expose the students to debates on the politics and economics of work.
5. To help students reflect critically on gender violence.
6. To expose students to more egalitarian interactions between men and women.

UNIT 1: Understanding Gender

Gender: Why Should We Study It? (*Towards a World of Equals:* Unit -1)

Socialization: Making Women - Making Men (*Towards a World of Equals:* Unit -2) Introduction - Preparing for Womanhood - Growing up Male - First lessons in Caste - Different Masculinities.

UNIT 2: Gender and Biology

Missing Women: Sex Selection and Its Consequences (*Towards a World of Equals:* Unit -4) Declining Sex Ratio - Demographic Consequences.

Gender Spectrum: Beyond the Binary (*Towards a World of Equals:* Unit -10) Two or Many? - Struggles with Discrimination.

UNIT 3: Gender and Labour

Housework: The Invisible Labour (*Towards a World of Equals:* Unit -3) "My Mother doesn't Work." - "Share the Load."

Women's Work: Its Politics and Economics (*Towards a World of Equals:* Unit -7) Fact and Fiction - Unrecognized and Unaccounted work - Additional Reading: Wages and Conditions of Work.

UNIT 4: Issues of Violence

Sexual Harassment: Say No! (*Towards a World of Equals:* Unit -6)

Sexual Harassment, not Eve-teasing - Coping with Everyday Harassment- Further Reading: "Chupulu".

Domestic Violence: Speaking Out (*Towards a World of Equals:* Unit -8)

Is Home a Safe Place? -When Women Unite [Film] - Rebuilding Lives - Additional Reading: New Forums for Justice - Thinking about Sexual Violence

(*Towards a World of Equals:* Unit -11) - Blaming the Victim -"I Fought for my Life…." - Additional Reading: The Caste Face of Violence.

UNIT 5: Gender: Co – Existence

Just Relationships: Being Together as Equals (*Towards a World of Equals:* Unit -12) Mary Kom and Onler - Love and Acid just do not Mix - Love Letters. Mothers and Fathers - Additional Reading: Rosa Parks-The Brave Heart.

Text Book:

"*Towards a World of Equals: A Bilingual Textbook on Gender*" written by A. Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, GoguShyamala, DeepaSreenivas and Susie Tharu and published by **Telugu Akademi, Hyderabad**,Telangana State in the year **2015**.

Reference Books:

1. Menon, Nivedita. Seeing like a Feminist, 2012, New Delhi: Zubaan-Penguin Books.
2. Abdulali Sohaila. "I Fought For My Life…and Won."Available online at: http://www.thealternative.in/ lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_hs51/preview Contexualising Gender by Prof.Rasmi Gaur, IIT Roorkee]
2. https://onlinecourses.nptel.ac.in/noc19_hs57/preview [Gender justice and Workplace security by Prof.Dipa Dube, IIT Kharagpur]

Course Outcomes (COs)

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

1. Relate the understanding of gender sensitization to basic dimensions of the biological, sociological, psychological and legal aspects of gender through discussion of materials derived from research, facts, everyday life, literature and film.
2. Develop a finer grasp of how gender discrimination works in our society and how to counter it.
3. Maximize their insight into the gendered division of labour and its relation to politics and economics.
4. Perceive the genders Men and women as professionals equipped to work and live together as equals.
5. Develop a sense of appreciation of women in all occupations.
6. Identify, Understand and respond to Gender issues and to address them legally protecting and safeguarding the individual's rights.

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I Year B.Tech. ECE II-Semester **L T P C**
Course Code: 122AK **3 1 0 4**

NUMERICAL TECHNIQUES AND TRANSFORM CALCULUS

(Common to EEE, ECE, CSE, IT, ETE, CST, CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. To learn an alternative method for analytical methods in mathematical concepts.
2. To apply numerical techniques in solving ordinary differential equations.
3. To study the properties of vector valued functions and differential operators.
4. To attain the knowledge on integrals of vector valued functions.

UNIT 1: Numerical Techniques - I (~9 Lecture Hours)

Numerical Solutions of Algebraic and Transcendental Equations: Introduction, Bisection Method, Regula- Falsi method, Iteration method and Newton Raphson method.

Solving linear system of equations by Gauss-Jacobi and Gauss-Seidel method.

Curve Fitting: Fitting a linear, second degree, exponential curve by method of least squares for the discrete data.

UNIT 2: Numerical Techniques - II (~9 Lecture Hours)

Numerical Integration: Newton-Cote's Quadrature Formula, Trapezoidal Rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ Rule. **Numerical solution of Ordinary Differential Equations:** Solution of ordinary differential equations by Taylor's Series, Picard's method of Successive approximations, Euler's and Modified Euler's method, Fourth Order Runge-Kutta Method.

UNIT 3: Laplace Transforms (~10 Lecture Hours)

Laplace Transforms - Laplace Transform of Standard functions, First and Second Shifting Theorems, Transforms of derivatives and integrals, Multiplication and Division by 't', Laplace Transform of Periodic Function, Unit Step function, Dirac's Delta function.

Inverse Laplace Transform- Method of Partial Fractions, Convolution theorem (only statement), First and Second shifting theorem.

Applications of Laplace Transforms to Ordinary Differential Equations.

UNIT 4: Vector Differentiation (~10 Lecture Hours)

Scalar and Vector point functions, Gradient, Divergence, Curl and related properties, Unit Normal Vector, Directional Derivatives and Angle between the surfaces, Laplacian operator, Vector identities.

UNIT 5: Vector Integration and Integral Theorems (~10 Lecture Hours)

Vector Integration - Line Integral-Work Done-Potential function, Area, Surface and Volume Integral.

Vector Integral Theorems: Green's theorem, Stoke's theorem and Gauss's divergence theorem (only statements) and their verification.

Text Books:

1. Dr.B.S Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. M.K.Jain, S.R.K.Iyengar and R.K.Jain, Numerical Methods for Science and Engineering Computation, 6th edition, New Age International Publishers.

Reference Books:

1. R K Jain & S R K Iyengar, Advanced Engineering Mathematics, 5th Edition, Narosa Publishers.
2. Murray R Spiegel and Seymour Lipschutz, Vector Analysis, 2nd Edition, Schaums' Outlilne Series.
3. S.S.Sastry, Introductory Methods of Numerical Analysis, 5th edition, PHI Learning Pvt. Ltd.

Online Resources:

1. https://nptel.ac.in/courses/111106101
2. https://nptel.ac.in/courses/111107108

Course Outcomes (COs)

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

1. Find the root of the algebraic and Transcendental equation and solution of a linear system of equations.
2. Fit a curve for the given data.
3. Numerical solutions for a given first order initial value problem and evaluate definite integral numerically.
4. Laplace Transform techniques and apply for solving ODE.
5. Understand the concepts of Gradient, Divergence and Curl of a Vector and scalar point functions.
6. Evaluate the line, surface and volume integrals.

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I Year B.Tech. ECE II-Semester **L T P C**
Course Code: 122AJ **3 0 0 3**

DATA STRUCTURES

(Common to EEE, ECE, CSE, IT, ETE, CST, CSM & CSD)

Prerequisites: Programming for Problem Solving.

Course Objectives:

1. Understand the notations used to analyze the performance of algorithms.
2. Understand and analyze various searching and sorting algorithms.
3. Understand the behavior of data structures such as stacks, queues, trees, hash tables, search trees, graphs and their reupresentations.
4. Choose an appropriate data structure for a specified application.

UNIT 1: (~10 Lecture Hours)

Basic Concepts: Algorithm-Introduction, Performance analysis – Time Complexity and Space Complexity, Asymptotic Notation – Big O, Omega and Theta notations, Complexity Analysis Examples.

Introduction to Data Structures: Linear and Non-linear data structures.

Review of Pointers: Pointers, Self-referential structures

Linear List: Array and Linked Representations, Singly Linked List, Operations – Insertion, Deletion and Searching, Circularly Linked List, Operations – Insertion, Deletion and Searching, Doubly Linked List, Operations– Insertion, Deletion and Searching, Applications of Linked List – Sparse matrix.

UNIT 2: (~9 Lecture Hours)

Stack: Definition, Array and Linked implementations, Applications– Infix to Postfix Conversion, Postfix Expression Evaluation, Recursion.

Queue: Definition, Array and Linked implementations, Circular Queues– Insertion and Deletion Operations.

UNIT 3: (~8 Lecture Hours)

Trees: Definitions, Terminology, Applications, Properties, Binary Tree - Array and Linked representations, Binary Tree Traversals, Threaded Binary Tree-Definition.

Priority Queues: Definition and Applications, Max Priority Queue – Implementation, Max Heap - Definition, Insertion and Deletion.

UNIT 4: (~8 Lecture Hours)

Searching: Linear Search, Binary Search,Hashing: Introduction, Hash Tables, Hash Functions, Overflow Handling. **Dictionaries:** Linear List Representation, Hash Table Representations, Operations - Insertion, Deletion and Searching.

Sorting: Insertion Sort, Selection Sort, Quick Sort, Merge Sort, Heap Sort, Comparison of Sorting Methods.

UNIT 5: (~ 10 Lecture Hours)

Graph: Definitions, Terminology, Applications, Properties, Graph Representations - Adjacency Matrix, Adjacency Lists, Graph Traversal Methods – DFS and BFS

Search Trees: Binary Search Trees, Definition, Operations- Searching, Insertion and Deletion.

Balanced Search Trees: AVL Trees- Definition and Insertion, B-Trees- Definition and Examples, Comparison of Search Trees.

Text Books:

1. E. Horowitz, S. Sahni and Susan Anderson Freed, Fundamentals of Data Structures in C, 2^{nd} Edition, Universities Press.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2^{nd} Edition, Pearson.

Reference Books:

1. Reema Thareja, Data structures using C, 2^{nd} Edition, Oxford higher education.
2. A. S. Tanenbaum, Y. Langsam and M.J. Augenstein, Data Structures using C, PHI/Pearson Education.
3. R. F. Gilberg and B.A. Forouzan, Data Structures: A Pseudocode Approach with C, 2^{nd} Edition, Cengage Learning.
4. D. Malhotra, N. Malhotra, Data Structures and Program Design Using C: A Self-Teaching Introduction, Mercury Learning and Information.
5. D. Samanta, Classic Data Structures, 2^{nd} Edition, PHI.

Online Resources:

1. www.geeksforgeeks.org/data-structures
2. https://www.tutorialspoint.com/data_structures_algorithms/index.htm

Course Outcomes:

After completion of the course, students will be able to

1. Determine and analyze the complexity of given algorithms.
2. Use basic data structures such as linked list, stack and queue.
3. Implement various kinds of searching and sorting techniques.
4. Design programs using advanced data structures like hash tables, binary trees,heaps and graphs.
5. Build and compare search trees and balanced search trees.
6. Choose appropriate data structures as applied to specified problem definition.

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I Year B.Tech. ECE II-Semester **L T P C**
Course Code: 122AC **3 0 0 3**

BASIC ELECTRICAL ENGINEERING

(Common to EEE, ECE, ETE, CST)

Pre Requisites: Physics

CourseObjectives:

1. Concepts of Basic Magnetic and Electrical AC&DC Circuits.
2. Understand the concepts of Electrical Machines
3. To understand the VI characteristics of various Electronic components like Diode, BJT and SCR.

Unit-1:Magnetic Circuits and DC Circuits (~11 Lecture Hours)

Magnetic Circuits: Flux, flux density, Magnetic field Intensity, reluctance, MMF, Faraday's laws of Electromagnetic induction – statically & dynamically induced EMF-Lenz's law-Fleming'srules, Simple problems **DC Circuits:** Electrical Circuit elements: R,L and C, voltage and current sources, KCL&KVL, Analysis of simple DC Circuits, Nodal and Mesh analysis of simple circuits with DC excitation, Simple problems.

Unit-2: Single Phase AC Circuits (~10 Lecture Hours)

Network Theorems: Superposition, Thevenin's and Norton's Theorems with in dependent sources (DC excitation only),Simple Problems.

1-j **AC Circuits:** Representation of sinusoidal waveforms, Average and RMS values, phasorrepresentation, power factor; Impedance and Power triangles, Resonancein Series RLC Circuit.

Unit-3: DC Machines & Batteries (~9 Lecture Hours) DC Machines:

DC Generators–construction, principle of operations and types, EMF equations, simple problems. **DCMotors**–Principle of operation, significance of Back EMF, Torqueequation, Characteristics & applications, losses & efficiency, Direct Loadtest.

Construction, Principle of Operation, EMF Equation, Losses and efficiency (Direct Load Test).

Unit-4: AC Machines (~7 Lecture Hours)

Transformers: Construction, Principle of Operation, EMF Equation, Losses and fficiency (Direct Load Test) **Inductionmotors:**Construction, Principle of Operation, Production of rotating magnetic field, Speed-Torque characteristics, Applications, simple Problems.

Synchronous Generators–Construction, Classification, Principle of Operation.

Synchronous Motors–Principle of operation and applications.

Unit-5:Basic Electronics (~7 Lecture Hours)

Operation of PN Junction Diode, BJT & SCR and their Static Characteristics, Halfwave and Full wave Diodebridge rectifiers.

Text Books:

1. T.K.Nagasarkar and M.S.Sukhija, Basic Electrical Engineering, Oxford University Press, 3rd Edition, 2018.
2. D.P. Kothari and I.J.Nagrath Basic Electrical Engineering, TataMcGraw Hill, 3rd Edition, 2010.
3. Dell, Ronald MRand, DavidAJ, ‘Understanding Batteries’, Royal Society of Chemistry, (2001).

Reference Books:

1. P.S.Bimbhra, Power Electronics Khanna Publications
2. D.C.Kulshreshtha, Basic Electrical Engineering, McGraw Hill, 1st Edition, 2009.

Course Outcomes:

After completion of the course students should be able to:

1. Explain and analyze the magnetic and electric circuits.
2. Analyze the basic circuits with application of Network Reduction Techniques and Network Theorems.
3. Demonstrate the working principles of DC Electrical machines.
4. Demonstrate the working principles of transformers and various AC Machines.
5. Demonstrate the principle and operation of various Electronic devices like Diode, BJT and SCR.

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I Year B.Tech. ECE II-Semester **L T P C**
Course Code: 122AE **1 0 3 2.5**

ENGINEERING GRAPHICS

(Common to EEE, ECE, ETE, CST)

Prerequisites: -Nil-

Course Objectives:

The course will enable the students

1. To impart skills of drawing instruments and their use to convey exact and complete information of any object.
2. To construct conics and cycloidal curves used for various engineering applications.
3. To impart knowledge about standard principles of orthographic projection of objects.
4. To develop different surfaces of simple solids.
5. To differentiate between isometric view and projection and conversion of isometric views to orthographic views vice-versa.
6. To acquire computer drafting skill for communication of concepts, ideas in the design of engineering products.

UNIT 1: (~ 3 Lecture Hours and 9 Practical Hours)

Introduction to Engineering Graphics: Principles of Engineering Graphics and their significance.

Scales- Plain & diagonal.

Conic Sections- Construction of ellipse, parabola andhyperbola (general method only).

Cycloidal curves: Cycloid, Epicycloid andHypocycloid (general methods only).

UNIT 2: (~ 3 Lecture Hours and 9 Practical Hours)

Orthographic Projections: Principles of orthographic projections-conventions- Projections of points in all positions; projection of straight lines-line inclined to one reference plane and with two reference planes (excluding traces and midpoint problems).

UNIT 3: (~ 3 Lecture Hours and 9 Practical Hours)

Projections of Planes: Plane inclined to one reference plane and with two reference planes.

Projections of Solids: Projections of solids (prisms, pyramids, cylinders and cones) in simple position and axis inclined to one reference plane only.

UNIT 4: (~ 3 Lecture Hours and 9 Practical Hours)

Development of Surfaces: Basic concepts of development of surfaces, Methods of development – Parallel line development and radial line development, Development of prisms, pyramids, Cylinders and cones.

UNIT 5: (~ 4 Lecture Hours and 12 Practical Hours) **Isometric Projection:** Principles of Isometric Projection – Isometric Scale Isometric Views – Isometric views of Lines, Planes and Simple Solids only. **Orthographic Views:** Conversion of Isometric Views to Orthographic Views.

Introduction to computer aided drafting (**For internal evaluation weightage only**) Introduction to Computer Aided Drafting, views and commands, orthographic projection of points, lines, planes and solids. Conversion of orthographic projection into isometric view.

Note: Syllabus for external examination will be from 1-5 units in conventional mode and introduction to computer aided drafting is exempted from the external examination.

Text Books:

1. Basanth Agrawal, Agrawal C.M., Engineering Graphics, First Edition, 2018, Tata McGrawHill.
2. Bhatt N.D., Engineering Drawing, fifty third edition, 2016, CharotarPublishing house pvt. limited.

Reference Books:

1. Venugopal.K, Engineering Drawing and Graphics Plus Autocad, 2010, New Age International (P) Ltd., New Delhi.
2. Dhananjay A Jolhe, Engineering Drawing, 2014, Tata McGrawHill.
3. Engineering Drawing and graphics Using AutoCAD Third Edition, T. Jeyapoovan, Vikas: S. Chand and company Ltd.
4. Computer Aided Engineering Drawing – K Balaveera Reddy – CBS Publishers & distributors, 2015

Online Resources:

1. www.engineeringdrawing.org
2. Virtual labs(www.vlab.co.in)

Course Outcomes:

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

1. Acquire proficiency in instrumental drawing and will be able to visualize the object, draw conic sections and cycloidal curves.
2. Draw and understand about orthographic projections of points, straight lines.
3. Improve visualization skills in different types of planes and solids.
4. Draw and understand about the development of surfaces of various solids.
5. Ability to read, understand and interpret engineeringdrawings.
6. Apply computer aided drafting tools to create objects.

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I Year B.Tech. ECE II-Semester **L T P C**
Course Code: 12204 **1 0 3 2.5**

ENGINEERING WORKSHOP

(Common to EEE, ECE, ETE, CST)

Prerequisites: -Nil-

Course Objectives: The course will enable the students

1. To study of different hand operated Power Tools, uses and their demonstration.
2. To gain a good basic working knowledge required for the production of various engineering products.
3. To provide hands on experience about use of different Engineering materials, tools, equipment's and processes that are common in the Engineering field.
4. To develop a right attitude, team working, precision and safety at work place.
5. To study commonly used carpentry joints.
6. To have practical exposure to various welding and joining processes.

I) Trades for Exercises: (~12 Lectures + 36 Practices)

At least two exercises from each trade:

i) Carpentry
ii) Fitting
iii) Tin-Smithy and Development of jobs carried out and Soldering
iv) House-wiring
v) Foundry
vi) Black smithy

II) Trades for Demonstration and Exposure:

i) Plumbing
ii) Welding

Text Books:

1. B.L. Juneja, "Workshop Practice", Cengage publications.
2. K. Venugopal, "Workshop Manual", Anuradha Publications.

Reference Books:

1. P. Kannaiah & K. L. Narayana, "Workshop Manual", 2nd Edition, Scitech publications (I) Pvt. Ltd., Hyderabad, 2015.
2. K. Venugopal, Dr. V. Prabhu Raja, G. Sreekanjana ,"Workshop Manual" 1st Edition, Anuradha Publications, 2012.

3. Hajra Choudury S.K., Hajra Choudury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Media Promoters and Publishers private limited, Mumbai, vol I 2008 and Vol II 2010.

Online Resources:

1. www.technologystudent.com

Course Outcomes:

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

1. Demonstrate and understand the Engineering workshop safety regulations.
2. Identify and use marking tools, measuring equipment and to work to prescribed accuracies.
3. Understand the practical difficulties encountered in industries during any assembly work.
4. Do simple electrical work through their carrier.
5. Design different prototype in the fittings, carpentry, foundry, black smithy and sheet metal work.

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I Year B.Tech. ECE II-Semester **L T P C**
Course Code: 12209 **0 0 3 1.5**

DATA STRUCTURES LAB

(Common to EEE, ECE, CSE, IT, ETE, CST, CSM & CSD)

Prerequisites: Programming for Problem Solving

Course Objectives:

1. Write data structure programs using arrays, structures and pointers.
2. Develop applications using linear data structures such as linked lists, stacks and queues.
3. Learn to write programs to implement various sorting and searching algorithms.
4. Write programs to implement various non-linear data structures like trees, graphs and search trees.

List of Experiments:

Week 1: Write a C program to create structure with the name – student, which contains the fields - name, rollno and gender. With the help of pointer read and display the student details.

Week 2: Write a C program that uses functions to perform the following operations on a singly linked list of integers:

a. Creation b. Insertion c. Deletion d. Display

Week 3: Write a C program that uses functions to perform the following operations on a doubly linked list:

a. Creation b. Insertion c. Deletion d. Display

Week 4: Write a C program to implement stack using an array and a linked list.

Week 5: Write a C program that uses stack operations to convert a given infix expression into its postfix equivalent. Implement the stack using an array.

Week 6: Write a C program to implement a queue using an array and a singly linked list.

Week 7: Write a C program that uses functions to perform the following:

a. Search for a key element in a list of elements using linear search.
b. Search for a key element in a list of sorted elements using binary search.
c. To arrange a list of elements in ascending order using insertion sort.

Week 8: a. Write a C program that implements selection sort algorithm to arrange a list of elements in descending order.

b. Write a C program that implements heap sort algorithm for sorting a list of integers in ascending order.

Week 9: a. Write a C program that implements quick sort algorithm to arrange a list of elements in ascending order.

b. Write a C program that implements merge sort algorithm for sorting a list of integers in ascending order.

Week 10: Write a C program to implement all the functions of a dictionary using hashing.

Week 11: Write a C program that uses functions to perform the following:

a. Create a binary search tree of integers.

b. Traverse the above binary search tree recursively in preorder, inorder and postorder.

c. Search for an integer key in the above binary search tree recursively.

d. Traverse the above binary search tree non-recursively in inorder.

Week 12: Write a C program to perform the following:

a. Traverse a given graph using DFS algorithm.

b. Traverse a given graph using BFS algorithm.

Text Books:

1. E. Horowitz, S. Sahni and Susan Anderson Freed, Fundamentals of Data Structures in C, 2^{nd} Edition, Universities Press.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2^{nd} Edition, Pearson.

Reference Books:

1. Reema Thareja, Data structures using C, 2^{nd} Edition, Oxford higher education.
2. A. S. Tanenbaum, Y. Langsam and M.J. Augenstein, Data Structures using C, PHI/Pearson Education.
3. R. F. Gilberg and B.A. Forouzan, Data Structures: A Pseudocode Approach with C, 2^{nd} Edition, Cengage Learning.
4. D. Malhotra, N. Malhotra, Data Structures and Program Design Using C: A Self-Teaching Introduction, Mercury Learning and Information.
5. D. Samanta, Classic Data Structures, 2^{nd} Edition, PHI.

Online Resources:

1. www.geeksforgeeks.org/data-structures
2. https://www.tutorialspoint.com/data_structures_algorithms/index.htm

Course Outcomes:

After completion of the course, students will be able to

1. Use arrays, structures and pointers for implementing various data structures.
2. Implement various kinds of searching algorithms.
3. Implement various internal and external sorting algorithms.
4. Develop the programs for various linear data structures like stack, queue and linked list.
5. Implement non-linear data structures like graphs and trees.
6. Choose the appropriate data structure for solving real world problems.

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I Year B.Tech. ECE II-Semester	**L**	**T**	**P**	**C**
Course Code: 12203	**0**	**0**	**3**	**1.5**

BASIC ELECTRICAL ENGINEERING LAB

(Common to EEE, ECE, ETE & CST)

Prerequisites: -Nil-

Course Objectives:

1. To verify the Network Theorems and understand the usage of common electrical measuring instruments.
2. To understand the basic characteristics of Transformers and Electrical Machines.
3. To understand the VI characteristics of various Electronic components like Diode, BJT and SCR.

PART-A (Compulsory)

1. Verification of KCL&KVL.
2. Verification of Superposition theorem with DC excitation.
3. Verification of Thevenin's & Norton's theorems with DC excitation.
4. Direct Load Test on Single Phase Transformer
5. OCC Test on DC Shunt Generator
6. Torque-Speed characteristics of a 3-ϕ Induction Motor by conducting Load Test.
7. V-I Characteristics of PN Junction Diode and Zener Diode.
8. V-I Characteristics of SCR.

PART-B (Any two experiments)

1. Study of different types of batteries.
2. Determination of Resonant frequency & Bandwidth for a series RLC resonance circuit.
3. Output waveforms of Half wave and full wave bridge Rectifiers.
4. Static output and input characteristics of BJT.

Text Books:

1. T.K.Nagasarkar and M.S.Sukhija, Basic Electrical Engineering, Oxford University Press, 3rd Edition, 2018.
2. D.P.Kothari and I.J.Nagrath, Basic Electrical Engineering, Tata McGraw Hill, 3rd Edition, 2010.
3. Dell, Ronald M Rand, David A J, 'Understanding Batteries', Royal Society of Chemistry, 2001.
4. D.P.Kothari and I.J.Nagrath Theory and problems of Basic Electrical Engineering, PHI, 2016.

Reference Books:

1. P. S. Bimbhra, Power Electronics, Khanna Publications, 2018.
2. D.C.Kulshreshtha, Basic Electrical Engineering, McGraw Hill, 1st Edition, 2009.
3. Jimmie J. Cathey, Syed A. Nasar, Basic Electrical Engineering, Schaum's Outline.
4. Huges, Electrical and Electronic Technology, Person, 2010.

Online Resources:

1. https://nptel.ac.in/courses/108108076

Course Outcomes:

After completion of the course, students should be able to

1. Analyze and solve circuits using Kirchoff's Laws.
2. Apply network theorems to analyze and solve DC circuits.
3. Comprehend the OCC test on Separately excited DC Generator.
4. Analyze the performance of a 3ϕ Induction motor and Transformer.
5. Analyze and interpret VI characteristics of a Diode & SCR.
6. Identify and compare the characteristics of different types of Batteries.

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I Year B.Tech. ECE II-Semester **L T P C**

Course Code: 122AD **2 0 0 2**

DESIGN THINKING

(Common to EEE, ECE, ETE & CST)

Prerequisites: -Nil-

Course Objectives: The main objectives of this course are

1. To inculcate attitude to solve societal problems using design thinking tools.
2. To come-up with proper design which further leads to successful products or enterprises.
3. To instill a sense of significance towards applying creativity to product and service design.

UNIT 1: (~ 6 Lecture Hrs)

Introduction to Design Thinking: Origin of Design thinking, Importance of Design thinking, Understanding Design thinking: A non- linear process - 5-stage d.school process model, Application of design thinking.

UNIT 2: (~ 7 Lecture Hrs)

Empathy: Difference between Empathy and Sympathy, Role of Empathy in design thinking, Empathy mapping, Understanding empathy tools: Customer Journey map, Persona; Importance of Empathizing before Ideating.

Define: Explore define phase in Design Thinking, Methods of Define phase.

UNIT 3: (~ 6 Lecture Hrs)

Ideation: Introduction, Types of Thinking- convergent, divergent, critical and creative thinking; Ideation Methods- Brainstorming, Storyboarding, Bingo Selection, Six Thinking Hats, Mind mapping.

UNIT 4: (~ 6 Lecture Hrs)

Prototyping and Testing: Prototyping and methods of prototyping. User testing methods, Advantages and disadvantages of user Testing/ Validation. Iteration and Pitching.

UNIT 5: (~ 7 Lecture Hrs)

Innovation: Definition, Innovation and creativity, Innovation Triangle-Desirability, Feasibility and Viability; Types of Innovation – Product Innovation, Process Innovation and Business model Innovation.

Design thinking in various sectors: Design thinking to meet corporate needs.Case studies in Information Technology, Finance, Education, Management, Health care and Retail sector.

Textbooks:

1. Daniel Ling, Complete Design Thinking Guide for Successful Professionals, 2015, CreateSpace Independent Publishing.
2. Andrew Pressman, Design Thinking: A Guide to Creative Problem Solving for Everyone, 2019, Routledge Taylor and Francis group.

References:

1. Idris Mootee, Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design school, 2013, John Wiley & Sons.
2. Tim Brown, Change by Design_ How Design Thinking Transforms Organizations and Inspires Innovation, 2009, Harper Bollins.
3. George E Dieter, Engineering Design, 5th-edition, 2013, The McGraw-Hill Companies.

Online Resources:

1. https://www.interaction-design.org/
2. https://designthinking.ideo.com/
3. https://www.innovationtraining.org/design-thinking-mindsets/
4. https://onlinecourses.nptel.ac.in/noc20_mg38/preview
5. https://www.ideou.com/blogs/inspiration/what-is-design-thinking

Course Outcomes:

After completion of this course, student will be able to

1. Understand the importance of various phases of Design Thinking.
2. Empathize with the customers and formulate specific problem statement.
3. Generate an idea through ideation techniques.
4. Understand various prototyping methods and Iterate solutions.
5. Understand innovation, and application of design thinking in various sectors.

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I Year B.Tech. ECE II-Semester **L T P C**
Course Code: 12206 **2 0 0 -**

ENVIRONMENTAL SCIENCE AND TECHNOLOGY

(Common to ECE, EEE, ETE & CST)

Pre requisites: Knowledge on Environmental Issues, natural resources, biodiversity, sustainable development.

Course Objectives:

- To imbibe the importance of ecological balance for sustainable development.
- To acquire the knowledge on the impacts of developmental activities and mitigation measures.
- To study the international and national environmental policies and regulations.

UNIT 1: (~ 6 Lecture Hours)

Eco Systems: Definition, Scope, and Importance of ecosystem (ecosystem value, services and carrying capacity), classification, structure, and functions of an ecosystem (food chains, food webs, and ecological pyramids. flow of energy, Bio - Geo Chemical Cycles), Bio accumulation, Bio-magnification, Field visits.

UNIT 2: (~ 6 Lecture Hours)

Natural Resources: Classification of NaturalResources and their uses: Living and Non-Living resources, **Water resources:** use and over utilization of surface and ground water, floods and droughts, dams benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources: Forest resources**, **Energy resources:** growing energy needs, renewable and non- renewable energy sources, use of alternate energy source, case studies.

UNIT 3: (~ 6 Lecture Hours)

Bio diversity and Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; (consumptive use, productive use, social, ethical, aesthetic and optional values). India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: (habitat loss, poaching of wildlife, man-wildlife conflicts);conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act, Field Trip to nearby lake.

UNIT 4: (~ 7 Lecture Hours)

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, causes, effects and control methods of**Air Pollution, Water Pollution, Soil Pollution and Noise Pollution: Solid Waste and its Management:** and characteristics of e -Waste and its management. Swach Bharat Mission – Save Soil Campaign

Global Environmental Issues and Global Efforts: Climate change and impacts on human environment. Ozone depletion and Ozone Depleting Substances (ODS). International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol. NAPCC-GoI Initiatives. Environmental Control of Epidemics and Pandemics.

UNIT 5: (~ 7 Lecture Hours)

Environmental Policy, Legislation & EIA: Salient Features ofEnvironmental Protection Act, Air Act-1981, Water Act, Forest Act, Wild life Act, National Green Tribunal Act, 2010 Municipal Solid Waste (Management and Handling) Rules, Bio- medical Waste (Management and Handling) Rules, Hazardous Waste (Management and Handling) Rules, e -Waste (Management and Handling) Rules. EIA: Concept of EIA and importance of EIA. **Towards Sustainable Future:** Concept of Sustainable Development Goals, Crazy Consumerism, Urban Sprawl, Human health, Concept of Green Building, Ecological Foot Print, Life Cycle Assessment (LCA), Low Carbon Life Style. Environmental Ethics and Economics.

Text Books:

1. Erach Bharucha, Text book of Environmental Studies for Undergraduate Courses, University Grants Commission.
2. R.Rajagopalan, Environmental Studies,Oxford University Press.

Reference Books:

1. RichardT.Wright., Environmental Science:towards a sustainable future, PHL Learning Private Ltd. NewDelhi, 2008.
2. Gilbert M.Masters and WendellP.Ela., Environmental Engineering and science PHI Learning Pvt.Ltd., 2008.
3. DanielB.Botkin & Edward A.Keller, Environmental Science, WileyINDIA Edition.
4. AnubhaKaushik, Environmental tudies, 4th Edition, New age international publishers.
5. Dr.M.AnjiReddy, Textbook of Environmental Science and Technology, BS Publications, 2007.
6. Y. Anjaneyulu, Introduction to Environmental Science, BS.Publication.

Online Resources:

1. https://www.epa.gov/students/lesson-plans-teacher-guides-and-online-environmental-resources-educators.
2. https://onlinecourses.swayam2.ac.in/cec20_hs10/preview
3. https://open.ed.ac.uk/environment-sustainability-resources/
4. https://onlinepublichealth.gwu.edu/resources/sources-for-climate-news/

Course Outcomes:

After completion of the course, students will be able to

1. Based on this course, the Engineering graduate will understand/evaluate/develop technologies based on ecological principles and environmental regulations, which in turn helps in sustainable development.
2. Acquire the knowledge on ecological principles and functions of eco systems and their importance for survival.
3. Develop the knowledge on role of natural resources for sustenance of life.
4. Analyze the concepts of bio - diversity and its role in the maintenance of ecological balance.
5. Evaluate the various causes, effects, control/mitigation of environmental pollution on man and environment.
6. Follow the environmental legislations in their daily life and professional practice to protect the environment.

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II Year B.Tech. ECE I-Semester	**L**	**T**	**P**	**C**
Course Code: 123AX	**3**	**0**	**0**	**3**

SPECIAL FUNCTIONS AND COMPLEX VARIABLE THEORY

(Common to ECE, EEE, ETE)

Prerequisites: -Nil-

Course Objectives:

1. To introduce effective mathematical tools for the solution of partial differential equations.
2. Differentiation and integration of functions of complex variable that are used in various techniques dealing in engineering problems.
3. To evaluate the real integrals by representing into Beta and Gamma functions.

UNIT 1 : Beta and Gamma Functions (~08 lectures)

Beta function, properties of Beta function, express the integral in terms of Beta function.

Gamma function, properties of gamma function, relation between Beta and Gamma functions, evaluation of integrals by using Beta - Gamma functions.

UNIT 2 :First Order Partial Differential Equations (~08 lectures)

Formation of partial differential equations by the elimination of arbitrary constants and arbitrary functions. Lagrange's method to solve first order linear equations and the standard type methods to solve first order non linear equations.

UNIT 3 : Analyticity of complex functions (~12 lectures)

Limit, continuity, differentiability, analyticity of complex functions and its properties, Cauchy-Riemann equations in Cartesian and polar coordinates, Harmonic functions, Milne-Thomson Method.

UNIT 4 :Complex Integration (~10 lectures)

Simply and multiply connected domains (definitions), Cauchy's integral theorem, Cauchy's integral formula, Cauchy's generalized integral formula.

Power series, Taylor's theorem, Laurent's theorem (only statement), classification of singular points.

UNIT 5 : Residue Calculus (~10 lectures)

Calculus of residues, Residue theorem (only statement),evaluation of real definite integrals of the types

a) $\int_c^c$ a) $\int_c^{c+2\pi} f(cos\theta, sin\theta)\, d\theta$ b) $\int_{-\infty}^{\infty} f(x)dx$

Text Books:

1. J.N.Sharma, Functions of A Complex Variables, 49th Edition, Krishna Prakashan Publishers.
2. B.S. Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.

Reference Books:

1. H.S.Kasana, Complex Variables-Theory and Applications, 2nd Edition, Eastern Economy Edition.
2. Ravish R Singh and Mukhul Bhatt, Engineering Mathematics: A Tutorial Approach, 2nd Edition, McGraw Hill Education.
3. James Ward Brown & Ruel, V.Churchill, Complex Variables and Applications, 8th Edition, International Edition.

Online Resources:

1) https://www.youtube.com/watch?v=JoyvDWZ0aMY
2) https://youtu.be/Mwpz1zjPlzI

Course Outcomes (COs):

After completing the course the student will be able to

1. Evaluate the integral using Beta – Gamma functions.
2. Solve first order partial differential equations.
3. Understand about analyticity of complex valued functions and its properties.
4. Integrate a complex function over a given contour.
5. Expand a complex function in a given region of convergence using Taylor's and Laurent's series.
6. Apply knowledge of complex integrals for evaluation of real integrals.

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II Year B.Tech. ECE I-Semester **L T P C**
Course Code: 123AV **2 0 0 2**

PYTHON PROGRAMMING

(Common to ECE, CSE, IT, CST, CSE(AI&ML) & CSE(DS)

Prerequisites: -Nil-

Course Objectives:

1. Learn syntax and semantics and create functions in Python.
2. Facilitate learning to use lists, tuples, strings and dictionaries in Python programs.
3. Impart knowledge on files and exception handling in Python.
4. Introduce GUI programming and data handling.

UNIT 1: (~5 Lecture Hours)

Introduction to Python Programming: Using Python, The IDLE Programming Environment, Input, Processing and Output, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations, More about Data Output: New line, Item Separator, Escape Characters, Formatting parameters.

Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables.

UNIT 2: (~5 Lecture Hours)

Repetition Structures: Introduction, while loop, for loop, Sentinels, Input Validation Loops, Nested Loops. **Functions:** Introduction, Defining and Calling a Function, designing a Program to use Functions, Local Variables, Passing Arguments to Functions, Global Variables and Global Constants, Value-Returning Functions: Generating Random Numbers, Writing Our Own Value-Returning Functions, Recursion.

UNIT 3: (~6 Lecture Hours)

Lists and Tuples: Sequences, Introduction to Lists, List slicing, Finding Items in Lists with the in Operator, List Methods and Useful Built-in Functions, Copying Lists, Processing Lists, Two-Dimensional Lists, Tuples.

Strings: Basic String Operations, String Slicing, Testing, Searching, and Manipulating Strings.

Dictionaries and Sets: Dictionaries, Sets, Serializing Objects.

UNIT 4: (~6 Lecture Hours)

Files and Exception: Introduction to File Input and Output, Using Loops to Process Files, Processing Records, Exceptions.

Modules: Namespaces, Importing Modules, Importing Module attributes, Module built-in functions, Packages, other features of Module.

Regular Expressions: Introduction, Special Symbols and Characters, REs and Python.

UNIT 5: (~ 6 Lecture Hours)

GUI Programming: Graphical User Interfaces, Using the tkinter Module, Display text with Label Widgets, Organizing Widgets with Frames, Button Widgets and Info Dialog Boxes, Getting Input with Entry Widget, Using Labels as Output Fields, Radio Buttons, Check Buttons.

Introduction to Plotting in Python – Basic Plots- Line and Scatter Plot, box plot, bar plots, Histograms and plotting data contained in files.

Text Books:

1. Tony Gaddis, "Starting Out with Python", 3rd Edition, Pearson, 2015.
2. Wesley J. Chun, Core Python Programming, 2nd Edition, Pearson.

Reference Books:

1. Reema Thareja "Python Programming", Oxford Press,2017.
2. Allen Downe, "Think Python: How to Think like Computer Scientist", 2nd Edition, O'Reilly publications.

Online Resources:

1. https://www.python.org/
2. https://www.w3schools.com/python/
3. https://www.tutorialspoint.com/python/index.htm
4. https://www.digimat.in/nptel/courses/video/106106182/L01.html
5. https://www.geeksforgeeks.org/simple-plot-in-python-using-matplotlib/

Course Outcomes (COs):

After completion of the course, students will be able to

1. Understand the fundamental concepts of Python Programming.
2. Apply the concepts of control structures and usage of functions in Python Programming.
3. Design Python programs using data structures like List, Tuple, Strings and Dictionaries.
4. Develop proficiency in handling files, exceptions and modules.
5. Construct regular expressions and design GUI based applications using Python.
6. Interpret various data visualization techniques.

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II Year B.Tech. ECE I-Semester **L T P C**
Course Code: 123AR **3 1 0 4**

ELECTRONIC DEVICES AND CIRCUITS

(Common to ECE, ETE)

Prerequisites: Physics.

Course Objectives:

1. To review the basic concepts of semiconductor devices.
2. To explore the construction, operation and characteristics of various electronic devices like diodes and transistors (BJTs and FETs).
3. To Analyze the low frequency response of BJT and FET and to understand different transistor Biasing circuits.
4. To differentiate between various feedback Amplifiers.

UNIT 1: (~10 Lecture Hours)

P-N Junction Diode: Diode equation, Volt-Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuits, Load line analysis, Diffusion and Transition Capacitances. Break down Mechanisms-Avalanche breakdown, Zener breakdown, Zener Diode as a Regulator, Tunneling Phenomenon.

Rectifiers: P-N junction as a rectifier - Half Wave Rectifier, Ripple Factor, Full Wave Rectifier, Bridge Rectifier. Rectifiers with Inductive, Capacitive, L and Π filters.

UNIT 2: (~10 Lecture Hours)

Bipolar Junction Transistor (BJT): Construction, Principle of Operation, Symbol, Amplifying Action, Common Emitter, Common Base and Common Collector configurations.

Transistor Biasing and Stabilization: Operating point, DC & AC load lines, Biasing - Fixed Bias, Emitter Feedback Bias, Collector to Emitter feedback bias, Voltage divider bias, Bias stability, Stabilization against variations in V_{BE} and β.

UNIT 3: (~8 Lecture Hours)

Small Signal Low Frequency Model of BJT: BJT modelling, Hybrid model (Exact and simplified), Determination of h-parameters from transistor characteristics, Analysis of CE, CB and CC configurations using h-parameters, low frequency response of BJT Amplifiers, effect of coupling and bypass capacitors, Comparison of CE, CB and CC configurations.

UNIT 4: (~8 Lecture Hours)

Field Effect Transistors: JFET Construction and Principle of operation, Symbol, Pinch-Off Voltage, Volt- Ampere Characteristic, Small Signal Model, Biasing FET, MOSFET characteristics (Enhancement and depletion mode), Symbols of MOSFET, Comparison of BJT and FET.

UNIT 5: (~9 Lecture Hours)

Positive & Negative Feedback in Amplifiers: Introduction to feedback circuits, Concepts of feedback-

Classification of feedback amplifiers - General characteristics of negative feedback amplifiers-Effect of Feedback on Amplifier characteristics-Voltage series, Voltage shunt, Current series and Current shunt Feedback configurations-Simple problems. Barkhausen criterion, RC oscillators (phase shift, Wienbridge), LC oscillators (Hartley, Colpitts), Crystal oscillators.

Text Books:

1. J.Millman, C.C.Halkias, and SatyabrathaJit, Electronic Devices and Circuits, 2nd Edition, Tata McGraw Hill, 2007.
2. R.L. Boylestad and Louis Nashelsky, Electronic Devices and Circuits, 9th Edition, Pearson/Prentice Hall, 2006.

Reference Books:

1. G. Streetman, and S. K. Banerjee, Solid State Electronic Devices, 7th Edition, Pearson, 2014.
2. Millman, Christos Halkias, Chetan D Parikh Integrated Electronics, 2nd Edition, Tata McGraw Hill, 2011.
3. S.G.Burns and P.R.Bond, Principles of Electronic Circuits, 2nd Edition, Galgotia Publications, 1998.
4. C.T. Sah, Fundamentals of Solid State Electronics, World Scientific Publishing Co. Inc,1991.
5. T.F. Bogart Jr., J.S.Beasley and G.Rico, Electronic Devices and Circuits, 6th Edition, Pearson Education, 2004.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ee45/preview (‘Analog Electronic Circuits’ by Prof.Pradip Mandal, IIT Kharagpur)
2. https://onlinecourses.nptel.ac.in/noc21_ee80/preview (‘Semiconductor Devices and Circuits’ by Prof.Sanjiv Sambandan, IISc)

Course Outcomes (COs)

After completion of the course, students will be able to

1. Define and narrate the basic features of different semiconductor diodes, rectifiers, BJTs and FETs.
2. Explain the construction, operation and characteristics of PN junction diode, Zener diode, BJT, JFET and MOSFET and to outline the transistor biasing circuits.

3. Apply small signal low frequency model for BJT and develop CE, CB and CC configurations using h- parameters.
4. Analyze low frequency response of BJT and FET amplifiers with suitable biasing and facilitate comparison of BJT and FET models.
5. Differentiate between different types of feedback amplifiers and deduce the effects of feedback on Amplifier Characteristics.
6. To distinguish between Amplifiers and Oscillators, discuss and design different RC and LC oscillators and verify their performance characteristics.

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II Year B.Tech. ECE I-Semester	**L**	**T**	**P**	**C**
Course Code: 123AW	**3**	**1**	**0**	**4**

SIGNALS AND SYSTEMS

(Common to ECE & ETE)

Prerequisites: Linear Algebra and Multivariable Calculus.

Course Objectives:

1. To provide basics of signals and systems required for analyzing various areas related to signal processing.
2. To analyze spectral behavior of signals and systems using different transform techniques.
3. To develop mathematical skills to solve problems involving convolution.
4. To understand the importance of sampling theorem.

UNIT 1: (~9 Lecture Hours)

Classification of continuous time signals and systems: Classification of Signals– continuous & discrete, periodic & non-periodic, energy & power signals, even & odd, deterministic & random signals, causal ,non causal & anti casual signals, right sided ,left sided and two sided signals, problems ,Elementary Signals- Impulse function, Unit Step function, Signum function, rectangular pulse, triangular signal, Exponential and Sinusoidal signals, Operation on signals-Addition, Subtraction, multiplication, Amplitude scaling, Time shifting, Time scaling ,Time folding, problems Classification of continuous time systems- linear & non Linear, time-invariant & time-variant, causal & non causal, stable & unstable , dynamic & static, invertible & non invertible (problems on each category).

UNIT 2: (~9 Lecture Hours)

Fourier representation of continuous time periodic signals: Orthogonality concept, Fourier Series representation of Continuous time periodic signals, Dirichlet conditions, derivation of co-efficients of Trigonometric Fourier Series and Exponential Fourier Series, Problems, Properties of Exponential Fourier Series (with proof) –Linearity, time shifting, frequency shifting, conjugation, time reversal, time scaling, periodic convolution, multiplication, differentiation in time, integration in time,Parseval's theorem for periodic signals.

UNIT 3: (~9 Lecture Hours)

Fourier Transform for continuous time aperiodic signals: Deriving Fourier Transform from Fourier series, Fourier Transform of elementary signals, Fourier Transform of Periodic Signals, Properties of Fourier Transform(with proof)- Linearity, time shifting, frequency shifting, conjugation, time reversal, time scaling, multiplication in time, differentiation in time, differentiation in frequency, integration in time, Parseval's theorem for aperiodic signals, problems using properties of Fourier Transform.

UNIT 4: (~9 Lecture Hours)

Convolution: Continuous time LTI system – convolution integral (derivation), problems, properties of impulse response of LTI system, step response, sinusoidal response, Concept of convolution in Time domain and Frequency domain. Graphical representation of Convolution of- two finite duration signals, finite duration and infinite duration signals & two infinite duration signals, Convolution property of Fourier Transform.

Sampling: Sampling theorem - Graphical and analytical proof for Band Limited Signals, Impulse Sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing.

UNIT 5: (~9 Lecture Hours)

Laplace Transform: Representation of Signals Using Continuous Time Complex Exponential-Laplace Transform: Introduction, Laplace transform (LT), region of convergence (ROC) & properties of ROC, LT of standard signals, unilateral LT, properties of LT w.r.t to ROC(with proofs)- linearity, time scaling & shifting, S-domain shift, convolution, differentiation in time & S-domain, integrity property, initial & final value theorems). Inverse Laplace transform w.r.t ROC, solving differential equation using Laplace transform.

Text Books:

1. B.P. Lathi Signals, Systems & Communications, BS Publications, 2009
2. Simon Haykin and Van Veen, Signals & Systems, 2^{nd} edition,Wiley, 2003
3. A. V. Oppenheim, A.S. Willsky and S.H. Nawab, Signals and Systems, 2^{nd} edition, 2013, PHI.

References:

1. Michel J. Robert, Fundamentals of Signals and Systems, 2^{nd} edition, 2008, MGH International Edition.
2. B.P. Lathi, Principles of Signal Processing and Linear Systems, 1^{st} edition, 2014, Oxford University Press
3. Signals & systems ,Tarun Kumar Rawat, 1^{st} edition, 2010, Oxford university press.
4. Ashok Ambardar, Analog and Digital Signal Processing 2^{nd} Edition, 2001, Brooks/ Cole Publishing Company (An international Thomson Publishing Company).

Online Resources:

1. Signals and Systems,Prof. Dennis Freeman,Massachusetts Institute of Technology https://ocw.mit.edu/courses/6- 003-signals-and-systems-fall-2011/video_galleries/lecture-videos/

2. Principles of Signals and Systems,Prof.Aditya K.Jagannatham,IIT Kanpur https://www.digimat.in/nptel/ courses/video/108104100/L01.html

Course Outcomes (COs)

After the completion of the course students will be able:

1. To define the basic concepts of signals and describe the classification of continuous signals and systems
2. To outline and express the spectral characteristics of continuous time signals using Fourier series representation and Fourier transform techniques.
3. To apply the contents of convolution in time domain, frequency domain and construct the graphical representation of convolution of two different signals to interpret the response of an LTI system.
4. To establish sampling theorem for band limited signals, distinguishing between different types of samplings and examine the signal reconstruction.
5. To explain the need for Laplace Transformation, evaluate the Laplace Transform and Inverse Laplace Transform of different types of signals assessing Region of Convergence and apply the Laplace Transform techniques to engineering problems.

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II Year B.Tech. ECE I-Semester **L T P C**

Course Code: 123AT **3 0 0 3**

NETWORK THEORY AND ANALYSIS

(Common to ECE & ETE)

Prerequisites: Basic Electrical Engineering.

Course Objectives:

1. To Analyze the given network using Theorems, Transient, Laplace transform and Network topology.
2. To Distinguish between Series and Parallel resonance.
3. To Classify a given network in terms of different two port network parameters.
4. To Design different Passive filters and resistance attenuators.

UNIT 1: (~10 Lecture Hours)

Review of DC Network basics, Nodal and Mesh Analysis.

Network Topology: Terminology, Cut-set and Tie-set matrices for Planar Networks with DC sources, related definitions and problems, Source Transformation and Duality.

Network Theorems: Thevenin's, Norton's, Maximum Power Transfer, Superposition, Tellegan's, Reciprocity, Millers, Millman's and Compensation theorems with DC and AC excitations.

UNIT 2: (~9 Lecture Hours)

Transient analysis: RC, RL and RLC series and parallel Circuits with DC, step, impulse, ramp, exponential and AC response using Time Domain and Laplace transform methods.

UNIT 3: (~10 Lecture Hours)

Two port networks: Z, Y, h, g, ABCD and inverse ABCD parameters, Relationship among all the parameters, interconnection of 2 two port networks and problems.

Network function: Driving point and transfer functions and their properties and problems.

UNIT 4: (~8 Lecture Hours)

Resonance: Series resonance, parallel resonance circuits, resonance frequency, impedance variation, current variation, voltage variations, bandwidth and Q factor.

UNIT 5: (~8 Lecture Hours)

Filters: Image impedance, iterative impedance of T, p, L Sections, Characteristic impedance, Image transfer constants, Filter fundamentals, design of LP, HP and BP Filters using constant-k, m derived and composite filters, Attenuators.

Text Books:

1. Van Valkenburg, Network Analysis, 3rd Edition, Prentice Hall of India, 2000.
2. A. Sudhakar and Shyammohan S.Palli, Circuits & Networks, 3rd Edition, Tata Mc Graw- Hill company, 2006.
3. William Hayt and Jack E. Kemmerly, Engineering Circuit Analysis, 8th Edition, Tata Mc Graw Hill Company, 2013.

Reference Books:

1. J.D.Ryder, "Networks, Lines and Fields" 2nd Edition, PHI, 1999.
2. Charles K Alexander and Mathew N O Sadiku, "Fundamentals of electric circuits", Mc Graw Hill Company, 2013.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ee64/preview ('Basic Electrical Circuits': by Prof. Nagendra Krishnapura, IIT Madras)
2. https://onlinecourses.nptel.ac.in/noc21_ee14/preview ('Network Analysis': by Prof. Tapas Kumar Bhattacharya, IIT Kharagpur)

Course Outcomes (COs)

After completion of the course students will be able to

1. Label the network topology parameters, define the network theorems, source transformations and duality features.
2. Illustrate the features of RC/RL/RLC series and parallel circuits and outline their transient responses using time domain and Laplace transform methods.
3. Model two port networks using Z/Y/h/g/ABCD parameters and network functions and develop the relationship between different two port network parameters.
4. Differentiate and distinguish between series and parallel resonant circuits and examine their response characteristics.
5. Define, differentiate and estimate the image/iterative/characteristic impedance of T/p/L section networks and explain their significance for filter circuits.
6. Study the filter fundamentals, design LP/HP/BP filters using Constant K, m-derived and composite filters, discuss their response characteristics and construct different types of resistance attenuators.

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II Year B.Tech. ECE I-Semester **L T P C**

Course Code: 12311 **0 0 3 1.5**

BASIC SIMULATION LAB

(Common to ECE & ETE)

Prerequisites:- Nil

Course Objectives:

1. To introduce MATLAB software.
2. To demonstrate the concepts learnt in Signals and Systems in MATLAB software
3. To enable students use graphical programming environment for modeling, simulating and analyzing few concepts of signals and systems using MATLAB software.
4. To prepare students on how to make use of MATLAB software for various Engineering problems.

List of Experiments:

1. Basic operations on matrices.
2. Generation of various signals (Periodic and Aperiodic), such as unit impulse, unit step, square, saw tooth, triangular, sinusoidal, ramp, sinc.
3. Operations on signals such as addition, multiplication, scaling, shifting, folding, computation of energy and average power.
4. Finding the even and odd parts of signals and real and imaginary parts of signals.
5. Convolution for signals.
6. Verification of linearity and time invariance properties of a given continuous time system.
7. Computation of unit sample, unit step and sinusoidal responses of the given LTI system and verifying its physical realizability and stability properties.
8. Gibbs phenomenon simulation.
9. Finding the Fourier transform of all elementary signals and plotting their respective magnitude and phase spectrums.
10. Finding the Inverse Fourier Transform of a given X(f) signal.
11. Finding the trigonometric and exponential Fourier series coefficients of a periodic rectangular signal and plotting the discrete spectrum of the signal
12. Finding the frequency response of LTI system given in differential equation/ transfer function form
13. Computing Laplace Transform of all elementary signals

14. Computing Inverse Laplace Transform of a given X(S) signal
15. Waveform synthesis using Laplace transforms.
16. Locating the zeroes and poles and plotting the pole-zero maps in S- plane for the given transfer function.
17. Sampling theorem verification.

Note:

1. Minimum 12 experiments should be conducted. All these experiments are to be simulated using MATLAB.
2. Experiment numbers 3, 5, 6, 12 are also to be simulated using Simulink.

Online Resources:

1. https://ocw.mit.edu/courses/6-003-signals-and-systems-fall-2011/video_galleries/lecture-videos/
2. https://www.digimat.in/nptel/courses/video/108104100/L01.html

Course Outcomes (COs)

After completion of the course, students will be able to

1. To narrate the basic features of MATLAB software as applicable to generation of elementary signals and simulation of the mathematical operations
2. To demonstrate the convolution of signals in time domain and to illustrate responses of LTI system to various inputs using MATLAB simulations
3. To develop MATLAB codes for computing Fourier series, Fourier transforms to estimate the signal spectral characteristics.
4. To categorize MATLAB codes for computation of Laplace transform and Inverse Laplace transforms of given signals and examine the pole-zero plots.
5. To construct MATLAB simulations for verification of Gibb's phenomenon and Sampling theorem.
6. To build relevant simulation codes, with and without usage of built in functions and estimate the numerical results with supporting plots.

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II Year B.Tech.ECE I-Semester **L T P C**

Course Code: 12317 **0 0 2 1**

PYTHON PROGRAMMING LAB

(Common to ECE,CSE, IT, CST, CSE (AI&ML) & CSE(DS))

Prerequisites: Programming for Problem Solving.

Course Objectives:

1. Describe the core syntax and semantics of Python programming language.
2. Learn the fundamental sequence types like lists, dictionaries, tuples, sets.
3. Handle files and modules in python.
4. Learn how to write string, Exception Handling programs in python.

List of Experiments:

Week 1:

a) Write a program to demonstrate different number data types in Python.

b) Write a program to illustrate various types of operations in Python.

Week 2:

a) Write a Python program to find largest of three numbers.

b) Write a Python program to convert temperatures to and from Celsius, Fahrenheit. [Formula: c/5 = f-32/9]

c) Write a Python program that prints prime numbers less than 20(using for-else).

d) Write a Python program to construct the following pattern, using a nested for loop.

```
1
2 2
3 3 3
4 4 4 4
5 5 5 5 5
4 4 4 4
3 3 3
2 2
1
```

e) Write a program to get the binary form of a given number.

Week 3:

a) Write a program to demonstrate various list methods in Python.

b) Write a program to get a list of even numbers from a given list of numbers. (use only list comprehensions).

Week 4:

a) Write a program to add an item in a tuple without converting into a list.

b) Write a program to count the elements in a list until an element is a tuple.

c) Write a Python program to demonstrate set operations.

Week 5:

a) Write a program to access a sub string from a given string (Use slicing)
   - Get the first 5 characters of a string.
   - Get a substring of length 4 from the 3rd character of the string.
   - Get the last 5 characters of a string.
   - Get a substring which contains all characters except the last 4 characters and the 1st character.
   - Get every other character from a string.

b) Get a string from a given string where all occurrences of its first char have been changed to '$', except the first char itself Eg: restart output: resta$t

c) Write a program to sort a dictionary by a value.

d) Write a program to display the count of individual vowels in the input string-using dictionary. (Ex: Input String: "welcome" Output: {'a':0,'e':2,'i':0,'o':1,'u':0})

Week 6:

a) Write a Python program to find N largest element from given list of integers using functions.

b) Write a Python program to find sum of elements of nested list using recursion. (Input: [9, 1, [3,4], [5,2]], Output:24)

c) Write a Python program to define a module to find Fibonacci Numbers and import the module to another program.

d) Define a module that consist of factorial and sum of individual digits of a number as functions.

e) Write a program to find ncrby importing only factorial function from the above module.

Week 7:

a) Write a program to handle exceptions using try..except..finally…else

b) Write a program to sort words in a file and put them in another file. The output file should have only lower- case words, so any upper-case words from source must be lowered. (Handle exceptions)

c) Write a program that inputs a text file. The program should print all of the unique words in the file in alphabetical order.

Week 8: Write a Python application to create basic calculator to demonstrate following GUI components.

i) Button ii) Text box iii) Text area

Week 9: Write a Python application to create basic Registration form to demonstrate following GUI components.

i) Text box ii) Button iii) Submit button

iv) Combo box v) Check button vi) Text widget

vii) Radio button viii) Scrolled Text

Week 10: Write a Python program to draw following plots

i) Bar graph. ii) Scatter plot. iii) Box plot.

Text Books

1. Wesley J. Chun, Core Python Programming, 2nd Edition, Pearson.
2. Gowrishankar S, Veena A, Introduction to Python Programming, 1st Edition, CRC Press/Taylor Francis, 2018. ISBN-13: 978-0815394372.

Reference Books:

1. Y Daniel Liang, Introduction to Programming Using Python, 1st Edition, Pearson India, 2017.

Online Resources:

1. www.w3schools.org.in
2. https://www.sgul.ac.uk/about/ourprofessionalservices/information services/library/documents/training- manuals/ExcelFundamentals-Manual.pdf
3. www.lynda.com
4. www.coursera.org

Course Outcomes(COs):

After completion of the course, students will be able to

1. Understand and Apply basic concepts of Python.
2. Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.
3. Determine the methods to create Python programs by utilizing lists, dictionaries, tuples, sets and strings.
4. Develop the proficiency in handling of files and modules.
5. Implement the concept of Exception handling using Python.
6. Utilize Python libraries for data visualization.

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II Year B.Tech. ECE I-Semester	**L**	**T**	**P**	**C**
Course Code: 12315	**0**	**0**	**3**	**1.5**

ELECTRONIC DEVICES AND CIRCUITS LAB

(Common to ECE, ETE)

Prerequisites: -Nil-

Course Objectives:

1. To familiarize with various circuit components, Display devices.
2. To understand the characteristics of various semiconductor devices.
3. To plot the frequency response of various Amplifiers.
4. To know the functionality of different oscillators.

Part A: Electronic Workshop Practice (in 3 lab sessions)

1. Identification, Specification, testing of R,L,C components (color codes), Potentiometers (SPDT, DPDT, and DIP), Coils, Gang Condensers, Relays, Bread Board, PCB's.
2. Identification, Specification, testing of Active devices: Diodes, BJT, Low power JFET's, MOSFET's, Power Transistors, LED's, LCD's, SCR, UJT.
3. Study and operation of: i. Millimeters (Analog and Digital) ii. Function Generator iii. Regulated Power Supplies iv. CRO.

Part B: (Minimum of 12 experiments to be conducted)

1. V-I characteristics of PN junction Diode under Forward and Reverse Bias.
2. V-I characteristics of Zener diode and Zener diode as voltage regulator.
3. Input and output Characteristics of a BJT in CE configuration.
4. Input and output Characteristics of a BJT in CB configuration.
5. Drain and Transfer characteristics of JFET.
6. HWR with and without filter.
7. FWR with and without filter.
8. Transistor as a Switch.
9. BJT Biasing circuits (Calculation of Operating point).
10. Frequency response of CE Amplifier.
11. Frequency response of CC Amplifier.
12. Frequency response of JFET CS Amplifier.
13. RC phase shift and Hartley Oscillator.
14. Voltage Series Feedback Amplifier.
15. Current Shunt Feedback Amplifier.

Online Resources :

https://circuitdigest.com/electronic-circuits https://www.elprocus.com/simple-electronic-circuits-for-beginners/

Course Outcomes (COs)

After completion of the course, students will be able to

1. Illustrate the utility of various semiconductor devices, passive elements, basic measuring instruments and label the parameters to be estimated.
2. Identify specifications, choice of semiconductor device and equipment required and demonstrate their V-I characteristics.
3. Construct different types of rectifier circuits and estimate their performance characteristics with and without filters.
4. Test and examine BJT and FET amplifier circuits and analyze their frequency response characteristics.
5. Configure BJT amplifier with and without feedback and access their performance characteristics.
6. Design, develop and test RC and LC oscillators and estimate their Circuit Characteristics.

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II Year B.Tech. ECE I-Semester **L T P C**
Course Code: 12312 **2 0 0 0**

CONSTITUTION OF INDIA
(Mandatory Course)

Prerequisites: NIL

Course Objectives:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To realise the significance of constitution of India from all walks of life and to understand the basic concepts of Indian constitution.

UNIT 1: (~8 Lecture Hours)

HISTORY OF MAKING OF THE INDIAN CONSTITUTION & PHILOSOPHY OF THE INDIAN CONSTITUTION HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee (Composition & Working) **Philosophy of the Indian Constitution**: Preamble, Salient Features.

UNIT 2: (~6 Lecture Hours)

CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights - Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies; Directive Principles of State Policy, Fundamental Duties.

UNIT 3: (~6 Lecture Hours)

ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions- Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT 4: (~6 Lecture Hours)

LOCAL ADMINISTRATION

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayati Raj : Introduction, PRI : ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Position and role, Block Level : Organizational Hierarchy (Different departments), Village level : Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT 5: (~6 Lecture Hours)

ELECTION COMMISSION

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Book:

The Constitution of India, 1950 (Bare Act), Government Publication.

Reference Books:

1. Dr.S.N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st edition, 2015.
2. M.P. Jain, Indian Constitution Law, 7th Edition, Lexis Nexis, 2014.

Online Resources:

1. https://nptel.ac.in/courses/129106003 [Constitutional Studies by Prof. Sudhir Krishna Swami, IIT Madras]
2. https://onlinecourses.swayam2.ac.in/cec20_hs38/preview [Indian Government and Politics by Dr.Aijaz Ashraf Wani, University of Kashmir, Srinagar]

Course Outcomes (COs):

After learning the contents of this course, the students will be able to

1. Tell about function of Indian constitution with clarity and understanding.
2. Identify the Rights of equality, the Right of freedom and the Right to constitutional remedies
3. Mark the knowledge of union government & their powers and function.
4. Define the state and central policies, fundamental duties
5. Explain the powers and functions of Municipalities, Panchayats and Co-operative Societies
6. Discuss the Electoral Process, special provisions

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II Year B.Tech. ECE II-Semester **L T P C**
Course Code: 124BN **3 0 0 3**

PROBABILITY THEORY AND STOCHASTIC PROCESSES

(Common to ECE, ETE)

Prerequisites: -

Course Objectives:

1. To introduce a basic methodology of randomness in nature and a general overview of statistical methods, probability theory, and random variables
2. To deal with multiple random variables.
3. To analyse random processes and obtain statistical characteristics of the response of LTI system.
4. To study spectral characteristics of the response of the LTI system.

UNIT 1 : (~ 09 lectures)

Probability: Probability introduced through sets and relative frequency – experiments and sample spaces, discrete and continuous sample spaces, events, probability definitions and axioms, mathematical model of experiments, Probability as a relative frequency, joint and conditional probabilities, total probability, Baye's theorem, independent events.

Random Variable: Definition of a random variable, conditions for a function to be a random variable, discrete, continuous and mixed random variables.

UNIT 2 : (~10 lectures)

Distribution & Density Functions of Random Variable: Distribution function, density function, The Gaussian random variable, other distribution and density examples, conditional distribution and density functions.

Operation on One Random Variable – Expectations: Introduction, expectation – expected value of a random variable, expected value of function of a random variable, moments, Chebychev's inequality, Markov's inequality, Chernoff's bound, functions that give moments – characteristic function, moment generating function, Transformations of a random variable.

UNIT 3 : (~11 lectures)

Multiple Random Variables: Vector random variables, joint distribution and its properties, joint density function and its properties, conditional distribution, and density – Point conditioning, conditional distribution and density - Interval conditioning, statistical independence.

Operations on Multiple Random Variables: Expected value of a function of random variables, joint moments about origin, joint central moments, joint characteristic functions, jointly Gaussian random variables, transformations of multiple random variables, linear transformations of Gaussian random variables, Law of large numbers (statement), distribution and density of sum of random variables, Central limit theorem (statement)- equal distributions, unequal distributions, problems on central limit theorem.

UNIT 4 : (~08 lectures)

Stochastic Processes – Temporal Characteristics: The stochastic process concept, stationarity and independence – distribution and density functions, statistical independence, first-order stationary processes, second-order and wide-sense stationarity, Nth order and strict-sense stationarity, time averages and ergodicity – mean-ergodic processes (Proof not expected), correlation-ergodic processes (Proof not expected), correlation functions, Gaussian random processes, Poisson random process, random signal response of linear system.

UNIT 5 : (~07 lectures)

Stochastic Processes – Spectral Characteristics: Power density spectrum and its properties, relationship between power spectrum and autocorrelation function, cross-power density spectrum and its properties, relationship between cross-power density spectrum and cross-correlation function, spectral characteristics of system response.

Text Books:

1. Peyton Z. Peebles, “Probability, Random Variables & Random Signal Principles”, 4th Edition, TMH, 2010.
2. Athanasios Papoulis and S. Unnikrishna Pillai, “Probability, Random Variables and Stochastic Processes” 4th Edition, TMH, 2011.

Reference Books:

1. Mallikarjuna Reddy, “Probability Theory and Stochastic Processes”, 4th Edition, Cengage Learning, 2013.
2. “Schaum’s outline of Theory and Problems of Analog and Digital Communications” - Schaum’s Outline Series, 2nd Edition, McGraw-Hill, 2004.
3. Henry Stark and John W. Woods, “Probability and Random Processes with Application to Signal Processing”, 4th Edition, Pearson Education, 2012.

Online Resources:

1. http://nptel.ac.in/courses/117105085/ (Probability and Random Processes- by Prof Mrityunjoy Chakraborty, IIT Kharagpur)
2. https://nptel.ac.in/courses/111102111(Introduction to Probability Theory and Stochastic Processes- by Dr.S.Dharamraja, IIT Delhi)

Course Outcomes (COs)

After completion of the course, students will be able to

1. Define probability through axioms and relative frequency, random variables, and random processes.
2. Identify probabilistic models and functions of random variables using single and multiple random variables, and describe the significance of various inequalities and bounds.
3. Calculate moments, and characteristic functions for single and multi-random variables.
4. Analyse the temporal and spectral characteristics of random processes.
5. Evaluate the characteristics of response of LTI system with respect to the input applied to the system.

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II Year B.Tech. ECE II-Semester **L T P C**
Course Code: 124BJ **3 0 0 3**

ELECTROMAGNETIC THEORY AND TRANSMISSION LINES

Prerequisites: -Nil-

Course Objectives:

This is a structured foundation course, dealing with concepts, formulations and applications of Electromagnetic Theory and Transmission Lines, and is the basic primer for all electronic communication engineering subjects. The main objectives of the course are

1. To learn the Basic Laws, Concepts and proofs related to Electrostatic Fields and Magnetostatic Fields, and apply them to solve physics and engineering problems.
2. To distinguish between static and time-varying fields, and understand the significance and utility of Maxwell's Equations and Boundary Conditions, and gain ability to provide solutions to communication engineering problems.
3. To analyze the characteristics of Uniform Plane Waves (UPW), determine their propagation parameters and estimate the same for dielectric and dissipative media.
4. To conceptually understand the phenomena of reflection and refraction at different boundary surfaces.
5. To determine the basic Transmission Line Equations and telephone line parameters and estimate the distortions present.
6. To understand the concepts of RF Lines and their characteristics, Smith Chart and its applications, acquire knowledge to configure circuit elements, QWTs and HWTs, and to apply the same for practical problems.

UNIT 1: (~12 lecture hours)

Electrostatics: Review of Co-ordinate systems & Vector Algebra, Coulomb's Law, Electric Field Intensity - Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential, Relations Between E and V, Maxwell's Two Equations for Electrostatic Fields, Energy Density, Illustrative Problems. Convection and Conduction Currents, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations; Capacitance -Parallel Plate, Coaxial, Spherical Capacitors, Illustrative Problems.

UNIT 2: (~10 lecture hours)

Magnetostatics: Biot-Savart's Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magnetostatic Fields, Vector Potentials, Illustrative Problems, Introduction to Ampere's Force Law.

Maxwell's Equations (Time Varying Fields): Faraday's Law and Transformer EMF, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Final Forms and Word Statements, Conditions at a Boundary Surface : Dielectric- Dielectric and Dielectric-Conductor Interfaces, Illustrative Problems.

UNIT 3: (~10 lecture hours)

EM Wave Characteristics-I: Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves-Definition, All Relations Between E &H, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics-Characterization, Wave Propagation in Good Conductors and Good Dielectrics, Polarization, Illustrative Problems.

EM Wave Characteristics-II: Reflection and Refraction of Plane Waves – Normal Incidence for both Perfect Conductor and Perfect Dielectrics, Qualitative understanding of Oblique incidence with final expressions (no derivations) Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Poynting Vector and Poynting Theorem – Applications, Illustrative Problems.

UNIT4: (~7 lecture hours)

Transmission Lines-I: Types, Parameters, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts, Losslessness /Low Loss Characterization, Distortion – Condition for Distortionlessness and Minimum Attenuation, Illustrative Problems.

UNIT 5: (~7 lecture hours)

Transmission Lines-II: Input Impedance Relations, SC and OC Lines, Reflection Coefficient, VSWR. UHF Lines as Circuit Elements; $\lambda/4$, $\lambda/2$, $\lambda/8$ Lines-Impedance Transformations, Significance of Zmin and Zmax, Smith Chart-Configuration and Applications, Single Stub Matching, Illustrative Problems.

Text Books:

1. Matthew N.O. Sadiku and, S.V. Kulkarni-Principles of Electromagnetics, Oxford University Press, 6th Edition, Aisan Edition, 2015.
2. E.C. Jordan and K.G. Balmain, Electromagnetic Waves and Radiating Systems, 2nd Edition, PHI, 2000.

Reference Books:

1. William H. Hayt Jr. and John A. Buck -Engineering Electromagnetics, 7th Edition, McGraw Hill Education, 2006.
2. Nathan Ida, Engineering Electromagnetics, 2nd Edition, Springer (India) Pvt. Ltd., New Delhi, 2005.

Online Resources:

1. https://nptel.ac.in/courses/117101056
   (Course Title : Transmission Lines and EM Waves, by Prof. R.K.Shevgaonkar (IITB))
2. https://onlinecourses.nptel.ac.in/noc16_ph03
   (Course Title : Introduction to Electromagnetic Theory by Dr. Manoj Kumar Harbola (IITK))
3. https://onlinecourses.nptel.ac.in/noc21_ee83
   (Course Title : Electromagnetic Theory by Prof. Pradeep Kumar (IITK))
4. https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ee82/
   (Course Title : Applied Eletromagnetics for Engineers by Prof. Pradeep Kumar (IITK))

Course Outcomes (COs)

After completion of the course, students will be able to

1. Student will be able to Define and narrate the basic concepts of electrostatic fields and relate the corresponding Maxwell's equations.
2. Students will be able to Explain Maxwell's two equations for magnetostatic fields and outline magnetic vector potential concepts.
3. Students will be able to Develop the Maxwell's equations for time varying fields, and apply them to build the boundary conditions.
4. Students will be able to Define a Uniform Plane Wave (UPW), derive the wave equations and establish the wave propagation characteristics in different media, categorizing the phenomena of reflection and refraction at different boundaries.
5. Students will be able to Deduce the transmission line equations, evaluate the line parameters and assess losslessness and distortionlessness.
6. Students will be able to Compile the transmission characteristics for RF lines, configuring the impedance transformations using QWT design and single stub matching with and without Smith charts.

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II Year B.Tech. ECE II-Semester **L T P C**
Course Code: 124AZ **3 0 0 3**

ANALOG CIRCUITS

(Common to ECE, ETE)

Prerequisite: 1. Electronic Devices and Circuits 2. Network Theory

Course Objectives:

1. To familiarize with different types of Power Amplifiers, Wave shaping circuits and Multivibrators.
2. To understand the working of Op-amp and its applications.
3. To know the functionality of ADC and DAC circuits
4. To distinguish between various modes of 555 Timer.

UNIT 1: (~10 Lecture Hours)

Multistage Amplifiers: Different coupling schemes used in amplifiers, Analysis of two stage RC Coupled Amplifier, Darlington pair and Bootstrap Darlington pair.

Power amplifiers: Classification of Amplifiers – Distortion in amplifiers, Various classes of operation (Class A, B), Class A Power Amplifier, Maximum Efficiency of Class A Amplifier, Transformer Coupled Class A Amplifier, Push- Pull and Complimentary Symmetry Class B, Concept of Tuned Amplifier and its applications.

UNIT 2:(~10 Lecture Hours)

Linear Wave Shaping: High pass and low pass RC circuits and their response for Sinusoidal, Step, Pulse, Square, & Ramp inputs, High pass RC network as Differentiator, Low pass RC circuit as an Integrator.

Non-Linear Wave Shaping: Diode clippers, Clipping at two independent levels, Positive and Negative Clampers, Clamping circuit theorem.

UNIT 3:(~8 Lecture Hours)

Multivibrators: Analysis and Design of Bistable Multivibrator, Commutating Capacitors, Types of Triggering, Collector coupled Monostable and Astable Multivibrators, Schmitt trigger using Transistors.

UNIT 4: (~8 Lecture Hours)

Operational Amplifier:

Ideal and Practical Op-Amp, Op-Amp Characteristics, DC and AC Characteristics, Features of 741 Op-Amp, Modes of Operation - Inverting, Non-Inverting, Applications of Op-Amp - Differential Amplifier, Logarithmic amplifier, Differentiator and Integrator, Summing Amplifier, Precision Rectifier.

UNIT 5: (~9 Lecture Hours)

IC 555Timer: Functional Diagram, Monostable and Astable Operations, Applications, **IC565 PLL**- Block Schematic & Applications, **Digital-to-Analog converters (DAC)-**Weighted Resistor, R-2R ladder, **Analog-to-Digital converters (ADC)-**Dual slope, Successive approximation, Flash.

Text Books :

1. J. Millman, H. Taub and Mothiki S. Prakash Rao, "Pulse, Digital and Switching Waveforms", 2^{nd} Edition, McGraw Hill, 2008.
2. J.Millman and Christos C Halkias , "Integrated Electronics", TMH 2010.
3. Ramakanth A. Gayakwad, "Op-Amps & Linear ICs", PHI, 2003.

References:

1. D. Roy Chowdhury, "Linear Integrated Circuits", 2^{nd} Edition, New Age International (p) Ltd, 2003.
2. J. Millman and A. Grabel, "Microelectronics", 2^{nd} edition, McGraw Hill, 1988.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ee45/preview ('Analog Electronic Circuits' by Prof. Pradip Mandal, IIT, Kharagpur.)
2. https://nptel.ac.in/courses/108101094 (Lectures on 'Analog Circuits' by Prof. Jayanta Mukherjee, IIT Bombay.)

Course Outcomes (COs):

After completion of the course the student should be able to

1. After completion of the course, students will be able to Identify the need for Multistage Amplifiers, different coupling schemes and estimate the amplifier parameters.
2. Compare the performance characteristics of Class A/B/C Power Amplifiers and outline their applications.
3. Construct linear and nonlinear wave shaping circuits and interpret their responses.
4. Analyze and Design different types of Multivibrators and Schmitt Trigger using transistors.
5. Illustrate the Op-amp characteristics and its linear/nonlinear applications.
6. Explain the functional schematic of IC 555, IC 565 and their applications, study the performance characteristics of different ADCs and DACs.

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II Year B.Tech. ECE II-Semester **L T P C**

Course Code: 124BE **3 0 0 3**

DIGITAL ELECTRONICS AND LOGIC DESIGN

(Common to ECE, ETE)

Course Objectives:

1. To understand common forms of number representation in digital electronic circuits and convert between different representations.
2. To design combinational logic circuits.
3. To design sequential logic circuits.
4. To impart student the concepts for analyzing digital systems in terms of state machines.

UNIT1: (~ 8 Lecture Hours)

Number Systems: Review of number systems, Complements of Numbers, Codes - Binary Codes, Binary Coded Decimal Code and its Properties.

Boolean Algebra and Switching Functions: Basic Theorems and Properties, Switching Functions, Canonical and Standard Form, Algebraic Simplification of Digital Logic Gates, Universal Gates, Multilevel NAND/NOR realizations.

UNIT 2: (~11 Lecture Hours)

Minimization of Combinational Circuits: Introduction, The Karnaugh Map Method-Up to Five Variable Maps, Don't Care Map Entries, Tabular Method.

Design of Combinational Logic: Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Carry Look Ahead Adder, Comparators, Multiplexers, Demultiplexers, Decoders, Encoders and Code Converters, BCD to Seven Segment Decoder, PLD's: PROM, PLA, PAL, Realization of circuits using PLD's.

UNIT 3: (~11 Lecture Hours)

Sequential Machines Fundamentals: Basic Architectural Distinctions between Combinational and Sequential Circuits, Latches: SR, JK, Race Around Condition in JK, Flip Flops: JK Master Slave, D and T Type Flip Flops, Excitation Table of all Flip Flops, Design of a Clocked Flip-Flop, Timing and Triggering Consideration, Clock Skew, Conversion from one type of Flip-Flop to another.

UNIT 4: (~7 Lecture Hours)

Registers and Counters: Shift Registers, Shift Register Configuration, Bidirectional Shift Registers, Applications of Shift Registers, Design and Operation of Ring and Twisted Ring Counter, Asynchronous and Synchronous Counters, mod-n Counters.

UNIT 5: (~9 Lecture Hours)

Finite State Machines: State Diagrams, Mealy and Moore Models, Finite State Machines – Capabilities, Limitations, Minimization of Completely and Incompletely Specified FSMs.

Logic Families: Introduction, Characteristics of Digital ICs, Transistor Transistor Logic, Emitter Coupled Logic, MOS Logic, CMOS Logic.

Text Books:

1. Morris Mano, "Digital Design", Pearson, 5th Edition, 2012.
2. R.P. Jain, "Modern Digital Electronics", Tata McGraw Hill, 4th Edition, 2009.
3. Zvi Kohavi & Niraj K. Jha, "Switching and Finite Automata Theory", Cambridge University Press, 3rd Edition, 2009.

Reference Books:

1. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill, 2nd Edition, 2012.
2. W. H. Gothmann, "Digital Electronics- An Introduction to Theory and Practice", PHI, 2nd Edition, 2006.
3. A. Anand Kumar, "Switching Theory and Logic Design", PHI, 3rd Edition, 2013.

Online Resources:

1. https://www.youtube.com/watch?v=CeD2L6KbtVM&list=PL803563859BF7ED8C - Digital Circuits & Systems by Prof. S. Srinivasan, Department of Electrical Engineering, IIT Madras
2. https://onlinecourses.nptel.ac.in/noc20_cs67/preview - Switching Circuits and Logic Design by Prof Indranil Sengupta, Department of Computer Science and Engineering, IIT Kharagpur

Course Outcomes (COs)

After completion of the course the student will be able to

1. Recall fundamental concepts and techniques involved in the design of digital circuits.
2. Comprehend the concepts required to design basic combinational and sequential circuits.
3. Demonstrate building of various designs using basic digital blocks.
4. Design complex digital systems using simpler digital subsystems.
5. Verify the digital designs for required functionality.
6. Provide solutions for various requirement specifications in the form of digital designs.

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II Year B.Tech. ECE II -Semester **L T P C**
Course Code: 124BC **3 0 0 3**

CONTROL SYSTEMS ENGINEERING

(Common to ECE, ETE)

Prerequisites: Ordinary Differential Equations & Laplace Transform, Linear Algebra, Mathematics I

Course Objectives:

1. To understand the different ways of system representations such as Transfer function representation and state space representations and to assess the system dynamic response.
2. To assess the performance of linear control systems using time domain analysis and methods for improving it.
3. To assess the performance of linear control systems using frequency domain analysis and techniques for improving the performance.
4. To design various compensators to improve system performance.

UNIT 1: (~10 Lecture hours)

Introduction: Introduction, time variant, time invariant open loop and closed loop Control System. Development of Block diagrams and Transfer Function of physical/Mechanical and Electrical systems. Feedback elements of closed loop Control Systems: DC and AC Servo motors, Synchro's, Tachometer. Block diagram reduction, signal flow graphs, Mason's gain formula, numerical problems.

UNIT 2: (~8 Lecture hours)

Time Domain Analysis: Unit step, ramp and impulse signals, Steady state error using error constants, step and ramp response of first order and second order systems, time domain specifications, derivations, problems, P, PD, PI, PID controllers with derivations.

UNIT 3: (~9 Lecture hours)

Stability Analysis: Concept of stability, Absolute stability, Conditional stability, Relative stability, Limited stability, Routh Hurwitz criterion, Problems.

Root Locus: Construction of Root locus, Effect of addition of poles and zeros in transfer function on stability.

UNIT 4: (~10 Lecture hours)

Nyquist, Bode plots and compensators: Frequency domain specifications, Bode plot, finding frequency domain specifications from plot, Effect of gain K, frequency domain specifications with the help of Bode plot. Nyquist plot of different systems including systems with dead time, Performance specifications like ùc, ùg Gain margin, Phase margin.

Compensators: Lead, Lag compensators, Lead-Lag compensators. Design of system using compensators.

UNIT 5: (~8 Lecture hours)

State Variable Analysis: Concept of state, State Equations, State Transition matrix, State Transition Equation, Transfer Function from differential equations and state equations, State equations from differential equations, State models, Controllability, Observability.

Digital Control Systems Digital control, advantages and disadvantages, and digital control system architecture. The discrete transfer function.

Text Books:

1. B.C. Kuo, Automatic Control Systems, 10^{th} edition, John Wiley and sons, 2017.
2. I.J. Nagrath and M. Gopal, Control Systems Engineering, 6^{th} edition, New Age International (P) Limited, Publishers, 2018.

Reference Books:

1. Katsuhiko Ogata, Modern Control Engineering, 5^{th} edition, Prentice Hall of India Pvt.Ltd., 2010.
2. M. Gopal, Control Systems Principles and Design, 4^{th} edition, Tata McGraw-Hill, 2012.
3. A.Nagoorkani, Control Systems, 3^{rd} Edition, RBA Publications, 2017.
4. A K. Jairath, Solutions and Problems of Control Systems, 7^{th} edition, CBS publications and distributors, 2021.
5. Gopal, Madan, "Digital Control Engineering," 1/e, New Age Publishers, 2008.

Online Resources:

1. Control Engineering, Dr. Rama Krishna Pasumarthy, Associate Professor, IIT Madras. https://nptel.ac.in/ courses/108106098/
2. Control Engineering, Prof.S.D.Agashe, Professor, IIT Bombay. https:// www.digimat.in/nptel/courses/video/ 108101037/L01.html

Course Outcomes (COs):

After completion of the course the student will be able

1. To narrate the basic features of Open Loop and Closed Loop control systems, illustrate the physical and electrical systems and formulate their transfer function
2. To categorize first order and second order systems and examine their time domain responses for different inputs and analyze the transfer

function of proportional (P), proportional plus derivative (PD), proportional plus integral (PI), proportional plus derivative plus integral controllers (PID)

3. To define the concept of stability and analyze the system stability using RH criteria and Root Locus technique
4. To assess the stability in frequency domain using Bode, Nyquist plots and develop compensators to meet given frequency domain specifications.
5. To define the basic concepts of state variable analysis, derive state equations and establish transfer functions for a given system and discuss their controllability and observability. To define the basics of Digital control system and its Transfer function.

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II Year B.Tech. ECE II-Semester **L T P C**
Course Code: 12418 **0 0 3 1.5**

ANALOG CIRCUITS LAB

(Common to ECE, ETE)

Prerequisites: -Nil-

Course Objectives:

1. To design, simulate various non-linear wave shaping circuits, multivibrators.
2. To verify practically different applications of Op-Amp.
3. To familiarize with the operation of DACs.
4. To know the functionality of 555 timer in different modes.

Minimum Twelve experiments to be conducted List of Experiments:

1. Design, develop and Testing of a Two Stage RC Coupled Amplifier.
2. Design, develop and Testing of a Non-linear wave shaping circuits
   a) Clippers b) Clampers
3. Design, develop and Testing of a Bi-stable Multivibrator.
4. Design, develop and Testing of a Monostable Multivibrator.
5. Design, develop and Testing of a Astable Multivibrator.
6. Design, develop and Testing of a Schmitt Trigger.
7. Design an Adder, Subtractor using Op-amp 741.
8. Design an Integrator and Differentiator using Op-amp 741.
9. Design an Inverting Amplifier and Non-Inverting Amplifier using Op-amp 741.
10. Design an R-2R ladder DAC.
11. Design a Weighted Resistor DAC.
12. Design a Monostable Multivibrator using 555 Timer.
13. Design an Astable Multivibrator using 555 Timer.

Note:

1. Any 3 Experiments from 1 to 6 Experiments to be implemented using Simulation (Multisim or equivalent) and 1 to 6 Experiments to be implemented using Hardware realization.
2. Experiments 7 to 13 to be implemented using Design and Hardware realization.
3. Minimum 12 out of 13 to be carried out.

Online Resources: https://onlinecourses.nptel.ac.in/noc18_ee11/preview

Course Outcomes (COs)

After completion of the course the student should be able to

1. Demonstrate the frequency response characteristic of a two stage RC coupled amplifier.
2. Build different non-linear wave shaping circuits and outline their responses.
3. Design, develop and test Multivibrators using transistors and IC 555 timer in Monostable, Astable modes.
4. Construct, develop and demonstrate linear/non-linear applications of IC741 Op-amp.
5. Develop different types of DAC circuits and illustrate their functionality.
6. Design and analyze analog circuits that uses IC741/IC555 for different electronic applications.

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II Year B.Tech. ECE II -Semester **L T P C**

Course Code: 12419 **0 0 3 1.5**

DIGITAL ELECTRONICS AND LOGIC DESIGN LAB

(Common to ECE, ETE)

Prerequisites: -Nil-

Course Objectives:

1. To realize and design combinational circuits.
2. To build sequential circuits.
3. To analyze the functionality of digital systems.

List of Experiments:

1. Design a 450 KHz clock using NAND / NOR gates.
2. Realize and design a 16 x 4 priority encoder using two 8 x 3 priority encoder.
3. Realize and design a 16-bit comparator using 4-bit comparators.
4. Realize and design a 16 x 1 multiplexer using 8 x 1 multiplexer.
5. Realize and design a 16-bit adder / subtractor using 4-bit adder / subtractor IC's
6. Realize and design 4 bit gray to binary and binary to gray code converters.
7. Plot the transfer characteristics of 74H, LS, HS series IC's.
8. Realize and design a modulo-53 counter using two decade counters.
9. Realize and design a 4-bit pseudo random sequence generator using 4-bit ring counter.
10. Realize and design a two digit 7-segment display unit. Display a Mod-53 counter output on the 7-segment display.
11. Realize and design an 8-bit parallel load and serial out shift register using two 4-bit shift register.
12. Realize and design an 8-bit serial in and serial out shift register using two 4-bit shift register.
13. Realize and design a ring counter and twisted ring counter using a 4-bit shift register
14. Realize and design a 4-digit hex counter using synchronous one digit hex counters.
15. Realize and design a 4-digit hex counter using asynchronous one digit hex counters.
16. Hobby Project

Note: Minimum of 12 experiments to be conducted.

Text Books:

1. Morris Mano, “Digital Design”, Pearson, 5^{th} Edition, 2012.
2. R.P. Jain, “Modern Digital Electronics”, Tata McGraw Hill, 4^{th} Edition, 2009.

Reference Books:

1. Charles Roth, “Digital System Design using VHDL”, Tata McGraw Hill, 2^{nd} Edition, 2012.
2. W. H. Gothmann, “Digital Electronics- An Introduction to Theory and Practice”, PHI, 2^{nd} Edition, 2006.
3. A. Anand Kumar, “Switching Theory and Logic Design”, PHI, 3^{rd} Edition, 2013.

Online Resources:

1. https://www.youtube.com/watch?v=CeD2L6KbtVM&list=PL803563859BF7ED8C - Digital Circuits & Systems by Prof. S. Srinivasan, Department of Electrical Engineering, IIT Madras
2. https://onlinecourses.nptel.ac.in/noc20_cs67/preview - Switching Circuits and Logic Design by Prof Indranil Sengupta, Department of Computer Science and Engineering, IIT Kharagpur

Course Outcomes (COs)

After completion of the course the student should be able to

1. Recall the concepts involved in combinational and sequential circuits.
2. Demonstrate the ability to build simple digital systems.
3. Interpret the outputs of the digital blocks with the help of timing diagrams.
4. Design complex digital systems using modular approach.
6. Discuss the approach used to build and verify the circuits.

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II Year B.Tech. ECE II-Semester	L	T	P	C
Course Code: 12422	**2**	**0**	**0**	**0**

HUMAN VALUES AND PROFESSIONAL ETHICS

(Mandatory Course)

Course Objectives:

1. To instill among the Engineering professionals, the need to follow ethical principles in life.
2. To stimulate thinking and help internalize the value systems and ethical behavior.
3. To enable the students to understand the need for value based education.
4. To inculcate a sense of moral responsibility and professional ethics as Engineers.
5. To understand the impact of ethical perspectives globally.

UNIT 1: (~7 Lecture Hours)

Understanding Value Education

Basic Concepts: Moral and Morality, Ethics, Values, Principles – Thoughts of Ethics: Indian Thought versus Global Thought – Objectives of Value Education – Importance of Value Education – Personal Ethics – Professional Ethics.

UNIT 2: (~7 Lecture Hours)

Understanding the Harmony at Various Levels

Harmony in the Self – Harmony in the Family – Harmony in the Society – Harmony in the Nature – Harmony in Existence – Understanding the Interconnectedness and Mutual fulfilment – Understanding Existence as Co-existence – CASE STUDIES.

UNIT 3: (~6 Lecture Hours)

Ethical Theories

Utilitarian Ethics – Kant's Deontological Theory – Virtue Ethics – Kohlberg's Levels of Moral Development – Gilligen's Theory - CASE STUDIES.

UNIT 4: (~6 Lecture Hours)

Professional Ethics

Profession and Professionalism – Ethics in Engineering – Role of Engineers – Responsibilities of Engineers – Engineering Code of Ethics – Ethical Dilemmas – CASE STUDIES.

UNIT 5: (~6 Lecture Hours)

Global Issues and Ethical Perspectives

Business Ethics – Environment Ethics – Computer Ethics – Media Ethics – Research Ethics – Intellectual Property Rights – Social Responsibility – CASE STUDIES.

Text Books:

1. A foundation course in Human Values and Professional Ethics by RR Gaur, R.Sangal and G.P.Bargaria,Excel Books (2011).
2. Human Values and Professional Ethics by Tanu Shukla, Anupam Yadav, Gajendra Singh Chauhan, Cengage Publications (2018).

Reference Books:

1. Fundamentals of Ethics for Scientists and Engineers by Edmund G, SeeBauer, Robert L, Barry Oxford University Press (2015)
2. Professional Ethics by R.Subramanian, Oxford University Press (2013)

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_mg54/preview [Ethics in Engineering Practice by Prof.Susmita Mukhopadhyay, IIT Kharagpur]
2. https://nptel.ac.in/courses/109104068 [Exploring Human Values by Prof.A.K.Sharma, IIT Kanpur]

Course Outcomes (COs):

After completion of the course the student should be able to

1. Understand the importance of imbibing and inhering Ethics and values as an individual and professional
2. Relate the need for establishing harmony at various levels.
3. Evaluate the relevance of ethical values in their academic and professional environment.
4. Develop right understanding about oneself and the rest of reality through self-exploration.
5. Identify the basis for universal human values based on right understanding providing the vision for the holistic way of living.
6. Value oneself as professionals with professional ethics and right code of conduct and behaviour in the working environment.

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III B.Tech ECE I-Semester **L T P C**

Course Code: 125BU **3 1 0 4**

ANALOG AND DIGITAL COMMUNICATIONS

(Common to ECE & ETE)

Prerequisites: Signals and Systems.

Course Objectives:

1. To develop the ability to analyze system requirements of Analog Communication Systems.
2. To analyze the generation, detection of various Analog Modulation Techniques with mathematical analysis.
3. To analyze different types of Digital Modulation Techniques and Information theory concepts.
4. To model digital communication system for bit error rate analysis.

UNIT 1: (~10 Lecture Hours)

Amplitude Modulation: Representation of band pass signals and signal envelopes, Need for modulation, FDM, Amplitude Modulation-Time andFrequency domain, single tone modulation, power relations , Generation of AM wave with switching modulator, Detection of AM Waves using Envelope detector, DSB-SC: Time and Frequency domain, Generation of DSB-SC-Ring Modulator, Coherent detection, Hilbert transform and properties, SSB-SC: Time and Frequency domain, Generation of SSB-Frequency and Phase discrimination method, Demodulation of SSB.

UNIT 2: (~8 Lecture Hours)

Angle Modulation: Frequency Modulation: Single tone Frequency Modulation, Spectrum Analysis of Sinusoidal FM Wave, Narrow band FM,Wide band FM, Transmission bandwidth of FM Wave, Generation of FM Waves-Direct and Indirect FM, Detection of FM Waves: Foster Seeley Discriminator, Phase locked loop, Comparison of FM and AM.

Noise: Types of Noise, Modelling of noise and AWGN, Comparison of Noise performance in AM, DSBSC, SSB & FM (without derivations), Pre- emphasis and De-emphasis, Superheterodyne Receiver.

UNIT 3: (~10 Lecture Hours)

Pulse Analog Modulation: Bandpass sampling, Types of sampling process, Types of Pulse Modulation, PAM- Generation and Demodulation, PWM-Generation and Demodulation, PPM- Generation and Demodulation, TDM.

Pulse Digital Modulation: PCM, Generation and Reconstruction, Quantization Noise, DPCM, DM and Adaptive DM, Noise in PCM and DM.

UNIT 4: (~10 Lecture Hours)

Digital Carrier Modulation Schemes: Optimum Receiver for Binary Digital Modulation Schemes, Description of Binary ASK,FSK,PSK and QPSK

Schemes, Transfer Function of the matched filter, Bandwidth and Probability of Error calculations of binary ASK, FSK, PSK and QPSK (Coherent schemes), Comparison of Digital Modulation Schemes. Introduction to QAM, Signal space representation of binary- ASK, PSK, FSK, QPSK and QAM.

UNIT 5: (~8 Lecture Hours)

Concepts of Information theory: Discrete Messages and Information Content-Entropy, Information Rate, Source Coding Theorem, Source Coding-Shannon Fano Coding, Huffman Coding, Shannons Theorem, Channel Capacity-Capacity of Gaussian Channel, Bandwidth-S/N Ratio Trade off, Mutual Information and Channel Capacity.

Text Books:

1. Simon Haykin, Communication Systems, 4th Edition, John Wiley and Sons
2. K.Sam Shanmugam, Digital and Analog Communication Systems, John Wiley and Sons, 2004

Reference Books:

1. Taub H and Schilling D.L., Principles of Communication Systems, TMH, 2001
2. R.P.Singh and S.D Sapre, Communication Systems Analog and Digital, TMH, 2006.
3. Wayne Tomasi, Electronics Communications Systems: Fundamentals Through Advanced, 5th Edition, Pearson, 2004.

Online Resources:

1. Analog communications by Prof.Goutam Das, IIT Kharagpur. https://nptel.ac.in/courses/117105143/
2. Principles of Digital communications by Prof.S.N.Merchant, IITB, https://nptel.ac.in/courses/108101113/

Course Outcomes:

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

1. Analyse different modulation and demodulation schemes under Analog Communication System.
2. Describe the modulation Index, power calculations and Phasor notations of Analog Communication Schemes.
3. Analyse Signal to noise ratio and figure of merit concepts and comparisons of various Analog Communication Schemes.
4. Discuss about various modulation and demodulation schemes of Pulse Analog and Pulse Digital Communications.
5. Calculate bit error rate, Spectral efficiency of Digital Carrier Modulation techniques.
6. Analyze the concept of information theory, source coding and channel coding techniques.

III Year B.Tech ECE I-Semester **L T P C**
Course Code: 125BV **3 0 0 3**

ANTENNAS AND WAVE PROPAGATION

(Common to ECE & ETE)

Prerequisites: Electromagnetic Theory and Transmission Lines

Course Objectives:

1. To study the concept of radiation, antenna definitions and significance of antenna parameters, to derive and analyze the radiation characteristics of thin wire dipole antennas and solve numerical problems.
2. To distinguish between UHF, VHF and Microwave Antennas, their requirements, specifications, characteristics and design relations.
3. To analyze the characteristics of yagi-uda antennas, helical antennas, pyramidal horns, microstrip patch antennas and parabolic reflectors and identify the requirements to facilitate their design.
4. To identify the antenna array requirements, to determine the characteristics of ULAs and estimate the patterns of BSA, EFA, and Binomial Arrays.
5. To understand the concepts and set-up requirements for microwave measurements, and familiarize with the procedure to enable antenna measurements.
6. To distinguish between different phenomena of wave propagation (ground wave, space wave and sky wave), their frequency dependence, and estimate their characteristics, identifying their profiles and parameters involved.

UNIT 1: (~ 12 Lecture Hours)

Antenna Basics: Introduction, Basic Radiation Equation, Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective Height, Antenna Theorems, Qualitative understanding of Fields from Oscillating Dipole (no derivation) Field Zones, Radiation, Retarded Potentials.

Thin Linear Wire Antennas-Qualitative understanding Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area and Effective Height, Natural Current Distributions, Patterns of Linear Antennas of Different Lengths, Illustrative Problems. Loop Antennas - Introduction, Small Loop, Comparison of Radiation Characteristics of Small Loop and Short Dipole (Qualitative Treatment).

UNIT 2: (~ 8 Lecture Hours)

VHF, UHF and Microwave Antennas-I : Arrays with Parasitic Elements, Yagi-Uda Array, Folded Dipoles and their Characteristics, Helical Antennas

-Helical Geometry, Helix Modes, Practical Design Considerations for Mono filar Helical Antenna in Axial and Normal Modes, Horn Antennas – Types, Fermat's Principle, Optimum Horns, Design Considerations of Pyramidal Horns, Illustrative Problems.

UNIT 3: (~ 8 Lecture Hours)

VHF, UHF and Microwave Antennas-II: Microstrip Antennas – Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas-Geometry and Parameters, Feeds, Characteristics of Microstrip Antennas. Reflector Antennas-Introduction, Flat Sheet and Corner Reflectors, Paraboloidal Reflectors-Geometry, Pattern Characteristics, Feed Methods, Reflector Types-Related Features, Illustrative Problems.

UNIT 4: (~ 8 Lecture Hours)

Antenna Arrays: Point Sources-Definition, Patterns, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays-Broadside Arrays, End fire Arrays, Derivation of their Characteristics and Comparison, BSAs with Non-uniform Amplitude Distributions-General Considerations and Binomial Arrays, Illustrative Problems.

Antenna Measurements: Introduction, Concepts - Reciprocity, Near and Far Fields, Coordinate System, Sources of Errors. Patterns to be Measured, Directivity Measurement, Gain Measurements (by Comparison, Absolute and 3-Antenna Methods).

UNIT 5: (~ 9 Lecture Hours)

Wave Propagation-I: Introduction, Definitions, Categorizations and General Classifications, Different Modes of Wave Propagation, Ray/Mode Concepts, Ground Wave Propagation (Qualitative Treatment) – Introduction, Plane Earth Reflections, Space and Surface Waves, Wave Tilt, Curved Earth Reflections. Space Wave Propagation-Introduction, Field Strength Variation with Distance and Height, Effect of Earth's Curvature, Absorption, Super Refraction, M-Curves and Duct Propagation, Scattering Phenomena, Tropospheric Propagation.

Wave Propagation-II: Sky Wave Propagation – Introduction, Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF,Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multi-hop Propagation.

Text Books:

1. J.D. Kraus, R.J. Marhefka and Ahmad S. Khan-Antennas and Wave Propagation, 4th Edition (Special Indian Edition), McGraw Hill Education, New Delhi, 2010.
2. E.C. Jordan K.G. Balmain- Electromagnetic Waves and Radiating Systems, 2nd Edition, PHI, 2000.

Reference Books:

1. C.A. Balanis-Antenna Theory, 3rd Edition, John Wiley & Sons, 2005.
2. K.D. Prasad, SatyaPrakashan- Antennas and Wave Propagation, Tech India Publications, New Delhi, 2009.
3. SisirK.Das, Annapurna Das-Antenna and Wave Propagation, Tata McGraw Hill Education Private Limited, New Delhi, 2016 Reprint.

Online Resources:

1. Prof. Girish Kumar (IIT Bombay) https://nptel.ac.in/courses/108101092/

Course Outcomes:

Having gone through this course on Antenna Theory and Techniques, and Wave Propagation, the students would be able to

1. Explain the mechanism of radiation, distinguish between different antenna characteristic parameters, establish their mathematical relations, and estimate them for different practical cases. Distinguish between short dipoles, half-wave dipoles, quarter-wave monopoles and small loops, configure their current distributions, derive their far fields and radiation characteristics and sketch their patterns.
2. Characterize the antennas based on frequency, configure the geometry and establish the radiation patterns of folded dipole, YagiUda Antenna, Helical Antennas, Horn Antennas, and to acquire the knowledge of their analysis, design and development.
3. Analyze a microstrip rectangular patch antenna and a parabolic reflector antenna, identify the requirements and relevant feed structure, carry out the design and establish their patterns.
4. Specify the requirements for microwave measurements and arrange a setup to carry out the antenna far zone pattern and gain measurements in the laboratory.
5. Carry out the Linear Array Analysis, estimate the array factor and characteristics and sketch the pattern for 2-element array, N-element BSA, EFA, Binomial Arrays.
6. Classify the different wave propagation mechanisms, identify their frequency ranges, determine the characteristic features of ground wave, ionospheric wave, space wave, ductand tropospheric propagations, and estimate the parameters involved.

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III Year B. Tech. ECE I-Semester **L T P C**
Course Code: 125CY **3 1 0 4**

MICROPROCESSORS AND MICROCONTROLLERS

(Common to ECE, ETE & EEE)

Prerequisites: Digital Electronics and Logic Design

Course Objectives:

1. Describe the architecture of Microprocessor and Microcontrollers.
2. Understand and apply the fundamentals of assembly language and C programming of Microprocessors and Microcontrollers.
3. Experimenting with memory and I/O interfacing of Microcontroller.
4. Study the basic concepts of ARM Cortex-M3 architecture.

UNIT 1: (~10 Lecture Hours)

8086 Architecture: 8086 Architecture-Functional diagram, Register Organization, Memory Segmentation, Programming Model, Memory addresses, Physical Memory Organization, Architecture of 8086, Signal descriptions of 8086, Interrupts of 8086.

UNIT 2: (~8 Lecture Hours)

Instruction Set and Assembly Language Programming of 8086: Instruction formats, addressing modes, Instruction Set, Assembler Directives, Macros, and simple Programs involving Logical, Branch and Call Instructions, Sorting, String Manipulations.

UNIT 3: (~8 Lecture Hours)

Introduction to Microcontrollers: Overview of 8051 Microcontroller, Architecture, I/O Ports, Memory Organization, Addressing Modes, and Instruction set of 8051.

8051 Real Time Control: Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication, Interrupts, Programming 8051 Timers, and Counters.

UNIT 4: (~10 Lecture Hours)

I/O and Memory Interface: LCD, Keyboard, ADC, DAC Interface, External Memory RAM, ROM Interface to 8051.

Serial Communication and Bus Interface: Serial Communication Standards, Serial Data Transfer Scheme, On board Communication Interfaces-I2C Bus, SPI Bus, UART; External Communication Interfaces- RS232, USB.

UNIT 5: (~10 Lecture Hours)

ARM Cortex-M3 processor: Introduction, Applications, The Cortex-M3 Processor System Block Diagram, Programming model – Registers, Special Registers, Operation modes, Instruction set, Exceptions and Interrupts, Vector

Tables, Reset Sequence, Unified Assembler Language, Memory Maps, Pipeline.

Text Books:

1. K. Ray and K.M. Bhurchandani, "Advanced Microprocessors and Peripherals", TMH, 2nd Edition, 2006.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, "The 8051 Microcontroller ad Embedded. Systems Using Assembly and C". Pearson, 2nd Edition, 2008.
3. Joseph Yiu, "The definitive guide to ARM Cortex-M3", Elsevier, 2nd Edition, 2011.

Reference Books:

1. D.V. Hall, Microprocessors and Interfacing, 2nd Edition, TMGH, 2006.
2. K.Uma Rao, Andhe Pallavi, The 8051 Microcontrollers, Architecture and Programming and Applications, Pearson, 2009.
4. Kenneth. J. Ayala, The 8051 Microcontroller, 3rd Edition, Cengage Learning, 2006.
5. Shibu K.V, Introduction to Embedded Systems, Tata McGraw Hill Education Private Limited, 2nd Edition, 2009.
6. Dr. K.V.K.K. Prasad, ¯Embedded / Real-Time Systems: Concepts, Design & Programming, Dreamtech publishers, 1st Edition, 2003.
7. Mazidi M., "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson, 200.

Online Resources:

1. https://lecturenotes.in/subject/22/microprocessor-and-microcontroller-mpmc
2. NPTEL Material on Microprocessors by Dr. Pramod Agarwal, IIT Roorkee http://nptel.ac.in/courses/108107029/

Course Outcomes :

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

1. Familiarize with the internal architecture and organization of 8086/8051/ARM Cortex-M3.
2. Write assembly language programs using 8086/8051.
3. Design and develop micro controller based systems using 8051 interfacing
4. Apply the knowledge of 8051 micro controller in real time applications.
5. Relate the memory organization and memory interface to 8086/8051/ ARM Cortex-M3.
6. Discuss various serial communication interface standards.

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III Year B.Tech ECE I-Semester	**L T P C**
Course Code: 125CB	**3 0 0 3**

COMPUTER ARCHITECTURE AND ORGANIZATION

Professional Elective-1

Prerequisites: Digital Electronics and Logic Design

Course Objectives:

1. To Understand the basic structure and operation of a digital computer.
2. To Realize the CPU design for a given instruction set.
3. To Comprehend the advantages of instruction level parallelism and pipelining for high performance processor designs.
4. To Visualize the hierarchical memory system.
5. To Comprehend the requirements of IO interfacing with the computer.

UNIT 1: (~12 Lecture hours)

Basic Structure of Computers: Computer Types, Functional Units, Basic Operational concepts, Software, Performance.

Register Transfer Language and Microoperations: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro Operations, Logic Micro Operations, Shift Micro Operations, Arithmetic Logic Shift Unit.Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Register – Reference Instructions, Memory – Reference Instructions, Input – Output and Interrupt, Complete Computer Description.

UNIT 2: (~08 Lecture hours)

Basic Computer Organization and Design: Design of Basic Computer, Design of Accumulator Logic.

Micro Programmed Control: Hardwired vs Microprogrammed Control, Control Memory, Address Sequencing, Micro Program Example, Design of Control Unit.

UNIT 3: (~09 Lecture hours)

Central Processing Unit - Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, RISC and CISC Characteristics.

Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processing.

Computer Arithmetic: Addition, Subtraction, Multiplication and Division of Fixed-Point Numbers.

UNIT 4: (~09 Lecture hours)

The Memory System: Basic Concepts, Semiconductor RAM Memories, Read-Only Memories, Cache Memories, Performance Considerations, Virtual Memory.

UNIT 5: (~07 Lecture hours)

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access, Input-Output Processor (IOP).

Text Books:

1. M. Morris Mano - Computer System Architecture, PHI / Pearson, 3rd Edition, 2008.
2. Carl Hamacher, Zvonks Vranesic, Safwat Zaky - Computer Organization, McGraw Hill Education, 5th Edition, 2011

Reference Books:

1. William Stallings, Computer Organization and Architecture, PHI/Pearson, 8th Edition, 2006.
2. John P. Hayes-Computer Architecture and Organization, Mc Graw Hill International, 3rd Edition, 2012.

Online Resources:

1. NPTEL Course on Computer Organization and Architecture by Prof. S. Raman - IITM https://www.youtube.com/watch? v=leWKvuZVUE8 &list=PLQObLunIEgaQ7Drxp8yCmsJqidgSsTqlw
2. Web Course for NPTEL on Computer Organization and Architecture – https://nptel.ac.in/courses/106103068/pdf/coa.pdf

Course Outcomes:

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

1. Recognize the basic building blocks and functional details of a CPU.
2. Demonstrate the construction and operation of individual building blocks of a CPU.
3. Illustrate the generation of control and timing signals for the CPU design.
4. Employ advanced architectural features for performance improvement of the CPU.
5. Analyze the different types of memories and their significance in the memory hierarchy.
6. Discuss the concept of data transfer between central computer and I/O devices.

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III Year B.Tech. ECE I-Semester	**L T P C**
Course Code: 125CK	**3 0 0 3**

ELECTRONIC MEASURING INSTRUMENTS AND SENSORS

(Common to ECE & ETE)

Professional Elective-1

Prerequisites: - Basic Electrical and Electronics Engineering.

Course Objectives:

1. To provide an understanding of various measuring systems functioning and metrics for performance analysis.
2. To impart the knowledge of principles of operation, working of different electronic instruments viz. signal generators, signal analyzers, and measuring equipment.
3. To expose the students to many varieties of transducers, measuring instruments, bridges and their operating principles and construction.
4. To create a conceptual understanding of the principles of sensors and their applications.

UNIT 1: (~ 10 Lecture Hours)

Block Schematics of Measuring Systems: Performance Characteristics, Static Characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag; Measuring Instruments: DC Voltmeters, D' Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments.

UNIT 2: (~ 8 Lecture Hours)

Signal Analyzers: AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators.

Signal Generators: AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary Waveform Generator, Video Signal Generators, and Specifications.

UNIT 3: (~ 10 Lecture Hours)

Special Purpose Oscilloscopes: CRT, Block Schematic of CRO**,** Dual Beam Oscilloscope, Sampling Oscilloscopes, Storage Oscilloscopes, Digital Storage Oscilloscope.

Transducers: Classification, Bounded, Unbounded, Resistance Thermometers, LVDT, Thermocouples, Synchros, Digital Temperature sensing system, Piezoelectric Transducers.

Bridges: DC Bridges - Wheatstone's bridge, Kelvin's bridge.

UNIT 4: (~ 10 Lecture Hours)

Sensors/Transducers: Principles, Classification, Environmental Parameters (EP), Characterization.

Mechanical and Electromechanical Sensors: Introduction, Resistive Potentiometer, Strain Gauge, Resistance Strain Gauge, Semiconductor Strain Gauges, Inductive Sensors- Electromagnetic Transducer, Magnetostrictive Transducer, Capacitive Sensors, Electrostatic Transducer, Ultrasonic Sensors.

UNIT 5: (~ 8 Lecture Hours)

Smart Sensors: Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, the Automation. **Sensors Applications:** Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Sensors for environmental Monitoring.

Text Books:

1. H.S.Kalsi, Electronic Instrumentation: 3rd Edition, McGraw HillEducation, 2010.
2. D. Patranabis, "Sensors and Transducers", Prentice Hall India Pvt., 2nd Ed, 2021.

Reference Books:

1. Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press,1997.
2. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W.D. Cooper: PHI 5th Edition 2003.
3. Clarence W. De Silva, "Sensors and Actuators Engineering System Instrumentation", Taylor & Francis Ltd, 2nd Ed, 2015.
4. Industrial Instrumentation: T.R. Padmanabham Springer 2009.

Online Resources:

1. https://www.tutorialspoint.com/electronic_measuring_instruments/index.htm
2. https://onlinecourses.nptel.ac.in/noc19_ee44/preview (Course Title: Electrical Measurement and Electronic Instruments, Prof. By Avishek Chatterjee, IIT IIT Kharagpur)
3. https://onlinecourses.nptel.ac.in/noc21_ee32/preview

Course Outcomes:

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

1. Identify the various electronic instruments based on their specifications for carrying out a particular task of measurement.
2. Evaluate and perform accurate measurements for any engineering system

with clear idea of the potential errors.

3. Relate and apply instruments like spectrum analyzer, signal generators, DSO and other virtual instrumentation techniques for appropriate measurements.
4. Explain the working principles of various transducers, sensors and bridges.
5. Distinguish different types of transducers and sensors.
6. Interpret the usage of various types of transducer and sensors.

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III Year B.Tech.ECE I-Semester	**L T P C**
Course Code: 125BY	**3 0 0 3**

BIO-MEDICAL ELECTRONICS

Professional Elective-1

Prerequisites: -

Course Objectives:

1. To acquire knowledge on basics of human physiology and cardiovascular systems.
2. To study different bioelectrodes, biomedical transducers and measurements of physiological parameters.
3. To learn about ECG, EEG, EMG & ERG recordings and their interpretations.
4. To learn how electronic instruments works and relate them to engineering problems in medical field.

UNIT 1: (~ 8 Lecture Hours)

Human physiological Systems: Brief introduction to Human Physiology, Cells and their structure, Transport of ions through the cell membrane, Resting and Action potentials, Bioelectric potentials, Nerve tissues and organs, Different systems of human body.

UNIT 2: (~ 11 Lecture Hours)

Biomedical Transducers: The transducer and transduction principles, Active transducers, Passive transducers, transducers for biomedical applications.

Bio-electrodes: Electrode theory, Biopotential Electrodes, Biochemical transducers, Types of Electrodes.

UNIT 3: (~ 10 Lecture Hours)

Bioelectric potentials and Measurements: Resting and action potentials, propagation of action potentials, Bioelectric potentials for ECG, EMG, EEG and ERG machines.

UNIT 4: (~ 8 Lecture Hours)

Cardiovascular System and Measurements: The heart and Cardiovascular System, Measurement of Blood Flow: Radiographic, Indicator Dye Dilution, Thermal Convection, Magnetic Blood Flow Rate, Ultrasonic Blood Flow meter. Measurement of blood pressure: Direct and Indirect methods, Blood Gas Analyzer, Plethysmography, Principles of Ultrasonic measurement, Ultrasonic Imaging, CT Scanning, X-ray and Nuclear imaging.

UNIT 5: (~ 8 Lecture Hours)

Prosthetic Devices: Pacemakers, Defibrillators, Heart-lung machine, Hemodialysis Machine.

Safety aids: Introduction, radiation safety instrumentation, Microshock and Macroshock hazards, aids for the handicapped, devices to protect against electric hazards.

Text Books:

1. Dr. M. Arumugam, Biomedical Instrumentation, 2nd Edition, Anuradha Publications, 2007.
2. Leslie Cromwell, F.J.Weibell, E.A.Pfeiffer, Biomedical Instrumentation and Measurements, 2nd Edition, PHI, 2004.

Reference Books:

1. L.A. Geoddes and L.E. Baker, Principles of Applied Biomedical Instrumentation, 3rd Edition, John Wiley and Sons, 1991.
2. R.S. Khandpur, Hand-book of Biomedical Instrumentation, 2nd Edition, McGraw-Hill, 200
3. A. M. Cook and J.G. Webster(eds.), Therapeutic Medical Devices: Application and Design, Prentice-Hall, 1982.
4. Arun Ghosh, Introduction to measurements and instrumentation, 3rd Edition, PHI learning, 2010.
5. W. F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical, Publishers, 1977.
6. John G. Webster, Medical Instrumentation, Application and Design, 3rd Edition, John Wiley, 2001
7. J.J. Karr & J.M. Brown, Introduction to Biomedical Technology, 4th Edition, Pearson Publications, 2001.

Online Resources:

1. Lectures on Biomedical Signal Processing by Prof.Sudipta Mukhopadhyay, IIT KGP. https://nptel.ac.in/courses/108105101/

Course Outcomes:

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

1. Describe the functioning of human physiological systems.
2. Understand the origin of Bioelectric Potential and their measurements using electrodes and transducers.
3. Explore the electronic systems in biomedical applications namely the ECG, EMG, EEG & ERG machines.
4. Analyse the biological processes and non-electrical parameters of human system.
5. Examine the various medical imaging techniques and discuss therapeutic and assist devices.
6. Evaluate the practical limitations on the electronic components while handling bio-substances.

III Year B.Tech. ECE I-Semester **L T P C**
Course Code: 125CW **3 0 0 3**

DATA SCIENCE

Professional Elective-1

Prerequisites: Python Programming

Course Objectives:

1. To learn concepts, techniques and tools to deal with various facets of data science practice, including data collection and integration.
2. To learn Ipython concepts like NumPy, Pandas and Matplotlib.
3. To understand predictive analytics techniques such as linear and logistic regression in detail.
4. To understand the fundamental differences between supervised and unsupervised methods.
5. To gain knowledge on different data visualization techniques.

UNIT 1: (~10 Lecture Hours)

Introduction: Data science basics, statistical inference, exploratory data analysis, and the data science process – statistical thinking in the age of big data, exploratory data analysis, and the data science process. Overview of Random variables and distributions.

Statistical learning: Assessing model accuracy, Bias-Variance Trade-Off, Descriptive Statistics, Dependent and Independent events.

UNIT 2: (~10 Lecture Hours)

IPython: Beyond Normal Python, Introduction to NumPy. Data Manipulation with Pandas – Objects, Data Indexing and selection, Handling Missing Data, Hierarchical Indexing, Combining **Datasets:** Concat, append, merge, join; and working with time series.

UNIT 3: (~9 Lecture Hours)

Scikit: Learn Introduction, Hyper parameters and Model Validation, Feature Engineering, Naïve Bayes classification, and Linear regression- simple linear regression, basic function regression, regularization, example-predicting bicycle traffic.

Logistic regression: Thought experiments, classifiers, M6D logistic regression case study.

UNIT 4: (~8 Lecture Hours)

Support Vector Machines, Decision Tree and Random Forests, Principle Component Analysis, Manifold Learning, k-Means Clustering, Gaussian Mixture Models, Kernel Density Estimation.

UNIT 5: (~8 Lecture Hours)

Data Visualization with Matplotlib: Tips, Simple line and scatter plots, Visualizing Errors, Density and contour plots, Histogram, Binnings, and Density, Customizing, subplots, text and annotation, and Three Dimensional Plotting.

Text Books:

1. Jake VanderPlas, Python Data Science Hand Book, Published by O'Reilly Media, 2017.
2. Joel Grus, Data Science from Scratch: First Principles with Python, 2nd Edition, Published by O'Reilly Media, 2019.

Reference Books:

1. Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from The Frontline, O'Reilly, 2013.
2. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Introducing Data Science, 1st edition, Manning Publications Co., 2016.
3. Jure Leskovek, Anand Rajaraman, Jeffrey Ullman, Mining of Massive Datasets. v2.1, Cambridge University Press, 2014.
4. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning: with Applications in R, Springer, 1st edition, 2013.

Online Resources:

1. https://www.coursera.org/learn/data-science-and-scikit-learn-in-python?
2. https://www.coursera.org/learn/python-for-applied-data-science-ai?
3. https://www.coursera.org/specializations/statistical-learning-for-data-science?
4. https://www.coursera.org/specializations/deep-learning?
5. https://www.coursera.org/specializations/data-analysis-visualization-foundations?

Course Outcomes:

After completion of the course, students will be able to

1. Explore basic and advanced data science concepts.
2. Analyze the datasets by using statistical analytical methods.
3. Understand and apply python libraries for data science process.
4. Understand predictive analytics methods for applications handling large data.
5. Explore data analysis techniques by using various machine learning algorithms.
6. Project the inference drawn through visualization techniques.

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III Year B.Tech. ECE I-Semester **L T P C**
Course Code: 125CH **3 0 0 3**

PROGRAMMING WITH VERILOG HDL

Professional Elective-2

Prerequisites: Digital Electronics and Logic Design.

Course Objectives:

1. Understand the need of Hardware Descriptive Languages.
2. Expose students to language constructs and conventions of Verilog HDL.
3. Design digital circuits using Verilog HDL.
4. Verify the digital system designs using testbenches and assertions.

UNIT 1: (~6 Lecture Hours)

Introduction to Verilog HDL: Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Functional Verification, Module, Testbench.

Language Constructs and Conventions: Introduction, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data types, Scalars and Vectors, Parameters, Memory, Operators. System Tasks.

UNIT 2: (~8 Lecture Hours)

Gate Level Modelling: Introduction, AND Gate Primitive, Module Structure, Other gate Primitives, Illustrative Examples, Tristate Gates, Array of Instances of Primitives, Design of Flip-Flops with Gate Primitives, Delays, Strengths and Construction Resolution, Net Types, Design of Basic Digital Circuits using Gate level and Structural Modelling.

Modelling at Dataflow Level: Introduction, Continuous Assignment Structure, Delays and Continuous Assignments, Assignments to Vectors, Operators, Design of Basic Digital Circuits using Dataflow Modelling.

UNIT 3: (~8 Lecture Hours)

Behavioural Modelling : Introduction, Operations and Assignments, Functional Bifurcation, ‘Initial’ Construct, ‘Always’ construct, Assignments with delays, ‘Wait’ construct, Multiple Always Blocks, Designs at Behavioural Level, Blocking and Non-Blocking Assignments, The ‘Case’ statement, Simulation Flow, ‘If’ and ‘If – Else’ Constructs, ‘Assign and De-Assign’ Constructs, ‘Repeat’ Construct, For loop, The ‘Disable’ Construct, While Loop, Forever loop, Parallel Blocks, ‘Force- Release’ Construct, Event, Generate Block, Design of Basic Digital Circuits using Behavioural Modelling.

UNIT 4: (~12 Lecture Hours)

Switch Level Modelling: Basic Transistor Switches, CMOS Switches, Bidirectional Gates, Time Delays with Switch Primitives, Instantiation with ‘Strengths’ and ‘Delays’, Strength Contention with Trireg Nets.

System Tasks, Functions and Compiler Directives: Parameters, Path Delays, Module Parameters, System Tasks and Functions, File Based Tasks and Functions, Compiler Directives, Hierarchical Access, User Defined Primitives.

UNIT 5: (~12 Lecture Hours)

Sequential Circuit Description: Functional Registers Coding, State Machine Coding.

Component Test and Verification: Test Bench – Combinational and Sequential circuit Testing, Test Bench Techniques, Design Verification, Assertion Verification.

Text Books:

1. T.R. Padmanabhan, B. Bala Tripura Sundari, Design Through Verilog HDL, Wiley, 2009.
2. Zainalabdien Navabi, Verilog Digital System Design, TMH, II Edition, 2006.

Reference Books:

1. Stephen Brown, Zvonkoc Vranesic, “Fundamentals of Digital Logic with Verilog Design”, TMH, II Edition, 2010.
2. Sunggu Lee, “Advanced Digital Logic Design using Verilog, State Machine & Synthesis for FPGA”, Cengage Learning, 2012.
3. Samir Palnitkar, “Verilog HDL”, II Edition, Pearson Education, 2009.
4. Michel D. Ciletti, “Advanced Digital Design with the Verilog HDL”, PHI, 2009.

Online Resources:

1. Hardware Modelling using Verilog by Prof. Indranil Sengupta, IIT Kharagpur - https://nptel.ac.in/courses/106105165
2. System Design through Verilog by Prof.Shaik Rafi Ahamed, IIT Guwahati - https://archive.nptel.ac.in/courses/108/103/108103179/
3. Verilog HDL: A Guide to Digital Design and Synthesis, Second Edition by Samir Palnitkar, https://d1.amobbs.com/bbs_upload782111/files_33/ourdev_585395BQ8J9A.pd

Course Outcomes:

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

1. Identify the need for hardware descriptive languages, various language constructs and conventions of Verilog HDL.
2. Design basic digital systems using Verilog HDL.

3. Write test benches to analyse and verify the digital systems.
4. Illustrate various test bench techniques for effective simulation of digital systems.
5. Implement digital circuits using advanced Verilog HDL constructs.
6. Apply the concepts of Verilog HDL to model complex digital systems.

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III Year B. Tech. ECE I-Semester	**L T P C**
Course Code: 125BK	**3 0 0 3**

OBJECT ORIENTED PROGRAMMING THROUGH JAVA

Prerequisites: Programming for Problem Solving.

Course Objectives:
1. Learn the concepts of object-oriented programming.
2. Introduce the implementation of inheritance, packages and interfaces.
3. Understand the concepts of exception handling and multithreading.
4. Introduce the java collection framework and I/O classes.
5. Gain knowledge of swing controls and connecting to database using JDBC.

UNIT 1: (~9 Lecture Hours)

OOP Concepts: Data Abstraction, Encapsulation, Inheritance, Polymorphism, Classes and Objects, Procedural and Object Oriented Programming Paradigms.

JAVA Basics: History of Java, Java Buzzwords, Data Types, Variables, Arrays, Operators, Expressions, Control Statements, Introducing Classes, Methods, Constructors, Inner Classes, Anonymous Inner Classes, String Handling, Random, Scanner.

UNIT 2: (~10 Lecture Hours)

Inheritance: Inheritance Concepts, Member Access, Creating Multilevel Hierarchy, using super, using final with Inheritance, Forms of Inheritance, Benefits of Inheritance, Costs of Inheritance, Polymorphism-Adhoc Polymorphism, Pure Polymorphism, Method Overriding, Abstract Classes, Object Class.

Packages: Defining a Package, Classpath, Access Protection, Importing Packages. **Interfaces:** Defining an Interface, Implementing Interfaces, Nested Interfaces, Variables in Interfaces and Extending Interfaces.

UNIT 3: (~10 Lecture Hours)

Exception handling: Fundamentals of Exception Handling, Exception Types, using try and catch, Multiple catch clauses, nested try statements, throw, throws and finally, Built-In Exceptions, Creating Own Exception Subclasses.

Multithreading: Differences between Thread-Based Multitasking and Process-Based Multitasking, Java Thread Model, Creating Threads, Thread Priorities, Synchronizing Threads, Inter Thread Communication.

JDBC: Introduction to JDBC drivers, Types of Drivers, java.sql package, Connecting to a Database using JDBC, Manipulating data in Database.

UNIT 4: (~10 Lecture Hours)

Event Handling: The Delegation Event Model - Events, Event Sources, Event Listeners, Event Classes, Handling Mouse and Keyboard Events, Adapter Classes, Regular Expressions - Regular Expression Processing.

GUI Programming with Swing: Introduction, Limitations of AWT, MVC Architecture, Swing Components, Swing Containers, Swing Controls - JLabel, JTextField, JButton, JToggleButton, JCheckBox, JRadioButton, JTabbedPane, JScrollPane, JList, JComboBox, Swing Menus, Dialogs. Layout Managers-FlowLayout, BorderLayout, GridLayout, CardLayout, GridBagLayout.

UNIT 5: (~ 9 Lecture Hours)

Stream based I/O (java.io): The Stream Classes - Byte Streams and Character Streams, Reading Console Input and Writing Console Output, File class, Reading and Writing files, Random Access File operations, Generics, Enumerations, Lamda Expressions- Lamda Expression Fundamentals, Functional Interfaces, Lamda Expression examples.

The Collections Framework (java.util): Collections Overview, Collection Interfaces, The Collection Classes - ArrayList, LinkedList, Iterator, The For-Each alternative, HashTable, Stack, StringTokenizer, Calendar.

Text Books:

1. Herbert Schildt, Java: The Complete Reference, 10th Edition, McGraw Hill Education (India) Pvt. Ltd.
2. Herbert Schildt and Dale Skrien, Java Fundamentals - A Comprehensive Introduction, McGraw Hill Education (India) Pvt. Ltd., 2013.
3. Jim Keogh, J2EE: The Complete Reference, McGraw Hill Education (India) Pvt. Ltd., 2017.

Reference Books:

1. Jaime Nino and Frederick. A. Hosch, An Introduction to Programming and Object Oriented Design using Java, John Wiley & sons, 2013.
2. Timothy Budd, Understanding Object-Oriented Programming with Java, updated Edition, Pearson Education.
3. Y. Daniel Liang, Introduction to Java Programming, Comprehensive Version, 7th Edition, Pearson Education.
4. H.M. Dietel and Dietel, Java – How to Program, 6th Edition, Pearson Education/PHI.
5. Cay Horstmann, Big Java, 4nd Edition, John Wiley and Sons Publisher, 2009.

Online Resources:

1. https://docs.oracle.com/javase/tutorial/java/TOC.html
2. https://onlinecourses.nptel.ac.in/noc22_cs47/preview
3. www.javatpoint.com/java-tutorial

Course Outcomes:

After completion of the course, students will be able to

1. Understand the Object Oriented Programming concepts and solve real world problems.
2. Understand the concepts of Exception Handling and Event Handling.
3. Recognize the importance of multithread with Synchronization.
4. Demonstrate the use of Inheritance and Packages.
5. Solve problems using Java Collection Framework and I/O classes.
6. Design GUI using Swing Controls and connecting to Database.

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III Year B. Tech. ECE I-Semester **L T P C**
Course Code: 125ED **3 0 0 3**

INTERNET OF THINGS

Professional Elective-2

Prerequisites: 1. Programming for Problem Solving, 2. Digital Electronics & Logic Design

Course Objectives:

1. To understand the fundamental concepts, characteristics, and enabling technologies of the Internet of Things.
2. To Explore the types and characteristics of sensors and actuators used in IoT devices and learn how to interface them with microcontrollers.
3. To Gain practical experience in working with Arduino, ESP8266, and Raspberry Pi for building IoT devices and prototypes.
4. To Understand the application of IoT in various domains such as home automation, agriculture, industry, and health.

UNIT 1: (~9 Lecture Hours)

Introduction to IoT: Definition and Characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoT enabled Technologies: Wireless Sensor Networks, Cloud Computing, Big data analytics, Embedded Systems, IoT Levels and Templates. Domain Specific IoTs: Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health, and Lifestyle.

UNIT 2: (~9) Lecture Hours)

Sensors- Definition and Characteristics of Sensors, Actuators, Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Rain sensor, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, ultrasonic sensor.

UNIT 3: (~10 Lecture Hours)

IoT Physical Devices and Endpoints- Introduction to Arduino, ESP8266 and Raspberry Pi- Installation, TINKER CAD simulation, Arduino Programming Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Stepper motors.Serial SPI and I2C Interfaces, Programming: Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins.

UNIT 4: (~9 Lecture Hours)

IoT Communication Protocols: Link Layer: IEEE802.3, IEE802.11- Wi-Fi, BLE, IEEE802.16 - Wi-Max, Zigbee, IEEE802.15.4-LR-WPAN, 2G/3G/4G/5G Mobile communication, Network/Internet Layer: IPv4, IPv6, IPv6LoWPAN, Transport Layer: TCP/IP, UDP, Application Layer: HTTP, CoAP, WebSocket, MQTT, XMPP, DDS, AMQP.

UNIT 5: (~ 9 Lecture Hours)
IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs Webserver-Web server for IoT, Cloud for IoT, Python web application framework, designing a RESTful web API. Temperature and Humidity, Ultrasonic sensor, and Rain sensor interface over Thing Speak Cloud using Arduino UNO and ESP8266.

Text Books:

1. Perry Lea, "Internet of Things for Architects", Packt Publishers, January 2018.
2. Sudip Misra, Anandarup Mukherjee, and Arijit Roy , "Introduction to IoT", kindle edition, January, 2022.
3. Arshdeep Bahga and Vijay Madisetti, "Internet of Things - A Hands-on Approach", Universities Press, 2015.

Reference Books:

1. John C. Shovic, Raspberry Pi IoT Projects Prototyping Experiments for Makers, APress; 2nd ed. Edition, March 2021.
2. Marco Schwartz , Internet of Things with ESP8266: Build amazing Internet of Things projects using the ESP8266 Wi-Fi chip, Packt Publishing Limited, 29 July 2016.
3. Pratik Desai, Python Programming for Arduino: Develop practical Internet of Things prototypes and applications with Arduino and Python Paperback – Import, 31 March 2015.
4. David, Hanes and Salgueiro Gonzalo, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, Pearson 2017.
5. Dirk Slama and Frank Puhlmann, Enterprise IoT: Strategies and Best Practices for Connected Products and Services by 2015.
6. Matt Richardson and Shawn Wallace, "Getting Started with Raspberry Pi", O'Reilly (SPD), 2014.

Online Resources:

1. https://nptel.ac.in/courses/106105166_(Course Title: Introduction to Internet of Things, Prof. Sudip Mishra, IIT Kharagpur)
2. https://nptel.ac.in/courses/106106182 (Course Title: The Joy of Computing using Python, Prof. Sudarshan Iyengar, IIT Ropar)
3. https://www.edureka.co.

Course Outcomes:

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

1. Understand the fundamental concepts, characteristics, and enabling technologies of the Internet of Things.
2. Explore the types and characteristics of sensors and actuators used in IoT devices and learn how to interface them with microcontrollers.
3. Gain practical experience in working with Arduino, ESP8266, and Raspberry Pi for building IoT devices and prototypes.
4. Learn about various communication protocols at different layers of the IoT architecture and understand how to select the appropriate protocol for different scenarios.
5. Design and implement web servers, RESTful APIs, and cloud storage integration for IoT applications.
6. Understand and discuss the application of IoT in different domains, analyzing the benefits and challenges specific to each domain.

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III Year B.Tech. ECE I-Semester	**L T P C**
Course Code: 125BA	**3 0 0 3**

ARTIFICIAL INTELLIGENCE

(Common to ECE & ETE)
Professional Elective-2

Prerequisites: -Nil-

Course Objectives:

1. To learn the difference between optimal reasoning vs human like reasoning.
2. To understand the notions of state space representation, exhaustive search, heuristic search.
3. To learn different knowledge representation techniques.
4. To understand the applications of AI like Game Playing and Expert Systems.
5. To introduce the concept of Machine Learning.

UNIT 1: (~ 10 Lecture Hours)

Introduction: History, Intelligent Systems, Foundations of AI, Sub areas of AI & Applications. Problem Solving - State-Space Search and Control Strategies, General Problem Solving Techniques, Characteristics of Problem, Exhaustive Searches, Heuristic Search Techniques, Iterative-Deepening A*, Constraint Satisfaction. Game Playing, Bounded Look-ahead Strategy and use of Evaluation Functions, Alpha-Beta Pruning.

UNIT 2: (~ 10 Lecture Hours)

Logic Concepts and Logic Programming: Introduction, Propositional Calculus, Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Tableau System in Propositional Logic, Resolution Algorithm, Predicate Logic, Logic Programming.

UNIT 3: (~ 10 Lecture Hours)

Knowledge Representation: Introduction, Approaches to Knowledge Representation, Knowledge Representation using Semantic Network, Extended Semantic Networks for KR, Knowledge Representation using Frames.

Advanced Knowledge Representation Techniques: Case Grammars, Semantic Web.

UNIT 4: (~ 8 Lecture Hours)

Uncertainty Measure - Bayesian Belief Networks, Certainty Factor Theory, Dempster-Shafer Theory. Introduction to Machine Learning: Machine Learning Systems, Supervised and unsupervised learning.

UNIT 5: (~ 10 Lecture Hours)

Expert System and Applications: Introduction, Phases in Building Expert Systems, Expert System Architecture, Expert Systems Vs Traditional Systems, Rule based Expert Systems, Truth Maintenance Systems, Applications of Expert Systems, List of Shells and Tools.

Text Books:

1. Saroj Kaushik, Artificial Intelligence, Cengage Learning, 2011.

Reference Books:

1. Rich, Knight, Nair: Artificial intelligence, Tata McGraw Hill, 3rd Edition, 2009.
2. Eugene Charniak, Introduction to Artificial Intelligence, Pearson, 2007.
3. Dan W.Patterson, Introduction to Artificial Intelligence and Expert Systems, PHI, 1990.
4. George Fluger, Artificial Intelligence, 5th Edition, Pearson.

Online Resources:

1. http://www.vssut.ac.in/lecture_notes/lecture1428643004.pdf
2. http://nptel.ac.in/courses/106105077/
3. https://onlinecourses.nptel.ac.in/noc18_cs18/preview
4. https://www.edx.org/course/artificial-intelligence-ai-columbiax-csmm-101x-4

Course Outcomes:

After completion of the course, students will be able to

1. Understand the basics of AI and to formulate efficient problem space and select a search algorithm for a problem.
2. Apply AI techniques to solve problems related to Game playing, Expert systems.
3. Understand and apply Logic programming in problem solving.
4. Represent knowledge using appropriate techniques.
5. Interpretation of probabilistic and logical reasoning in knowledge base.
6. Understand the concepts of machine learning.

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III Year B.Tech. ECE I-Semester **L T P C**
Course Code: 12529 **0 0 2 1**

ANALOG AND DIGITAL COMMUNICATIONS LAB

(Common to ECE & ETE)

Prerequisites: - Nil

Course Objectives:

1. To analyze analog modulation techniques and simulate them using MATLAB software.
2. To implement and analyze sampling concepts and multiplexing.
3. To implement and analyze the pulse digital modulation techniques.
4. To analyze Power Spectral Density of analog and digital modulation techniques using spectrum analyzer.

List of Experiments:

1. Amplitude modulation and demodulation.
2. DSB-SC Modulator & Detector
3. SSB-SC Modulator & Detector (Phase Shift Method).
4. Frequency modulation and demodulation.
5. Time Division Multiplexing & De-multiplexing.
6. Sampling Theorem
7. Pulse Position Modulation & Demodulation.
8. PCM Generation and Detection.
9. Differential Pulse Code Modulation.
10. Delta Modulation.
11. Frequency Shift Keying: Generation and Detection
12. Phase Shift Keying: Generation and Detection
13. Amplitude Shift Keying: Generation and Detection
14. QAM, and analyze the Spectral characteristics of QAM using Spectrum analyzer.
15. QPSK: Generation and Detection
16. AM and FM modulation schemes using Spectrum analyzer

Note: 1. Minimum of 12 experiments to be conducted.

2. Hard ware Implementation of the following experiments.
3. Implementation of all the above experiments using MATLAB.

Online Resources:

1. http://onlinecources.nptel.ac.in/noc18_ee26 (Analog communications by Prof.Goutam Das, IIT Kharagpur)
2. http://onlinecources.nptel.ac.in/noc18_ee27 (Principles of Digital communications by Prof.S.N.Merchant,IITB,)

Course Outcomes:

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

1. Understand fundamentals in implementation and Simulation of Analog and Digital Communication concepts.
2. Comprehend the theoretical concepts and relate the same to the circuit schematics used in AM, FM, Pulse modulation and TDM technique.
3. Develop code for simulation of Analog modulation and Pulse modulation techniques, and analyze the performance of the system.
4. Analyse the implementation details of Digital Carrier modulation techniques, and Simulate the same in MATLAB.
5. Generate the Simulation code, to implement the concepts/application of Communications in MATLAB.
6. Develop the hardware for basic analog/digital communication concepts, and comprehend the Numerical results from experimental measurements..

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III Year B.Tech. ECE I-Semester **L T P C**
Course Code: 12535 **0 0 2 1**

MICROPROCESSORS AND MICROCONTROLLERS LAB

(Common to ECE, ETE & EEE)

Prerequisites: Nil.

Course Objectives:

1. Infer the basics of the microprocessor and its assembly language.
2. Extend the basics of assembly language to the microcontroller.
3. Provide foundation on interfacing the external devices to the micro controller.
4. Develop solutions for the real time applications.

List of Experiments:

Implement the following experiments using TASM/MASM assembler for 8086 and Keil µ Vision IDE for 8051.

1. Write a program for 16 bit arithmetic, logical, shift, rotate operations for 8086.
2. Write a program for 16 bit sorting an array for 8086.
3. Write a program for string manipulations (searching a character, insertion, deletion, comparison) using string instructions of 8086.
4. Write a program using arithmetic, logical and bit manipulation instructions of 8051.
5. Write a program to interface LEDs to 8051.
6. Write a program to generate a square wave of 50% duty cycle on the P1.5 bit using Timer 0 for generating the time delay and calculate the delay generated.
7. Write a program to configure external Interrupts INT0 and INT1 as interrupt request resources and turn on LEDs respectively in 8051.
8. Write a program for serial communication from PC to 8051.
9. Write a program to interface stepper motor with 8051.
10. Write a program to interface Seven Segment Display to 8051.
11. Write a program to interface LCD to 8051.
12. Write a program to interface 4X4 Matrix Keyboard to 8051.
13. Write a program to interface 8bit ADC to 8051.
14. Write a program to generate a triangular wave using DAC interface to 8051.

Note: Minimum of 12 experiments to be conducted.

Online Resources:

1. https://lecturenotes.in/subject/22/microprocessor-and-microcontroller-mpmc
2. NPTEL Material on Microprocessors by Dr. Pramod Agarwal, IIT Roorkee http://nptel.ac.in/courses/108107029/

Course Outcomes (COs):

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

1. Understand the architecture of 8086 microprocessor and 8051 microcontroller.
2. Comprehend the knowledge of instruction set of 8086 microprocessor and 8051microcontroller.
3. Develop algorithms to implement the given task using 8086 microprocessor.
4. Develop algorithms to implement the given task using 8051 microcontroller.
5. Design and build the 8086 microprocessor/8051 microcontroller based systems.
6. Verification and analysis of the programs and their results.

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III Year B.Tech I Semester **L T P C**
Course Code: 12528 **0 0 2 1**

ADVANCED COMMUNICATION SKILLS LAB

Course Objectives:

1. To address various challenges of communication as well as personality traits faced by individuals at workplace and organizations through case studies and interactions.
2. To help the students engage with each other's confidently through various discussions and presentations.
3. To help the students write business documents and generate content effectively.
4. To enhance soft skills among the students and to enable them to understand its impact on employability.
5. To equip the students with career planning and employability.

1. Fundamentals of Interpersonal Communication Skills (ICS):

Definition of ICS – Types of ICS: Verbal, Written and Non-verbal - Forms of ICS: Face-to-face conversation: Phone calls, E-mails and Video conference – Stages of ICS: Acquaintance, Build-up, continuation, bringing to a close, ending – Principles of ICS – a sender, a receiver, medium, encoding, decoding and feedback – Strategies for effective ICS – Objectives of ICS - Barriers to ICS.

Activities :

- Role plays on Conflict management, Negotiation, Problem solving, Assertiveness
- Conducting a meeting
- E-mail etiquette and netiquette
- Scenario based Role-plays
- Case study based Role-plays

2. Reading Comprehension Skills (RCS):

Importance of RCS: Understanding grammar, vocabulary and semantics – Benefits of RCS – strategies to improve RCS: Skimming, Scanning, Visualization, Summarizing, Questioning, predicting – Essential skills for RCS: Decoding, Fluency, Vocabulary, Coherence – Schema in reading through – stories, poetry and dramas.

Activities:

- Paraphrasing the Reading passage.
- Critical Analysis of the Reading passage.
- Vocabulary and Grammar Quizzes/Exercises.

3. **Writing Skills (WS):**

   Importance of WS : The message with clarity and ease to larger audience – Basic elements of writing : Spelling, Capitalization, Punctuation, Sentence structure, handwriting – Essential steps of writing : Planning, Drafting, Sharing, Evaluating, Revising, Editing and Publishing – Types of writing : Essays-Expository, Descriptive, Persuasive and Narrative; Journal Writing, reflective Writing – Structure of writing : Process writing : Paragraph writing, Essay writing; Product writing: Report writing, Resume writing and SOP writing.

   Activities:

   - Drafting a Report.
   - Building a Resume.
   - Writing Statement of Purpose (SOP)

4. **Presentation Skills (PS):**

   Definition of PS – Types of presentation: Informative, Instructional and persuasive – Stages of oral presentation: Identifying purpose, planning, preparation, presenting, concluding and handling Q & A's – Guidelines for Power Point presentation:

   Content on each slide, font sizes, visual images, number of slides, tools used for PPT.

   Activities:

   - Poster Presentation.
   - Pecha Kucha Presentation.
   - Field Research Project Presentation.
   - Project elevator pitch

5. **Personal Branding and Self Development (PB&SD):**

   Definition of Personal Branding – Importance of PB – Self assessment based on purpose, values, authenticity, strengths achievements and credentials – ways to create personal branding – Understanding the importance of soft skills for self-development and professional development: Communication, being engaged, ability to participate fully, to think critically, to demonstrate leadership, to develop team building.

   Activities:

   - Self-Introduction. (personal elevator pitch)
   - Mock Interviews.
   - Group Discussions.

Reference Books:

1. T.M.Farhathullah, *Communication Skills for Technical Students*, Orient BlackSwan Pvt. Ltd., (2002).
2. Sangeetha Sharma and Binod Mishra, *Communication Skills for Engineers and Scientists*, PH1 Learning Pvt.Ltd., (2011).
3. Sanjay Kumar and Pushp Lata, *Communication Skills,* Oxford Higher Education, 2nd Education (2015).

Online Resources:

1. https://onlinecourses.swayam2.ac.in/ntr23_ed43/preview
2. https://onlinecourses.swayam2.ac.in/nou23_cm21/preview
3. https://onlinecourses.nptel.ac.in/noc23_hs146/preview
4. https://onlinecourses.nptel.ac.in/noc23_hs115/preview

Course Outcomes:

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

1. Apply basic communication skills (LSRW) in work-related situations.
2. Acquire, organize, interpret and evaluate information for effective communications within a group.
3. Demonstrate the ability to combine ideas or information in new ways and present information on guided and structured format.
4. Make decisions and solve problems by specifying goals, identifying resources and constraints and evaluating results.
5. Display personal qualities such as responsibility, self-management, self-confidence, ethical behaviour and respect for self and others.
6. Learn to work cooperatively with people of diverse backgrounds and abilities, identify group's goals and values and contribute to a group process with ideas, suggestions and efforts.

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III Year B.Tech.ECE II-Semester **L T P C**
Course Code: 126EG **3 0 0 3**

MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

(Common to CSE, CSD, CSM, CST, ECE, EEE, ETE & IT)

Prerequisites:- Nil

Course Objectives:

1. Provide the basic concepts of Managerial economics.
2. Interlink the concepts of Managerial economics for effective business decision making.
3. Provide Fundamental knowledge in accounting and interpretation of the statements.

UNIT 1: (~10 Lecture Hours)

Managerial Economics and Demand Analysis

Managerial Economics: Introduction to Economics - Definition of Managerial Economics - Nature and Scope of Managerial Economics - Multidisciplinary Nature of Managerial Economics.

Demand Analysis: Introduction to Demand - Determinants of demand - Law of demand, and its Exceptions - Types & Nature of demand - Movement and Shift of demand curve.

Elasticity of demand: Concept of Elasticity of demand - Types of Elasticity- Price, Income, Cross and Advertising.

Demand Forecasting: Need for Demand Forecasting - Factors governing Demand Forecasting - Methods of Demand Forecasting (Survey methods and Statistical methods.)

UNIT 2: (~08 Lecture Hours)

Production and Cost Analysis:

Production Analysis: Factors of Production - Production Function - Production function with one variable input - two variable inputs using Isoquant and Isocosts - Optimal combination of Resources using Isoquants and Isocosts - Laws of returns.

Cost Analysis: Cost classification - Cost concepts relevant for Managerial decision making – Cost relationship – Determinants of cost.

UNIT 3: (~10 Lecture Hours)

Break Even Analysis, Market Structures and Pricing

Break Even Analysis: Need - Scope and Significance – Assumptions - Advantages and Limitations -Practical Applications (with simple problems).

Market Structures: Classification of Markets - Features of Perfect Competition – Monopoly- Monopolistic - Oligopoly and Duopoly.

Pricing: Pricing Objectives - Methods of Pricing and Pricing strategies.

UNIT 4: (~10 Lecture Hours)

Introduction to Financial Accounting

Financial Accounting: Introduction to Accounting - Double Entry Book-Keeping - Accounting Concepts and Conventions - Accounting Terminology. Journal - Ledger - Trial Balance - Final Accounts with Adjustments (Simple Problems).

UNIT 5: (~10 Lecture Hours)

Financial Analysis and Interpretation

Ratio Analysis: Need and importance - significance of Ratio Analysis - Liquidity Ratios - Profitability Ratios - Activity Ratios - Solvency Ratios - Interpretation of Ratios for decision making (Simple Problems).

Text Books:

1. P L Mehta (2016) Managerial Economics- Analysis, Problems & Cases, 21st Edition, Sultan Chand & Sons.
2. T.S.Grewal (2006) Double Entry Book keeping, Sultan Chand & Sons.

Reference Books:

1. D.N.Dwivedi (2016) Managerial Economics, 8th Edition, Vikas Publishing House Pvt. Ltd.
2. S.N. Maheshwari, Suneel K Maheshwari, Sharad K. Maheshwari (2018) Financial Accounting, 6th Edition, Vikas Publishing House Pvt. Ltd.
3. I.M.Pandey (2021) Financial Management, 12th Edition, Pearson.
4. R.L.Varshney, K.L Maheshwari (2004) Managerial Economics, 22nd Revised Edition, Sultan Chand & Sons.

Online Resources:

1. Managerial Economics https://onlinecourses.nptel.ac.in/noc20_mg67/preview
2. Financial Accounting http://nptel.ac.in/courses/110107073/

Course Outcomes (COs)

After learning the contents of this course, the student must be able to

1. Understand the Basic Concepts of Managerial Economics.
2. Demonstrate the significance of demand, its analysis and forecasting for decision making.
3. Apply the theory of production function and Cost concepts for problem solving and decision making.
4. Analyze different market structures & pricing strategies for business decision making.
5. Evaluate the concepts of Accounting for Business decision making.
6. Interpret the Financial Statements for management decision making.

III Year B.Tech.ECE II-Semester **L T P C**

Course Code: 126DV **3 0 0 3**

DIGITAL SIGNAL PROCESSING

(Common to ECE & ETE)

Prerequisites: Signals and Systems.

Course Objectives:

1. Underline the fundamental concepts of Discrete time signals, classification and systems.
2. Analyze the discrete signals and systems using different transforms like Fourier Series, FourierTransform and ZT.
3. Apply the concepts of different Transforms to find the response of Discrete time systems using convolution.
4. Evaluate computational efficiency of DFT using FFT algorithms.
5. Design and realize structures of different filters.

UNIT-I: (~9 Lecture Hours)

Introduction: Introduction to Digital Signal Processing, Advantages and application of DSP, classification of sequences based on duration, shape, periodicity, power, and energy. Operation on signals like shifting, folding, decimation, interpolation, fractional delay, Concept of frequency in continuous time and discrete time, Properties of LTI system, Classification of systems like linearity, time variance, causality, Discrete convolution, Frequency domain representation of discrete time signals and systems.

UNIT 2: (~9 Lecture Hours)

Z-Transform: Z- Transform of a discrete sequence, Region of convergence in Z-Transform, constraints on ROC for various classes of signals, properties of Z-transforms, one sided Z- transform, application-solution to difference equation, Inverse Z-transform using contour integration, power series expansion and partial fraction method.

Discrete Time Fourier Series and Transform: Representation of Periodic Sequences (DFS), Properties of Discrete Fourier Series, Discrete Time Fourier Transform (DTFT) of aperiodic sequence, properties of DTFT with proof.

UNIT 3: (~9 Lecture Hours)

Discrete Fourier Transform: Frequency domain Sampling, Discrete Fourier Transforms, Problems on DFT and IDFT, DFT as a Linear Transformation, Properties of DFTs like linearity, periodicity, time shifting, DFT of real valued and complex valued sequence, central coordinates, Parseval's theorem, Time reversal of a sequence, circular time shift of a sequence, circular frequency shift, duality. linear convolution of sequences using DFT, Over- lap Add method, Over-lap Save method, Relation between DTFT, DFS, DFT and Z-Transform.

Fast Fourier Transform:

Fast Fourier transforms (FFT) - Radix-2 decimation-in-time and decimation-in-frequency FFT Algorithms, Advantages, Inverse DFT using FFT

UNIT 4: (~9 Lecture Hours)

IIR Digital Filters: Analog filter approximations – Design of analog LPF using Butterworth and Chebyshev, Design of IIR Digital filters from analog filters using Impulse invariant techniques and Bilinear transformation method, Spectral transformations to covert LPF to other filters in S domain

Realization of IIR Filters:

Direct form, signal flow graphs and transposed structure, Cascade and Parallel forms.

UNIT 5: (~9 Lecture Hours)

FIR Digital Filters: Advantages of FIR filters, condition for filters to have linear phase response, Frequency response of Type 1,2,3 and 4, location of zeros of FIR transfer function, Design of FIR Filters using Fourier Series Method, Window Techniques like Rectangular, Triangular, Hanning, Hamming, Blackman windows and Frequency Sampling technique, Comparison of IIR & FIR filters.

Realization of FIR Filters: Direct form I and II, Cascaded form.

Text Books:

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G. Manolakis, Pearson Education / PHI, 2007.
2. Discrete Time Signal Processing – A. V. Oppenheim and R.W. Schaffer, PHI, 2009.

Reference Books:

1. Digital Signal Processing - Ramesh Babu.
2. Fundamentals of Digital Signal Processing using Matlab – Robert J. Schilling, Sandra L. Harris, Thomson, 2007
3. Tarun Kumar Rawat, "Digital Signal Processing", 1st edition, Oxford university press, 2015.
4. Ashok Ambardar, "Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 2001.
5. DSP by A Anandkumar, PHI.

Online Resources:

1. https://onlinecourses.nptel.ac.in
2. https://www.classcentral.com/course/swayam-digital-signal-processing-14007

Course Outcomes

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

1. Underline the fundamental concepts of Discrete time signals, classification, and systems
2. Analyze the discrete signals and systems using different transforms like Fourier Series, Fourier Transform and ZT.
3. Apply the concepts of different Transforms to find the response of Discrete time systems using convolution.
4. Evaluate computational efficiency of DFT using FFT algorithms.
5. Design and realize structures of IIR filter.
6. Design and realize structures of FIR filter.

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III Year B.Tech.ECE II-Semester **L T P C**

Course Code:126ES **3 1 0 4**

VLSI DESIGN

Prerequisites: - 1. Electronic Devices & Circuits 2. Digital Electronics and Logic Design.

Course Objectives:

1. To know electrical properties of MOS and BiCMOS devices and to analyze the behaviour of inverters designed with various loads.
2. To draw the layout of any logic circuit with the specified design rules.
3. To provide concept to design different types of digital circuits using CMOS logic.
4. To understand Sub system design, basic programmable logic devices.

UNIT 1: (~ 10 Lecture Hours)

Introduction to MOS Technology: Introduction to Integrated Circuit Technology, The Integrated Circuit Era, MOS and Related Technology, Basic MOS Transistors, Operation of Enhancement and Depletion Mode Transistors.

Fabrication Process: Silicon Wafer Preparation, Epitaxial Growth, Oxidation, Photolithography, Diffusion, Ion Implantation, Metallization, Assembly Processing and Packaging, Encapsulation, nMOS and pMOS fabrication, CMOS fabrication using p-Well, n-Well and Twin Tub processes, BiCMOS technology and its fabrication.

UNIT 2: (~ 10 Lecture Hours)

Basic Electrical Properties: Basic Electrical Properties of MOS, CMOS and BiCMOS Circuits: I_{DS}- V_{DS} relationships, MOS transistor threshold Voltage, g_m, g_{ds}, figure of merit, Pass transistor, NMOS inverter, Various pull - ups, Determination of pull-up to pull-down ratio (Zpu / Zpd) , CMOS Inverter analysis and design, Bi CMOS inverters, Latch-up in CMOS circuits.

UNIT 3: (~ 10 Lecture Hours)

VLSI Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layouts, Lambda based design rules, Contact cuts, CMOS Lambda based design rules, Layout Diagrams for logic gates, Transistor structures, wires and vias, Scaling of MOS circuits - Scaling models, scaling factors, scaling factors for device parameters.

Gate Level Design: Architectural issues, Switch logic networks: Gate logic, Alternate gate circuit: Pseudo-NMOS, Dynamic CMOS logic. Basic circuit concepts, Sheet Resistance RS and its concept to MOS, Area capacitance Units, Calculations, Delay unit T, Inverter Delays, Driving large Capacitive Loads.

UNIT 4: (~ 8 Lecture Hours)

Data Path Subsystems: Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters. **Array Subsystems:** SRAM, DRAM, ROM, Serial Access Memories.

UNIT 5: (~ 8 Lecture Hours)

Programmable Logic Devices: Programmable Read Only Memories (PROMs), Programmable Logic Arrays (PLAs), Programmable Array Logic (PALs), Altera MAX 7000 CPLD Architecture, Function Blocks, I/O Blocks, Clock Drivers, Interconnect, Xilinx XC4000 Series FPGA Architecture.

Text Books:

1. Kamran Eshraghian, EshraghianDougles and A. Pucknell- Essentials of VLSI Circuits and Systems, 1st Edition, PHI, 2005.
2. Neil H. E Weste, David Harris, Ayan Banerjee-CMOS VLSI Design – A Circuits and Systems Perspective, 3rd Edition, Pearson, 2009.
3. Advanced Digital Design with Verilog HDL – Michael D. Ciletti, PHI Learning Private Limited, 2013.

Reference Books:

1. Ming-BO Lin -Introduction to VLSI Systems: A Logic, Circuit and System Perspective, CRC Press, 2011.
2. John, P. Uyemura - CMOS Logic Circuit Design, Springer, 2007.
3. Wayne Wolf - Modern VLSI Design, 3rd Edition, Pearson Education, 1997.
4. M. Michael Vai - VLSI Design, CRC Press, 2001.

Online Resources:

1. NPTEL material on VLSI Design (Web) by Prof. A.N. Chandorkar, IIT Bombay https://nptel.ac.in/courses/117101058/.
2. VLSI Design tutorial :https://www.tutorialspoint.com/vlsi_design/index.htm
3. Online VLSI courses : https://www.udemy.com/topic/vlsi/
4. VLSI Training course : http://www.vlsiguru.com/
5. VLSI concepts : http://www.vlsi-expert.com/p/vlsi-basic.html

Course Outcomes:

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

1. Acquire qualitative knowledge on the fabrication process of integrated circuits using MOS transistors.
2. Analyse the modes of operation of MOS transistor and its basic electrical properties.
3. Explain the physical properties of MOS devices.
4. Design different VLSI Datapath Subsystems
5. Illustrate Semiconductor memory design using MOS transistors.
6. Implement different kind of Programmable Logic Devices.

III Year B.Tech ECE II-Semester **L T P C**
Course Code: 126DT **3 0 0 3**

DATA COMMUNICATIONS AND COMPUTER NETWORKS

Professional Elective-3

Prerequisites: - NIL

Course Objectives:

1. Know the Categories and functions of various Data Communication Networks
2. Design and analyze various error detection techniques.
3. Demonstrate the mechanism of routing the data in network layer.
4. Know the significance of various Flow control and Congestion control Mechanisms.
5. Know the Functioning of various Application layer Protocols.

UNIT 1: (~ 9 Lecture Hours)

Introduction to Data Communications: Components, Data Representation, Data Flow, Networks- Distributed Processing, Network Criteria, Physical Structures, Network Models, Categories of Networks, Interconnection of Networks, The Internet - A Brief History, The Internet Today, Protocol and Standards - Protocols, Standards, Standards Organizations, Internet Standards. Network Models- Layered Tasks, OSI model, Layers in OSI model, TCP/IP Protocol Suite, Addressing Introduction.

UNIT 2: (~ 9 Lecture Hours)

Data Link Layer: Links, Access Networks, and LANs- Introduction to the Link Layer, The Services Provided by the Link Layer, Types of errors, Redundancy, Detection vs Correction, Forward error correction Versus Retransmission Error-Detection and Correction Techniques, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC) , Framing, Flow Control and Error Control protocols , Noiseless Channels and Noisy Channels, HDLC, Multiple Access Protocols, Random Access, ALOHA, Controlled access, Channelization Protocols. 802.11 MAC Protocol, IEEE 802.11 Frame format.

UNIT 3: (~ 9 Lecture Hours)

The Network Layer: Introduction, Forwarding and Routing, Network Service Models, Virtual Circuit and Datagram Networks-Virtual-Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks, Inside a Router-Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane, The Internet Protocol (IP): Forwarding and Addressing in the Internet- Datagram format, IPv4 Addressing, Internet Control Message Protocol (ICMP), IPv6, Routing Algorithms- The Link -

State Routing Algorithm, The Distance Vector Routing Algorithm, Hierarchical Routing.

UNIT 4: (~ 9 Lecture Hours)

Transport Layer: Introduction and Transport Layer Services : Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and De-multiplexing, Connectionless Transport: UDP -UDP Segment Structure, UDP Checksum, Connection Oriented Transport: TCP - The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, Principles of Congestion Control - The Cause and the Costs of Congestion, Approaches to Congestion Control, TCP Congestion Control.

UNIT 5: (~ 9 Lecture Hours)

Application Layer: Principles of Networking Applications – Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport ServicesProvided by the File Transfer: FTP, - FTP Commands and Replies, Electronic Mail in the Internet-STMP, Comparison with HTTP, DNS-The Internet's Directory Service – Service Provided by DNS, Overview of How DNS Works, DNS Records and messages.

Text Books:

1. James F Kurose, Keith W Ross, "Computer Networking A Top-Down Approach", Pearson Education Inc , 5th Edition.
2. Data Communications and Networking Behrouz A. Forouzan 4th Edition McGraw-Hill Education.
3. Ad Hoc Wireless Networks: Architectures and Protocols by by C. Siva Ram Murthy , B. S. Manoj, Pearson Education India; 1st edition (1 January 2006).

Reference Books:

1. Data communication and Networks - Bhusan Trivedi, Oxford university press, 2016.
2. Computer Networks — Andrew S Tanenbaum, 4th Edition, Pearson Education.
3. Understanding Communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.

Online Resources:

1. https://nptel.ac.in/courses/106105082 (Course Title: Data Communication, Prof. Ajit Pal, IIT Kharagpur)
2. NPTEL/SWAYAM:https://archive.nptel.ac.in/courses/106/105/106105183/
3. NPTEL/SWAYAM https://nptel.ac.in/courses/106105080

4. MOOC: https://www.coursera.org/learn/crypto
5. e-PG Pathashala: - https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=fBYckQKJvP3a/8Vd3L08tQ==#
6. Other Government initiatives: https://www.education.gov.in/en/ict-initiatives / UP Govt. MOOC, Swayam Prabha | 34 DTH channels | India

Course Outcomes:

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

1. Independently understand basic computer network technology and enumerate services and role of each layer of OSI model and TCP/IP.
2. Discussion the functions Data link layer and its protocols.
3. Acquaint with the knowledge of various routing protocols and Identify the different types of network devices and their functions within a network.
4. Distinguish various Internet Transport Protocols and demonstrate the knowledge of Port addressing, Connection Management, Error control and Flow control mechanism.
5. Analyze the Functioning of various Application layer Protocols STMP, HTTP & DNS etc.
6. Get Familiarity with various types of messages being exchanged at different layers of an Internet.

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III Year B.Tech. ECE II-Semester **L T P C**
Course Code: 126EB **3 0 0 3**

INFORMATION THEORY AND CODING

Professional Elective-3

Prerequisites: Analog and Digital Communications.

Course Objectives:

1. To enhance knowledge on Entropy and Mutual Information, apply Source coding for better information rate.
2. To analyze Channel Capacity of various channel models.
3. To study the Channel coding and decoding methods of Linear Block Codes and Cyclic Codes.
4. To understand coding and decoding of Convolutional Codes.

UNIT 1: (~9 Lecture hours)

Basics of Information Theory: Review of Information Theory Concepts (Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information) Chain rules for Entropy, Relative Entropy and Mutual Information, Statements of Jensen's Inequality, Log Sum Inequality, Fano's Inequality, Data Processing Inequality, Asymptotic Equipartition Property - Asymptotic Equipartition Property Theorem, Consequences of the AEP: Data Compression, High Probability Sets and the Typical Set.

UNIT 2: (~10 Lecture hours)

Source coding and Channel Capacity: Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length, Huffman Codes, Optimality of Huffman Codes, The Lempel-Ziv (LZ) Algorithm, Channel Capacity**,** Symmetric Channels, Properties of Channel Capacity, Definitions of Discrete Channel, Discrete Memoryless Channel (DMC), (M, N) Code, Conditional Probability of Error, Maximal Probability of Error, Average Probability of Error, Rate R of an (M, N) Code, Capacity, Jointly Typical Sequences, Channel Coding Theorem.

UNIT 3: (~9 Lecture Hours)

Linear Block Codes: Introduction to Error Correction Codes, Error probability with repetition in Binary Symmetric Channel, Parity Check bit coding for error detection, Block coding for error detection and correction, The Hamming distance, Upper bound of probability of error with coding, Matrix description of Linear Block Codes, Equivalent Codes, Parity Check Matrix, Decoding of Linear Block Code, Syndrome Decoding, Perfect Codes, Hamming Codes, Extended codes, Optimal Linear Codes, Maximum Distance Separable Codes.

UNIT 4: (~10 Lecture Hours)

Cyclic Codes: Introduction to Cyclic Codes, The Division algorithm for polynomials, Generation of Cyclic Codes, Matrix description of Cyclic Codes, Error correction, Burst Error Correction, Cyclic Redundancy Check (CRC) Codes, Circuit implementation of Cyclic Codes, Brief introduction to BCH Codes, Primitive elements, Minimal Polynomials, Some examples of BCH codes.

UNIT 5: (~8 Lecture Hours)

Convolutional Codes: Introduction to Convolutional Codes, Tree Codes and Trellis Codes, Polynomial description of Convolutional codes, Distance notions for Convolutional codes, The Generating function, Matrix description of Convolutional Codes, Viterbi decoding of Convolutional Codes, Comparison of Error rates in coded and uncoded transmission.

Text Books:

1. Thomas M Cover, Joy A Thomas, Elements of Information Theory, 2nd Edition, Wiley, 2006.
2. K.Sam Shanmugam, Digital and Analog Communication Systems, John Wiley and Sons, 2004.
3. Simon Haykin, Communication systems, 4th Edition, John Wiley & sons, INC.

Reference Books:

1. Ranjan Bose, Information Theory Coding and Cryptography, 1st Edition, TMH, 2002.
2. Herbert Taub, Donald L Schilling, GoutamSaha, Principles of Communication Systems, 4th Edition, McGraw-Hill Education, 2013.
3. Shulin, Daniel J.Costello, Error Control Coding, 2nd Edition, Pearson.

Online Resources:

1. Lectures on Information Theory and Coding Prof. S.N. Merchant, IIT Bombay https://nptel.ac.in/courses/117101053/
2. Lectures on Error control coding: An introduction to linear block code (Video) Dr.Adrish Banerjee , IIT K https://nptel.ac.in/courses/ 117104121/
3. Lectures on Error Control Coding: An Introduction to Convolutional Codes (Video) by Dr.Adrish Banerjee , IITK https://nptel.ac.in/courses/ 117104120/

Course Outcomes:

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

1. Understand the applicability of Information theory concepts and various methods of error detection and correction.
2. Analyze the performance of various source coding techniques to achieve data compression.
3. Derive the different channel capacities, and bounds for various channels.
4. Analyze the capabilities of block codes and cyclic codes in terms of optimal encoding and decoding.
5. Compare error handling capabilities and circuit complexities.
6. Design codes for error detection and correction of sequential data with low error probability

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III Year B.Tech. ECE II-Semester **L T P C**
Course Code: 126CF **3 0 0 3**

DESIGN FOR TESTABILITY
Professional Elective-3

Prerequisites: Digital Electronics and Logic Design, Verilog HDL.

Course Objectives:
1. Understand need for testing of manufactured ICs
2. Expose students to the testing terminology.
3. Generate test patterns for testing of digital circuits.
4. To build digital circuits which are easily testable.

UNIT 1: (~8 Lecture Hours)
Importance of Testing, Testing During VLSI Lifecycle, Challenges in VLSI Testing, Fault and Defect Modeling: Fault Modeling, Structural Gate Level Faults.

UNIT 2: (~8 Lecture Hours)
Fault Simulation, Test Generation, Controllability and Observability, Deterministic Test Generation Methods, Sequential Circuit Test Generation, Test Data Compaction.

UNIT 3: (~12 Lecture Hours)
Design for Test by Means of Scan: Making Circuits Testable, Testability Insertion, Full Scan DFT Techniques, Scan Architectures, RT Level Scan.

UNIT 4: (~10 Lecture Hours)
Logic Built-in Self-test: BIST Basics, Test Pattern Generation, Output Response Analysis, BIST Architectures, RT Level BIST Design.

UNIT 5: (~8 Lecture Hours)
Standard IEEE Test Access Methods: Boundary Scan Basics, Boundary Scan Architecture, Boundary Scan Test Instructions, Board Level Scan Chain Structure, RT Level Boundary Scan, Boundary Scan Description Language.

Text Books:
1. Wang, Wu, Wen, "VLSI Test Principles and Architectures", Morgan Kaufmann Publishers, First Edition, 2011.
2. Zainalabedin Navabi, "Digital System Test and Testable Design using HDL models and Architectures", Springer International Edition, 2014.

Online Resources:

1. NPTEL course on VLSI Physical Design by Indranil Sen Gupta, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc21_cs12/course
2. NPTEL course on Digital VLSI Testing by Shantanu Chattopadhyay, IIT Kharagpur https://www.youtube.com/watch?v=MEaMm423t0w&list= PLzkO3QQCXjbVIEsRgNkolA vs-SFXPUjpb

Course Outcomes:

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

1. Understand different types of faults that can occur in a system and learn the concept of testing and adding extra hardware to improve testability of system.
2. Recognize the need for fault models, controllability, and observability in generation of test vectors for testing digital systems.
3. Understand the importance of Fault Simulation and Test Generation.
4. Design different architectures for Chip Level DFT Techniques.
5. Illustrate different architectures for System Level DFT Techniques.
6. Incorporate the different DFT architectures into digital designs using RTL code.

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III Year B.Tech.ECE II-Semester **L T P C**
Course Code: 126DK **3 0 0 3**

GREEN COMMUNICATIONS

Professional Elective-3

Prerequisites: -

Course Objectives:

1. To comprehend the principles of green communications and the trade-offs exist in it while satisfying the user demands in the network.
2. To impart concepts on various energy efficient systems.
3. To design the green networks by optimizing its different layers to solve the coexistence problems due to huge power dissipation.
4. To design the self-sustainable cooperative networks by energy harvesting the ambient sources and optimal power management over the operating devices.

UNIT 1: (~ 10 Lecture Hours)

Introduction: Fundamental Tradeoffs on the Design of Green Radio Networks: Insight from Shannon's capacity formula - impact of practical constraints - latest research and directions; Algorithms for Energy Harvesting Wireless Networks: Energy harvesting technologies - PHY and MAC layer optimization for energy harvesting wireless networks.

UNIT 2: (~ 10 Lecture Hours)

Green Modulation and Coding: Modulation: Green modulation and coding schemes in energy constrained wireless networks - energy consumption of uncoded scheme - energy consumption analysis of LT coded modulation.

UNIT 3: (~ 8 Lecture Hours)

Co-operative Techniques: Co-operative Techniques for Energy Efficient Wireless Communications: Energy efficiency metrics for wireless networks – co-operative networks - optimizing the energy efficiency performance of co-operative networks - energy efficiency in co-operative base stations.

UNIT 4: (~ 8 Lecture Hours)

Base Station Power Management Techniques: Base Station Power Management Techniques for Green Radio Networks: Opportunistic spectrum and load management for green radio networks - energy saving techniques in cellular wireless base stations - power management for base stations in a smart grid environment.

UNIT 5: (~ 12 Lecture Hours)

Introduction to SWIPT: Challenges in Wireless Information and Power Transfer, Multi-Objective Resource Allocation Optimization for SWIPT in Small-Cell Networks, Efficient Wireless Power Transfer Minimization Algorithms.

Text Books:

1. Ekram Hossain, Vijay K. Bhargava and Gerhard P. Fettweis, “Green Radio Communication Networks”, Cambridge University Press, 2012.
2. F. Richard Yu, Yu, Zhang and Victor C. M. Leung “Green Communications and Networking”, CRC press, 2012.
3. Wireless Information and Power Transfer: A New Paradigm for Green Communications D. N. K. Jayakody, J. T. S. Chatzinotas, S. Durrani Springer.

Reference Books:

1. Mazin Al Noor, “Green Radio Communication Networks Applying Radio-Over-Fibre Technology for Wireless Access”, GRIN Verlag, 2012.
2. Jinsong Wu, SundeepRangan and Honggang Zhang, “Green Communications: Theoretical Fundamentals, Algorithms and Applications”, CRC Press, 2012.
3. Mazin Al Noor, “WiMAX Improvements in Green Radio Communications Utilizing Radio-Over- Fiber”, GRIN Verlag, 2012.
4. Ramjee Prasad and Shingo Ohmori, Dina Simunic, “Towards Green ICT”, River Publishers, 2010.
5. Mohammad S. Obaidat, AlaganAnpalagan and Isaac Woungang, “Handbook of Green Information and Communication Systems”, Academic Press, 2012.

Online Resources:

1 ebook online: https://ieeexplore.ieee.org/document/6295070

2 Green Communication in Nex Generation Cellular Networks: A Survey: https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7939957

Course Outcomes:

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

1. Analyze the importance of reducing energy consumption
2. Inculcate green concepts for energy efficient approaches while designing next generation wireless networks.
3. Design new green radio architectures and radio techniques to reduce the overall energy consumption.
4. Examine Wireless Information and Power Transfer techniques.
5. Analyze the challenges in Simultaneous Wireless Information and Power Transfer (SWIPT) along with the optimization of resource allocations.
6. Interpret efficient Wireless Power Transfer Minimization Algorithms.

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III Year B.Tech.ECE II-Semester **L T P C**

Course Code: 12640 **0 0 2 1**

DIGITAL SIGNAL PROCESSING LAB

(Common to ECE & ETE)

Prerequisites: -

Course Objectives:

1 To use relevant simulation software tools.

2 To demonstrate the concepts learnt in Digital Signal Processing using supporting software tools.

3 To enable students use graphical programming environment for modeling, simulating and analyzing few concepts of Digital Signal Processing using MATLAB Simulink software.

4 To prepare students on how to make use of relevant simulation software tools for various engineering problems.

List of Experiments:

1. (a) Generation of various discrete signals (Periodic and Aperiodic), such as unit impulse, unit step, square, saw tooth, triangular, sinusoidal, ramp, sinc.

   (b) Operations on discrete signals such as addition, multiplication, scaling, shifting, folding, computation of energy and average power.
2. Verification of linearity and time invariance properties of a given discrete time system.
3. To find Z-Transform of given discrete time signal, locating the Zeros and Poles and plotting the Pole-Zero maps in Z-Plane for the given transfer function
4. To find DFT / IDFT of given discrete time signal.
5. To find response of LTI system using graphical approach of Linear Convolution.
6. Determination of Power Spectrum of a given Signal using Wiener-Kintchine relation.
7. To Verify Parseval's theorem of Discrete Fourier Transform.
8. To find Frequency Response of a discrete system given in Transfer Function/ Difference equation form.
9. Implementation of FFT of given Sequence.
10. Implementation of Low Pass and High Pass FIR Filters using Windowing technique.
11. Implementation of Band Pass and Band Reject FIR Filters using Windowing technique.
12. Implementation of Low Pass Analog and Digital Butterworth IIR Filters.

13. Implementation of Low Pass Analog and Digital Chebyshev-Type 1 IIR Filters.
14. Practical implementation of Up-Sampling of a given sinusoidal signal.
15. Practical implementation of Down-Sampling of a given sinusoidal signal.
16. Implementation of I/D Sampling Rate Converters.
17. Generation of DTMF Signals.
18. Filtering of long data sequences using DFT/IDFT.

Note:

- Minimum 12 experiments should be conducted. All these experiments are to be implemented using software (MATLAB) / Hardware (DSP processor).
- At least two experiments are to be simulated using Simulink.

Online Resources:

1. https://www.youtube.com/watch?v=0ENnxVXEv_U&list=PLOzRYVm0a65cU4xstihn bnrCPHenmJJ7f
2. https://www.classcentral.com/course/swayam-digital-signal-processing-14007

Course Outcomes:

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

1 Understand fundamental concepts & usage of simulation software in the field of Digital Signal Processing.
2 Identify the specifications, requirements & built in functions to perform mathematicaloperations involving discrete sequences.
3 Develop code for designing various filters.
4 Develop code for analyzing Fourier and Z-transforms and their utility.
5 Develop code for sampling rate conversion.
6 Generate relevant simulation codes, with and without usage of built in functions & estimation of thenumerical results with supporting plots

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III Year B.Tech ECE II-Semester **L T P C**

Course Code: 12647 **0 0 2 1**

VLSI DESIGN LAB

Prerequisites: - 1. Electronic Devices & Circuits 2. Digital Electronics and Logic Design.

Course Objectives:

1. To verify the functionality of basic logic gates, combinational circuits, using Verilog/VHDL programming language.
2. To verify the functionality of sequential circuits, using Verilog/VHDL programming language.
3. To implement various combinational and Sequential circuits using FPGA kits.
4. To perform the circuit simulation for various combinational and Sequential circuits.

List of Experiments:

Part A: e-CAD programs: Programming can be done using any complier. Download the programs on FPGA/CPLD boards and performance testing may be done using pattern generator (32 channels) and logic analyzer apart from verification by simulation with any of the front end tools.

1. HDL code to realize all the logic gates.
2. Design and Implement 2-to-4 decoder.
3. Design and Implement 8-to-3 encoder (without and with priority).
4. Design and Implement 8-to-1 multiplexer and 1-to-8 demultiplexer.
5. Design and Implement 4 bit binary to gray code converter.
6. Design and Implement 4 bit comparator.
7. Design and Implement Full adder using 3 modeling styles.
8. Design and Implement flip flops: SR, D, JK, T.
9. Design and Implement 4-bit binary, BCD counters (synchronous/ asynchronous reset) or any sequence counter.
10. Design and Implement Finite State Machine Design of sequence detector.

Part B: VLSI circuit design experiments: Experiments can be done by Mentor Graphics/Cadence/Synopsis Tools.

1. Simulate and Verify the Layouts of all CMOS logic gates.
2. Simulate and Verify the Layout of CMOS inverter.
3. Simulate and Verify the Layout of CMOS NOR/ NAND gates.
4. Simulate and Verify the Layout of CMOS XOR and MUX gates.
5. Simulate and Verify the Layout of Static / Dynamic logic circuit (register cell).

6. Simulate and Verify the Layout of Latch circuit.
7. Simulate and Verify the Layout of 2x1 MUX using Pass transistor.

Note: Any SIX of the above experiments from each part are to be conducted (Total 12)

Course Outcomes:

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

1. Develop the concepts of digital design and VLSI Design.
2. Simulate, synthesize and implement various combinational and sequential logic circuits.
3. Analyze the static and dynamic characteristics of CMOS inverter.
4. Perform circuit simulation, physical verification, DC/Transient analysis, static timing analysis, layout verification of various digital CMOS circuits and pass transistor logic circuits
5. Design and analyze Analog circuits.
6. Interpret and verify the results of various combinational and sequential circuit designs.

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IV Year B.Tech. I-Semester **L T P C**

Course Code: 127FN **3 0 0 3**

FUNDAMENTALS OF MANAGEMENT

(Common to CSE, CSD, CSM, CST, ECE, EEE, ETE & IT)

Prerequisites: Managerial Economics and Financial Analysis.

Course Objectives:

1. Educate the importance of Management in Business Decision Making.
2. Inculcate the conceptual aspects required for Managerial Decision Making.
3. Outline the practical application of Management in Engineering Decision Making.

UNIT 1 : (~09 Lecture Hours)

Introduction to Management :

Management: Definition - Nature and Scope – Functions - Managerial Roles - Levels of Management - Managerial Skills - Challenges of Management - Evolution of Management - Classical Approach- Scientific Management and Administrative Theory - The Behavioral approach - The Quantitative approach - The Systems Approach - Contingency Approach – Corporate Social Responsibility of Business.

UNIT 2 : (~ 10 Lecture Hours)

Planning and Decision Making

Planning : Plans - Types of Plans - Planning – Features – Principles of Planning, Types of Planning – Concept of MBO - Development of Business Strategy – Steps of Strategic Planning Process.

Decision Making – Characteristics of Decision Making - Types of Decisions - Steps in Decision Making - Approaches to Decision Making – Techniques of Individual and Group Decision Making.

UNIT 3 : (~10 Lecture Hours)

Organization and HRM

Organization: Principles of Organization - Organizational Design – Departmentation – Delegation – Centralization, Decentralization and Recentralization - Organizational Structures - Concept of Organizational Culture, Climate and Change.

Human Resource Management: Talent Management – Importance – HRM - Features – Principles – Job Analysis - Functions of HRM – Recruitment and Selection - Training and Development - Performance Appraisal.

UNIT 4 : (~ 09 Lecture Hours)

Leading and Motivation

Leading: Leadership - Characteristics of a Leader - Power and Authority - Leadership Styles - Leadership Theories – Trait Theory - Behavioral Leadership Theories - Situational Leadership Theories (Fielders Contingency Theory – House path Goal Theory – Life Cycle Situational Theory – Leader as Mentor and Coach – Team Leadership.

Motivation - Types of Motivation - Relationship between Motivation and Performance - Motivational Theories – Abraham Maslow's Need Hierarchy Theory - Fredrick Herzberg's Two Factor Theory – Mc. Gregor Theory X and Y – Theory Z - ERG Theory - Mc. Clelland Theory of Motivation.

UNIT 5 : (~ 09 Lecture Hours)

Communication and Controlling

Communication : Importance - Types - Process - Barriers.

Controlling - Principles of Controlling - Types and Strategies for Control – - Steps in Control Process - Methods of Budgetary and Non- Budgetary Controls - Characteristics of Effective Control System – Methods of Controlling (Traditional and Modern Techniques.)

Text Books:

1. Stephen P. Robbins (2016) Fundamentals of Management, 9th Edition, Pearson Education.
2. K. Aswathappa (2023) Organisational Behavior, 14th Edition, Himalaya Publishing House.

Reference Books:

1. Y K Bhushan (2016) Fundamentals of Business organization and Management, 20th Edition, Sultan Chand and Sons.
2. Andrew DuBrin (2012) Management Essentials, 9th Edition, Cengage Learning.
3. VSP Rao (2012) Management (Text & cases), 2nd Edition, Excel Books.
4. James A.F. Stoner, R. Edward Freeman, Danial R.Gilbert (2018) Management, 6th Edition, Prentice - Hall of India Pvt. Ltd.
5. L.M.Prasad (2019) Organisational Behavior, 6th Edition, Sultan Chand and Sons.

Online Resources:

1. Concept of Management and Evolution of Management Thought https://archive.nptel.ac.in/courses/122/108/122108038
2. Principles of Management : https://nptel.ac.in/courses/110107150

Course Outcomes (COs)

After learning the contents of this course, the student must be able to

1. Understand the concept of Management in practical scenario for effective decision making.
2. Summarize the preparation of effective plans in strategizing the decision making process.
3. Identify the Organizational Structure and confine authority responsibility conduct in an organization.
4. Apprehend the human resource management in an organization for its effectiveness.
5. Assess the role of leader and build motivation to attain the objectives of an organization.
6. Communicate and Design techniques of controlling in the process of an organization.

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IV Year B.Tech.ECE I-Semester **L T P C**
Course Code: 127GH **3 0 0 3**

WIRELESS COMMUNICATIONS AND NETWORKS

Prerequisites: Digital Communications.

Course Objectives:

1. To provide the students with the fundamentals of wireless communications concept.
2. To analyze the concepts of Mobile Radio Propagation, Fading and Diversity reception techniques.
3. To equip the students with various kinds of wireless networks and its operations.
4. To provide an analytical perspective on the design and analysis of the traditional and emerging wireless networks, and to discuss the nature of, and solution methods to, the fundamental problems in wireless networking.

UNIT 1: (~10 Lecture Hours)

The Cellular Concept-System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and system capacity – Co channel Interference and system capacity, Adjacent Channel interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring, Overview of 1G to 5G wireless standards.

UNIT 2: (~9 Lecture Hours)

Mobile Radio Propagation: Large Scale Path Loss: Introduction to Radio Wave Propagation, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Outdoor Propagation Models-Okumura model, HATA model, Indoor Propagation Models, Signal Penetration into Buildings, Ray Tracing and Site Specific Modeling.

UNIT 3: (~10 Lecture Hours)

Mobile Radio Propagation: Small –Scale Fading and Multipath: Small-Scale multipath propagation, Impulse Response Model, Small-Scale multipath measurements, Parameters of Mobile Multipath Channels, Types of Small Scale Fading, Rayleigh and Ricean Distributions.

UNIT 4: (~9 Lecture Hours)

Equalization and Diversity: Equalization: Fundamentals of Equalization, Training a Generic Adaptive Equalizer, Equalizers in a Communications Receiver, Classification of equalization techniques. Linear Equalizers, Nonlinear Equalization, Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization.Diversity: Diversity techniques, Space, Frequency Diversity, Time Diversity, RAKE Receiver.

UNIT 5: (~10 Lecture Hours)

Wireless Networks: Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11, IEEE 802.11 Medium Access Control, Comparision of IEEE 802.11 a, b, g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL.

Text Books:

1. William C.Y. Lee, Mobile Cellular Telecommunications: Analog and Digital Systems, 2nd Edition, TMH, 2006.
2. T.S. Rappaport, Wireless Communications, Principles and Practice, 2nd Edition, PHI, 2010.
3. Siva Ram Murthy C, Bs Manoj, Ad Hoc Wireless Networks Architectures & Protocols, 1st Edition, Pearson Education Limited.

Reference Books:

1 Andrea Goldsmith, Wireless Communications, 1st Edition, Cambridge University Press, Stanford University, 2005.
2. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE
3. Wireless Communication and Networking – William Stallings, 2003, PHI
4. UpenaDalal, Wireless Communication, Oxford University Press, 2009.

Online Resources:

1. http://nptel.ac.in/courses/117104099/
2. http://nptel.ac.in/courses/117102062/
3. https://www.cse.wustl.edu/~jain/cse574-16/ftp/j_195g.pdf
4. https://www.researchgate.net/publication/293593557

Course Outcomes:

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

1. Understand the cellular system design concepts.
2. Analyze path loss, interference in wireless communication systems.
3. Demonstrate the concepts of multipath fading environment.
4. Comprehend the types of diversity and equalization.
5. Demonstrate wireless Local and Wide area networks and their specifications.
6. Familiar with some of the existing and emerging wireless standards.

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IV Year B.Tech ECE I-Semester **L T P C**
Course Code: 127FR **3 0 0 3**

MICROWAVE ENGINEERING AND OPTICAL COMMUNICATIONS

Professional Elective-4

Prerequisites: -Nil

Course Objectives:

1. To get familiarized with microwave frequency bands their applications and to conceptually understand the waveguides and to determine the characteristics, microstriplines.
2. To impart the knowledge of Scattering Matrix, its formulation and utility, and establish the SMatrix for various types of microwave junctions and Ferrites.
3. To differentiate various microwave tubes, know their structures, principle of power generation, performance characteristics and applications.
4. To Understand solid-state devices and power generation with applications and establish microwave bench set up for various methods of measurements.
5. To Understand the utility of Optical Fibres in Communication.

UNIT 1: (~ 12 Lecture Hours)

Waveguides: Electromagnetic Spectrum and Bands. Rectangular Waveguides – Solution of Wave. Equations in Rectangular Coordinates, TE/TM mode analysis, Expressions for Fields, Characteristic Equation and Cut-off Frequencies, Dominant and Degenerate Modes, Sketches of TE and TM mode fields in the cross-section, Waveguide Characteristics, Impossibility of TEM Mode. Microstrip Lines – Zo Relations, Effective Dielectric Constant.

Waveguide Components: Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide Windows, Tuning Screws and Posts, Matched Loads, Directional Couplers – 2 Hole, Bethe Hole, Attenuators – Different Types, Resistive Card and Rotary Vane Attenuators; Phase Shifters – Types, Dielectric and Rotary Vane Phase Shifters, Waveguide Tees- E, H Planes and Magic Tees Ferrites– Composition and Characteristics, Faraday Rotation, Ferrite Components –Gyrator, Isolator.

UNIT 2: (~ 10 Lecture Hours)

Microwave Tubes: Limitations and Losses of conventional Tubes at Microwave Frequencies, Microwave Tubes – O Type and M Type Classifications, O-type Tubes: 2 Cavity Klystrons – Structure, Reentrant Cavities, Velocity Modulation Process and Applegate Diagram, Bunching Process and Small Signal Theory – Expressions for O/P Power and Efficiency. Reflex Klystrons – Structure, Velocity Modulation and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes and O/P Characteristics. Helix TWTs: Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process (qualitative treatment), Suppression of Oscillations, Gain Considerations, Introduction to M-Type Tubes.

UNIT 3: (~ 8 Lecture Hours)

Microwave Solid State Devices: Introduction, Classification, Applications. TEDs – Introduction, Gunn Diodes – Principle, RWH Theory, Characteristics, Modes of Operation - Gunn Oscillation Modes, Introduction to Avalanche Transit Time Devices.

Microwave Measurements: Scattering matrix: Scattering Matrix Properties, [s] matrix of Microwave Components, Description of Microwave Bench – Different Blocks and their Features, Errors and Precautions, Measurement of Attenuation, Frequency. Standing Wave Measurements, measurementof Low and High VSWR, Cavity Q, Impedance Measurements.

UNIT 4: (~ 8 Lecture Hours)

Optical Sources- LEDs, Structures, Materials, Quantum Efficiency, Power, Modulation, Power Bandwidth Product, Injection Laser Diodes- Modes, Threshold Conditions, External Quantum Efficiency, Laser Diode Rate Equations, Resonant Frequencies, Reliability of LED & ILD. Source to Fiber Power Launching: - Output Patterns, Power Coupling, Power Launching, Equilibrium Numerical Aperture, Laser Diode to Fiber Coupling.

UNIT 5: (~ 8 Lecture Hours)

Optical Detectors: Physical Principles of PIN and APD, Detector Response Time, Temperature Effect on Avalanche Gain, Comparison of Photo Detectors, Optical Receiver Operation- Fundamental Receiver Operation, Digital Signal Transmission, Error Sources, Receiver Configuration, Digital Receiver Performance, WDM Concepts, Optical Fiber System link budget.

Text Books:

1. Microwave Devices and Circuits – Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Optical Fiber Communication – Gerd Keiser, TMH, 4th Ed., 2008.

Reference Books:

1. Electronic Communications Systems- Wayne Tomasi, Pearson, 5th Edition
2. Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3rd ed., 2011 Reprint.
3. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012.

4. Electronic Communication System – George Kennedy, 6th Ed., McGrawHill.

Online Resources:

1. Lectures on Basic Tools of Microwave Engineering (Video) by Prof. Amitabha Bhattacharya IIT KGP https://nptel.ac.in/courses/117105122/
2. Lectures on Microwave Theory and Techniques (Video) by Prof. Girish Kumar, IITB https://nptel.ac.in/courses/108101112/
3. Lectures on Fibre Optic Communication technology By DeepaVenkitesh, IITM https://archive.nptel.ac.in/courses/108/106/108106167/

Course Outcomes:

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

1. To analyze completely the rectangular waveguides and their mode characteristics and apply them for solving practical microwave transmission line problems.
2. To distinguish between the different types of waveguide and ferrite components and its S- Matrix, explain their functioning and select proper components for engineering applications.
3. To distinguish between the methods of power generation at microwave frequencies, establish the performance characteristics of 2-Cavity and Reflex Klystrons, Magnetrons, TWTs and estimate their efficiency levels, and solve related numerical problems
4. To realize the need for solid state microwave sources, understand the concepts of TEDs, RWH Theory and explain the salient features of Gunn Diodes and ATT Devices.
5. To set up a microwave bench, establish the measurement procedure and to conduct the experiments in microwave lab for measurement of various microwave parameters identifying the possible errors.
6. To understand the mechanism of light propagation and detection through Optical Fibres.

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IV Year B.Tech. ECE I-Semester **L T P C**
Course Code: 127FH **3 0 0 3**

EMBEDDED SYSTEM DESIGN

Professional Elective-4

Prerequisites: -1. Microprocessors and Microcontrollers, 2. Computer Architecture and Organization.

Course Objectives:

1. Discuss the major components that constitute an embedded system.
2. Implement small programs to solve well-defined problems on an embedded platform.
3. Develop familiarity with tools used to develop in an embedded environment.
4. Design, describe, validate and optimize embedded electronic systems in different industrial application areas.

UNIT 1: (~8 lecture hours)

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT 2 : (~10 lecture hours)

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT 3: (~10 lecture hours)

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

The Embedded System Development Environment: The Integrated Development Environment, Types of files generated on cross compilation, Disassemble/Decompiler, Simulators, Emulators and Debugging.

The Embedded Product Development Life Cycle (EDLC): Introduction to EDLC, Objectives, Different Phases.

UNIT 4: (~8 lecture hours)

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

UNIT 5: (~10 lecture hours)

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/ Synchronization Issues, Task Synchronization Techniques, Device Drivers, Choice of RTOS.

Text Books:

1. Shibu K.V, Introduction to Embedded Systems, 2nd Edition, McGraw Hill, 2016.
2. Dr. K.V. K. K. Prasad, Embedded Real Time Systems programming, 1st Edition, Dreamtech Press, 2003.

Reference Books:

1. Frank Vahid, Tony Givargis, Embedded System Design A Unified Hardware Software Introduction, 3rd Edition, John Wiley India, 2014.
2. David E.Simon, An Embedded Software Primer, 2nd Edition, AddisonWesley, 2006.

Online Resources:

1. https://www.tutorialspoint.com/embedded_systems/
2. Lectures on Embedded Systems Design (Video) by Prof. Anupam Basu IIT KGP, https://nptel.ac.in/syllabus/106105159/
3. https://openlabpro.com/guide/embedded-systems-design/
4. https://www.elprocus.com/embedded-systems-real-time-applications/

Course Outcomes:

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

1. Explain the basic characteristics of general computing systems and embedded systems..
2. Describe the Core of the Embedded System with peripherals.
3. Compare and distinguish memories, general purpose processors and domain specific purpose processors.
4. Learn the method of designing an Embedded System for any type of applications.
5. Introduce concepts of Real-Time Operating Systems.
6. Design and implement an embedded system using RTOS.

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IV Year B.Tech. ECE I-Semester **L T P C**
Course Code: 127CX **3 0 0 3**

MACHINE LEARNING

(Common to ECE & ETE)
Professional Elective-4

Prerequisites: -Nil-

Course Objectives:

1. To be able to identify machine learning problems corresponding to different applications.
2. To understand a various machine learning algorithms along with their strengths and weaknesses.
3. To understand the basic theory underlying machine learning.
4. To Introduce Decision Tree learning, Instance Based Learning techniques.

UNIT 1: (~10 Lecture Hours)

Introduction: Well posed learning problems, designing a learning system Perspectives and issues in machine learning, Types of learning.

Concept Learning: Concept learning task, Concept Learning as search through a hypothesis space, Finding maximally specific hypotheses, Version spaces and the candidate elimination algorithm, Remarks on them, Inductive Bias.

UNIT 2: (~10 Lecture Hours)

Decision Tree Learning: Decision Tree representation and learning algorithm, appropriate problems for Decision Tree Learning, Hypothesis space search in Decision Tree Learning, Inductive bias in Decision Tree Learning: Occam's razor, Issues in Decision Tree Learning.

Artificial Neural Networks: Introduction, The Neuron Model, Activation Functions, Neural Network Architecture: Single-Layer Feed-Forward Networks, Multi-Layer Feed-Forward Networks.

UNIT 3: (~9 Lecture Hours)

Support Vector Machines: Introduction, Linear Classifier, Non-linear Classifier, Training SVM, Support Vector Regression.

Bayesian Learning: Bayes theorem and concept learning, Minimum Description Length Principle, Bayes optimal classifier, Gibbs Algorithm, Naïve Bayes Classifier, The EM algorithm.

UNIT 4: (~ 8 Lecture Hours)

Computational Learning Theory: PAC Hypothesis, Sample complexity for finite and infinite hypothesis spaces, Mistake bound model.

Instance – Based Techniques: K-nearest neighbor Learning, Locally Weighted Regression, Radial Basis Function, Case Based reasoning, Remarks on Lazy vs Eager learning.

UNIT-5: (~ 8 Lecture Hours)

Genetic Algorithm: Biological motivation, Representing Hypothesis, Genetic Operators, Fitness function and selection, Hypothesis space search, Genetic Programming, Models of Evolution and Learning, Parallelizing Genetic Algorithms.

Text Books:

1. Tom M. Mitchell, Machine Learning, McGraw Hill Education, Edition 2013.

Reference Books:

1. Saroj Kaushik, Artificial Intelligence, CENGAGE Learning, 2011.
2. Trevor Hasti, Robert Tibshirani and Jerome Friedman, The Elements of Statistical Learning, 2nd Edition, Springer Series in Statistics, 2001.
3. William W Hsieh, Machine Learning Methods in the Environmental Sciences, Neural Networks and Kernels,Cambridge University Press.
4. Stephen Marsland, Machine Learning - An Algorithmic Perspective, CRC Press, 2009.

Online Resources:

1. http://www.cs.cmu.edu/~tom/
2. http://www.holehouse.org/mlclass/

Course Outcomes:

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

1. Gain Knowledge on the basic theory in machine learning
2. Understand to solve machine learning problems corresponding to different applications.
3. Create solutions with Decision trees and Bayesian classifiers for various business problems.
4. Implement the instance-based learning and analytic learning for suitable applications.
5. Apply Genetic algorithms and Reinforcement learning on real-world applications
6. Design application using real datasets and evaluate the performance of the different algorithms.

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IV Year B.Tech.ECE I-Semester **L T P C**
Course Code: 127FD **3 0 0 3**

DIGITAL IMAGE AND VIDEO PROCESSING

Professional Elective-5

Prerequisites: Nil

Course Objectives:

1 Provide the student with fundamentals of Digital Image Processing.
2 Give the student idea of general applications for the theories taught in the subject.
3 Have the notion of practical approach to image processing operations.
4 Give the students a useful skill base in the area of Image & Video processing that creates interest in doing projects.

UNIT 1: (~ 8 Lecture Hours)

Fundamentals of Image Processing and Image Transforms: Fundamentals steps in Digital Image Processing, Image Sampling & Quantization, Basic relationships between Pixels. Introduction to DFT and its properties, DCT, Walsh Transform, Hadamard Transform, Haar Transform, Hotelling Transform.

UNIT 2: (~ 10 Lecture Hours)

Image Enhancement: Basic intensity level transformations, Histogram processing, Basics of Spatial filtering, Smoothening Spatial filters, Sharpening Spatial filters, Filtering in frequency domain, Smoothening frequency domain filters, Sharpening frequency domain filters, Homomorphic filtering.

Image Segmentation: Point, Line and Edge detection, Thresholding- Basic Global, Optimum global thresholding, Region –based Segmentation.

UNIT 3: (~ 8 Lecture Hours)

Image Restoration & Color Image Processing: Model of Image degradation/ restoration process, Periodic noise reduction by Frequency domain filtering, Linear, position Invariant degradations, Estimating the Degradation function, Inverse filtering, Minimum mean square error filtering, Geometric mean filter.

Color Image Processing: color fundamentals, Color models, Pseudocolor image processing, Basics of full Color image processing, Color Transformations, Smoothening and Sharpening.

UNIT 4: (~ 8 Lecture Hours)

Image Compression: Redundancies and their Removal Methods, Fidelity Criteria, Image Compression Models, Arithmetic Coding, LZW Coding, Predictive Coding, Block Transform Coding, JPEG 2000 Standards.

UNIT 5: (~ 12 Lecture Hours)

Introduction to Video Processing: Digital Video signal and standards, Optical flow, General methodologies, Block matching Algorithm- EBMA, Fractional Accuracy Search, Fast Algorithms, Phase Correlation Method, Multiresolution motion Estimation.

Text Books:

1. Rafael C Gonzalez and Richard E Woods, Digital Image Processing, 3rd Edition, PHI 2006.
2. Yao Wang, JoemOstermann and Ya–quin Zhang, Video Processing and Communications, 1st Edition, PHI.

Reference Books:

1. Fundamentals of Digital Image Processing – A K Jain, PHI, 1989.
2. S Jayaraman, S Esakkirajan, T Veerakumar, Digital Image Processing, TMH, 2010.
3. Rafael C Gonzalez and Richard E Woods, Digital Image Processing using MATLAB , 2nd Edition, McGraw Hill Education, 2010.
4. Alan C. Bovik. Handbook of Image and Video Processing. Academic Press Series in Communications, Networking and Multimedia, Orlando, FL, USA 2005
5. A. Murat Tekalp. Digital Video Processing Prentice Hall Press (2nd ed.). Upper Saddle River, NJ, USA. 2015.

Online Resources:

1. https://nptel.ac.in/courses/117105135/Course Title :Digital Image Processing Prof. P. K. Biswas , IIT Kanpur.
2. https://nptel.ac.in/downloads/117104020/: Course Title Digital Video Signal Processing, Prof. Sumana Gupta , IIT Kanpur.

Course Outcomes:

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

1. Analyze the need for various advanced image transforms, types and their properties.
2. Apply different techniques used for enhancement of images both in spatial, frequency domain and also use basic segmentation algorithms.
3. Explore image degradation function, model few basic degradation functions to obtain restored image.
4. Comprehend the different Color models and Color Transformations.
5. Compare the various image coding techniques used for image compression
6. Discuss the basic concepts of Motion Estimation for Video processing.

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IV Year B.Tech.ECE I-Semester **L T P C**

Course Code: 127GD **3 0 0 3**

VOICE OVER INTERNET PROTOCOL

Professional Elective-5

Prerequisites: -Nil-

Course Objectives:

1. To provide detailed description regarding IPV4, IPV6 and RTP protocols.
2. To inculcate knowledge about the challenges in the implementation of VOIP and new protocols developed for its implementation.
3. To provide knowledge about interworking of SS7 and VoIP architectures.
4. To give an insight into QOS issues in VOIP and also it's internetworking with other existing internet protocols.

UNIT 1: (~10 Lecture Hours)

Transporting Voice by Using IP: Overview of IP Protocol Suite, The Internet Protocol, The Transmission Control Protocol (TCP), The User Datagram Protocol (UDP), The Real-time Transport Protocol (RTP), IP multicast, IP version 6 (IPv6), Interworking IPv4 and IPv6, The VoIP Market, VoIP Challenges.

UNIT 2: (~9 Lecture Hours)

H.323: The H.323 Architecture, Overview of H.323 Signaling, RAS Signaling, Call Signaling, Call Scenarios, H.245 Control Signaling, Conference calls, The Decomposed Gateway.

UNIT 3: (~9 Lecture Hours)

The Session Initiation Protocol (SIP): SIP architecture, Overview of SIP Messaging Syntax-Examples of SIP Message sequences, Redirect Servers, Proxy Servers, The Session Description Protocol (SDP), Usage of SDP with SIP.

UNIT 4: (~10 Lecture Hours)

Media Gateway Control and the Softswitch Architecture: Separation of Media and Call Control, Softswitch Architecture, Requirements for Media Gateway Control, Protocols for Media Gateway Control, MGCP, The MGCP Model, MGCP Endpoints, MGCP Calls and Connections, Overview of MGCP Commands, Overview of MGCP Responses, Command and Response Details, Call Setup Using MGCP, MGCP Events, Signals and Packages, Internetworking between MGCP and SIP.VOIP and SS7: Sigtran Architecture, Interworking SS7 and VoIP Architectures, Interworking Soft switch and SS7, Interworking H.323 and SS7.

UNIT 5: (~10 Lecture Hours)

Quality of Service (QoS): Need for QOS, End-to-end QoS, Overview of QOS solutions, The Resource reservation Protocol (RSVP), Diffserv, The Diffserv Architecture, Multi- protocol Label Switching (MPLS), The MPLS Architecture, MPLS Traffic Engineering, Label Distribution Protocols, Constraint Based Routing ,Combining QoS Solutions.

Text Books:

1. Daniel Collins, "Carrier Grade Voice over IP", Second Edition., TMH.
2. Behrouz A. Forouzan, "TCP/IP Protocol Suite", Fourth Edition, TMH.

Reference Books:

1. Nicholas Wittenberg, "Understanding Voice over IP Technology", Cengage, First Edition, 2010.
2. Michael, F. Finnevan, "Voice Over WLANS – The Complete Guide", Elsevier, 2008.
3. Thiagarajan Vishwanathan, "Telecommunication switching systems and networks" PHI publications, 2006.

Online References:

1. http://nptel.ac.in/courses/117105081/32
2. http://nptel.ac.in/courses/117101050/29

Course Outcomes (COs)

After completion of the course students should be able to

1. Understand various concepts related to IPV4, IPV6 and RTP.
2. Illustrate various challenges in the implementation of VOIP and modifications required to meet these challenges.
3. Analyze the architectures of in H.323, SIP and MGCP protocols developed for the implementation of VOIP.
4. Analyze the message formats used in H.323, SIP and MGCP protocols developed for the implementation of VOIP.
5. Design protocols to ensure Quality of Service for VoIP.
6. Implement Internetworking of VOIP with already existing networks to attain required network performance.

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IV Year B.Tech. ECE I-Semester **L T P C**

Course Code: 127GK **3 0 0 3**

WIRELESS SENSOR NETWORKS

Professional Elective -5

Prerequisites: - Computer Networks

Course Objectives:

The objectives of this course are to make the student to

1. Analyse the fundamentals and architecture of the sensor networks.
2. Describe the various MAC protocols of Wireless sensor networks.
3. Analyse the operation and performance of various routing protocols in wireless sensor network.
4 Obtain the knowledge on Transport layer protocols and security issues in Wireless SensorNetworks.

UNIT 1: (~ 9 Lecture Hours)

Wireless Sensor Networks (TB1) Introduction: Applications of Sensor Networks, Comparison with Ad Hoc Wireless Networks, Issues and Challenges in Designing a Sensor Network, Sensor Network Architecture: Layered Architecture, Clustered Architecture, Data Dissemination: Flooding, MAC Protocols for Sensor Networks: Self-Organizing MAC for Sensor Networks and Eavesdrop and Register, Hybrid TDMA/FDMA, CSMA-Based MAC Protocols, Evolving Standards and other issues: Energy-Efficient Design , Synchronisation, Transport layer Issues, Security and real time communication

UNIT 2: (~ 9 Lecture Hours)

Physical Layer (TB1) Wireless Channel and Communication Fundamentals: Frequency allocation, Modulation and demodulation, wave propagation effects and noise, channel models, spread spectrum communications, packet transmission and synchronisation, Quality of wireless channels and measures for improvement. Physical layer and transceiver design consideration in WSNs.: Energy usage profile, Choice of modulation scheme, Antenna considerations.

UNIT 3: (~ 10 Lecture Hours)

Medium Access Control Protocols (TB2 &TB3) Introduction, Fundamentals of MAC Protocols: Performance Requirements, Common Protocols, MAC protocols for wireless sensor networks, Contention-based protocols: CSMA Protocols, PAMAS, Schedule- based protocols: LEACH, SMACS, Traffic-adaptive medium access protocol (TRAMA).

Link-layer protocols: Fundamentals, Error control, Framing, Link management.

UNIT 4: (~ 10 Lecture Hours)

Routing Protocols for Wireless Sensor Networks (TB3) Introduction, Routing Challenges and Design Issues: Network Scale and Time-Varying

Characteristics, Resource Constraints, Sensor Applications Data Models, Routing Strategies in Wireless Sensor Networks: WSN Routing Techniques, Flooding and Its Variants, Sensor Protocols for Information via Negotiation, Low-Energy Adaptive Clustering Hierarchy, Power-Efficient Gathering in Sensor Information Systems, Directed Diffusion, Geographical Routing.

UNIT 5: (~ 9 Lecture Hours)

Transport Control Protocols (TB3)TCP, UDP, Mobile IP, Transport protocol design Issues, Transport control protocols: CODA, ESRT,RMST, PSFQ, GARUDA and ATP, Problems with transport control protocol performance of trans port control protocols: Congestion, Packet loss recovery.

Security(TB2)

Security considerations in wireless sensor networks, Denial-of-service attacks

Text Books:

1. Ad Hoc Wireless Networks Architectures and Protocols C. Siva Ram Murthy and B.S. Manoj, Prentice Hall, 6th Edition, 2008.
2. Protocols and Architectures for Wireless Sensor Networks- Holger Karl and Andreas Willig John Wiley & Sons Ltd., 2005.
3. Wireless Sensor Networks; Technology, Protocols and Applications - K Sohraby, D Minoli, and T Znati, Wiley Interscience.2007.

Reference Books:

1. Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control - Jagannathan Sarangapani, CRC Press, Taylor & Francis Group, 2007.

Online Resources:

1. https://nptel.ac.in/courses/106106091 (Course Title : Computer Networks by Prof. A. Hema Murthy, IIT Madras
2. http://onlinecources.nptel.ac.in/noc18_cs38 (Computer Networks and internet protocol, Prof. Soumya kannato Ghosh & Prof. Sandip Chakraborty, IIT Kharapur)
3. http://onlinecources.nptel.ac.in/noc18_ee29 (Introduction to wireless cellular communications by Prof. David Koilpillai, IITM).

Course Outcomes:

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

1 Describe the necessities about Wireless Sensor Networks, their characteristics and applications.
2 Analyze Physical layer and transceiver design consideration in WSNs
3 Acquire the knowledge of MAC protocols in Wireless Sensor Networks.
4 Examine the challenges and designing issues of a routing protocols
5 Understand the Transport Layer Protocols in Wireless Sensor Networks
6 Describe the security issues in wireless sensor networks.

IV Year B.Tech. ECE I-Semester **L T P C**
Course Code: 127FQ **3 0 0 3**

LOW POWER VLSI DESIGN

Professional Elective 5

Prerequisites: VLSI Design.

Course Objectives:

1. Understand the Need of Low Power VLSI Design Methodologies.
2. Attain the basic Knowledge of Semiconductor Physics.
3. Characterize Different Sources of Power Dissipations in Static and Dynamic CMOS Circuits.
4. Apply the Techniques to Reduce Leakage Currents in Static and Dynamic CMOS Circuits.

UNIT 1: (~ 10 Lecture Hours)

Introduction to Low Power: Historical Background, Why Low Power, Sources of Power Dissipations, Dynamic Power Dissipations, Static Power Dissipations, Low-Power Design Methodologies.MOS Transistors**:** The Structure of MOS Transistor, The Fluid Model, Electrical Characteristics of MOS Transistors, Threshold Voltage, Body Effect, Short-Channel Effects.

UNIT 2: (~ 10 Lecture Hours)

Sources of Power Dissipation: Introduction, Short-Circuit Power Dissipation, Switching Power Dissipation, Dynamic Power for a Complex Gate, Reduced Voltage Swing, Internal Node Power, Switching Activity, Switching Activity of Static CMOS Gates, Mutually Dependent Inputs, Transition Probability in Dynamic Gates, Glitching Power Dissipation, Leakage Power Dissipation, P-N Junction Reverse-Biased Current, Band-to-Band Tunnelling Current, Subthreshold Leakage Currents.

UNIT 3: (~ 08 Lecture Hours)

Circuits Techniques for Dynamic Power Reduction: Dynamic Power Consumption Components, Circuit Parallelization, Memory Parallelization, Voltage Scaling Based Circuits Techniques, Multiple Voltage Techniques, Low Voltage Swing, Precomputation, Retiming, Synthesis for FSM with Gated Clocks, Circuit Technology Dependent Power Reduction, Path Balancing.

UNIT 4: (~ 10 Lecture Hours)

Leakage Power Minimization: Introduction, Fabrication Of Multiple Threshold Voltages, Multiple Channel Doping, Multiple Oxide CMOS, Multiple Channel Length, Multiple Body Bias, VTCMOS Approach, Transistor Stacking, MTCMOS Approach, Power Gating, Clock Gating Versus Power Gating, Power-Gating Issues, State Retention Strategy, Power-Gating Controller, Power Management, Combining DVFS and Power Management, Dual-Vt Assignment Approach (DTCMOS).

UNIT 5: (~ 8 Lecture Hours)

Low Power Arithmetic Circuits: Introduction, Addition, 1-Bit Addition Cells, Sequential Adder, Propagate and Generate Mechanisms, Carry Select Adder, Carry Skip Adder, Logarithmic Adders.

Low Power Very Fast Dynamic Logic Circuits: Single Clock Latches and Flip-Flops, TSPC Latches and Flip-Flops, Differential Single Clock Latches and Flip-Flops.

Text Books:

1. Ajit. Pal, "Low Power VLSI Circuits and Systems", Springer 2000.
2. Christian Piguet, "Low Power CMOS VLSI Circuits", Taylor & amp; Francis. Inc., 2006.
3. Kaushik Roy and Sharat C. Prasad, "Low-Power CMOS VLSI Design", Wiley-Interscience, 2000.

Reference Books:

1. Neil H. E. Weste and K. Eshraghian, "Principles of CMOS VLSI Design, 2nd Edition, Addison Wesley (Indian reprint).
2. A.P.Chandrasekaran and R.W.Broadersen, "Low power digital CMOS design", Kluwer,1995.
3. Bellamour, and M. I. Elmasri, "Low Power VLSI CMOS Circuit Design", Kluwer Academic Press, 1995.
4. Gary Yeap, "Practical low power digital VLSI design", Kluwer, 1998.

Online Resources:

1. https://dokumen.tips/documents/low-power-vlsi-question-paper.html (Course Title: Low Power VLSI Circuits and Systems, Springer Prof. Ajit Pal, IIT Kharagpur).
2. https://archive.nptel.ac.in/courses/106/105/106105034/ (Course Title: Low Power VLSI Circuits and Systems, Springer Prof. Ajit Pal, IIT Kharagpur).

Course Outcomes:

At the end of the Course, the Students will be able to

1. Understand the Need of Low Power for CMOS Circuits.
2. Apply the Knowledge of Semiconductor Physics to CMOS Circuits.
3. Analyze the Sources of Power Dissipation in Low Power CMOS VLSI Circuits and Systems.
4. Apply the Techniques to Reduce Static and Dynamic Power Dissipations in CMOS Circuits and Systems.
5. Design and Analyze the Low Power CMOS Arithmetic and Sequential Circuits.

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IV Year B.Tech.ECE I-Semester **L T P C**
Course Code: 12768 **0 0 2 1**

WIRELESS COMMUNICATIONS AND NETWORKS LAB
(Common to ECE & ETE)

Prerequisites: Nil

Course Objectives:

1. To analyze Cellular system concepts and CDMA networks.
2. To evaluate the fading mechanism and effect of fading on Mobile communication.
3. To know the role of equalization in Mobile communication and to study adaptive Equalizers.
4. To explain various standards and technologies in wireless LAN

List of Experiments:Software Required:

MATLAB /Octave (for experiments 1,2,4,5,6,7,8,10) and NetSim (for experiments 3,9,11,12, 13,14)

1. Simulation of Handoff performance in mobile communication system.
2. Resource Allocation using frequency reuse in cellular network using MATLAB/Octave software.
3. Measurement of call blocking probability in cellular network using Netsim software.
4. Simulation of the following Outdoor Path Loss Propagation models using MATLAB/Octave software. a. Free Space Propagation model b. Okumura model c. Hata model
5. Simulation of Indoor propagation models using MATLAB software.
6. Simulation of Rayleigh and Ricean fading channel models using MATLAB/Octave software.
7. Simulation of Adaptive Linear Equalizer using MAT LAB/Octave software.
8. Simulation of RAKE Receiver for CDMA communication using MATLAB/Octave software.
9. Measurement of throughput in LTE network using Netsim software.
10. Implementation of WLAN using Matlab Simulink.
11. Multi-AP Wi-Fi Networks: Channel Allocation using Netsim software.
12. One Hop IoT Network over IEEE 802.15.4 using Netsim software.
13. Quality of Service (QoS) in 802.11e based WLANs using NetSim.
14. Performance evaluation of an IEEE 802.15.4 sensor network with a star topology using NetSim.

Course Outcomes:

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

1. Apply cellular concepts to evaluate the signal reception performance in a cellular network and traffic analysis.
2. Design Path-Loss models.
3. Analyze the impact of multi path effects in the design of wireless system.
4. Implement RAKE receiver for CDMA communication system.
5. Design Wireless LAN cellular network with given quality of service constraints.
6. Understand various medium access control (MAC) protocols for WSNs

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IV Year B.Tech. ECE I-Semester **L T P C**
Course Code: 12759 **0 0 2 1**

MICROWAVE AND OPTICAL COMMUNICATIONS LAB

Prerequisites: -Nil-

Course Objectives:

1. The lab course will give a practical exposure to students to learn the characteristics of Microwave components and Optical Sources.
2. To gain the practical hands on experience by exposing the students to various microwave components.
3. To Learn the principle of Numerical Aperture and Losses for a Fiber Cable.

List of Experiments

1. Reflex Klystron Characteristics.
2. Gunn Diode Characteristics.
3. Attenuation measurement.
4. Directional coupler Characteristics.
5. Scattering parameters of wave guide components.
6. Frequency measurement.
7. Impedance measurement.
8. VSWR measurement.
9. Antenna Pattern Measurement.
10. Characterization of LED.
11. Characterization of Laser Diode.
12. Intensity modulation of Laser output through an optical fiber.
13. Measurement of Data rate for Digital Optical link.
14. Measurement of Numerical Aperture of fiber cable.
15. Measurement of losses for Optical link

Content beyond syllabus

1. Characteristics of E-Plane, H-Plane and Magic Tee.
2. Testing of MSPA using VNA

Note: Minimum of 12 experiments to be conducted

Course Outcomes:

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

1. Model a microwave bench set up for any type of microwave lab measurement in X band.
2. Relate the functionality of each microwave component and distinguish between different microwave sources.
3. Classify and specify microwave components needed for each experiment.
4. Design a set output for antenna pattern measurement and compare the experimental results with theoretical ones and justify the results obtained.
5. Analyze various types of Optical sources and its Characteristics.
6. Understand the Principle of Numerical Aperture and Losses that occur in Fiber Optic Cable.

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IV Year B.Tech.ECE I-Semester **L T P C**
Course Code: 12756 **0 0 2 1**

EMBEDDED SYSTEM DESIGN LAB

Prerequisites: - 1. Microprocessors and Microcontrollers.

Course Objectives:

1. Understand the design, characteristics, and technologies of Embedded systems.
2. Practically interface sensors/output devices using Arduino.
3. To introduce the concept of machine-to-machine communication.
4. To Introduce Raspberry PI platform, which is used in many IOT applications.

List of Experiments:

Arduino Experiments

1. Controlling an LED using pushbutton switch (Tinkercad).
2. Controlling speed of DC Motor using potentiometer (Tinkercad).
3. Controlling LED with PIR sensor using Arduino.
4. Interfacing Stepper motor with Arduino.
5. Measuring Distance with the Ultrasonic Sensor Sensor and Displaying it on LCD.
6. Interfacing GSM and Sending GPS location to your mobile number through GSM using Arduino.
7. Interfacing Temperature Sensor with Arduino/ESP8266 and Sending the output to Thingspeak Cloud.
8. Interfacing Ultrasonic Sensor and sending the values to Thingspeak Cloud.

Raspberry pi Experiments:

1. Flashing the OS on to the device into a stable functional state by porting desktop environment with necessary packages.
2. Making use of available laptop/desktop displays as a display for the device using SSH client & X11 display server.
3. Programming of available GPIO pins of the corresponding device using native programming language. Interfacing of I/O devices like LED, Switch and testing the functionality.
4. Using the light sensors, monitor the surrounding light intensity and automatically turn ON/OFF the high intensity LED by taking some pre-defined threshold light intensity value.
5. Displaying the RSS news feed headlines on a LCD display connected to device. This can be adapted to other websites like twitter or other information websites.

6. Interfacing the regular USB webcam with the device and turn it into fully functional IP webcam and test the functionality.

Note: Minimum of 12 experiments to be conducted.

Devices mentioned in the above lists include Arduino, Esp8266, Raspbery Pi.

Online Resources:

1. https://projecthub.arduino.cc/
2. https://nptel.ac.in/courses/106105166 (Course Title: Introduction to IoT, Prof. Anupam Basu, Sudip Mishra, IIT Kharagpur).

Course Outcomes:

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

1. Connect and control the data from or to Sensors/Output devices using Aurdino.
2. Understand the design, characteristics of Embedded systems.
3. Illustrate different sensors for sensing real world entities.
4. Understand the Cloud interface in IoT Architectures.
5. Interpret the impact and challenges posted by IoT networks leading to new architectural models.
6. Identify the applications of IoT in industry.

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IV Year B.Tech ECE I-Semester | **L T P C**
Course Code: 12734 | **0 0 2 1**

IV Year B.Tech ECE I-Semester	**L**	**T**	**P**	**C**
Course Code: 12734	**0**	**0**	**2**	**1**

MACHINE LEARNING LAB

(Common to ECE & ETE)

Prerequisites: Python Programming

Course Objectives:

1. Familiarize with the basics of Python.
2. Implement different machine learning algorithms and techniques using Python.
3. Analyze the performance of different machine learning algorithms.
4. To build Machine learning models for real world problems.

List of Programs:

Week 1:

Getting familiarized with basic concepts like data types, data frames, control structures, list, tuple dictionary and functions in Python.

Week 2:

Implement FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples.

Week 3:

For a given set of training data examples, implement Candidate Elimination algorithm to output a description of the set of all consistent hypothesis.

Week 4:

Build FIND-S and Candidate-Elimination algorithm on a different dataset.

Week 5:

Implement Decision tree for classification of any given data set.

Week 6:

Implement pruning of Decision tree.

Week 7:

Implement SVM algorithm to classify any given data set.

Week 8:

Implement k-Nearest Neighbour algorithm to classify any given data set.

Week 9:

Implement the naive Bayesian classifier and compute the accuracy, precision and recall.

Week 10:

Implement Regression algorithm in order to fit data points.

Week 11:

Implement Radial basis algorithm in order to fit data points.

Week 12:

Implement an algorithm to demonstrate the significance of genetic algorithm.

Text Books:

1. Tom M. Mitchell, Machine Learning, Mc Graw Hill Education, 1997.
2. Sebastian Raschka, Python Machine Learning, PACKT Publishing, 2015.

Reference Books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MITPress, 2012.
2. Trevor Hastie, Robert Tibshirani and Jerome Friedman, The Elementsof Statistical Learning, 2nd Edition, Springer Series in Statistics, 2001
3. William W Hsieh, Machine Learning Methods in the Environmental Sciences, Neural Networks and Kernels, Cambridge University Press.
4. Stephen Marsland, Machine Learning - An Algorithmic Perspective, CRC Press, 2009.

Online Resources:

1. http://www.cs.cmu.edu/~tom/
2. http://www.holehouse.org/mlclass/

Course Outcomes:

After completion of the course, students will be able to

1. Program using basic features of Python.
2. Apply and analyse concept learning techniques to version spaces.
3. Design statistical and hierarchical models in Machine Learning.
4. Analyse lazy and eager learning algorithms.
5. Identify machine learning techniques appropriate to respective problems.
6. Compare various machine learning algorithms along with their strengths and weaknesses.

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IV Year B.Tech.ECE II-Semester	**L T P C**
Course Code: 128GW	**2 0 0 2**

ENTREPRENEURSHIP AND PROJECT MANAGEMENT

(Common to CSE, CSD, CSM, CST, ECE, EEE, ETE & IT)

Prerequisites: Fundamentals of Management.

Course Objectives:

1. Inculcate the entrepreneurial knowledge required to start and/or to run a business.
2. Hone entrepreneurial skills and create sensibility in entrepreneurial establishment.
3. Develop strategic skills in the project planning and implementation.

UNIT 1 : (~ 05 lectures)

Introduction to Entrepreneurship

Entrepreneurship: Introduction to Entrepreneur - Characteristic and skills of an Entrepreneur – Functions and Types of Entrepreneurs – Theories of Entrepreneurship - Process of Entrepreneurship - Factors affecting Entrepreneurship development - Women Entrepreneurs - Growth and Problems – Importance of Entrepreneurial Marketing.

UNIT 2 : (~ 06 lectures)

Entrepreneurial business selection

Entrepreneurial business selection: Criteria for selection of Business Structure - Types of Business Structures - Sole Proprietorship – Partnership - Limited Liability Partnership(LLP) - One-person company - Joint stock company – Features - Merits & Demerits – Suitability.

UNIT 3 : (~ 07 lectures)

Project Finance for Entrepreneur: Introduction to Capital-Types of Capital-Factors affecting Fixed Capital and Working Capital requirements -Sources of raising Finance – Entrepreneurial Finance (Seed Funding, Business Angels, Venture Capital, Family Offices, Financial bootstrapping, Buyouts, Accelerators and Incubators, Crowdfunding, IP based Investment funds)

UNIT 4 : (~ 07 lectures)

Project Appraisal/Evaluation Techniques

Capital Budgeting: Introduction - Need and Importance of Capital Budgeting -Traditional methods - Payback Period Method - ARR Method. Discounted Cash Flow Method – NPV - PI and IRR (simple problems).

Network Analysis - Introduction to Network analysis – PERT & CPM Analysis. Identification of Critical Path - Probability of Completing the Project within a given time - Calculation of Float/Slack - Importance of PERT & CPM in Decision Making – Project audit.

UNIT 5 : (~ 07 lectures)

Entrepreneurial Business Plan:

Entrepreneurial Business Plan - Preparation – Aspects to be considered in preparing Business Plan – Objectives – Elements of Business Plan (Production plan and Operational Plan)- Understanding Risk assessment of Enterprise towards Entrepreneurial Success. India- Case Study.

Text Books:

1. Dr. S.S. Khanka (2021) Entrepreneurial Development, 4th Edition, S.Chand & Company.
2. L. S. Srinath (2012) PERT & CPM – Principles & Applications, 3rd Edition, EWP.

Reference Books:

1. Khan & Jain (2018) Financial Management, 8th Edition, TMH.
2. Robert.D.Hisrich, Mathew. J. Manimala, Michael. P. Peter, Dean A.Shepherd (2017) Entrepreneurship, 9th Edition, Mc. Graw Hill.
3. S. D. Sharma (2008) Operations Research, 15th Edition, Macmillan.
4. Tulsian (2002) Business organization & Management, 1st Edition, Pearson.

Online Resources:

1. Entrepreneurship Essentials https://onlinecourses.nptel.ac.in/noc21_ge06/preview
2. Project Management https://onlinecourses.nptel.ac.in/noc21_mg71/preview
3. Financial Management for Managers https://nptel.ac.in/courses/110107144

Course Outcomes (COs)

After learning the contents of this course, the student must be able to

1. Summarize the entrepreneurial ingenuity and skills required for business functioning.
2. Relate the probable business structures for entrepreneurial decisions.
3. Identify the probable finance alternatives available for investment in the project.
4. Deduct the investment opportunities and resource allocation decisions.
5. Evaluate the time feasibility of entrepreneurial project implementation.
6. Integrate and formulate an entrepreneurial business plan.

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IV Year B.Tech. ECE II-Semester **L T P C**
Course Code: 128HF **3 0 0 3**

RADAR SYSTEMS

Professional Elective-6

Prerequisites: Analog and Digital Communications.

Course Objectives:

1. To understand the working principle of a radar, identify the frequency bands, and formulate the complete radar range equation, listing out all the losses to be accounted for.
2. To identify the need for modulation and Doppler effect; to get acquainted with the working principles of CW radar, FM-CW radar.
3. To impart the knowledge of functioning of MTI radar and its variants; to establish the DLC features and to bring out the MTI radar performance limitations.
4. To establish the principle of Tracking Radar and differentiate between different types of tracking radars, identifying their principle of operation with necessary schematics.
5. To explain the concept of a Matched Filter in radar receiver, and to configure its response characteristics; to impart the working knowledge of different receiver blocks-duplexers, displays, phased array antennas, their requirements and utilities.

UNIT 1: (~10 Lecture Hours)

Basics of Radar: Introduction, Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, Illustrative Problems. Radar Equation: SNR, Envelope Detector – False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets , Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems.

UNIT 2: (~8 Lecture 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.

UNIT 3: (~8 Lecture Hours)

MTI and Pulse Doppler radar: Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line

Cancellers-Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler Radar.

UNIT 4: (~10 Lecture Hours)

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

UNIT 5: (~12 Lecture Hours)

Detection of Radar Signals in Noise : Introduction, Matched Filter Receiver-Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non-matched Filters, Matched Filter with Non-white Noise. Radar Receivers – Noise Figure and NoiseTemperature, Displays – types. Duplexers-Branch type and Balanced type, Circulators as Duplexers.

Introduction to Phased Array Antennas-Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Applications, Advantages and Limitations.

Text Books:

1. Introduction to Radar Systems – Merrill I. Skolnik, TMH Special Indian Edition, 2nd Ed., 2007.

Reference Books:

1. Radar: Principles, Technology, Applications – Byron Edde, Pearson Education, 2004
2. Radar Principles – Peebles, Jr., P.Z., Wiley, New York, 1998.
3. Principles of Modern Radar: Basic Principles – Mark A. Richards, James A. Scheer, William A. Holm, Yesdee, 2013
4. Radar Handbook - Merrill I. Skolnik, 3rd Ed., McGraw Hill Education, 2008. in Statistics, 2nd Edition 2001.

Online Resources:

1. https://www.ll.mit.edu/outreach/radar-introduction-radar-systems-online-course - Introduction to Radar Systems — Online Course by Robert M. O'Donnell, a former researcher at MIT Lincoln Laboratory, Massachusetts Institute of Technology, 244 Wood Street, Lexington, MA 02421-6426
2. https://onlinecourses.nptel.ac.in/noc23_ee133/preview -by Prof. Amitabha Bhattacharya, IIT Kharagpur, India.

Course Outcomes:

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

1. Explain the working principle of a pulse radar and establish the complete radar range equation, identifying the significance and choice of all parameters involved, and solve numerical problems to establish the radar characteristics.
2. Account for the need and functioning of CW, FM-CW and MTI radars, identifying the complete block diagrams and establishing their characteristics.
3. Illustrate the DLC characteristics, account for the range gated Doppler filter bank, and estimate the MTI radar performance characteristics and limitations.
4. Distinguish between Sequential Lobbing, Conical Scan, Mono-pulse type of Tracking Radars, specify their requirements and compare their characteristic features.
5. Derive the matched filter response characteristics for radar applications and account for correlation receivers; to distinguish between different radar displays and duplexers.
6. Account for the electronic scanning principle, and implement the same through phased array antennas, knowing their requirements and utilities.

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IV Year B. Tech. ECE II-Semester **L T P C**
Course Code: 128HA **3 0 0 3**

5G COMMUNICATION TECHNOLOGIES

(Common to ECE & ETE)

Professional Elective-6

Prerequisite: Wireless Communications and Networks

Course Objectives:

1. Understand the historical background and evolution of mobile communications and the need for the development of 5G technologies.
2. Familiarize with the key concepts, requirements, and performance indicators of 5G networks and its use cases in various domains.
3. Explore the architectural components of 5G networks, including NFV (Network Function Virtualization) and SDN (Software-Defined Networking)
4. Gain insights into machine-type communications (MTC) and device-to-device (D2D) communications in 5G, including use cases, requirements, and fundamental techniques.
5. Understand the spectrum landscape, access modes, and sharing scenarios in 5G, along with the technologies used for efficient spectrum utilization.
6. Explore mobility and handoff management in 5G networks, including network deployment types, interference management, mobility management, and dynamic network reconfiguration.

UNIT 1: (~10 Lecture Hours)

Introduction: Mobile Radio Standards (1G, 2G, 2.5G and 3G Standards), GSM architecture and subsystems, Fundamentals of 4G, Introduction to 5G Communications, Historical background,Industrial and Technological revolution: from steam engines to the Internet, From ICT to whole economy, Rationale of 5G, Global Initiatives, Standardization activities.

UNIT 2: (~10 Lecture Hours)

5G use cases and system concepts: Use Cases, requirements and key performance indicators. 5G system concept: Concept overview, extreme mobile broadband, massive machine-type communication, ultra-reliable machine-type communication dynamic radio access network, lean system control plane, localized content and traffic flows, spectrum toolbox.

UNIT 3: (~8 Lecture Hours)

The 5G architecture: Introduction: NFV and SDN, basics about RAN architecture, High-level requirements for 5G architecture, functional architecture and 5G flexibility, physical architecture and 5G deployment.

UNIT 4: (~10 Lecture Hours)

Machine-type communications: Introduction, Use cases and categorization of MTC, MTC requirements, Fundamental techniques for MTC, Massive MTC, Ultra-reliable low-latency MTC

Device-to-device (D2D) communications: D2D:from 4G to 5G, Radio resource management for mobile broadband D2D, Multi-hop D2D communications for proximity and emergency services, Multi-operator D2D communication.

UNIT 5: (~10 Lecture Hours)

5G Radio Spectrum: 5G spectrum landscape and requirements, Spectrum access modes and sharing scenarios, 5G spectrum technologies.

Mobility and Handoff Management in 5G: Network deployment types, Interference management in 5G, Mobility management in 5G, Dynamic network reconfiguration in 5G.

Text Books:

1. Afif Osseiran, Jose F Monserrat, Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016
2. T.S.Rappaport, Wireless Communications, Principles and Practice, 2nd Edition, PHI, 2010.
3. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies", CRC Press, Taylor & Francis Group, First Edition, 2018.

References:

1. Harri Holma, Antti Toskala, Takehiro Nakamura, "5G Technology 3GPP NEW RADIO", John Wiley & Sons First Edition,2020
2. Gordon L. Stuber, "Principles of Mobile Communication", KLUWER ACADEMIC PUBLISHERS, 2nd Edition, 2002
3. Joseph C. Liberti, Theodore S. Rappaport, "Smart Antennas for Wireless Communications", Prentice Hall PTR, 1999 76
4. Ying Zhang, "Network Function Virtualization Concepts and Applicability in 5G Networks", John Wiley & Sons, 2018

Online References:

1. Ericsson learning resources: https://www.ericsson.com/en/portfolio/training-offerings ?page=courselist&cat=5G/IOT&pageno=1
2. Evolution Of Air Interface Towards 5G.
   https://onlinecourses.nptel.ac.in/noc22_ee56/pr eview
3. 5G Technologies with AI and Cloud. https://iisc.talentsprint.com/5g/

Course Outcomes (COs)

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

1 Analyze the historical evolution of mobile communications and evaluate the significance of 5G technologies in addressing industry needs.

2 Evaluate the use cases and requirements of 5G networks and assess key performance indicators for different applications.

3 Assess the impact of architectural components, such as NFV and SDN, on the flexibility and scalability of 5G networks.

4 Apply the knowledge of machine-type communications and device-to-device communications to analyze use cases, requirements, and fundamental techniques in the context of 5G.

5 Compare and contrast different spectrum technologies, access modes, and sharing scenarios in 5G, and evaluate their suitability for efficient spectrum utilization.

6 Design and implement mobility and handoff management techniques in 5G networks, considering network deployment types, interference management, and dynamic network reconfiguration.

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IV Year B.Tech ECE II-Semester	**L T P C**
Course Code: 128GY	**3 0 0 3**

STATIC TIMING ANALYSIS

Professional Elective-6

Prerequisites: Digital Electronics and Logic Design, VLSI Design.

Course Objectives:

1. Review the terminology related to Static Timing Analysis.
2. Understand timing considerations at cell and interconnect level.
3. Address signal integrity issues in circuits.
4. Perform timing estimation and timing checks on digital circuits.

UNIT 1: (~ 10 Lecture Hours)

Introduction: Static Timing Analysis, Design Flow, STA at Different Design Phases, Limitations of Static Timing Analysis, Power Considerations, Reliability Considerations.

STA Concepts: CMOS Logic Design, Modelling of CMOS Cells, Switching Waveform, Propagation Delay, Slew of a Waveform, Skew between Signals, Timing Arcs and Unateness, Min and Max Timing Paths, Clock Domains, Operating Conditions.

UNIT 2: (~ 8 Lecture Hours)

Standard Cell Library: Pin Capacitance, Timing Modeling, Timing Models - Combinational Cells, Timing Models - Sequential Cells, State-Dependent Models, Interface Timing Model for a Black Box, Power Dissipation Modeling, Other Attributes in Cell Library, Characterization and Operating Conditions.

UNIT 3: (~ 7 Lecture Hours)

Interconnect Parasitics: RLC for Interconnect, T-model, Pi-model, Wireload Models, Representation of Extracted Parasitics, Representing Coupling Capacitances, Hierarchical Methodology, Reducing Parasitics for Critical Nets.

UNIT 4: (~ 8 Lecture Hours)

Delay Calculation: Overview, Delay Calculation Basics, Delay Calculation with Interconnect, Cell Delay using Effective Capacitance, Interconnect Delay, Slew Merging, Different Slew Thresholds Different Voltage Domains, Path Delay Calculation, Combinational Path Delay, Path to a Flip-flop, Input to Flip- flop Path, Flip-flop to Flip-flop Path, Multiple Paths, Slack Calculation.

Crosstalk and Noise: Overview, Crosstalk Glitch Analysis, Crosstalk Delay Analysis, Timing Verification Using Crosstalk Delay, Setup Analysis, Hold Analysis, Computational Complexity, Noise Avoidance Techniques.

UNIT 5: (~ 10 Lecture Hours)

Timing Verification: Setup Timing Check, Hold Timing Check, Multicycle Paths, False Paths, Half-Cycle Paths, Removal Timing Check, Recovery Timing Check, Timing across Clock Domains.

Text Books:

1. Static Timing Analysis for Nanometer Designs, A Practical Approach - J. Bhasker, Rakesh Chadha, Springer, 2009.
2. Static Timing Analysis for VLSI Circuits, R. Jayagovwri, Pushpendra S. Yadav, Scientific International Pvt. Ltd, 2018.

Reference Books:

1. Essential EDA: A Comprehensive Guide to Electronic Design Automation" by Sandeep K. Shukla and R. Iris Bahar.
2. Principles of CMOS VLSI Design: A Systems Perspective" by Neil Weste and David Harris.

Online Resources:

1. Design and Analysis of VLSI Subsystem, Dr. Madhav Rao, IIIT Bangalore https://onlinecourses.nptel.ac.in/noc22_ee44/preview
2. Static Timing Analysis Bootcamp, VLSI Academy https://www.youtube.com/watch?v=jcKVrkEvoA8&list=PL1h5a0eaDD3rMBdiRd8vyQDr8rR Fbe4pG
3. VLSI Backend Adventure
   https://www.vlsi-backend-adventure.com/sta.html

Course Outcomes:

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

1. Memorize the terminology used in Static Timing Analysis.
2. Describe timing considerations at the cell level in digital circuits.
3. Model and represent interconnect parasitics in digital circuits.
4. Estimate timing of the design using cell and path delays.
5. Examine the parameters that affect signal integrity of a design.
6. Validate the timing checks performed as a part of the timing analysis.

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IV Year B.Tech. ECE II-Semester **L T P C**

Course Code: 128HH **3 0 0 3**

SATELLITE COMMUNICATIONS AND NAVIGATION SYSTEMS

Professional Elective-6

Prerequisites: Nil

Course Objectives:

1. To explain the basic satellite communication operation with Geo Stationary Orbit systems.
2. To classify the various Orbit systems and NGSO constellations and make the students understand the GNSS segments and signal structure.
3. To distinguish between the coordinates systems likely to be encountered by GPS users.
4. To demonstrate an understanding of error sources in GPS observations, and explain the uses and critical factors of Differential GPS techniques.
5. To analyze the GPS navigation and observation files and determine the position.
6. To demonstrate the necessity of augmentation systems and help the students understand their operation.

UNIT 1: (~8 Lecture Hours)

Satellite Communication Fundamentals: Orbit and Description, Satellite Frequency Bands, Applications, Orbital Period and Velocity, Coverage angle and slant Range, Eclipse.

Satellite Subsystems: Communication Subsystem, Telemetry Command and Ranging Subsystem, Attitude Control Subsystem, Electrical Power Subsystem, Satellite Antennas.

UNIT 2: (~10 Lecture Hours)

GNSS Basics: Overview of GNSS segments, Space Segment, Ground Segment and Control Segment.

Overview of GNSS Constellations: GPS, GLONASS, GALILEO, IRNSS (NAVIC), Beidou, Concept of Ranging Using TOA Measurements, Time references. Dilution of precision: HDOP, VDOP and GDOP, GNSS applications.

UNIT 3: (~10 Lecture Hours)

Coordinate systems and Sources of Error:

Coordinate Systems: Geodetic reference systems: Earth-Centered Inertial Coordinate System, Earth-Centered Earth-Fixed Coordinate System, World Geodetic System, Indian Geodetic System (IGS).

Sources of error in GNSS: Satellite and Receiver clock errors, Ephemeris error, Multipath error**,** Atmospheric errors**-** Troposphere errors and Ionospheric errors, Hardware bias error and Pseudorange error budget. Effects of Satellite Outages on GPS Availability.

UNIT 4: (~8 Lecture Hours)

GPS Signal Structure, C/A Code and P code GPS Receivers, Pseudorange Measurements, Carrier Phase Measurements, Signal Acquisition, GPS navigation and observation data formats (RINEX).

UNIT 5: (~9 Lecture Hours)

Differential GPS (DGPS), Local Area DGPS (LADGPS), Wide Area DGPS (WADGPS). Augmentation systems: Need for augmentation, Types of augmentation systems: Space Based Augmentation system (SBAS), GPS Aided GEO Augmented Navigation (GAGAN), Ground Based Augmentation System (GBAS).

Text Books:

1. Satellite Communications – Timothy Pratt, Jeremy Allnutt, WSE, Wiley Publications, 3rd Edition, 2019.
2. Digital Satellite Communications —- Tri T.Ha, 2/e, Tata McGraw-Hill, 2009.
3. Introduction to GPS — Ahmed El-Rabbany, 2/e, Artech House Publishers, Boston, 2006.
4. Understanding GPS Principles and Applications, Elliot D Kaplan and Christopher J Hegarty, 2/e, Artech House Publishers, Boston & London 2005.

Reference Books:

1. Satellite Communications: Design Principles – M. Richharia, BS Publications, 2nd Edition, 2003.
2. B.Hofmann-Wellenhof, H.Lichtenegger, and J.Collins, “GPS Theory and Practice”, Springer Verlog, 5/e, 2008.
3. Bradford W.Parkinson and James J.Spilker, “Global Positioning system: Theory and Application”, Vol.II, American Institution of Aeronautices and Astronautics Inc., Washington, 1996.

Online Resources:

1. UCLA University EC ENGR X 422.19 https://www.uclaextension.edu/engineering/electrical-computer- engineering/course/satellite-communication-system-design-ec-engr-x
2. MIT Open courseware https://ocw.mit.edu/courses/16-851-satellite-engineering-fall- 2003/resources/l2_orbital_mech/
3. https://deeppradhan.heliohost.org/gis/indian-grid/
4. https://www.sac.gov.in/SACSITE/GAGAN%20&%20IRNSS.pdf
5. https://www.insidegnss.com/auto/julyaug17-IRNSS.pdf

6. http://insidegnss.com/wp-content/uploads/2018/01/janfeb16-GAGAN.pdf

Course Outcomes (COs)

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

1. Explain the operation of basic satellite communication along with Geo stationary Satellite system.
2. Identify Low Earth Orbit and describe the NGSO constellation designs.
3. Interpret various coordinate systems for estimating position.
4. Estimate the various errors and their effect on position estimation.
5. Analyze GPS signal structure and differentiate the various Observation data formats.
6. Apply DGPS principle and can also analyze various augmentation systems.

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III Year B.Tech. II-Semester	**L**	**T**	**P**	**C**
Course Code: 126KF	**3**	**0**	**0**	**3**

FUNDAMENTALS OF DATA STRUCTURES

(Open Elective-1)

Prerequisites:- Nil

Course Objectives:

1. Understand the notations used to analyze the performance of algorithms.
2. Understand the basic concepts such as Linear and Nonlinear Data structures.
3. Understand the behavior of data structures such as stacks, queues, trees, search trees, graphs and their representations.
4. Choose the appropriate data structure for a specified application.
5. Understand and analyze various searching and sorting algorithms.

UNIT 1: (~10 Lecture Hours)

Basic concepts- Algorithm Specification, Performance Analysis - Time Complexity and Space Complexity, Asymptotic Notation-Big O, Omega and Theta notations, Introduction to Linear and Non Linear data structures. Stacks, Queues, Circular queues, Applications of stacks: infix to postfix conversion, postfix expression evaluation.

UNIT 2 : (~9 Lecture Hours)

Linked list: Singly Linked List, Doubly Linked List, Circular linked list working and representation. Implementation of stacks and queues using linked list.

UNIT 3: (~9 Lecture Hours)

Trees: Introduction, Basic terminology, Binary Trees, Sequential and Linked representation, Operations - insertion, deletion and traversal.

Hashing: Introduction, Hash Functions, Collision Resolution Techniques.

UNIT 4: (~9 Lecture Hours)

Searching: Linear and binary Search methods.

Sorting: Bubble Sort, Selection Sort, Insertion Sort, Quick sort, Merge sort, Heap sort, Time complexities.

UNIT 5: (~8 Lecture Hours)

Graphs: Terminology, Properties, Graph representations – Adjacency matrix, Adjacency list.

Graph Traversals: Depth First Search & Breadth First Search.

Search Trees: Binary Search Trees, Definition, Operations - Insertion and Deletion, m- way search trees (Definition only).

Text Books:

1. R.Thareja, Data Structures using C, Oxford University Press, October 2015.
2. Horowitz, Sahni, and Anderson - Freed, Fundamentals of Data Structures in C, 2nd Edition, Universities Press.

Reference Books:

1. R.F.Gilberg and B.A.Forouzan, Data Structures: A Pseudocode Approach with C, 2nd Edition, Cengage Learning.
2. A.M.Tanenbaum, Y.Langsam and M.J. Augenstein, Data Structures using C, 2004, Pearson Education Asia.

Online Resources:

1. https://www.cise.ufl.edu/~sahni/fdsc2ed/instruct/index.html
2. www.geeksforgeeks.org/data-structures
3. https://nptel.ac.in/courses/106102064
4. https://www.coursera.org/learn/data-structures
5. https://ict.iitk.ac.in/wp-content/uploads/CS210-Data-Structures-Module-1-Motivation.pdf

Course Outcomes:

After completion of the course, students will be able to

1. Understand the time and space complexities of algorithms.
2. Differentiate between linear and non-linear data structures.
3. Use basic data structures such as linked list, stack and queue for data representation.
4. Understand non linear data structures like binary trees, search trees and graphs.
5. Choose appropriate data structures as applied to specified problem definition.
6. Analyze Various Kinds Of Searching And Sorting Techniques.

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III Year B. Tech. II-Semester **L T P C**
Course Code: 126KG **3 0 0 3**

FUNDAMENTALS OF DATABASE MANAGEMENT SYSTEMS
(Open Elective - 1)

Prerequisites: Nil

Course Objectives:
1. Understand the basic concepts and the applications of database systems.
2. Understand the relational database design principles.
3. Master the basics of SQL and construct queries using SQL.
4. Understand the design databases using data modelling and data normalization techniques.

UNIT 1: (~ 10 Lecture Hours)
Introduction: History of database system**,** Database-system applications, Purpose of database systems, View of data, Database languages, Relational databases, Data storage and querying, Transaction management, Database architecture, Database users and administrators.

UNIT 2: (~ 8 Lecture Hours)
Database Design and E-R Model: The Entity-Relationship model, Constrains, Removing Redundant Attributes in Entity Sets, Entity-Relationship Diagrams, Reduction to Relational Schemas, Entity-Relationship Design issues, Extended E-R Features.

Introduction to Relational Model: Structure of Relational Databases, Database Schema, Schema Diagrams, Relational Query Languages, Relational Operations.

UNIT 3: (~ 9 Lecture Hours)
Relational Query Languages: The Relational Algebra, Tuple Relational Calculus, Domain Relational Calculus.

Introduction to SQL : Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Sub Queries, Modification of the Database.

UNIT 4: (~ 9 Lecture Hours)
Advanced SQL: Join Expressions, Views, Integrity Constraints, Accessing SQL from a Programming Language, Functions and procedures, Triggers.

UNIT 5: (~ 9 Lecture Hours)
Relational Database Design: Features of Good Relational Designs, Atomic Domains and First Normal Form, Decomposition Using Functional

Dependencies, Functional Dependency Theory, Algorithms for Decompositions, Decomposition using Multi Valued Dependencies, More Normal Forms.

Text Books:

1. A. Silberschatz, Henry.F. Korth and S. Sudharshan, Database System Concepts, 6th Edition, Mc Graw Hill Education (India) Private Limited.

Reference Books:

1. C.J. Date, A.Kannan, and S.Swami Nadhan, An Introduction to Database systems, 8th Edition, Pearson Education.
2. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3rd Edition, Mc Graw Hill Education (India) Private Limited.
3. R Elmasri and Shamkant B. Navathe, Database Systems, 6th Edition, Pearson Education.

Online Resources:

1. www.w3schools.in
2. https://beginnersbook.com/2015/04/dbms-tutorial/
3. https://www.coursera.org/courses?query=database
4. https://onlinecourses.nptel.ac.in/noc18_cs15

Course Outcomes:

After completion of the course, students will be able to

1. Understand concepts and the applications of database systems and implement in real time applications.
2. Design an Entity-Relationship (E-R) model from specifications and transform to relational model.
3. Demonstrate the basic concepts of relational database management system.
4. Construct unary/binary/set/aggregate queries in Relational Algebra and in SQL.
5. Articulate the SQL commands for retrieval and management of data.
6. Apply normalization on database schema.

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III Year B.Tech. II-Semester **L T P C**
Course Code: 126KK **3 0 0 3**

OPERATING SYSTEMS

(Open Elective - 1)

Prerequisites: Nil

Course Objectives:

1. Interpret the role of an Operating System in the overall computer system and study the operations performed by it as a resource manager.
2. Understand the scheduling policies and different memory management techniques for different Operating Systems.
3. Examine process concurrency, synchronization and deadlock situation.
4. Assess the concepts of I/O, storage and file management and introduce system call interface for file and process management.
5. Outline the goals and principles of protection.

UNIT 1: (~10 Lecture Hours)

Introduction: Overview-Introduction-Operating System objectives and functions, User view, System view, Operating System definition, Evolution of Operating System- Simple Batch systems, Multiprogrammed, Time Sharing Systems, OS Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments.

Operating System services, User and OS Interface, System Calls, Types of System Calls, System Programs, Operating System Design and Implementation, OS Structure.

UNIT 2: (~9 Lecture Hours)

Process: Process concepts-The Process, Process State, Process State transitions, Process Control Block, Context Switch. Threads: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.

Process Scheduling: Scheduling Queues, Schedulers, Scheduling Criteria, Scheduling algorithms, Multiprocessor Scheduling. Case Studies: Linux, Windows.

UNIT 3: (~10 Lecture Hours)

Process Synchronization: Inter-process Communication - Background, The Critical Section Problem, Race Conditions, Mutual Exclusion, Peterson’s solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization - Bounded Buffer Problem, The Producer/ Consumer Problem, Reader’s & Writer’s Problem, Dinning Philosopher Problem, Event counters, Monitors, Message passing.

Deadlocks: Deadlocks - System Model, Deadlock Characterization - Necessary and sufficient conditions for Deadlock, Methods for Handling

Deadlocks - Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery from Deadlock.

UNIT 4: (~10 Lecture Hours)

Memory Management: Basic Hardware, Address Binding, Logical and physical address space, Dynamic loading, linking and shared libraries, Swapping, Contiguous Memory Allocation- Fixed and variable partition - Internal and External fragmentation and Compaction, Segmentation, Paging-Hardware support for paging, Protection, shared pages, Structure of Page Table, Case Studies - Linux, Windows.

Virtual Memory Management: Background, Demand Paging-locality of reference, Page fault, Copy-on-Write, Page replacement, Page Replacement Algorithms, Allocation of Frames, Thrashing.

UNIT 5: (~9 Lecture Hours)

File Management: Concept of File - Attributes, operations, file types, internal structure, access methods, Directory structure, file protection, file system structure, Allocation methods (contiguous, linked, indexed), Freespace management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk formatting- Bootblock, Bad blocks.

Protection: System Protection, Goals of Protection, Principles of Protection.

Text Books:

1. Abraham Silberschatz, Peter B.Galvin and Greg Gagne, Operating System Concepts, 9th Edition, Wiley AsiaStudent Edition.
2. William Stallings, Operating Systems: Internals and Design Principles, 5th Edition, Prentice Hall of India.

Reference Books:

1. Charles Crowley, Operating System: A Design-oriented Approach, 1st Edition, Irwin Publishing.
2. Gary J. Nutt and Addison, Operating Systems: A Modern Perspective, 2nd Edition, Wesley.
3. Maurice Bach, Design of the UNIX Operating Systems, 8th Edition, Prentice Hall of India.
4. Daniel P. Bovet and Marco Cesati, Understanding the Linux Kernel, 3rd Edition, O'Reilly and Associates.

Online Resources:

1. https://www.docdroid.net/vp5Cfdg/abraham-silberschatz-operating-system-concepts- 9th201212-pdf
2. https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/

Course Outcomes:

After completion of the course, students will be able to

1. Understand fundamentals of Operating System.
2. Demonstrate the concepts of process, thread and scheduling algorithms.
3. Apply process synchronization methods to solve critical section problem.
4. Solve deadlock problems using various deadlock management techniques.
5. Compare the different memory management techniques.
6. Summarize file & disk management, protection & security concepts and evaluate the performance of disk scheduling algorithms.

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III Year B. Tech. II-Semester	**L T P C**
Course Code: 126KQ	**3 0 0 3**

SOFTWARE ENGINEERING

(Open Elective - 1)

Prerequisites: Nil

Course Objectives:

1. Understand the software life cycle models.
2. Understand the importance of the software development process.
3. Understand the importance of modelling and modelling languages.
4. Design and develop correct and robust software product.

UNIT 1: (~10 Lecture Hours)

Introduction to Software Engineering: The evolving role of software, changing nature of software, software myths.

A Generic view of process: Software engineering- a layered technology, A process framework, The capability maturity model integration (CMMI), Process patterns, Process assessment, Personal and team process models.

Process models: The Waterfall model, Incremental process models, Evolutionary process models, The unified process.

UNIT 2: (~9 Lecture Hours)

Software Requirements: Functional and non-functional requirements, User requirements, System requirements, Interface specification, The software requirements document.

Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management.

System models: Context models, Behavioural models, Data models, Object models, Structured methods.

UNIT 3: (~9 Lecture Hours)

Design Engineering: Design process and design quality, Design concepts, The design model.

Creating an architectural design: Software architecture, Data design, Architectural styles and patterns, Architectural design, Conceptual model of UML, Basic structural modeling, Class diagrams, Sequence diagrams, Collaboration diagrams, Use case diagrams, Component diagrams.

Performing user interface design: Golden rules, User interface analysis and design, Interface analysis, Interface design steps, Design evaluation.

UNIT 4: (~9 Lecture Hours)

Testing Strategies: A strategic approach to software testing, Test strategies for conventional software, Blackbox and white-box testing, Validation testing, System testing, The art of debugging.

Product metrics: Software quality, Metrics for analysis model, Metrics for design model, Metrics for source code, Metrics for testing, Metrics for maintenance.

UNIT 5: (~8 Lecture Hours)

Metrics for Process and Products: Software measurement, Metrics for software quality. **Risk management:** Reactive Vs proactive risk strategies, Software risks, Risk identification, Risk Projection, Risk refinement, RMMM, RMMM plan.

Quality Management: Quality concepts, Software quality assurance, Software reviews, Formal technical reviews, Statistical software quality assurance, Software reliability, The ISO 9000 quality standards.

Text Books:

1. Roger S. Pressman, Software Engineering- A Practitioner's Approach, 6th Edition, McGraw Hill Companies, Inc.
2. Sommerville, Software Engineering, 7th Edition, Pearson Education.

Reference Books:

1. Grady Booch, James Rambaugh and Ivar Jacobson, The Unified Modeling Language User Guide, 2nd Edition, Pearson Education.
2. Waman S Jawadekar, Software Engineering Principles and Practice, The McGraw- Hill Companies, 2004.

Online Resources:

1. https://alison.com/courses/software-engineering.
2. https://study.com/articles/
List_of_Free_Online_Software_Engineering_Courses.ht ml

Course Outcomes:

After completion of the course, students will be able to

1. Understand basic software engineering methods along with practices, process framework and process models.
2. Analyze software requirements, SRS documents and Project Management.
3. Develop different system models that describe the functionality of the system.
4. Design and maintain efficient, reliable and cost effective software solutions and suitable software metrics.
5. Understand various software testing approaches and techniques used for software assessment.
6. Interpret the significance of Software measurement, software risks and quality control.

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III Year B.Tech.II-Semester **L T P C**
Course Code: 126KD **3 0 0 3**

FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE
(Open Elective- 1)

Prerequisites: Nil

Course Objectives:
1. To learn the difference between optimal reasoning vs human like reasoning.
2. To understand the notions of state space representation, exhaustive search, heuristic search.
3. To learn logic programming and different knowledge representation techniques.
4. To understand the applications of AI like Game Playing and Expert Systems.
5. To introduce the concept of Intelligent agents.

UNIT 1: (~10 Lecture Hours)

Introduction: History, Intelligent Systems, Foundations of AI, Sub areas of AI & Applications.

Problem Solving - State-Space Search and Control Strategies, General Problem Solving Techniques, Characteristics of Problem, Exhaustive Searches, Heuristic Search Techniques, Iterative-Deepening A*, Constraint Satisfaction. Game Playing, Bounded Look- ahead Strategy and use of Evaluation Functions, Alpha-Beta Pruning.

UNIT 2: (~10 Lecture Hours)

Logic Concepts and Logic Programming: Introduction, Propositional Calculus, Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Tableau System in Propositional Logic, Resolution Algorithm, Predicate Logic, Logic Programming.

UNIT 3: (~10 Lecture Hours)

Knowledge Representation: Introduction, Approaches to Knowledge Representation, Knowledge Representation using Semantic Network, Extended Semantic Networks for KR.

Uncertainty Measure - Bayesian Belief Networks, Certainty Factor Theory, Dempster- Shafer Theory.

UNIT 4: (~ 8 Lecture Hours)

Expert System and Applications: Introduction, Phases in Building Expert Systems, Expert System Architecture, Expert Systems Vs Traditional Systems, Rule based Expert Systems, Truth Maintenance Systems, Applications of Expert Systems, List of Shells and Tools.

UNIT 5: (~ 10 Lecture Hours)

Introduction to Intelligent Agents: Introduction, Agents vs software programs, Classification of agents, Working of an agent, Single-agent and Multi-agent systems, Performance Evaluation of agents, Applications, Multi-Agent Application.

Text Books:

1. Saroj Kaushik, Artificial Intelligence, Cengage Learning, 2011.

Reference Books:

1. Rich, Knight, Nair: Artificial intelligence, Tata McGraw Hill, Third Edition, 2009.
2. Eugene Charniak, Introduction to Artificial Intelligence, Pearson, 2007.
3. Dan W.Patterson, Introduction to Artificial Intelligence and Expert Systems, PHI, 1990.
4. George Fluger, Artificial Intelligence, 5^{th} Edition, Pearson.

Online Resources:

1. http://www.vssut.ac.in/lecture_notes/lecture1428643004.pdf
2. http://nptel.ac.in/courses/106105077/
3. https://onlinecourses.nptel.ac.in/noc18_cs18/preview
4. https://www.edx.org/course/artificial-intelligence-ai-columbiax-csmm-101x-4

Course Outcomes:

After completion of the course, students will be able to

1. Understand the basics of AI and to formulate efficient problem space and select a search algorithm for a problem.
2. Apply AI techniques to solve problems related to Game playing.
3. Understand and apply Logic programming in problem solving.
4. Represent knowledge and uncertainty measures using appropriate techniques.
5. Knowledge required for developing expert systems.
6. Understand the concepts of Intelligent systems.

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III Year B.Tech. II-Semester **L T P C**
Course Code: 126KE **3 0 0 3**

FUNDAMENTALS OF DATA SCIENCE
(Open Elective- 1)

Prerequisites: Nil

Course Objectives:
1. To be exposed with basics of data science.
2. To understand data pre-processing and data visualization methods on real world data.
3. To understand machine learning methods to develop predictive model from pre- processed data.
4. To be exposed with the working methodology of various machine learning models.
5. To know the statistical performance metrics of machine learning methods.
6. To understand the ethical way of dealing with the data and its security.

UNIT 1:(~10 Lecture Hours)
Fundamentals of Data Science - Introduction to data science, Data analytics life cycle, Type of data analysis, Types of jobs in data analytics, Data science tools, Fundamental areas of study in data science, Role of SQL in data science, Pros and cons of data science.

UNIT 2: (~10 Lecture Hours)
Data Preprocessing, Plotting and Visualization- Data types and forms, Possible data error types, Various data preprocessing operations, Introduction to data visualization, Visual encoding, Data visualization libraries, Basic data visualization tools.

UNIT 3: (9 Lecture Hours)
Statistical Data Analysis and Machine Learning-Role of statistics in data science, Descriptive statistics, Inferential statistics, Overview of machine learning, Supervised machine learning, Regression methods, Classification methods, Unsupervised machine learning, Clustering methods, Association analysis.

UNIT 4: (~ 8 Lecture Hours)
Time-series Analysis- Overview of time-series analysis, Components of time-series, Time- series forecasting models.

UNIT 5: (~ 8 Lecture Hours)
Ethics and Data Science- The Five Cs: Consent, Clarity, Consistency and Trust, Control and Transparency, Consequences, Implementing Five Cs,

Data's Day of Reckoning, Ethics and Security Training, Developing Guiding Principles, Building Ethics into Data-drive Culture, Regulation. Recent Trends in the Domain of Data Science.

Text Books:

1. Data Science Fundamentals and Practical Approaches by Gypsi Nandi and Rupam Kumar Sharma First Edition, BPB Publications India.
2. Ethics and Data Science by Mike Loukides, Hilary Mason, & D J Patil First Edition, O'Reilly.

Reference Books:

1. Introducing Data Science by Davy Cielen, Arno D. B. Meysman, Mohamed Ali Latest Edition, Manning.
2. Data Science and Analytics with Python by Jesus Rogel-Salazar Latest Edition, CRC Press Taylor & Francis Group.

Online Resources:

1. http://www.biomedicahelp.altervista.org/Magistrale/Clinics/BIC_PrimoAnno/Identi ficazioneModelliDataMining/Business/Intelligence/Carlo/Vercellis.pdf
2. https://learning.oreilly.com/library/view/business-intelligence- 2nd/9780123858894/xhtml/Title_page.html
3. https://learning.oreilly.com/library/view/successful-business-intelligence/9780071498517/title.html
4. https://www.youtube.com/watch?v=Hg8zBJ1DhLQ
5. https://nptel.ac.in/courses/110107092
6. https://www.udemy.com/course/introduction-to-intelligence/

Course Outcomes:

1. Design and do analysis of an enterprise datasets.
2. Apply data pre-processing and data visualization methods on real world data.
3. Apply machine learning methods to develop predictive model from pre-processed data.
4. Analyze the working methodology of various machine learning models.
5. Evaluate the statistical metrics of machine learning methods using suitable performance metrics.
6. Inculcate the ethical way of dealing with the data in a secured manner.

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III Year B.Tech. II-Semester **L T P C**
Course Code: 126KP **3 0 0 3**

R PROGRAMMING
(Open Elective-1)

Prerequisites: Nil

Course Objectives:
1. Understand the fundamental knowledge of' 'R' programming.
2. Learn how to carry out a range of commonly used statistical methods including analysis of variance and linear regression.
3. Explore data-sets to create testable hypotheses and identify appropriate statistical tests.
4. Analyze and evaluate different types of plots , graphs and scripts.

UNIT 1: (~9 Lecture Hours)

Introducing R: Getting the Hand of R, Running the R Program, Finding Your Way with R, Command Packages.

Becoming Familiar with R: Reading and Getting Data into R, Viewing Named Objects, Types of Data Items, The Structure of Data Items, Examining Data Structure Working with History Commands, Saving your Work in R.

Working with Objects: Manipulating Objects, Viewing Objects within Objects, Constructing Data Objects, Forms of Data Objects: Testing and Converting.

UNIT 2: (~9 Lecture Hours)

Data: Descriptive statistics and tabulation.

Distribution: Looking at the Distribution of Data.

Simple Hypothesis Testing: Using the Student's t-test, The Wilcoxon U-Test (Mann- Whitney), Paired t- and U-Tests, Correlation and Covariance, Tests for Association.

UNIT 3: (~9 Lecture Hours)

Introduction to Graphical Analysis: Box-whisker Plots, Scatter Plots, Pairs Plots (Multiple Correlation Plots) Line Charts, Pie Charts, Cleveland Dot Charts, Bar Charts, Copy Graphics to Other Applications.

Formula Notation and Complex Statistics: Examples of Using Formula Syntax for Basic tests, Formula Notation in Graphics, Analysis of Variance (ANOVA).

UNIT 4: (~9 Lecture Hours)

Manipulating Data and Extracting Components: Creating Data for Complex Analysis, Summarizing Data.

Regression (Linear Modeling): Simple Linear Regression, Multiple Regression, Curvilinear Regression, Plotting Linear Models and Curve Fitting, Summarizing Regression Models.

UNIT 5: (~9 Lecture Hours)

More about Graphs: Adding elements to existing plots, Matrix plots, multiple plots in one window, exporting graphs.

Writing your own scripts: Beginning to Program: Copy and Paste Scripts, Creating Simple Functions, Making Source Code.

Text Books:

1. "Beginning R the statistical programming language" Dr. Mark Gardener, Wiley Publications, 2015.

References Books:

1. **Hands-On** Programming with R Paperback by Grolemund, Garrett, SPD,2014.
2. The R Book, Michael J. Crawley, WILEY, 2012.

Online Resources:

1. https://www.udemy.com/**r/online-course**
2. https://www.courseera.org/learn/r-pragramming
3. https://www.codecademy.com/learn/ learn-r

Course Outcomes:

After completion of the course, students will be able to

1. Develop and implement R analytics to create business insights of real time projects.
2. Understand the relevant data descriptions and process in R language.
3. Learn a wide range of analytical methods and produce the quality graphics.
4. Solve various real time problems using formula notation and statistics in R.
5. Evaluate different data models and perform regression analysis.
6. Explore on various ways to display results through plots and scripts.

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III Year B.Tech. II-Semester **L T P C**
Course Code: 126KA **3 0 0 3**

BIOMEDICAL ELECTRONICS AND APPLICATIONS

(Open Elective-1)

Prerequisites: Nil

Course Objectives:

1. To acquire knowledge on basics of human physiology.
2. To study different bio electrodes, biomedical transducers and measurements of physiological parameters.
3. To deal with ECG, EEG &EMG machines, recordings and their interpretations.
4. To learn how electronic instruments works in various departments and laboratories of a hospital and solve engineering problems related to medical field.

UNIT 1: (~ 10 Lecture Hours)

Recording Instruments: Electro Physiology and Bio potential Recording The Origin of Bio potentials Bio potential Electrodes Biological Amplifiers ECG, EEG, EMG, PCG, EOG Lead Systems and Recording Methods Typical Waveforms and Signal Characteristics.

UNIT 2: (~ 10 Lecture Hours)

Measurement and Analysis Technique: Measurement of Blood Flow Radiographic Indicator Dye Dilution Thermal Convection Magnetic Blood Flow Rate Ultrasonic Blood Flow meter, Sphygmomanometer, Blood Gas Analyzer, Oximeter, Auto Analyzers, Electrophoresis, Colorimeter, Spectrophotometer, Flame Photometer.

UNIT 3: (~ 10 Lecture Hours)

Therapeutic Equipment's and Patient Safety: Stimulators- Defibrillators, Pacemakers, Diathermy, Respirators, Blood Pumps, Ventilator, Haemodialysis Machine Role of Laser in Health Care, Patient Safety, Macro, Micro Shock Preventive Measures, Earth Free Patient Monitoring.

UNIT 4: (~ 10 Lecture Hours)

Medical Imaging: X Ray Imaging and CT scan Application and X Ray Therapy CAT Scan, MRI, PET, Physics of Ultrasound, Ultrasound Imaging A Scan and B Scan, Displays Multi Array Scanning, M Mode Scanning, Advantages and Disadvantages of Ultrasound Scanning, Thermal Imaging Systems.

UNIT 5: (~ 08 Lecture Hours)

Computer Applications in Medical Field: Computer Applications in Medicine, Patient Monitoring System, Endoscopy Unit, Radio pill, Telemedicine and Medical Informatics.

Text Books:

1. Dr. M. Arumugam, Biomedical Instrumentation, 2nd Edition, Anuradha Publications, 2007.
2. Leslie Cromwell, F.J.Weibell, E.A.Pfeiffer, Biomedical Instrumentation and Measurements, 2nd Edition, PHI, 2004.
3. John G. Webster, Medical Instrumentation, Application and Design, 3rd Edition, John Wiley, 2001.

Reference Books:

1. L.A. Geoddes and L.E. Baker, Principles of Applied Biomedical Instrumentation, 3rd Edition, John Wiley and Sons, 1991.
2. R.S. Khandpur, Handbook of Biomedical Instrumentation, 2nd Edition, McGraw Hill, 2003.
3. A. M. Cook and J.G. Webster(eds.), Therapeutic Medical Devices: Application and Design, Prentice Hall, 1982.
4. Arun Ghosh, Introduction to measurements and instrumentation, 3rd Edition, PHI learning, 2010.
5. W. F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical, Publishers, 1977.
6. J.J. Karr & J.M. Brown, Introduction to Biomedical Technology, 4th Edition, Pearson Publications, 2001.

Online Resources:

1. Lectures on Biomedical Signal Processing by Prof. Sudipta Mukhopadhyay, IIT KGP. https://nptel.ac.in/courses/108105101/

Course Outcomes:

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

1. Describe the functioning and recording of human physiological parameters using ECG, EEG, EMG systems.
2. Understanding the measurement of Blood pressure and Blood Flow meters.
3. Explore the applications of the electronic systems as prosthetic devices in biological and medical applications pacemakers defibrillators, Heart lung machine etc.
4. Examine the various medical imaging techniques and discuss therapeutic and assist devices.
5. Evaluate the practical limitations on electronic components while handling bio substances.
6. Illustrate the various computer aided applications in the field of medical applications.

III Year B.Tech. II-Semester **L T P C**
Course Code: 126KN **3 0 0 3**

PRINCIPLES OF COMMUNICATION TECHNOLOGIES

Open Elective-1

Prerequisites: -

Course Objectives:

1. Develop knowledge and understanding of the Communication Technology components.
2. Build up capacity on wireless technologies.
3. Discuss the fundamental problems in wireless networking.
4. Provide an analytical perspective on the design and analysis of the traditional and emerging wireless networks.

UNIT 1: (~9 Lecture Hours)

Basic Concepts of Communication Technology: Data communications system components, Data Representation, Data flow: simplex, half-duplex, or full–duplex, type of Connections: Point-to-Point, Multipoint, types of physical topology, Communication models: OSI model and the TCP/IP model.

UNIT 2: (~10 Lecture Hours)

Overview of Wireless n/w. and Technologies: Introduction, Different generations. Introduction to 1G, 2G, 3G, 4G and 5G, Bluetooth, Radio frequency identification (Rfid), Wireless Broadband, Wireless network topologies, Cell fundamentals and topologies, Global system for mobile communication, GSM architecture, network aspects in GSM, GPRS network architecture, GPRS network operation.

UNIT 3: (~9 Lecture Hours)

Mobile Computing: Architecture for mobile computing, Three tier architecture, design considerations for mobile computing, mobile computing through internet, Wireless network architecture, Applications, Security, Concerns and Standards, Benefits, Future evolution of mobile computing.

UNIT 4: (~9 Lecture Hours)

Wireless Networks: Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11, IEEE 802.11 Medium Access Control, Comparison of IEEE 802.11 a, b, g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL.

UNIT 5: (~9 Lecture Hours)

Telecommunication Systems: Telephone system, difference between wireless and fixed telephone nwtworks, Paging systems, Internet Telephony. Wireless Application Protocol(WAP), 3G Spread-spectrum Technology, FHSS, DSSS, CDMA versus GSM, applications in 3G Wireless LAN, WiFi v/s 3G Voice over Internet protocol.

Text Books:

1. Data Communications and Networking - Behrouz A. Forouzan, Fifth Edition TMH, 2013.
2. Mobile Computing, Asoke K Telukder, Roopa R Yavagal, TMH
3. Wireless Communication and Networking – William Stallings, 2003, PHI

Reference Books:

1. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE
2. Wireless Communications and Networks, 3G and beyond, ITI Saha Misra, TMH.
3. Vijay Garg, Wireless Communications and Networking, Elsevier Publications, 2007.

Online References:

1. https://onlinecourses.nptel.ac.in/noc22_ee61/preview Communication Networks by Prof. Goutam Das, IIT Kharagpur
2. https://nptel.ac.in/courses/117102062/: Wireless Communication by Dr. Ranjan Bose

Course Outcomes:

After completion of the course the student will be able to

1. Interpret the basic concepts of Communication Technology.
2. Comprehend wireless technology systems.
3. Devise mobile computing architecture and its standards.
4. Summarise mobile computing security concerns and applications.
5. Classify wireless Local and Wide area networks and their specifications.
6. Differentiate 2G and 3G wireless standards.

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III Year B.Tech. II-Semester **L T P C**

Course Code: 126KR **3 0 0 3**

VERILOG HDL

(Open Elective-1)

Prerequisites: Nil

Course Objectives:

1. Understand the need of Hardware Descriptive Languages.
2. Expose students to language constructs and conventions of Verilog HDL.
3. Design digital circuits using Verilog HDL.
4. Verify the digital system designs using testbenches.

UNIT 1: (~8 Lecture Hours)

Introduction to Verilog HDL: Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Functional Verification, Module, Testbench.

Language Constructs and Conventions: Introduction, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data types, Scalars and Vectors, Parameters, Memory, Operators, System Tasks.

UNIT 2: (~8 Lecture Hours)

Gate Level Modelling: Introduction, AND Gate Primitive, Module Structure, Other gate Primitives, Illustrative Examples, Tristate Gates, Array of Instances of Primitives, Design of Flip-Flops with Gate Primitives, Delays, Strengths and Construction Resolution, Net Types, Design of Basic Circuits.

UNIT 3: (~10 Lecture Hours)

Modelling at Dataflow Level: Introduction, Continuous Assignment Structure, Delays and Continuous Assignments, Assignments to Vectors, Operators.

Switch Level Modelling: Basic Transistor Switches, CMOS Switches, Bidirectional Gates, Time Delays with Switch Primitives, Instantiation with ‘Strengths’ and ‘Delays’, Strength Contention with Trireg Nets.

UNIT 4: (~10 Lecture Hours)

Behavioural Modelling : Introduction, Operations and Assignments, Functional Bifurcation, ‘Initial’ Construct, ‘Always’ construct, Assignments with delays, ‘Wait’ construct, Multiple Always Blocks, Designs at Behavioural Level, Blocking and Non- Blocking Assignments, The ‘Case’ statement, Simulation Flow, ‘If’ and ‘If – Else’ Constructs, ‘Assign and De-Assign’ Constructs, ‘Repeat’ Construct, For loop, The ‘Disable’ Construct, While Loop, Forever loop, Parallel Blocks, ‘Force-Release’ Construct, Event.

UNIT 5: (~10 Lecture Hours)

System Tasks, Functions and Compiler Directives: Parameters, Path Delays, Module Parameters, System Tasks and Functions, File Based Tasks and Functions, Compiler Directives, Hierarchical Access, User Defined Primitives.

Text Books:

1. T.R. Padmanabhan, B. Bala Tripura Sundari, Design Through Verilog HDL, Wiley, 2009.
2. Verilog HDL, Samir Palnitkar, II Edition, Pearson Education, 2009.

Reference Books:

1. Michel D. Ciletti, "Advanced Digital Design with the Verilog HDL", PHI, 2009.
2. Zainalabdien Navabi, "Verilog Digital System Design", TMH, II Edition, 2006.

Online Resources:

1. Hardware Modelling using Verilog by Prof. Indranil Sengupta, IIT Kharagpur - https://nptel.ac.in/courses/106105165
2. System Design through Verilog by Prof. Shaik Rafi Ahamed, IIT Guwahati - https://archive.nptel.ac.in/courses/108/103/108103179/
3. Verilog HDL: A Guide to Digital Design and Synthesis, Second Edition by Samir Palnitkar, https://d1.amobbs.com/bbs_upload782111/files_33/ourdev_585395BQ8J9A.pdf

Course Outcomes:

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

1. Identify the need for hardware descriptive languages, various language constructs and conventions of Verilog HDL.
2. Design basic digital systems using gate level and switch level HDL modelling.
3. Build digital systems at dataflow level using Verilog HDL.
4. Demonstrate the use of behavioural level modelling constructs to design digital systems.
5. Write test benches to analyze and verify the digital systems.
6. Implement digital circuits using advanced Verilog HDL constructs.

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III Year B.Tech. II-Semester **L T P C**
Course Code: 126KM **3 - - 3**

PRINCIPLES OF COMMUNICATIONS

(Open Elective -1)

Prerequisites:-Nil-

Course Objectives:

1. Introduce the students to modulation and various analog modulation schemes.
2. Distinguish between Pulse, Analog and Digital Communication systems.
3. Analyze the concepts of satellite, optical communications.
4. Understand and compare cellular and telecommunication system concepts.

UNIT 1: (~8 Lecture Hours)

Introduction: Need for Modulation, Frequency translation, Electromagnetic spectrum, Gain, Attenuation and decibels.

UNIT 2: (~10 Lecture Hours)

Modulation Techniques: Analog Modulation- Amplitude Modulation Fundamentals, Amplitude Modulator and Demodulator Circuits, Fundamentals of Frequency Modulation, PAM, PWM, PPM, Pulse Code Modulation techniques. Transmission of Binary data in communication system-Principles of Digital transmission, Transmission efficiency, modern concepts, wide band modulation.

UNIT 3: (~10 Lecture Hours)

Satellite Communication: Satellite Orbits, satellite communication systems, satellite subsystems, Ground Stations Satellite Applications, Global Positioning systems.

UNIT 4: (~10 Lecture Hours)

Optical Communication: Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT 5: (~10 Lecture Hours)

Telecommunication Systems: Telephones Telephone system, Facsimile, Internet Telephony. Cellular Communications: Cell phone technologies-Cellular telephone systems, Mobile phone systems, Digital cell phone systems(2G, 2.5G, UMTS 3G, 4G).

Text Books:

1. Louis E. Frenzel -Principles of Electronic Communication Systems, 3rd Edition, McGraw Hill publications, 2008.
2. K.Sam Shanmugam, Digital and Analog Communication Systems, JohnWiley and Sons, 2004.

Reference Books:

1. Theodore S. Rappaport, Wireless Communications-Principles and practice, Prentice Hall, 2002.
2. Roger L. Freeman, Fundamentals of Telecommunications, 2nd Edition, Wiley Publications.

Online Resources:

https://nptel.ac.in/courses/108104098/

Course Outcomes:

After completion of the course, students will be able to

1. Analyze the basic concepts of modulation and understand the different kinds of analog modulation techniques.
2. Understand and analyze the different types of pulse analog and digital modulation systems.
3. Describe the Telephone systems and network fundamentals.
4. State the operative physical principle of launching satellites and explain the concept & operation of GPS.
5. Comprehend about the principle of optical communication system, functioning of optical cables and wave division multiplexing.
6. Describe the cellphone operational concepts.

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III Year B.Tech. II-Semester **L T P C**
Course Code: 126KC **3 0 0 3**

ENGINEERING MATERIALS
(Open Elective-1)

Prerequisite: -Nil-

Course Objectives:
1. To impart knowledge on the concepts of Dielectric electric materials in comparison with magnetic materials.
2. To introduce special purpose materials.
3. To make students familiar with the concepts of different materials for electrical applications.
4. To familiarize students with the concepts of semiconductor materials.

UNIT 1: (~ 8 Lecture Hours)
Electrical Materials Introduction: Types of Materials, Properties.
Dielectric materials: Types-Solid, Liquid and Gaseous dielectrics - Electric conductivity in Solid, Liquid and Gaseous dielectrics.

UNIT 2: (~ 8 Lecture Hours)
Semiconductor Materials
Types of semiconductors, properties, Doping Techniques, - Current carriers in Semiconductor- Photoconductors, Characteristics.

UNIT 3: (~ 8 Lecture Hours)
Magnetic Materials
Classification of Magnetic Materials, Properties, Curie point, Magnetically soft and hard Materials- Feebly Magnetic Materials, Cermet Permanent Magnets, Ageing of Magnets - Factors effecting Permeability and Hysteresis.

UNIT 4: (~ 8 Lecture Hours)
Special Purpose Materials
Refractory Materials, Radioactive Materials, Insulating varnishes and coolants, Properties and Applications of mineral oils, Testing of Transformer Oil as per BIS, IEC.

UNIT 5: (~ 8 Lecture Hours)
Materials for Specific Applications
Materials for solar cells and battery, Materials for coatings for enhanced solar thermal energy collection, Cold Mirror Coatings, Heat Mirror Coatings, Antireflection Coatings.

Text Books:

1. R K Rajput, A course in Electrical Engineering Materials, Laxmi Publications, 2009.
2. C S Indulkar and S Thiruvengadam, An introduction to Electrical Engineering Materials, Revised Edition, S. Chand & Company, 2013.
3. T K Basak, A course in Electrical Engineering Materials, New Age Science Publications, 2009.

Reference Books:

1. A.J. Dekker, Electrical Engineering Materials, PHI Publication, 2006.
2. TTTI Madras, Electrical Engineering Materials, McGraw Hill Education, 2004.

Course Outcomes:

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

1. Distinguish between different types of materials by virtue of their properties.
2. Categorize & analyze Dielectric and semiconductor materials.
3. Classify the magnetic materials using their properties.
4. Differentiate & identify special-purpose materials for electrical applications.
5. Identify special-purpose materials for non-electrical applications.
6. Analyze the working of materials from the point of view of specific applications in electrical & other fields.

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III Year B.Tech. II Semester **L T P C**
Course Code: 126KL **3 0 0 3**

OPERATIONS RESEARCH

(Open Elective-1)

PPrerequisites: - Nil-

Course objectives:

1. Define and formulate linear programming problems and appreciate their limitations.
2. Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action.
3. Develop mathematical skills to analyze and solve dynamic programming models arising from a wide range of applications
4. Help students develop the ability to make informed decisions based on quantitative analysis.

UNIT 1: (~ 10 Lecture Hours)

Introduction to Operations Research: Basics definition, scope, objectives, phases, models and limitations of Operations Research. Linear Programming Problem-Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables, big-M methods, Special cases in LP- Degeneracy, unbounded, infeasibility & alternative optima.

UNIT 2: (~ 9 Lecture Hours)

Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions-Northwest corner rule, least cost method and Vogel's approximation method. Optimality test by MODI method & stepping stone method.

UNIT 3: (~ 9 Lecture Hours)

Assignment model: Formulation. Hungarian method for optimal solution. Solving unbalanced Assignment problem.

Sequencing models: Solution of sequencing Problem-Processing n jobs through 2 Machines- Processing n jobs through 3 Machines-Processing n jobs through m Machines. Processing 2 jobs through m-machines.

UNIT 4: (~ 10 Lecture Hours)

Dynamic programming: Characteristics of dynamic programming. Dynamic programming approach for Coach/Shortest Path and cargo loading problems.

Inventory models: Inventory costs. Models with deterministic demand-model (a) demand rate uniform and production rate infinite, model (b) demand rate uniform and production rate finite

UNIT 5: (~ 10 Lecture Hours)

Games Theory: Competitive games rectangular game saddle point, minimax (maximin) method of optimal strategies, and value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point-mixed strategy for 2*2 games.

Replacement Models : Replacement of Items that deteriorate whose maintenance costs increase with time without change in the money value, Replacement of items that fail suddenly: individual replacement policy, group replacement policy.

Text Books:

1. S.D.Sharna, Operations research theory methods and applications, 2020th edition, Kedar Nath Ram Nath, 2014
2. J K Sharma, Operations Research, theory and applications, 6th edition, Macmillan India Ltd, 2017

Reference Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. F.H. Hillier and G.J. Lieberman, Introduction to Operations Research, Tata-McGraw-Hill, 2010.

Online Resources:

1. Website/ Materials: IOR Tutorials (Interactive Operations Research Tutorial)
2. Onlinecourses.nptel.ac.in

Course Outcomes:

At the end of the course students are expected to

1. Apply linear programming models to several Engineering Applications.
2. To use several other techniques like Transportation, Assignment, and Sequencing Models in the real world applications.
3. In Dynamic Programming selected models were taught.
4. Apply simple mathematical models in Inventory into the real Engineering Applications.
5. Solve Game theory problems related to business applications
6. Develop optimum replacement policy.

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III Year B.Tech. II-Semester	**L T P C**
Course Code: 126KJ	**3 - - 3**

INTRODUCTION TO DATA ANALYTICS

(Open Elective-1)

Course Objectives:

1. To learn the importance of data and its types.
2. To understand Regression Analysis and Multi Variate Data.
3. To gain a basic knowledge on Machine learning.
4. To study Non-Linear Optimization Techniques.

UNIT 1: (~9 Lecture Hours)

Fundamentals of Data Analytics: Role of data analytics in science and engineering, types of data and data summarization methods, levels of measurement, data storytelling, data journalism, data warehousing.

UNIT 2: (~6 Lecture Hours)

Simple-Linear Regression: Simple Linear regression model, estimate regression coefficients, properties of least square estimators, estimation of σ^2, confidence intervals and test for β_0 & β_1, ANOVA, Coefficient of determination.

UNIT 3: (~9 Lecture Hours)

Multiple Linear Regression : Multiple Linear Regression using Matrix Method-Test for significance for Regression coefficients-ANOVA, Regularization methods- LASSO, RIDGE, and Elastic nets.

UNIT 4: (~12 Lecture Hours)

Foundation for Machine learning: Machine learning Techniques- Overview, Introduction to Multivariate data, Principal Component Analysis, Dimensionality reduction -Linear Discriminant Analysis - Naive - Baye's classification, Hierarchical (Agglomerative) clustering, Non-Hierarchical clustering (K-means algorithm).

UNIT 5: (~9 Lecture Hours)

Non-Linear Optimization Techniques: Problem Formulation for Nonlinear Programming, Unconstrained optimization (Hessian Matrix Method), Constrained multivariate optimization with equality constraints (Lagrangian Multipliers Technique), constrained Multivariate optimization with inequality constraints (Kuhn Tucker conditions).

Text Books:

1. S.P.Gupta, Statistical Methods , Sultan and Chand & Sons, 46^{th} Edition
2. Galit Shmueli Peter C. Bruce Inbal Yahav Nitin R. Patel Kenneth C. Lichtendahl Jr. Data Mining for Business Analytics Concepts, Techniques, and Applications in R, Wiley Publications.
3. Operations Research by Er. Prem Kumar Gupta, Dr. D. S. Hira, S. Chand Publications.

Reference Text Books

1. Montgomery, Douglus C., and George C.Runger. Applied Statistics and Probability for Engineers John Wiley & Sons. 2010.
2. Tang-Ning-Tan, Micheal-Steinbach, Vipin Kumar, Anuj Karpatne, Introduction to Data Mining, Pearson India Education Services Ltd. (2016)
3. Roxy Peck,San Luis Obispo, Iowa Jay L. Devore ,Introduction to Statistics and Data Analysis, Cengage Learning, 5^{th} Edition.
4. Cole Nussbaumer Knaflic, Story Telling with Data, willey Publications.
5. Hiller and Lieberman, Introduction to Operation Research, McGraw Hill Higher Education, 7^{th} edition.

Online Resources:

1. E-book on Multivariate Data Analysis. https://www.drnishikantjha.com/papersCollection/Multivariate%20Data%20Analysis.pdf
2. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119296294
3. nptel.ac.in/courses/ Introduction to Data Analytics

Course outcomes:

After completing the course the student will be able to

1. Understand the definitions and concepts associated with data Analysis.
2. Determine the Simple Linear regression coefficient and test the significance.
3. Estimate the Multiple Linear regression coefficient and test the significance.
4. Implement the knowledge of Multivariate data and regularization methods.
5. Acquire basic concepts in Machine learning.
6. Learn about Optimization techniques.

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III Year B.Tech. II-Semester **L T P C**

Course Code: 126KH **3 - - 3**

INTELLECTUAL PROPERTY RIGHTS

(Open Elective-1)

Prerequisites: Nil

Course Objectives:

1. Educate the importance of IPR in Engineering
2. Enlighten the various types of IP's and their protection.
3. Maintain IPR's for Business sustainability.

UNIT 1: (~ 09 Lecture Hours)

Introduction to Intellectual property

Intellectual property: Introduction – Features - Types of Intellectual property - Importance of Intellectual property rights - International organizations - Agencies and treaties, Conventions.

UNIT 2: (~ 08 Lecture Hours)

Patents

Patents: Concept of Patent – Duration – Patent Process – Patent searching – Procedure for filing of Patents - Ownership, Transfer, Assignment and Licensing of Patent – Remedies for Infringement of Patents.

UNIT 3: (~10 Lecture Hours)

Copyrights and Trademarks

Copyrights – Fundamental of Copyright law - Originality of material- Rights of Reproduction - Rights to perform the work publicly - Copyright Ownership issues - Copyright registration - Notice of Copyright - Remedies for infringement in Copyrights.

Trademarks – Purpose and functions of Trademarks - Acquisition of Trademark rights - Protectable matter - Selecting and evaluating Trademark - Trademarks registration process – Remedies for infringement in Trade marks.

UNIT 4: (~ 08 Lecture Hours)

Industrial Designs

Industrial Designs – Importance of Industrial Design – Essential requirement of Registration – Registration Process of Industrial Designs – Benefits of registration – Assignment, Transmission and Licensing of Industrial Designs - Remedies for infringement of Designs.

UNIT 5: (~ 10 Lecture Hours)

Trade Secrets

Trade Secrets – Trade secret law – Determinants of Trade secret status - Liability for misappropriation of Trade Secrets – Protection for submission - Trade secret litigation – Unfair competition – Interface between Intellectual Property Rights and Competition – Safeguards against Unfair competition.

Intellectual property audits – Types of IP Audit – Procedure of Preparing Audit – Auditing IP Assets.

Text Books:

1. Deborah. E. Bouchoux (2015) Intellectual property right, 4th Edition, Cengage learning.
2. Prabuddha Ganguli (2017) Intellectual property right – Unleashing the knowledge economy, 4th Edition,Tata McGraw Hill Publishing company ltd.

Reference Books:

1. S.P Satarkar (2003) Intellectual Property Rights and Copyrights, Ess Ess Publications.
2. Kompal Bansal, Parikshit Bansal (2020) Fundamentals of Intellectual property for Engineers, BS Publications.

Online Resources:

1. Introduction on Intellectual Property to Engineers and Technologists https://nptel.ac.in/courses/109105112/

Course Outcomes (COs)

After learning the contents of this course, the student must be able to

1. Understand the dynamics and legalistic framework of IPR.
2. Acquaint the procedure of securing patents and its procedure.
3. Acquire information and make use of Copy right protection.
4. Examine the eminence of trade marks in growth of Business.
5. Identify the importance of safeguarding Industrial designs.
6. Sustain Trade Secrets and aspects of IP audit.

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III Year B.Tech. II-Semester **L T P C**
Course Code: 126KB **3 - - 3**

DISASTER MANAGEMENT
(Open Elective-1)

Prerequisites: -Nil-

Course Objectives:
1. To introduce the basic concepts in Disaster Management.
2. To explain the different types of natural and manmade disasters.
3. To provide the information on Disaster Management Mechanism.
4. To introduce the concept of capacity building, safety in industries.
5. To provide an overview on the roles of national and international cooperation in disaster management.
6. To explain the application of spatial technologies in disaster management.

UNIT 1: (**~** 9 Lectures)

Introduction to Disaster Management: Introduction – Hazard, Disaster, Vulnerability, Risk, Capacity Building, Environmental Hazard, Disaster and Stress, Disaster Phenomena and Events (Global, National and Regional).

Classification - Natural and Man-made Hazards (Planetary, Extra Planetary, Endogenous and Exogenous Hazards). Climate Change Impact – (Global Warming, Ozone Layer Depletion, Deforestation, Forest Fires).

UNIT 2: (**~** Lectures)

Planetary and Extra Planetary Hazards: Endogenous Hazards and Exogenous Hazards.

Earthquakes, Landslides, Volcanic Eruptions – Causes, Effects, distribution, human adjustment, perception and mitigation measures

Cyclones, Floods, Droughts, Cold Waves and Heat Waves - Causes, Effects, distribution, human adjustment, perception and mitigation measures.

Extra Planetary Hazards and Disasters – Asteroids, Meteoroids, Meteors, Meteorites

Man Induced Hazards and Disasters – Nuclear Hazards (Chernobyl), Industrial/ Chemical – (Bhopal Gas Tragedy), Biological – (Covid-19), Road and Rail Accidents, Plane Crash.

UNIT 3: (**~** 8 Lectures)

Disaster Management Mechanism: Disaster Management Cycle – Prevention, Mitigation, Preparedness, Response, Recovery and Rehabilitation. Planning for Relief. Concepts of Risk Management and Crisis Management **–** (Risk Reduction and Survival Strategies).

UNIT 4: (~ 9 Lectures)

Disaster Risk Reduction (DRR) - Structural and Non-Structural Measures; Risk Analysis, Vulnerability and Capacity Assessment; Early Warning Systems, Post Disaster Environmental Response (Water, Sanitation, Food Safety, Waste Management, Disease Control, Security, Communications); Roles and Responsibilities of Government, Community, Local Institutions, NGOs and other Stakeholders; Policies and Legislation for Disaster Risk Reduction, Industrial Safety Plan.

UNIT 5: (~ 9 Lectures)

National & International Co-Operation in Disaster Management:

DRR Programmes in India and the activities of National Disaster Management Authority, Role of NDMA, NDRF, NIDM in Disaster Management, NDMA Guidelines, Disaster Management Act, 2005 and National Policy on Disaster Management, 2009, The National Disaster Management Plan, 2016, Organizational Structure for Disaster Management. Global Framework for Disaster Risk Reduction (Sendai Framework, Paris Agreement, Sustainable Development Goals, Hyogo Framework, Yokohoma Strategy on Disaster Risk Reduction). Bilateral Agreements, Use of latest technologies – Remote Sensing (RS) and Geological Information System (GIS).

Text Books:

1. Manual on Disaster Management, National Disaster Management Agency, Govt of India.
2. Disaster Management by Mrinalini Pandey, Wiley, 1st Edition, 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Private Limited, 2015.
4. Disaster Mitigation: Experiences and Reflections by Pradeep Sahni, PHI Learning Private Limited, 2010.
5. Natural Hazards and Disasters by Donald Hyndman and David Hyndman - Cengage Learning, 2006.
6. UNEP – Disaster Risk Reduction - https://www.unep.org/explore-topics/disasters-conflicts/what-we- do/risk-reduction.

Reference Books:

1. Earth and Atmospheric Disasters Management by N. Pandharinath, CK Rajan, BS Publications, 2009.
2. Environmental Geography by R. B. Singh, Heritage Publishers, New Delhi, 1990.
3. Environmental Geography by Savinder Singh, Prayag Pustak Bhawann, 1997.
4. The Environment as Hazards by B. I. Kates and G. F. White. Oxford Press, New York, 1978.

5. Disaster Management by R. B. Singh, Rawat Publication, New Delhi, 2000.
6. Disaster Management by H. K. Gupta, Universities Press, India, 2003.
7. Space Technology for Disaster Mitigation in India (INCED) by R. B. Singh, University of Tokyo, 1994.
8. Disaster Management in Hills by Satender, Concept Publishing Co., New Delhi, 2003.
9. An Overview on Natural and Manmade Disaster and their Reduction by R. K. Bhandani, CSIR, New Delhi.
10. Manuals on Natural Disaster Management in India by M. C. Gupta, National Centre for Disaster Management, IIPA, New Delhi, 2001.

Web Resources:

1. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf).
2. National Institute of Disaster Management (NIDM) (https://nidm.gov.in)
3. WHO – Disaster Management Resources - https://www.who.int/surgery/publications/immesc_disaster_management/en/

Online Courses:

1. https://swayam.gov.in/courses/4983-disaster-management
2. https://reliefweb.int/training/2455444/free-online-course-disaster-risk-reduction-and-management
3. https://www.unisdr.org/we/inform/events/47107
4. https://www.futurelearn.com/courses/disaster-management/2
5. https://www.ifrc.org/en/get-involved/learning-education-training/certified-professional-development- courses/online-certificate-programme-in-disaster-management/

Course Outcomes:

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

1. Explain and differentiate disasters and their vulnerabilities - causes, impacts and mitigation measures.
2. Articulate the disaster management mechanism in natural and man induced disasters.
3. Design Industrial Safety Plan for Industrial Hazards.
4. Plan and implement for the Disaster Risk Reduction.
5. Prepare disaster management plan for specific disasters with the help of national and international agencies.
6. Sustain Trade Secrets and aspects of IP audit.

IV Year B.Tech. I-Semester **L T P C**
Course Code: 127KY **3 0 0 3**

INTERNET OF THINGS

(Open Elective-2)

Prerequisites: -Nil-

Course Objectives:

1. To introduce the terminology, technology and its applications.
2. To introduce the concept of M2M (machine to machine) with necessary protocols.
3. To introduce the Python Scripting Language which is used in many IoT devices.
4. To introduce the Raspberry Pi platform, that is widely used in IoT applications.
5. To introduce the implementation of web based services on IoT devices.

UNIT 1: (~9 Lecture Hours)

Introduction to Internet of Things-Definition and Characteristics of IoT, Physical Design of IoT-IoT Protocols, IoT Communication Models, IoT Communication APIs. IoT enabled Technologies- Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates Domain Specific IoTs-Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle.

UNIT 2: (~9 Lecture Hours)

IoT and M2M-Software Defined Networks, Network Function Virtualization, Difference between SDN and NFV for IoT Basics of IoT System Management with NETCONF, YANG- NETCONF, YANG, and SNMP NETOPEER.

UNIT 3: (~9 Lecture Hours)

Introduction to Python - Language features of Python, Data types, data structures, Control of flow, functions, Modules, packaging, File Handling, Date/Time Operations, Classes, Exception handling Python packages - JSON, XML, HTTPLib, URLLib, SMTPLib.

UNIT 4: (~9 Lecture Hours)

IoT Physical Devices and Endpoints-Introduction to Raspberry Pi- Interfaces (serial, SPI, I2C) Programming-Python program with Raspberry Pi with focus of interfacing external gadgets, Controlling Output and Reading input from pins.

UNIT 5: (~9 Lecture Hours)

IoT Physical Servers and Cloud Offerings – Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework, Designing a RESTful web API.

Text Books:

1. Arshdeep Bahga and Vijay Madisetti, Internet of Things - A Hands-on Approach, Universities Press, 2015, ISBN: 9788173719547.
2. Matt Richardson and Shawn Wallace, Getting Started with Raspberry Pi, O'Reilly (SPD), 2014, ISBN: 9789350239759.

Reference Books:

1. David, Hanes and Salgueiro Gonzalo, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, Pearson 2017.
2. Dirk Slama and Frank Puhlmann, Enterprise IoT: Strategies and Best Practices for Connected Products and Servicesby 2015.

Online Resources:

1. https://www.tutorialspoint.com
2. https://www.edureka.co
3. https://www.onlinecourses.nptel.ac.in

Course Outcomes:

After completion of the course, students will be able to

1. Understand the IoT Systems.
2. Apply the concept of M2M (machine to machine) with necessary protocols.
3. Create programs using python scripting language in IoT devices.
4. Build programs for Raspberry Pi interfaces.
5. Choose to communicate with IoT Systems through web-interface.
6. Apply IoT principles for domain specific applications.

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IV Year B.Tech. I-Semester **L T P C**
Course Code: 127KT **3 0 0 3**

CYBER SECURITY

(Open Elective-2)

Prerequisites:-Nil-

Course Objectives:

1. To familiarize various types of cyber-attacks and cyber-crimes, Laws and IT Acts.
2. To study the defensive techniques against Cyber attacks
3. To explore various security challenges faced by mobile workforce and their implications under Cybercrime.
4. To determine various web threats faced by organizations and understand about Social Media Networking.
5. To understand various data privacy issues and role of Cyber Forensics.

UNIT 1: (~9 Lecture Hours)

Introduction to Cybercrime: Introduction, Cybercrime – Definitions and origins of the word, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000 - Hacking and the Indian Law(s), A Global Perspective on Cybercrimes – Cybercrime and the Extended Enterprise.

UNIT 2: (~9 Lecture Hours)

Cyber Offenses: How Criminals Plan Them: Introduction – Categories of Cybercrime, How Criminals plan the Attacks – Reconnaissance, Passive Attacks, Active Attacks, Scanning and Scrutinizing Gathered Information, Attack, Social Engineering, Cyber stalking – Types, Cases reported on Cyberstalking, Working of Stalking, Real-Life incident of Cyberstalking, Cybercafé and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

UNIT 3: (~9 Lecture Hours)

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones.

Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT 4: (~9 Lecture Hours)

Privacy Issues

Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc.

Cybercrime: Examples and Mini-Cases Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances.

UNIT 5: (~9 Lecture Hours)

Cyber Security: Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications.

Social Media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

Cyber Forensics:

Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

Text Books:

1. Nina Godbole and SunitBelpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley.
2. B.B.Gupta, D.P.Agrawal, HaoxiangWang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

Reference Books:

1. James Graham, Richard Howard and Ryan Otson, Cyber Security Essentials, CRC Press.
2. Chwan-Hwa (john) Wu and J.David Irwin, Introduction to Cyber Security, CRC Press T&F Group.

Online Resources:

1. https://www.open.edu/openlearn/futurelearn/cyber-security
2. https://cloudian.com/guides/data-protection/data-protection-and-privacy-7-ways- to-protect-user-data/
3. https://www.cybersecurityeducation.org/resources/

4. https://onlinecourses-swayam2-ac- in.translate.goog/nou19_cs08/preview?_x_tr_sl=en&_x_tr_tl=ta&_x_tr_hl=ta&_x_tr_pto=sc
5. https://www.mygreatlearning.com/academy/learn-for-free/courses/cyber-forensics

Course Outcomes:

After completion of the course, students will be able to

1. Understand the evolution of Internet in the context of emerging Cyber threats and their laws.
2. Distinguish the forms of Cybercriminal activities and Social Engineering methods used to undertake crimes.
3. Understand the Security challenges posed by mobile and wireless devices.
4. Define privacy policies and their specifications;
5. Apply risk management policies to protect organization's critical information and forensically investigate security incidents.
6. Understand real time cybercrimes to assess the scenarios in India, Global and Legal Perspectives.

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IV Year B.Tech. I-Semester	**L T P C**
Course Code: 127KZ	**3 0 0 3**

MACHINE LEARNING BASICS

(Open Elective - 2)

Prerequisites: Nil

Course Objectives:

1. To be able to identify machine learning problems corresponding to different applications.
2. To understand a various machine learning algorithms along with their strengths and weaknesses.
3. To understand the basic theory underlying machine learning.
4. To Introduce Decision Tree learning, Instance Based Learning techniques.

UNIT 1: (~10 Lecture Hours)

Introduction: Well posed learning problems, designing a learning system Perspectives and issues in machine learning.

Concept Learning: Concept learning task, Concept Learning as search through a hypothesis space, Finding maximally specific hypothesis, Version spaces and the Cadidate-Elimination algorithm, Inductive Bias.

UNIT 2: (~10 Lecture Hours)

Decision Tree Learning: Decision Tree representation, appropriate problems for Decision Tree Learning, Hypothesis space search in Decision Tree Learning,Issues in Decision Tree Learning.

Neural Network Learning: Introduction, The Neuron Model, Activation Functions, Neural Network Architecture: Single-Layer Feed-Forward Networks, Multi-Layer Feed- Forward Networks.

UNIT 3: (~9 Lecture Hours)

Support Vector Machines: Introduction, Linear Classifier, Non-linear Classifier, Training SVM, Support Vector Regression.

Bayesian Learning: Bayes theorem and concept learning, Minimum Description Length Principle, Bayes optimal classifier, Gibbs Algorithm, Naïve Bayes Classifier, The EM algorithm.

UNIT 4: (~ 8 Lecture Hours)

Computational Learning Theory: Sample complexity for finite and infinite hypothesis spaces, Mistake bound model.

Instance – Based Techniques: K-nearest neighbor Learning, Locally Weighted Regression, Radial Basis Function, Case Based reasoning, Remarks on Lazy vs Eager learning.

UNIT5: (~ 8 Lecture Hours)

Genetic Algorithm: Biological motivation, Representing Hypothesis, Genetic Operators, Fitness function and selection, Models of Evolution and Learning, Parallelizing Genetic Algorithms.

Text Books:

1. Tom M. Mitchell, Machine Learning, McGraw Hill Education, Edition 2013.

Reference Books:

1. Saroj Kaushik, Artificial Intelligence, CENGAGE Learning, 2011.
2. Trevor Hasti, Robert Tibshirani and Jerome Friedman, The Elements of Statistical Learning, 2nd Edition,Springer Series in Statistics, 2001.
3. Stephen Marsland, Machine Learning - An Algorithmic Perspective, CRC Press, 2009.

Online Resources:

1. http://www.cs.cmu.edu/~tom/
2. http://www.holehouse.org/mlclass/

Course Outcomes:

After completion of the course, students will be able to

1. Gain Knowledge on the basic theory in machine learning
2. Understand machine learning problems corresponding to different applications.
3. Identify machine learning techniques appropriate to respective problems.
4. Compare various machine learning algorithms along with their strengths and weaknesses.
5. Analyze the machine learning algorithms under supervised and unsupervised paradigms.
6. Apply different learning algorithms to solve problems of moderate complexity.

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IV Year B.Tech. I-Semester **L T P C**
Course Code: 127KU **3 0 0 3**

DATA VISUALIZATION USING PYTHON

(Open Elective - 2)

Prerequisites: Nil

Course Objectives:

1. To understand the basics and data pre-processing techniques of data visualization.
2. Learn various techniques for visualization of data.
3. To draw the plots and learn how to customize them.
4. To Plot charts with images and maps.
5. To design the right plot to understand the data.

UNIT 1: (~8 Lecture Hours)

Introduction to Data & Visualization: Data foundations – Types of Data – Nominal, Ordinal, Interval, Ratio Scaled.

Data Pre-processing: Why Pre-process the data? Descriptive Data Summarization – Measuring the Central Tendency, Measuring the Dispersion of Data – Ratio scaled.

UNIT 2: (~8 Lecture Hours)

Visualizing Data: Mapping Data on to Aesthetics and Types of Data, Scales Map Data values on to Aesthetics.

Drawing your first plot and customizing them: Defining plot types – Bar, Line, and stacked charts. Defining plot line styles, properties, and format strings. Adding a legend and annotations. Making histograms, making pie charts count, Plotting with filled areas.

UNIT 3: (~10 Lecture Hours)

More plots and Customization: Adding a data table to the figure, using subplots, filling an under-plot area.

Plotting charts with images: Processing images with PIL, plotting with images, displaying an image with other plots in the figure.

UNIT 4: (~ 9 Lecture Hours)

Plotting charts with Maps: Plotting data on a map using base map, plotting data on a map using google API, Generating CAPTCHA images.

Using Right plots to understand the Data: Using scatter plots and histograms, plotting the cross correlations between two variables, importance of auto correlation.

UNIT 5: (~ 9 Lecture Hours)

Making 3D visualizations: Creating 3D bars and Creating 3D Histograms.

Case Studies on Data Visualization using Python: Visualizations in python on sales data, any other case study on real time dataset.

Text Books:

1. Igor Milovanovic, Python Data Visualization Cookbook, PACKT publishing, 2013.
2. Claus O. Wilke, Fundamentals of Data Visualization, First Release Edition, O'Reilly Publication.

Reference Books:

1. Daniel Keim, Georges Grinstein and Matthew O. Ward, Interactive Data Visualization Foundations, Techniques, and Applications, Natick, Massachusetts: A K Peters, Ltd.
2. Kieran Healy, Data Visualization: A Practical Introduction, 1st Edition, Princeton University Press.
3. Edward R. Tufte, The Visual Display of Quantitative Information, 2nd Edition, Graphics Press.

Online Resources:

1. https://clauswilke.com/dataviz/
2. https://www.coursera.org/learn/python-for-data-visualization

Course Outcomes:

After completion of the course, students will be able to

1. Understand fundamental computer knowledge in the visualization process and pre- processing of the data.
2. Analyze the tools for creating, importing & exporting data, and generate reports using different chart types.
3. Able to design plots and how customize them.
4. Knowledge on visualizing images, maps and generating CAPTCHAs.
5. Understand the data and choose correct visualization to that.
6. Able to apply data visualization techniques on real-time datasets.

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IV Year B.Tech. I-Semester **L T P C**
Course Code: 127KV **3 0 0 3**

SENSORS AND ACTUATORS
(Open Elective 2)

Prerequisites: Nil

Course Objectives:
1. To create a conceptual understanding of the basic principles of sensors, actuators, and their operations.
2. To promote awareness regarding recent developments in the fields of sensors and actuators
3. To provide an idea of strengths and weaknesses of the various types of sensors and actuators.
4. To analyze different types of Sensors, Pneumatic, Hydraulic, and Micro actuators.

UNIT 1: (~ 10 Lecture Hours)

Sensors/Transducers: Principles, Classification, Parameters, Characteristics, Environmental Parameters (EP), Characterization.

Mechanical and Electromechanical Sensors: Introduction, Resistive Potentiometer, Strain Gauge, Resistance Strain Gauge, Semiconductor Strain Gauges, Inductive Sensors- Sensitivity and Linearity of the Sensor.

Types: Capacitive Sensors, Electrostatic Transducer, Force/Stress Sensors using Quartz Resonators, Ultrasonic Sensors.

UNIT 2: (~ 9 Lecture Hours)

Thermal Sensors: Introduction, Gas thermometric Sensors, Thermal Expansion Type Thermometric Sensors, Acoustic Temperature Sensor, Dielectric Constant and Refractive Index Thermo-sensors, Resistance Change Type Thermometric Sensors.

Magnetic Sensors: Introduction, Sensors and the Principles Behind, Magneto-resistive Sensors, Anisotropic Magneto-resistive Sensing, Semiconductor Magneto-resistors, Inductance and Eddy Current Sensors, Angular/Rotary Movement Transducers.

UNIT 3: (~ 9 Lecture Hours)

Smart Sensors: Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, Automation.

UNIT 4: (~ 9Lecture Hours)

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

UNIT 5: (~ 9 Lecture Hours)

Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic-Linear, Rotary, Resonant, Electro Hydrodynamic Magnetic-Thermo magnetic, Magnetostatic micro actuators.

Text Books:

1. D. Patranabis, "Sensors and Transducers", Prentice Hall India Pvt., 2nd Ed, 2021.
2. Massood Tabib and Azar, "Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures", First edition, Kluwer academic publishers, Springer, 1997.
3. Manfred Kohl, "Shape Memory Actuators", first edition, Springer.

Reference Books:

1. Robert H Bishop, "The Mechatronics Hand Book", CRCPress, 2002.
2. Clarence W. De Silva, "Sensors and Actuators Engineering System Instrumentation", Taylor & Francis Ltd, 2nd Ed, 2015.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_ee32/preview
2. https://nptel.ac.in/courses/108108147

Course Outcomes:

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

1. List the different types of sensors and actuators based on their working principle.
2. Classify different Sensors & Actuators based on various physical phenomena and differentiate their performance characteristics
3. Interpret the functional principles of sensors and actuators.
4. Demonstrate the working operations, strengths, and weaknesses of the various types of sensors and actuators.
5. Distinguish different types of sensors and actuators based on their mathematical model.
6. Select the relevant Sensors, Pneumatic, Hydraulic and Micro actuators for real-time advanced applications.

IV Year B.Tech. I-Semester **L T P C**

Course Code: 127KW **3 0 0 3**

ELEMENTS OF SATELLITE COMMUNICATIONS

(Open Elective 2)

Prerequisites: - Nil-

Course Objectives:

1. Acquire foundation in orbital mechanics for the satellites with Applications of satellite Communication.
2. Provide basic knowledge of Satellite Sub Systems.
3. Familiarize basic knowledge of Link Design of Satellite.
4. Understand Earth Station Technology.
5. Understand the concepts of LEO , GEO stationary Satellite systems.

UNIT 1: (~ 10 Lecture Hours)

Introduction: Origin of Satellite Communications, Historical Back-ground, Basic Concepts of Satellite Communications, Frequency Allocations for Satellite Services, Applications, Future Trends of Satellite Communications.

Orbital Mechanics: Orbital Mechanics, Look Angle determination, Orbital Perturbations, Orbit determination, Orbital Effects in Communication Systems Performance.

UNIT 2: (~ 10 Lecture Hours)

Satellite Subsystems: Attitude and Orbit Control System, Telemetry, Tracking, Command And Monitoring, Power Systems, Communication Subsystems, Satellite Antennas, Equipment Reliability and Space Qualification.

UNIT 3: (~ 8 Lecture Hours)

Satellite Link Design: Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design of Down Links, Up Link Design, Design Of Satellite Links For Specified C/N, System Design Examples.

UNIT 4: (~ 8 Lecture Hours)

Earth Station Technology: Introduction, Transmitters, Receivers, Antennas, Tracking Systems, Terrestrial Interface, Primary Power Test Methods.

UNIT 5: (~ 12 Lecture Hours)

Low Earth Orbit and Non Geo-Stationary Satellite Systems: Orbit Considerations, Coverage and Frequency Consideration, Delay & Throughput Considerations, System Considerations, Operational NGSO Constellation Designs.

Text Books:

1. Satellite Communications – Timothy Pratt, Jeremy Allnutt, WSE, Wiley Publications, 3rd Edition, 2019.
2. Satellite Communication by Robert M. Gagliardi, CBS Publisher, 1ST Edition 2019.
3. Satellite Communications Engineering – Wilbur L. Pritchard, Robert A Nelson and Henri G. Suyderhoud, 2nd Edition, Pearson Publications, 2003.

Reference Books:

1. Satellite Communications: Design Principles – M. Richharia, BS Publications, 2nd Edition, 2003.
2. Satellite Communication – D.C Agarwal, Khanna Publications, 5th Edition 2008.
3. Satellite Communications: Concepts and Applications – K.N. Raja Rao, PHI, 2nd Edition 2004
4. Satellite Communications – Dennis Roddy, McGraw Hill, 4th Edition, 2009.

Online Resources:

1. UCLA University EC ENGR X 422.19 https://www.uclaextension.edu/engineering/electrical-computer- engineering/course/satellite-communication- system-design-ec-engr-x
2. MIT Open courseware https://ocw.mit.edu/courses/16-851-satellite-engineering-fall- 2003/resources/l2_orbital_mech/

Course Outcomes:

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

1. Understand basic concepts and frequency allocations for satellite communication, orbital mechanics.
2. Envision the satellite sub systems with the Knowledge of Multiple beam focusing.
3. Familiarize the concept of G/T ratio
4. Analyze in design of satellite links for specified C/N.
5. Understand Earth station technologies.
6. Know the concepts of LEO, NGSO Satellite Systems with High Throughput.

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IV Year B.Tech. I-Semester **L T P C**
Course Code: 127LC **3 0 0 3**

TELECOMMUNICATION SWITCHING SYSTEMS

(Open Elective-2)

Prerequisites: -Nil-

Course Objectives:

1. To expose through the evolution of switching systems from electromechanical systems to stored program controlled digitalsystems.
2. To provide knowledge to the students regarding design and analysis of electronic space division switching systems.
3. To provide knowledge to the students regarding design and analysis of time division switching systems.
4. To inculcate students on various traffic engineering concepts.
5. To inculcate students on various switching techniques used in Telecommunications.

UNIT 1: (~10 Lecture Hours)

Telecommunication Switching Systems: Introduction, Evolution ofTelecommunications, Basics of a switching system, Crossbar Switching, Principles of Crossbar Switching, Crossbar Switch Configuration, Crosspoint Technology, Crossbar Exchange Organization.

UNIT 2: (~8 Lecture Hours)

Electronic Space Division Switching: Stored Program Control,Centralized SPC, Distributed SPC, Software Architecture, Application Software, Enhanced services, Two- Stage Networks, Three-Stage Networks.

UNIT 3: (~8 Lecture Hours)

Time Division Switching: Basic Time Division Space Switching, Basic Time Division Time Switching, Time Multiplexed Space Switching, Time Multiplexed Time Switching, Combination Switching, Three Stage Combination Switching, n - Stage Combinational Switching.

UNIT 4: (~10 Lecture Hours)

Telecommunications Traffic : Introduction, The Unit of Traffic, Congestion, Traffic Measurement, A Mathematical Model, Lost-Call Systems, Theory, Traffic Performance, Loss Systems in Tandem, Use of Traffic Tables, Queuing Systems, The Second Erlang Distribution, Probability of Delay.

UNIT 5: (~10 Lecture Hours)

Circuit Switching and Packet Switching: Switching Networks, Circuit Switching Networks, Circuit Switching Concepts, Packet Switching Principles.

Virtual Circuit Switching: Global Addressing, Virtual Circuit Identifier, Three Phases, Data Transfer Phase, Setup Phase, Teardown Phase.

Text Books:

1. Thyagarajan Viswanathan, "Tele Communication Switching System and Networks", PHI, 2000.
2. J. E Flood, " Telecommunications Switching and Traffic Networks", Pearson Education, 2006.
3. William Stallings, "Data and Computer Communications", Seventh Edition, TMH, 2003.

Reference Books:

1. Behrouz A.Forouzan, "Data Communications and Networking", Third Edition, TMH.
2. Achyut. S.Godbole, " Data Communications & Networks", TMH, 2004.
3. H. Taub & D. Schilling, "Principles of Communication Systems", 2nd Edition, TMH, 2003.
4. S.Keshav, "An Engineering approach to computer networking", AddisonWesely.

Online References:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/0471208051
2. https://en.wikipedia.org/wiki/Telecommunication

Course Outcomes:

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

1. Understand the evolution of telecommunication systems, advancements in telecommunications, classification of switching systems as well as the basics of switching systems.
2. Analyse the principles and various configurations of Crossbar Switching considering factors like switching capacity and switching elements.
3. Analyze electronic space division switching, Two-Stage Networks, and Three-Stage Networks, considering factors like switching capacity, switching elements and blocking probability.
4. Understand various configurations of time division switching and combination of both Space Switching and Time Switching to achieve improved efficiency and flexibility.
5. Apply mathematical models to measure telecommunication traffic, predict congestion, and assess network performance, considering factors like call loss and queuing systems.
6. Develop an understanding of various switching techniques like Circuit switching, Packet switching and Virtual Circuit Switching.

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IV Year B.Tech. I-Semester **L T P C**
Course Code: 127LA **3 0 0 3**

RENEWABLE ENERGY SOURCES

(Open Elective-2)

Prerequisites: -Nil -

Course Objectives:

1. To understand various renewable energy resources available at a location and assessments of its potential, using tools and techniques.
2. To create awareness on Solar energy radiation, its interactions, measurement and estimation.
3. To study site selection for wind turbines, wind systems, measurements and instrument.
4. To acquire knowledge on Geothermal, wave, tidal and OTEC resources, site selection.

UNIT 1: (~7 Lecture Hours)

Introduction: Definitions, Concepts and limitations of RES Criteria for assessing the potential of NCES, Classification of RES- Solar-Wind-Geothermal- Biomass- Ocean energy sources, Comparison.

Solar energy: Solar radiation spectrum - Extra-terrestrial and terrestrial solar radiation, solar constant, Measurement of solar Radiation -Pyranometer, Pyrheliometer, sunshine recorder.

UNIT 2: (~9 Lecture Hours)

Solar Energy Collection, **Storage and Applications**: Energy Collection: Flat plate and Concentrating collectors, Classification of Concentrating collectors.

Energy Storage: Definition of Sensible heat, Latent heat, Stratified storage - Solar ponds - Applications.

Solar Photovoltaic Generation(elementary treatment only): PV Generation, Photovoltaic energy conversion – Operating principle, Photovoltaic cell concepts, Cell, module, array, Series and parallel combinations, Potential in India.

UNIT -3: (~9 Lecture Hours)

Wind energy(elementary treatment only): Power in Wind, Betz criteria, Types of wind mills, Aerodynamics of wind energy -basic components of wind energy systems, Potential in India.

Bio-energy: Biomass resources ,Bio-Conversion Technologies -Densification-Combustion and Incineration -thermo-chemical -Bio chemical – Aerobic &Anaerobic digestion -ethanol fermentation Types of Bio-gas plants-floating drum and fixed dome type.

UNIT 4: (~9 Lecture Hours)

Geothermal energy: Structure of Earth's Interior-Geothermal Resources - Hydro thermal resources -Geopressured -Hot dry rocks- magma resources. Geothermal Power generation from various geothermal resources.

Ocean energy:: OTEC - Principle of utilization, types up of OTEC plants- open loop and closed loop OTEC systems **Tidal and wave energy**: potential and conversion Techniques.

UNIT 5: (~6 Lecture Hours)

Direct Energy Conversion: Need for DEC, types of DEC-fuel cell, Magento hydro dynamic energy conversion (MHD) Thermoelectric conversion working principle (elementary treatment only)Combined cycle and Co-generation.

Text Books:

1. D.P.Kothari, K.C.Singhal and Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, 2nd Edition, P.H.I., 2014.
2. B.H.Khan ,Non-Conventional Energy Resources, Third edition McGraw Hill Education, 2017
3. Twidell&Wier, Renewable Energy Resources, 3rd Edition, CRC Press (Taylor & Francis), 2006.

Reference Books:

1. G.D. Rai, Non-Conventional Energy Sources, 5th Edition, Khanna Publishers, 2009
2. Sukhatme.S.P, Solar Energy: Principles of Thermal Collection and Storage, 3rd Edition, Tata McGraw Hill, 2008.

Online Resources :

https://nptel.ac.in/courses/103103206

Course Outcomes:

After completion of this course the students should able to

1. Define and comprehend the relevance of RES.
2. Identify different forms of Wind and Solar energy systems.
3. Assess working of OTEC, Ocean energy, Biomass energy and Geothermal energy systems.
4. Explain the need for usage of renewable energy resources and energy conservation.
5. Differentiate between power generation concepts of Renewable & Non-Renewable sources.
6. Describe the conversion technologies using biomass, Tidal, Wave and Geothermal energy resources.

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IV Year B.Tech. I-Semester	**L T P C**
Course Code: 127LB	**3 0 0 3**

RESEARCH METHODOLOGY

(Open Elective-2)

Course Objectives:

This course will enable the students:

1. To develop an understanding towards basic concepts of the research methodology.
2. To familiarize primary disparity between quantitative research and qualitative research.
3. To provide knowledge to define appropriate research problem and its parameters.
4. To familiarize tools and techniques used for preparation of report writing.

UNIT 1: (~ 10 Lecture Hours)

Research Methodology: Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods verses Methodology, Research and Scientific Method, Importance of Research Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India.

UNIT 2: (~ 9 Lecture Hours)

Defining the Research Problem: Definition of Research Problem, selecting the Problem, Necessity of Defining the Problem, Technique involved in Defining a Problem.

Literature Survey: Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Literature Review: Need of Review, Guidelines for Review, Record of Research Review.

UNIT 3: (~ 9 Lecture Hours)

Research Design: Meaning of Research Design, Need for Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design.

Design of Sample Surveys: Sample Design, Sampling and Non Sampling Errors, Sample Survey Versus Census Survey. Types of Sampling Designs: Non Probability Sampling, Probability Sampling.

UNIT 4: (~ 10 Lecture Hours)

Data Collection and Preparation: Collection of Primary data: Observation method, Interview method, Questionnaires, Schedules. Collection of Secondary data, Case study method.

Data Preparation: Questionnaire checking, Editing, Coding, Classification, Tabulation. Graphical Representation**:** Pie chart, Bar chart, Histogram, Frequency Polygon.

UNIT 5: (~ 10 Lecture Hours)

Interpretation and Report Writing: Meaning of Interpretation, Techniques of Interpretation, Precautions of interpretation. Significance of Report Writing, Steps in Writing the Report, Format of the Research Report. Technical paper writing/Journal paper writing, Making Presentation, Use of Visual Aids, Elementary Treatment of Plagiarism Tools.

Text Books:

1. C.R Kothari & Gaurav Garg, "Research Methodology, Methods & Technique", New Age International Publishers, 2019.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2016.

Reference Books

1. R .Pannerselvam, "Research Methodology", Prentice hall of India, 2014.
2. Ratan Khananabis and Suvasis Saha, "Research Methodology", Universities Press, Hyderabad, 2015.
3. G. Nageswara Rao, "Research Methodology and Quantitative methods",BS Publications, Hyderabad, 2012.

Online Resources:

1. Onlinecourses.nptel.ac.in

Course Outcomes:

At the end of the course students are expected to

1. Develop an understanding on various kinds of research and objectives of doing research.
2. Perform literature reviews using print and online databases.
3. Design good research.
4. Collect required data for Research and to adopt methods for data collection.
5. Interpret the data from research perception.
6. Write and present a substantial technical report and document.

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IV Year B.Tech I-Semester **L T P C**
Course Code: 127KX **3 0 0 3**

INDUSTRIAL MANAGEMENT
(Open Elective)

Prerequisites: -Nil-

Course Objectives:
1. Educate the importance of productivity in production process.
2. Managing various production activities and quality aspects.
3. Inculcate the importance of industrial safety & legislation.

UNIT 1: (~ 10 Lecture Hours)
Introduction to Industrial Management

Industrial Management – Introduction – Need and Scope of Industrial Management. **Production Management –** Plant location – Factors affecting Plant location - Plant Layout – Types of Plant Layout – Product, Process, Fixed Position and Combination Layout - Production **–** Introduction – Types of Production.

Productivity – Production vs Productivity – Objectives – Factors affecting Productivity – (Theory only) – Measures to improve Productivity and its benefits.

UNIT 2: (~ 09 Lecture Hours)
Operations and Materials Management

Operations Management – Work study – Definition – Objectives – Principles of Work study – Method study - Definition - Objectives – Steps of Method study. Work measurement – Definition - objectives – Time study – Steps in Time study – Uses of Time study.

Materials Management – Definition – Objectives – Functions – Purchase procedure – ABC analysis – VED Analysis.

UNIT 3: (~ 09 Lecture Hours)
Inventory and Stores Management

Inventory Management – Introduction - Functions of Inventory Control – Advantages of Inventory Control – Economic Order Quantity - Methods of Inventory issues – FIFO, LIFO, Simple average and Weighted Average methods (simple problems).

Stores Management – Stores Keeping – Classification of Stores – Stores Records.

Modern techniques in Inventory and Stores Management – Introduction to Material Resource Planning (MRP) - Enterprise Resource Planning (ERP) – Just in Time (JIT) - Supply Chain Management (SCM).

UNIT 4: (~ 10 Lecture Hours)

Quality Management and Control

Quality Management – Introduction, Contributions of Juran, Deming, Crosby, Total Quality Management.-Quality Policy.

Statistical Quality Control – Need for Quality control- Sampling techniques - Advantages of Quality control – Shewart Control Charts - Test of variables - Mean chart and Range chart – Test of Attributes – c Chart and p Chart (simple problems) - Six Sigma.

UNIT 5: (~ 10 Lecture Hours)

Industrial Safety and Security

Industrial Safety– Objectives of Industrial safety – Planning of Industrial safety – Industrial accidents and their types – Causes of Accidents – Risk Management in Industrial safety.

Industrial Security- Introduction- Need - Principles of security – Essential ingredients of security.

Text Books:

1. O.P. Khanna (2018) Industrial Engineering and Management, Dhanpat Rai Publications Pvt. Ltd.
2. T.R. Banga, N K Agarwal, S.C. Sharma (2008) Industrial Engineering and Management Science, 12th Edition, Khanna Publishers.

Reference Books:

1. Joseph, G. Monks (2012) Operations Management -Theory and Problems, 3rd Edition, McGraw-Hill Series.
2. NVS Raju (2013) Industrial Engineering & Management, Cengage Learning.
3. Besterfield (2013) Total Quality Management, 3rd Edition, Pearson.
4. S.Subramanian (2006) Industrial Security Management, Gyan Publishing House.

Online Resources:

1. Operations Management : https://onlinecourses.nptel.ac.in/noc18_me26/preview

Course Outcomes (COs):

After learning the contents of this course, the student must be able to

1. Organize the activities of Business efficiently.
2. Adapt to appropriate methods of production yielding productivity.
3. Identify efficient methods of production.
4. Handle inventory efficiently for improving Productivity.
5. Implement and maintain Quality standards in Production.
6. Understand industrial safety and security.

IV Year B.Tech. I-Semester **L T P C**
Course Code: 127KS **3 0 0 3**

BEHAVIOURAL SKILLS AND PROFESSIONAL COMMUNICATION

(Open Elective-2)

Course Objectives:

1. To achieve the desired life skills and social skills in their workplace.
2. To enable students to handle and overcome the professional challenges and conflicts in a working environment.
3. To facilitate the students to understand and develop their managerial skills in a professional environment.
4. To help the students understand professional and cross cultural communication through digital technologies.
5. To develop critical thinking skills for speech and writing.

UNIT 1: (~09 lecture hours)

LIFE SKILLS

Essential Social Skills and Presentation Skills– Confidence Building – Self-esteem– Positive Attitude – Assertiveness – Johari Window.

UNIT 2: (~10 lecture hours)

CRITICAL THINKING SKILLS

Decision Making - Problem Solving – Negotiation - Conflict Resolution and Creative Thinking – Blooms Taxonomy.

UNIT 3: (~10 lecture hours)

MANAGERIAL SKILLS

Time Management – Stress Management – Crisis Management – Conflict Management – Relationship Management.

UNIT 4: (~10 lecture hours)

PROFESSIONAL SKILLS

Digital Communication – Social Networking – Cross Cultural and Cross Functional Communication – Professional Etiquettes and Netiquettes.

UNIT 5: (~09 lecture hours)

FUNDAMENTAL VALUES THROUGH DIVERSITY AND INCLUSIVITY:

Meaning and concept of diversity and inclusivity – learner diversity—Diversity for sustainability—strength of diversity for inclusivity –Inclusivity in workplace— strategies for inclusivity Importance of Resilience – Concepts of resilience – qualities of a resilient person – strategies for building resilience.

Reference Books:

1. Meenakshi Raman and Shalini, *Softskills: Key to success in workplace and life,* Cengage Publications (2018).
2. Barun, K. Mitra, *Personality Development and Soft Skills*, Oxford University Press, 2nd Edition (2016).
3. Sailesh Sen Gupta, *Business and Managerial Communication*, PH1 Learning Pvt. Ltd., (2011).

Online Courses:

1. Softskills : https://onlinecourses.nptel.ac.in/noc21_hs76/preview
2. Emotional Intelligence: https://onlinecourses.nptel.ac.in/noc20_hs13/preview

Course Outcomes:

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

1. Communicate with more confidence and self-esteem.
2. Give better presentation and explanation using digital aids and tools.
3. Perform effectively and efficiently in the work place environment.
4. Exhibit better tolerance and receptiveness in understanding and accepting diversity.
5. Apply higher thinking order in the self-development process.
6. Equip oneself to handle the work related challenges and conflicts professionally.

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IV Year B.Tech. II-Semester **L T P C**
Course Code: 128LE **3 0 0 3**

CLOUD COMPUTING

(Open Elective -3)

Prerequisites: -Nil-

Course Objectives:

1. To explain evolving computer model called cloud computing.
2. To introduce the various levels of services that can be achieved by cloud.
3. To describe the security aspects of cloud.

UNIT 1: (~ 9 Lecture Hours)

Introduction- Cloud computing at a glance, Historical developments, Building cloud computing environments.

Cloud Computing Architecture - The cloud reference model, Types of clouds, Economics of the cloud, Open challenges.

UNIT 2: (~ 8 Lecture Hours)

Virtualization - Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples- Xen, VMware, Microsoft Hyper-V. Migrating into a Cloud, Virtual Machines Provisioning and Migration Services.

UNIT 3: (~ 10 Lecture Hours)

Cloud Platforms in Industry: Amazon web services, Google App Engine, Microsoft Azure, Aneka-Integration of private and public cloud.

Cloud Programming and Software Environments: Programming Support for Google App Engine: Programming the Google App Engine, Google File System(GFS), BigTable, Google's NOSQL System, Chubby, Google's Distributed Lock Service, Programming on Amazon AWS and Microsoft Azure: Programming on Amazon EC2, Amazon Simple Storage Service(S3), Amazon Elastic Block Store(EBS) and SimpleDB, Microsoft Azure Programming Support.

UNIT 4: (~ 9 Lecture Hours)

Security in the Cloud- Cloud Security Challenges, Software-as-a-Service Security.

Secure Distributed Data Storage in Cloud Computing - Cloud Storage: from LANs TO WANs, Technologies for Data Security in Cloud Computing.

Data Security in the Cloud- The Current State of Data Security in the Cloud, Cloud Computing and Data Security Risk, Cloud Computing and Identity, The Cloud, Digital Identity, and Data Security, Content Level Security-Pros and Cons.

UNIT 5: (~ 9 Lecture Hours)

SLA Management - Traditional Approaches to SLO Management, Types of SLA, Life Cycle of SLA, SLA Management in Cloud, Automated Policy-based Management.

Advanced Topics in Cloud Computing – Energy Efficiency in Clouds: Energy-Efficient and Green Cloud Computing Architecture, Market Based Management of Clouds: Market-Oriented Cloud Computing, A Reference Model for MOCC, Technologies and initiatives Supporting MOCC, Federated Clouds/InterCloud: Characteristics and Definition, Cloud Federation Stack.

Text Books:

1. Rajkumar Buyya, Christian Vecchiola and S.Thamarai Selvi, Mastering Cloud Computing: Foundations and Applications Programming, McGraw Hill Education, 2013.
2. Rajkumar Buyya, James Broberg and Andrzej, Cloud Computing: Principles and paradigms Wiley, 2011.
3. John W. Rittinghouse and James F. Ransome, Cloud Computing: Implementation, Management, and Security by CRC, 2010.

Reference Books:

1. Kai Hwang, Geoffrey C.Fox, Jack J Dongarra and Elsevier, Distributed and cloud computing, 2012.
2. A. Kannammal, Fundamentals of Cloud Computing, CL India, 2015.
3. Tim Mather, Subra Kumaraswamy and Shahed Latif, Cloud Security and Privacy, An Enterprise Perspective on Risks and Compliance. By Publisher: O'Reilly Media 2009.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc23_cs42
2. https://aws.amazon.com/
3. https://azure.microsoft.com/en-in
4. https://cloud.google.com/

Course Outcomes:

After completion of the course, students will be able to

1. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and Illustrate the broad perceptive of cloud architecture and model.
2. Apply and design suitable Virtualization concept.

3. Explore some important cloud computing driven commercial systems such as Google Apps, Microsoft Azure and Amazon Web Services and design other web cloud applications.
4. Assess Cloud storage systems and Cloud security, the risks involved, its impact and develop cloud application.
5. Devise performance negotiations between cloud service providers and consumers through SLAs.
6. Interpret enterprise level requirements by learning Energy efficient, Market ready, Federated cloud systems.

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IV Year B.Tech. II-Semester **L T P C**

Course Code: 128LD **3 0 0 3**

BLOCKCHAIN TECHNOLOGIES

(Open Elective -3)

Prerequisites: -Nil-

Course Objectives:

1. To enable students develop understanding on Blockchain Technology
2. To equip students with knowledge on cryptocurrencies working.
3. To empower students, gain knowledge on Blockchain implementation technologies.

UNIT 1: (~6 Lecture Hours)

Blockchain 101: - The History of Blockchain and Bitcoin, Types of Blockchain, Consensus, CAP theorem and blockchain.

Decentralization: - Decentralization using Blockchain, Methods of decentralization, Routes to decentralization Blockchain and Full Ecosystem, Smart contracts, Decentralized Organizations, Platforms for Decentralization.

UNIT 2: (~8 Lecture Hours)

Introducing Bitcoin: - Bitcoin, Digital Keys and Addresses, Transactions, Mining. **Bitcoin Network and Payments: –** Wallets, Bitcoin payments, Innovation in Bitcoin **Alternative Coins: –** Theoretical Foundations, Bitcoin limitations, Namecoin, Primecoin, Zcash

Smart Contracts: – Ricardian Contracts.

UNIT 3: (~10 Lecture Hours)

Ethereum 101: - The Ethereum network, Components of the Ethereum ecosystem. **Further Ethereum:** Programming Languages-Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols.

Development Tools and Frameworks: - Solidity Language.

UNIT 4: (~10 Lecture Hours)

Introducing Web3: - Web3 – Contract Deployment, POST Requests, Development frameworks.

Hyperledger: - Hyperledger as a protocol, The reference architecture, Fabric-Hyperledger Fabric–Distributed Ledger, Sawtooth Lake, Corda.

UNIT 5: (~10 Lecture Hours)

Alternative Blockchains: - Blockchains- Kadena, Ripple,Stellar, Rootstock, Quorum, Tezos, Storj, Maidsafe, BigchainDB, Multichain, Tendermint, Platforms and Frameworks- Eris.

Scalability and Other Challenges: -Scalability, Privacy.

Current Landscape and What's Next: – Emerging trends,Other Challenges, Blockchain Research, Notable Projects, Miscellaneous Tools.

Text Books:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.

Reference Books:

1. Arshdeep Bahga, Vijay Madisetti, "Blockchain Applications: A Hands On Approach", VPT, 2017.
2. Blockchain Technology, Chandramouli Subramanian, Asha A George, Abilash KA and MeenaKarthikeyan, Universities Press, 2020.
3. The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing and Securing Distributed Blockchain-based projects, Elad Elrom, Springer Nature B.V, 2019.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105184/
2. https://github.com/rddill-IBM/ZeroToBlockchain
3. https://tech.seas.harvard.edu/free-blockchain
4. https://www.codecademy.com/learn/introduction-to- blockchain/ modules/fundamental-blockchain-concepts
5. The Basics of Blockchain & Bitcoin Fundamentals Course | Udemy

Course Outcomes:

After completion of the course, students will be able to

1. Acquire understanding on Blockchain Technology built-in way
2. Interpret how various cryptocurrencies work.
3. Articulate Ethereum Blockchain for developing smart contracts.
4. Apprehend knowledge on Web3 and Hyperledger Fabric for decentralized apps.
5. Exemplifying different alternative and emerging Blockchains.
6. Discover real-time usage of Blockchain.

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IV Year B.Tech. II-Semester **L T P C**
Course Code: 128LL **3 0 0 3**

INTRODUCTION TO NATURAL LANGUAGE PROCESSING
(Open Elective – 3)

Prerequisites: Nil

Course Objectives:
1. To introduce the fundamental concepts and techniques of natural language processing.
2. To understand the role of syntax and semantics of the text processing.
3. To gain an in-depth understanding of the computational properties and commonly used algorithms for processing linguistic information.
4. To explore different ways of building an NLP system through a case study on Question Answering system.

UNIT 1: (~10 Lecture Hours)
Introduction: What is Natural Language Processing (NLP), Origins of NLP, Language and Knowledge, The Challenges of NLP, Language and Grammar, Processing Indian Languages, NLP Applications.
Finding the Structure of Words: Words and their Components, Issues and Challenges, Morphological Models.
Finding the Structure of Documents: Introduction, Methods, Complexity of Approaches, Performances of the Approaches.

UNIT 2: (~9 Lecture Hours)
Syntax: Parsing Natural Language,
Treebanks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure, Parsing Algorithms, Models for Ambiguity Resolution in Parsing, Multilingual Issues: Tokenization, Case and Encoding, Word Segmentation, Morphology.

UNIT 3: (~9 Lecture Hours)
Semantic Parsing: Introduction, Semantic Interpretation, System Paradigms, Wordsense, Predicate-Argument Structure, Meaning Representation.

UNIT 4: (~9 Lecture Hours)
Language Modeling: Introduction, N-Gram Models, Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models- Class- Based Language Models, Syntax-Based Language Models, Neural Network language Models, Language-Specific Modeling Problems.

UNIT5: (~ 8 Lecture Hours)

Question Answering: Introduction and History, Architectures, Source Acquisition and Preprocessing, Question Analysis, Search and Candidate Extraction, Answer Scoring, Cross Lingual Question Answering, A Case Study.

Text Books:

1. Daniel M. Bikel & ImedZitouni, Multilingual Natural Language Processing Applications: From Theory to Practice, Pearson Publication, 2013.

Reference Books:

1. Tanvier Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford Higher Education, 2008.
2. Daniel Jurafsky & James H. Martin, Speech and Language Processing, An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, 2011.
3. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, O Reilly, 2009.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc23_cs45/preview
2. Natural Language Processing Specialization (DeepLearning.AI) | Coursera
3. https://www.udemy.com/topic/natural-language-processing/
4. Stanford CS 224N | Natural Language Proce‘ssing with Deep Learning
5. CS 626-460: Natural Language Processing (iitb.ac.in)

Course Outcomes:

After completion of the course, students will be able to

1. Demonstrate knowledge on the fundamental principles of natural language processing and document structure.
2. Understand the syntax processing and multilingual issues of language processing.
3. Analyze semantic interpretation and system paradigms for semantic parsing.
4. Understand various parameters to evaluate language models.
5. Identify suitable modeling techniques for solving real time problems.
6. Explore different ways to model the system similar to question answering system.

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IV Year B.Tech. II-Semester **L T P C**
Course Code: 128LF **3 0 0 3**

DATA MINING
(Open Elective – 3)

Prerequisites: Nil

Course Objectives:
1. Learn data mining concepts understand association rules mining.
2. Discuss classification algorithms learn how data is grouped using clustering techniques.
3. To develop the abilities of critical analysis to data mining systems and applications.
4. To implement practical and theoretical understanding of the technologies for data mining.
5. To understand the strengths and limitations of various data mining models.

UNIT 1: (~9 Lecture Hours)

Introduction to Data Mining: What is Data Mining, Definition, KDD, Data Mining Architecture, Challenges, Data Mining Functionalities, Data Mining Task Primitives, and Major Issues in Data Mining?

Data Pre-processing: Data Cleaning, Data Integration and Transformation, Data Reduction: Dimensionality Reduction, Feature Subset Selection, Discretization and Binarization, Measures of Similarity and Dissimilarity Basics, Similarities and dissimilarities between Simple Attributes and Data Objects.

UNIT 2: (~9 Lecture Hours)

Association Rules: Problem Definition, Frequent Item Set Generation, The APRIORI Algorithm, Support and Confidence Measures, Association Rule Generation, FP- Growth Algorithm, Mining various kinds of Association rules, Compact Representation of Frequent Item sets: Maximal Frequent Item Sets, Closed Frequent Item Sets.

UNIT 3: (~9 Lecture Hours)

Classification and Prediction: Problem Definition, General Approaches to solving a classification problem, Evaluation of classifiers, Classification Techniques, Decision Tree Induction, Naive Bayes Classifier, Bayesian Belief Networks, K–Nearest neighbor classification Algorithm and Characteristics, Prediction: Linear, Logistic Regressions.

UNIT 4: (~9 Lecture Hours)

Clustering: Cluster Analysis, Categorization of Major Clustering Methods, Partitioning Clustering -K-Means Algorithm, K- Means Additional issues, PAM Algorithm, Hierarchical Clustering : Agglomerative Methods and divisive methods, Basic Agglomerative Hierarchical Clustering, Specific techniques: MIN, MAX, Group Average, Ward's method and Centroid methods Key Issues in Hierarchical clustering, Strengths and Weakness, Outlier Detection.

UNIT 5: (~9 Lecture Hours)

Mining Time Series and Sequence Data: Mining Time-Series Data, Mining Sequence Patterns in Transactional Databases.

Mining Multimedia, Text and Web Data: Multimedia Data Mining, Text Mining, Mining the World Wide Web.

Text Books:

1. Jiawei Han and Michelinen Kamber, Data Mining-Concepts and Techniques, 2012, 3rd Edition, Morgan Kaufmann Publishers, Elsevier.
2. Pang-Ning Tan, Vipin Kumar and Michael Steinbanch, Introduction to Data Mining, Pearson Education.

Reference Books:

1. Arun K Pujari, Data Mining Techniques, 3rd Edition, Universities Press.
2. Pualraj Ponnaiah, Data Warehouse Fundamentals by Wiley- Interscience Publication.
3. Vikaram Pudi and P Radha Krishna, Data Mining by Oxford University Press.

Online Resources:

1. https://www.kdnuggets.com/websites/index.html
2. https://www.ngdata.com/data-mining-resources.

Course Outcomes:

After completion of the course, students will be able to

1. Understand the fundamental concepts and tasks of data mining.
2. Perform the pre-processing of data.
3. Formulate the association rules using different Algorithms.
4. Evaluate various classifiers.
5. Analyze different clustering techniques.
6. Understand t he mining of temporal and multimedia data.

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IV Year B.Tech. II-Semester **L T P C**

Course Code: 128LP **3 0 0 3**

WEARABLE DEVICES AND ITS APPLICATIONS

(Open Elective-3)

Prerequisites: Nil

Course Objectives:

1. Identify the need for development of wearable devices and its implications on various sectors.
2. Comprehend the design and development of various wearable inertial sensors and wearable and physiological activity monitoring devices for use in healthcare applications.
3. Discuss the usage of various biochemical and gas sensors as wearable devices.
4. Acquaint various wearable locomotive sensors as assistive devices for tracking and navigation.

UNIT 1: (~08 Lecture Hours)

Introduction to Wearable Devices Motivation for development of Wearable Devices, The emergence of wearable computing andwearable electronics, Types of wearable Sensors: Invasive &Non-invasive;Intelligent clothing, Industry sectors' overview – sports, healthcare, Fashion and entertainment, military, environmentmonitoring, mining industry, public sector and safety.

UNIT 2: (~10 Lecture Hours)

Wearable Inertial Sensors Wearable Inertial Sensors - Accelerometers, Gyroscopic sensors and Magnetic sensors; Modalityof Measurement-Wearable Sensors, Invisible Sensors, In-Shoe Force and Pressure Measurement;Applications: Fall Risk Assessment, Fall Detection, Gait Analysis, Quantitative Evaluation of Hemiplegic and Parkinson's Disease patients.Physical Activity monitoring: Human Kinetics, Cardiac Activity, Energy Expenditure measurement: Pedometers, Actigraphs.

UNIT 3: (~Lecture Hours)

Wearable Devices for Healthcare Wearable Blood Pressure (BP) Measurement: Cuff-Based Sphygmomanometer, Cuffless Blood Pressure Monitor. Study of flexible and wearable Piezoresistive sensors for cuffless blood pressure measurement.Wearable sensors for Body Temperature: Intermittent and Continuous temperature monitoring, Detection principles – thermistor, infrared radiation, thermopile, Modality of measurement wearable, adhesive/tattoo type. Conductive textile electrodes, Knitted Piezoresistive Fabric (KPF) sensors.

UNIT 4: (~8 Lecture Hours)

Wearable Biochemical and Gas SensorsWearable Biochemical Sensors: Parameters of interest, System Design –Textile based,Microneedle based; Types: Non-invasive Glucose Monitoring Devices, GlucoWatch® G2Biographer, GlucoTrackTM; Pulse oximeter, Portable Pulse Oximeters, wearable pulse oximeter,Wearable capnometer for monitoring of expired carbon dioxide.

Wearable gas sensors: Metal Oxide (MOS) type,electro chemical type, new materials-CNTs, graphene, Zeolites; Detection of atmospheric pollutants.

UNIT 5: (~12 Lecture Hours)

Wearable Cameras and Microphones for Navigation

Cameras in wearable devices, Applications in safety and security, navigation, Enhancing sportsmedia, Automatic digital diary. Cameras in smart-watches; Use of Wearable Microphones: MEMSmicrophones, Bioacoustics, Microphones and AI for respiratory diagnostics and clinical trials.Wearable Assistive Devices for the Blind - Hearing and Touch sensation, Assistive Devices forFingers and Hands, Assistive Devices for wrist,forearm and feet, vests and belts, head-mounteddevices.

Text Books:

1. Toshiyo Tamura and Wenxi Chen, "Seamless Healthcare Monitoring", Springer 2018.
2. EdwardSazonov and Michael R. Neuman, "Wearable Sensors - Fundamentals, Implementation and Applications", Elsevier Inc., 2014.
3. Aimé Lay-Ekuakille and Subhas Chandra Mukhopadhyay,"Wearable and Autonomous Biomedical Devices and Systems for Smart Environment", Springer 2010.

Reference Books:

1. Subhas Chandra"Wearable Electronics Sensors - For Safe and Healthy Living", Springer (June 8, 2015).
2. Shantanu Bhattacharya, A K Agarwal, NripenChanda, Ashok Pandey and Ashis Kumar Sen, "Environmental, Chemical and Medical Sensors", Springer Nature Singapore Pte Ltd. 2018
3. M. Mardonova and Y. Choi, "Review of Wearable Device Technology and Its Applications to the Mining Industry," Energies, vol. 11, p. 547, 2018.
4. N. Luo, W. Dai, C. Li, Z. Zhou, L. Lu, C. C. Y. Poon, et al., "Flexible Piezoresistive Sensor Patch Enabling Ultralow Power Cuffless Blood Pressure Measurement," Advanced Functional Materials, vol. 26, pp. 1178-1187, 2016.

Online Resources:

1. https://www.udemy.com/course/wearable-technology-a-complete-primer-on-wearables
2. https://www.coursera.org/learn/wearable-technologies

Course Outcomes:

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

1. Identify and understand the need for development of wearable devices and its influence on various sectors.
2. Discuss the applications of various wearable inertial sensors for biomedical applications.
3. Design and development of various Wearable monitoring devices for detection of biochemical and physiological body signals activity for use in healthcare applications.
4. Discuss and analyze the usage of various biochemical and gas sensors as wearable devices.
5. Identify the use of various wearable locomotive tools for safety and security, navigation.
6. Acquaint the usage of wearable devices as environmental monitoring, safety and navigational assistive devices and other modern applications.

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IV Year B.Tech. II-Semester **L T P C**
Course Code: 128LG **3 0 0 3**

SYSTEMS ENGINEERING
(Open Elective-3)

Prerequisites: Nil

Course Objectives:
This can be termed an advance level course in the electronic communication engineering domain. The course has the following main objectives:
1. To demonstrate an understanding of systems terminology, definitions, the design process, maintenance, and support of modern technological systems.
2. To applying tools, methodologies, and procedures to manage systems engineering problems and model systems.
3. To analyze the functions of a system and validate them
4. To understand the risks involved in systems engineering and developing effective systems solutions to mitigate or reduce the risks.
5. To employ systems engineering analytical tools, techniques, methodologies, and processes to assist in designing efficient and cost-effective design solutions.
6. To evaluate a system and subsequently test it.

UNIT 1: (~ 10 Lecture Hours)
Introduction to Systems engineering: Need for systems engineering, Systems engg viewpoint, perspectives, domains, Systems engineering fields, approaches, activities, and products, Systems engineering as a profession
Complex system structure-building blocks, hierarchy, interfaces, environment, interactions, complexity, System development process – life cycle, evolutionary characteristics, Systems engineering method, Systems testing throughout development.

UNIT 2: (~ 10 Lecture Hours)
Managing systems: Development, risks, work breakdown structure (WBS), systems engineering management plan (SEMP), Systems risk management, organizing for systems engineering, Need analysis – originating, operations, functional, and feasibility, Need validation, systems ops requirement, System requirements development, performance requirements
Implementing concept : exploration, validating requirements, Concept definition – selection and validation, functional analysis and allocation, Systems architecture, system modeling languages, Model-Based Systems Engineering (MBSE), Decision making, modeling for decisions, Simulation, Trade-off analysis.

UNIT 3: (~ 8 Lecture Hours)

Risk Management : Program risk reduction, prototype development for risk mitigation, Development testing, risk reduction, Revision of functional analysis and design, Overview of probability data analysis, Hypothesis testing

UNIT 4: (~ 10 Lecture Hours)

Engineering design : Implementing system building blocks, component design, Design validation, change management, Concepts of reliability, redundancy, Concepts of maintainability, availability, producibility, User interface design and GUI, Case Studies and Case Study Presentation

UNIT 5: (~ 12 Lecture Hours)

Testing and Evaluation and Installation: Integration, testing and evaluating total system, Test planning and preparation, system integration, Developmental and operational test and evaluation, Engineering for production, transition from development to production, Installation, Installation testing, In-service support, Upgrades and modernization.

Text Books:

1. Systems Engineering Second ed. – Kossiakoff, A., Sweet, W.N., Seymour, S.J., and Biemer S.M., John Wiley Sons Inc., New Jersey, 2011
2. International Council of Systems Engineering, Systems Engineering Handbook, A guide for System Life Cycle Processes and Activities, version 3.2.1, January 2011.
3. Systems Engineering Fundamentals, Department of Defense, Defense Acquisition University, Systems Engineering Fundamentals, 2001.

Reference Book:

1. Blanchard, B. S., and Fabrycky, W. J. (2006). Systems Engineering and Analysis (5^{th} Ed).
2. Pearson Prentice Hall: Upper Saddle River, NJ. [ISBN 978-0-13-221735-4]

Online Resources:

1. Systems Engineering : Theory and Practice by Prof. Deepu Philip (IIT Kanpur) https://onlinecourses.nptel.ac.in/noc21_mg39/preview

Course Outcomes:

Having gone through this course on Systems Engineering, the students would be able to

1. Explain the significance of Systems Engineering and the System development process.
2. Carry out the Systems engineering Management Plan and risk management.
3. Model a system and implement decision making functions.
4. Develop prototype for risk mitigation and test it.
5. Implement, validate, maintain and design the user interface of the system.
6. Install, Test and evaluate the entire system.

IV Year B.Tech. II-Semester	L	T	P	C
Course Code: 128LN	3	0	0	3

WASTE MANAGEMENT TECHNIQUES AND POWER GENERATION

(Open Elective-3)

Pre-requisites:

Course Objectives:

1. To classify the sources of solid waste& e-waste.
2. To identify methods of solid waste disposal.
3. To understand various waste management techniques.
4. To study various energy generation methods as per type of waste available locally.
5. To analyze energy generation methods and recycling of waste.

UNIT 1: (~ 8 Lecture Hours)

Waste Management: Sources & types of wastes (Industrial, Municipal, agro, domestic).Generation of wastes, Pollution standards, Waste characterization. Functional elements of waste management, technological aspects related to waste, on site handling, storage, collection, transfer and transport.

UNIT 2: (~ 8 Lecture Hours)

Waste Management Issues: Planning, organization & control Hazardous & toxic wastes, hazard & its management, classification, generation, handling, processing and disposal. Industrial safety, Waste disposal, Environmental impact (toxic & non-toxic).

UNIT 3: (~ 10 Lecture Hours)

Conversion Techniques & Methods: Recovery of value added components: Recycling, conversion products and energy Conversion technologies: Incineration, – principal features of an incinerator – site selection and plant layout of an incinerator - Thermo-chemical conversions. Biochemical conversion: Biogas & ethanol Conventional Chemical & biological treatment. Power generation & its utilization.

UNIT 4: (~ 08 Lecture Hours)

Processing Techniques and Recovery of Energy: Processing techniques – purposes mechanical volume reduction – necessary equipment – chemical volume reduction – mechanical size reduction selection of equipment – components separation – methods – drying and dewatering. Refusal disposal – various methods.

UNIT5: (~ 10 Lecture Hours)

Concepts of Land Fill & e-Waste

Concepts of Land Fill: Land Fill method of solid waste disposal, Landfill classification, Types, methods and Sitting consideration, Layout and preliminary design of landfills: Composition, Movement and control of landfill leachate and gases, Environmental monitoring for land fill gases.

E-Waste: E-waste in global context, Environmental concerns, Global trading in hazardous waste, Management of e-waste, e-waste legislation, Government regulations on e-waste management & Recycling.

Text Books:

1. Nicholas P. Cheremisinoff. Handbook of Solid Waste Management and Waste Minimization Technologies. An Imprint of Elsevier, New Delhi (2003)
2. P.AarneVesilind, William A. Worrell and Debra R. Reinhart. Solid Waste Engineering. Thomson Asia Pte Ltd. Singapore (2002)
3. M.Dutta , B .P .Parida, B. K. Guha and T. R. Surkrishnan. Industrial Solid WasteManagement and Landfilling practice. Narosa Publishing House , New Delhi (1999).

Reference Books:

1. C.S.Rao. Environmental pollution Control Engineering. Wiley Eastern Ltd.New Delhi (1995).
2. " E- waste in India: Research unit, Rajya Sabha Secretariat, New Delhi, June 2011".
2. M.L. Davis and D.A. Cornwell. Introduction to environmental engineering. Mc Graw Hill International Edition, Singapore (2008).
3. S.K.Agarwal. Introduction to Environmental engineering. Mc Graw Hill International Edition, Singapore (2008).
4. Hagerty, D.Joseph; Pavoni . Joseph L; Heer , John E., " Solid Waste Management", New York, Van Nostrand , 1973.

Online Resource:

https://nptel.ac.in/courses/103107125

Course Outcomes:

Upon the completion of the course, the students will be able to:

1. Understand technologies for generation of energy from solid waste.
2. Compare methods of solid waste disposal.
3. Identify sources of energy from waste using various conversion techniques.
4. Analyze methods for waste management.
5. Assess the harmful effects of e-waste.
6. Differentiate between the normal waste and e-waste.

IV Year B.Tech. II-Semester **L T P C**
Course Code: 128LM **3 0 0 3**

MARKETING MANAGEMENT
(Open Elective-3)

Prerequisites:- Nil-

Course Objectives:

1. Outline the importance and key concepts of Marketing.
2. Understand and appreciate the emerging marketing trends
3. Highlight the foundation of Marketing mix and evolution of marketing mix in modern era.

UNIT 1: (**~** 08 Lecture Hours)

Introduction to Marketing Management

Marketing Management - Meaning and importance – Nature, Scope and Functions - Evolution of Marketing concepts from Production Concept to Holistic Marketing concept –Marketing Environment- Micro and Macro Environment.

UNIT 2: (~ 10 Lecture Hours)

Market Segmentation

Market Segmentation: -STP Process- Levels & Patterns of Market Segmentation – Segmentation of Consumer & Business Markets –Target Marketing – Developing and Communicating a positioning strategy – Differential Tools - New Product Development and its process.

UNIT 3: (~ 10 Lecture Hours)

Marketing Mix

Product Offering: Product and Product Mix – Product Line decisions – Brand Decisions – Packaging and Labelling.

Pricing Strategies: - Meaning and objectives -factors influencing Pricing-Pricing Methods and Strategies.

UNIT 4: (~ 09 Lecture Hours)

Distribution: - Concept and Importance- Different types of distribution channels - Channel Intermediaries.

Promotion: -Nature and Importance of Promotions – Designing and Managing Promotion Mix – Managing Advertising – Sales Promotion - Personal Selling – Public Relation – Direct Marketing – Publicity and Social Media. Brief overview of People, Process and Physical evidence.

UNIT 5: (~ 09 Lecture Hours)

Recent Trends in Marketing

Digital Marketing –Meaning and Importance - Green Marketing -– Managing Digital Communication – E-Marketing -M-Marketing and Services Marketing. Case study/Marketing Plan for a Product or Service.

Text Books:

1. Philip Kotler (2017). Marketing Management (15th ed.). Prentice – Hall of India Pvt. Ltd.
2. Philip Kotler, Kevin Lane Keller (2017). Marketing Management (15th ed.). Pearson.

Reference Books:

1. Rajagopal (2008). Marketing – Concept and Cases. New Age International (P) Ltd.
2. Tapan Panda (2009). Marketing Management(5th ed.). Excel Publication.
3. Ramaswamy, V.S. & Namakumari S. (2013). Marketing Management India (5th ed.). Macmillan Publication.
4. Saxena, R. (2019). Marketing Management (6th ed.). Tata McGraw Hill, New Delhi.
5. Richard, J. Semenik (2006). Promotion & Integrated Marketing Communication (1st ed.) Thomson South-Western.

Online Resources:

Marketing Management-I: https://nptel.ac.in/courses/110104068/

Marketing Management-II: https://nptel.ac.in/courses/110104070/

Course Outcomes (COs)

After learning the contents of this course, the student must be able to

1. Remember and Comprehend the importance of the Marketing Management Process.
2. Analyze the need and importance of Market segmentation, Targeting and Positioning.
3. Interpret the elements of Product mix.
4. Enumerate strategies of Pricing in fixation.
5. Comprehend the dynamics of distribution and Promotion mix elements to leverage marketing concepts for effective decision making.
6. Know the recent trends in marketing and Understand the steps involved in developing a Marketing plan.

IV Year B.Tech. II-Semester	**L T P C**
Course Code: 128LH	**3 0 0 3**

ENVIRONMENTAL IMPACT ASSESSMENT

(Open Elective -3)

Prerequisites: -Nil-

Course Objectives:

1. To explain various stages of EIA process in India.
2. To provide knowledge on various aspects of Environment Impact Assessment Methodologies and apply them on developmental activities.
3. To explain the outlines of EMP.
4. To explain the procedure on environmental audit.
5. To provide an overview of environmental legislation.
6. To review a few EIA reports.

UNIT 1: (**~** 9 Lecture Hours)

Basic Concepts of EIA: Introduction **-**Definition of Environmental Impact Assessment (EIA) and Environmental Impact Statement (EIS)**,** EIA Process Flow Chart- Initial Environmental Examination (IEE), (Screening, Scoping, Baseline Data Acquisition, Impact Identification, Prediction, Analysis, Public Hearing, Draft EIS, Final EIS), Classification of Impacts, Elements of EIA, Benefits of EIA, Preparation of Environmental Base map.

UNIT 2: (**~** 9 Lecture Hours)

EIA Methodologies: Introduction, Criteria for the Selection of EIA Methodology, Methods of Impact Analysis – Impact Identification, Impact prediction, Impact Evaluation.

Different EIA Methods- (Rapid, Comprehensive, Adhoc, Checklist, Matrix, Network, Environmental Media Quality Index and Overlay Methods), Cost Benefit Analysis.

Impacts of Development Activities on Environmental Components: Deforestation – Causes, Effects and Control Measures, Guidelines for Preparation of Environmental Impact Statement.

UNIT 3: (**~** 8 Lecture Hours)

Environmental Management Plan – Introduction, Objectives, Goals, Purpose, Importance, Elements, EMP Preparation, Monitoring of EMP.

UNIT 4: (**~** 9 Lecture Hours)

Environmental Audit: Objectives of Environmental Audit, Types of Environmental Audit, Audit Protocol. Stages of Environmental Audit - Onsite Activities, Evaluation of Audit Data and Preparation of Audit Report, Post

Audit Activities. Case Studies and Preparation of Environmental Impact Statement Report for various Industries.

UNIT 5: (~ 9 Lecture Hours)

Environmental Legislations: The Environmental (Protection) Act 1986, The Water (Prevention and Control of Pollution) Act 1974, The Air (Prevention and Control of Pollution) Act 1981, The Motor Act 1988, The Wild life (Protection) Act 1972, National Bio-Diversity Act, 2002, Concept of ISO 9001 and 14000 Standards.

Text Books:

1. Environmental Impact Assessment by Larry Canter, Mc Graw-Hill Publications, 1996.
2. Environmental Impact Assessment by R. R Barthwal, New Age International Publications, 2010.
3. Environmental Impact Assessment: Theory & Practice by P. Wathern Publishers Rutledge, London, 1992.

Reference Books:

1. Environmental Pollution by R.K. Khitoliya, S. Chand Publishing, 2014.
2. Environmental Science and Engineering by J. Glynn and W. H. Gary, Prentice Hall Publishers, 1996.
3. Environmental Science and Engineering by Suresh K. Dhameja, S.K. Kataria and Sons Publication, New Delhi.2006.
4. Environmental Pollution and Control by, H. S. Bhatia, Galgotia Publication Private Limited, Delhi. 2003.
5. Environmental Impact Assessment by M.Anji Reddy, BSP Books Private Limited, 2017.

Web Resources:

1. Environmental Impact Assessment – Open Educational Resource
   http://www.raymondsumouniversity.com/eia-local/about.html
2. Environmental Impact Assessment -
   https://unep.ch/etb/publications/enviImp Asse.php
3. Urban Environmental Management -
   http://www.gdrc.org/uem/eia/impactassess .html
4. Environmental Impact Assessment Report
   https://www.miga.org/sites/default/files/archive/ Documents/
   EIA_Rwanda_Stones.pdf

Online Courses:

1. https://cept.ac.in/cce/admin/images/files/1347949702_po7tf.pdf
2. https://www.iisd.org/learning/eia/
3. https://www.iaia.org/iaia-training-courses.php
4. https://www.eiatraining.com/index.html.

Course Outcomes:

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

1. Identify the environmental attributes to be considered for EIA study.
2. Apply different methodologies in impact identification, prediction and analysis.
3. Prepare EMP based on environmental legislation.
4. Carry out environmental audit.
5. Prepare EIA reports.
6. Prepare EIS for various industries.

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1:	Imparting the knowledge of basic sciences, mathematics and programming skills in solving various engineering problems pertaining to the field of Electronics and Communication Engineering.
PEO2:	Training the students in analysing, designing and imparting research based knowledge and acquainting them with modern scientific tools.
PEO3:	Creating professional, ethical environment and inculcating effective communication skills.
PEO4:	Encouraging Teamwork and interdisciplinary ideas benefiting the Society.
PEO5:	Motivating students to be independent with a desire for life-long learning and adapting to the changing professional needs.

PROGRAM OUTCOMES (POs) – B.Tech. (ECE)

PO1:	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2:	Problem Analysis:Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3:	Design & Development Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4:	Investigation of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5:	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6:	Engineering & Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7:	Environment & Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8:	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9:	Individual & Team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10:	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11:	Project management & finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12:	Life Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES – B.Tech. (ECE)

PSO1:	Research Activities:Develop abilities to successfully analyze, execute and synthesize hardware and software oriented mini-and technical major-projects in identified specializations and areas of interest, and enrich industry compatibility
PSO2:	Professional Outlook: Establish a good knowledge sharing network and peer connectivity through Professional Society Memberships, Conduct of seminars, Technical Events and Conference Paper Presentations, and earn prominence.

G.NARAYANAMMA INSTITUTE OF TECHNOLOGY & SCIENCE (For Women)

(AUTONOMOUS)

INSTITUTE VISION

To become a center of quality education in Engineering and Technology for women empowerment.

INSTITUTE MISSION

- To fulfill the academic aspirations of women engineers for enhancing their intellectual capabilities and technical competency.
- To Leverage Leading – Edge Technologies and cultivate exemplary work culture.
- To facilitate success in their desired career in the field of engineering to build a progressive nation.

INSTITUTE QUALITY POLICY

G. Narayanamma Institute of Technology and Science (For Women), Hyderabad is committed in imparting Quality Education and Training for women empowerment in the field of "Engineering and Technology" and to satisfy applicable requirements through continual improvement of the Quality Management System by facilitating and supporting the staff and students to work as a team in upgrading their knowledge and skill in tune with the industrial and technological developments through a set of Quality objectives.