# NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA, G.B. NAGAR (AN AUTONOMOUS INSTITUTE)



#### Affiliated to

#### DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, UTTAR PRADESH, LUCKNOW



## **Evaluation Scheme & Syllabus**

For

**Bachelor of Technology** 

**Electronics & Communication Engineering (ECE)** 

**Second Year** 

(Effective from the Session: 2025-26)

# NOIDA INSTITUTE OF ENGINEERING & TECHNOLOGY, GREATER NOIDA (AN AUTONOMOUS INSTITUTE)

## **Bachelor of Technology**

## **Electronics & Communication Engineering**

## **EVALUATION SCHEME**

#### **SEMESTER-III**

| S.  | Subject             | Subject Name   | Type of             | P  | erio | ds | Ev | aluat | ion Sche | mes | Er<br>Seme |     | Total | Credit |
|-----|---------------------|--|---------------------|----|------|----|----|-------|----------|-----|------------|-----|-------|--------|
| No. | Codes               | Subject Name   | Subject             | L  | T    | P  | СТ | TA    | TOTAL    | PS  | TE         | PE  | Total | Credit |
| 1   | BCSCC0301           | Employability Skill Development – I                              | Mandatory           | 2  | 0    | 0  | 60 | 40    | 100      |     |            |     | 100   | 2      |
| 2   | BASL0301N           | Technical Communication  | Mandatory           | 2  | 0    | 0  | 30 | 20    | 50       |     | 50         |     | 100   | 2      |
| 3   | BEC0301Z            | Digital System Design  | Mandatory           | 2  | 0    | 0  | 30 | 20    | 50       |     | 50         |     | 100   | 2      |
| 4   | BEC0302Z            | Analog Circuits  | Mandatory           | 3  | 0    | 0  | 30 | 20    | 50       |     | 100        |     | 150   | 3      |
| 5   | BEC0306             | Data Structures  | Mandatory           | 2  | 0    | 0  | 30 | 20    | 50       |     | 50         |     | 100   | 2      |
| 6   | BEC0304             | Computational Intelligence                                       | Mandatory           | 3  | 0    | 0  | 30 | 20    | 50       |     | 100        |     | 150   | 3      |
| 7   | BEC0351             | Digital System Design Lab  | Mandatory           | 0  | 0    | 4  |    |       |          | 50  |            | 50  | 100   | 2      |
| 8   | BEC0352             | Analog Circuits Lab  | Mandatory           | 0  | 0    | 4  |    |       |          | 50  |            | 50  | 100   | 2      |
| 9   | BEC0356             | Data Structures Lab  | Mandatory           | 0  | 0    | 2  |    |       |          | 25  |            | 25  | 50    | 1      |
| 10  | BEC0355             | IoT Workshop   | Mandatory           | 0  | 0    | 6  |    |       |          | 50  |            | 100 | 150   | 3      |
| 11  | BEC0359X            | Social Internship  | Mandatory           | 0  | 0    | 2  |    |       |          | 50  |            |     | 50    | 1      |
| 12  | BNC0301/<br>BNC0302 | Artificial Intelligence and Cyber Ethics / Environmental Science | Compulsory<br>Audit | 2  | 0    | 0  | 30 | 20    | 50       |     |            |     | 50    | NA     |
|     |                     | *Massive Open Online Courses<br>(For B.Tech. Hons. Degree)       | *MOOCs              |    |      |    |    |       |          |     |            |     |       |        |
|     |                     | TOTAL  |                     | 14 | 1    | 18 |    |       | 350      | 225 | 350        | 225 | 1150  | 23     |

#### \* List of MOOCs Based Recommended Courses for Second year (Semester-III) B. Tech Students

| Sr.<br>No. | Subject<br>Code | Course Name  | University / Industry Partner Name     | No of Hours | Credits |
|------------|-----------------|--|--|-------------|---------|
| 1          | BMC0012         | Data Structures and Algorithms using Python - Part 1 | Infosys Wingspan (Infosys Springboard) | 29h 27m     | 2       |
| 2          | BMC0020         | Express PCB Training                                 | Infosys Wingspan (Infosys Springboard) | 15h 6m      | 1       |

#### **PLEASE NOTE: -**

- A 3-4-week Internship shall be conducted during summer break after semester-II and will be assessed during semester-III
- Compulsory Audit (CA) Courses (Non-Credit Artificial Intelligence and Cyber Ethics / Environnemental Science)
  - ➤ All Compulsory Audit Courses (a qualifying exam) do not require any credit.
  - > The total and obtained marks are not added in the grand total.

#### **Abbreviation Used:**

L: Lecture, T: Tutorial, P: Practical, CT: Class Test, TA: Teacher Assessment, PS: Practical Sessional, TE: Theory End Semester Exam., CE: Core Elective, OE: Open Elective, DE: Departmental Elective, PE: Practical End Semester Exam, CA: Compulsory Audit, MOOCs: Massive Open Online Courses.

# NOIDA INSTITUTE OF ENGINEERING & TECHNOLOGY, GREATER NOIDA (AN AUTONOMOUS INSTITUTE)

# Bachelor of Technology Electronics & Communication Engineering EVALUATION SCHEME

#### **SEMESTER-IV**

| S.  | Subject             | Subject Name   | Type of Subject     | F  | Perio | ds | Ev | valuat | ion Schei | mes |     | nd<br>ester | Total | Credit |
|-----|---------------------|--|---------------------|----|-------|----|----|--------|-----------|-----|-----|-------------|-------|--------|
| No. | Codes               | S 40 2 1 (4222)  | 1, pe or suspect    | L  | T     | P  | CT | TA     | TOTAL     | PS  | TE  | PE          |       |        |
| 1   | BASCC0401           | Employability Skill Development – II                             | Mandatory           | 2  | 0     | 0  | 60 | 40     | 100       |     |     |             | 100   | 2      |
| 2   | BEC0401             | Analog and Digital Communication                                 | Mandatory           | 3  | 0     | 0  | 30 | 20     | 50        |     | 100 |             | 150   | 3      |
| 3   | BEC0403             | CMOS Digital Integrated Circuit                                  | Mandatory           | 3  | 0     | 0  | 30 | 20     | 50        |     | 100 |             | 150   | 3      |
| 4   | BEC0402N            | Microprocessor & Microcontroller                                 | Mandatory           | 3  | 0     | 0  | 30 | 20     | 50        |     | 100 |             | 150   | 3      |
| 5   |                     | Department Elective 1  | Elective            | 3  | 0     | 0  | 30 | 20     | 50        |     | 100 |             | 150   | 3      |
| 6   | BAS0403             | Advance Engineering Mathematics                                  | Mandatory           | 3  | 1     | 0  | 30 | 20     | 50        |     | 100 |             | 150   | 4      |
| 7   | BEC0452             | Microprocessor & Microcontroller Lab                             | Mandatory           | 0  | 0     | 4  |    |        |           | 50  |     | 50          | 100   | 2      |
| 8   | BEC0451N            | Analog and Digital Communication Lab                             | Mandatory           | 0  | 0     | 2  |    |        |           | 25  |     | 25          | 50    | 1      |
| 9   | BEC0455             | Verilog-HDL  | Mandatory           | 0  | 0     | 6  |    |        |           | 50  |     | 100         | 150   | 3      |
| 10  | BCSCC0452           | Problèm Solving Approches  | Mandatory           | 0  | 0     | 2  |    |        |           | 50  |     |             | 50    | 1      |
| 11  | BEC0459             | Mini Project   | Mandatory           | 0  | 0     | 2  |    |        |           | 50  |     |             | 50    | 1      |
| 12  | BNC0402/<br>BNC0402 | Environmental Science / Artificial Intelligence and Cyber Ethics | Compulsory<br>Audit | 2  | 0     | 0  | 30 | 20     | 50        |     |     |             | 50    | NA     |
|     |                     | *Massive Open Online Courses<br>(For B.Tech. Hons. Degree)       | *MOOCs              |    |       |    |    |        |           |     |     |             |       |        |
|     |                     | TOTAL  |                     | 18 | 1     | 16 |    |        | 350       | 225 | 500 | 175         | 1250  | 26     |

#### \* List of MOOCs Based Recommended Courses for Second year (Semester-IV) B. Tech Students

| Sr. No. | Subject<br>Code | Course Name                                     | University / Industry Partner Name     | No of<br>Hours | Credits |
|---------|-----------------|---|--|----------------|---------|
| 1       | BMC0023         | Internet of Things 201                          | Infosys Wingspan (Infosys Springboard) | 15h 59m        | 1       |
| 2       | BMC0021         | IoT Raspberry Pi with Projects                  | Infosys Wingspan (Infosys Springboard) | 12h 25m        | 0.5     |
| 3       | BMC0022         | Mobile Apps Development - Advanced Applications | Infosys Wingspan (Infosys Springboard) | 14h 23m        | 1       |

#### PLEASE NOTE: -

- A 3-4-week Internship shall be conducted during summer break after semester-IV and will be assessed during Semester-V
- Compulsory Audit (CA) Courses (Non-Credit Environmental Science / Artificial Intelligence and Cyber Ethics)
  - All Compulsory Audit Courses (a qualifying exam) do not require any credit.
  - The Total and obtained marks are not added in the Grand Total.

#### **Abbreviation Used:**

L: Lecture, T: Tutorial, P: Practical, CT: Class Test, TA: Teacher Assessment, PS: Practical Sessional, TE: Theory End Semester Exam., CE: Core Elective, OE: Open Elective, DE: Departmental Elective, PE: Practical End Semester Exam, CA: Compulsory Audit, MOOCs: Massive Open Online Courses

## **List of Departmental Electives**

| Sr. No. | Departmental Electives | Subject Codes | Subject Name                                   | Bucket Name             |
|---------|------------------------|---------------|--|-------------------------|
| 1       | Elective-I             | BEC0412       | Introduction to Robotics and it's Applications | Embedded & Robotics     |
| 2       | Elective-I             | BEC0411       | Artificial Intelligence                        | Artificial Intelligence |
| 3       | Elective-I             | BEC0413       | VLSI Technology                                | Embedded & VLSI         |

# NOIDA INSTITUTE OF ENGINEERING & TECHNOLOGY, GREATER NOIDA (AN AUTONOMOUS INSTITUTE)

# Bachelor of Technology Electronics & Communication and Engineering

#### **AICTE Guidelines in Model Curriculum:**

A student will be eligible to get Under Graduate degree with Honours only, if he/she completes the additional MOOCs courses such as Coursera certifications, or any other online courses recommended by the Institute (Equivalent to 20 credits). During Complete B.Tech. Program Guidelines for credit calculations are as follows.

| 1. | For 6 to 12 Hours | =0.5 Credit |
|----|-------------------|-------------|
| 2. | For 13 to 18      | =1 Credit   |
| 3. | For 19 to 24      | =1.5 Credit |
| 4. | For 25 to 30      | =2 Credit   |
| 5. | For 31 to 35      | =2.5 Credit |
| 6. | For 36 to 41      | =3 Credit   |
| 7. | For 42 to 47      | =3.5 Credit |
| 8. | For 48 and above  | =4 Credit   |

For registration to MOOCs Courses, the students shall follow Coursera registration details as per the assigned login and password by the Institute these courses may be cleared during the B. Tech degree program (as per the list provided). After successful completion of these MOOCs courses, the students shall provide their successful completion status/certificates to the Controller of Examination (COE) of the Institute through their coordinators/Mentors only.

The students shall be awarded Honours Degree as per following criterion.

- i. If he / she secures 7.50 as above CGPA.
- ii. Passed each subject of that degree program in the single attempt without any grace.
- iii. Successful completion of MOOCs based 20 credits.

| ~  | Code   | e: BCSC  | CC0301   |  |  | Course 1   | Name: I  | <mark>Employa</mark>   | bility Sk                                  | ill Deve                                       | <mark>lopment</mark>  | – I   |  | L  | T   | P  | C                                  |
|--|--|--|--|--|--|--|--|--|--|--|---|---|--|--|---|--|------------------------------------|
| Course   | Offe   | red in: l  | B.Tech   |  |  |  |  |  |  |  |   |   |  | 2  | 0   | 0  | 2                                  |
| Pre-req  | uisite   | e: Progra  | amming   | Languag  | ge C   |  |  |  |  |  |   |   |  |  |   |  |                                    |
| Course   | Obj  | jectives:  | This c   | ourse in   | troduces   | compu  | ter syste  | m fund   | amentals                                   | , basic  | mathema   | atics for   | com  | putin  | g, and                                    | softv  | vare                               |
| develop  | nent   | principl   | es. It en  | nphasize   | s algoritl   | hm desig   | n and C  | ++ progr   | ramming                                    | skills. T                                      | Through 1   | hands-on  | prac   | tice a   | nd pro                                    | ject-ba  | asec                               |
| learning   | , stu  | idents d   | evelop   | problem  | -solving   | abilities  | and te   | amwork   | while                                      | creating                                       | real-wo   | rld appl  | icatio   | ns, r  | nini-ga                                   | ames,  | and                                |
| simulation   | ons, e   | enhancir   | ng both t  | echnical   | and coll   | aborative  | e compet   | encies   |  | _  |   |   |  |  |   |  |                                    |
| Course   | Outo   | come: A  | fter com   | pletion o  | of the cou   | urse, the  | student  | will be al   | ble to                                     |  |   |   |  | Bloc   | om's K                                    | nowle  | dge                                |
|  |  |  |  | -  |  |  |  |  |  |  |   |   |  | Leve   | el (KL                                    | )  |                                    |
| CO1  | Ap   | ply sets,  | relation   | s, function  | ons to co  | mputatio   | onal prob  | lem-solv   | ving                                       |  |   |   |  |  | K   | 3  |                                    |
| CO2  |  | derstand   |  |  |  |  |  |  |  | cycle us                                       | ing logic   | al reason   | ning   |  |   |  |                                    |
| CO2  | and  | d flowch   | arts.  | -  | •  |  |  |  |  | •  |   |   | Ū  |  | K   | 3  |                                    |
| CO3  |  | sign and   |  | -  | scale so   | ftware p   | projects   | or game  | s using                                    | structure                                      | ed progra   | amming  | and  |  | K   | 6  |                                    |
|  | •  | oject-bas  |  |  |  |  |  |  |  |  |   |   |  |  | 17  | .0   |                                    |
| CO4  |  | llaborate  |  |  |  |  | present  | a comp   | olete sof                                  | tware pr                                       | oject, de   | emonstra  | ting   |  | K   | 6  |                                    |
|  |  | oblem-so   |  |  |  |  | `  |  |  |  |   |   |  |  |   |  |                                    |
|  |  | pping (S   | cale 1: I  | Low, 2: I  | Vledium  | , 3: High  | 1)   |  | 1  | 1  | 1   |   |  |  |   |  |                                    |
| CO-PC  |  | PO1  | PO2  | PO3  | PO4  | PO5  | PO6  | PO7  | PO8  | PO9  | PO10  | PO11  | PSO  | 1 1  | PSO2                                      | PSC  | )3                                 |
| Mappi  | ng   |  |  |  |  |  |  |  |  |  |   |   |  |  |   |  |                                    |
| CO1  |  | 3  | 3  | 2  | 2  | -  | -  | -  | 2  | -  | -   | -   | -  |  | -   | -  |                                    |
| CO2  |  | 3  | 3  | 3  | 2  | -  | -  | -  | 2  | -  | -   | -   | -  |  | -   | -  |                                    |
| CO3  |  | 3  | 3  | 3  | 2  | _  | _  | _  | 2  | _  | _   | _   | _  |  | _   | 1 _  |                                    |
|  |  | _  |  |  |  |  |  |  | 1  |  |   |   |  |  |   |  |                                    |
| CO4  |  | 3  | 3  | 3  | 3  | -  | -  | -  | 2  | -  | -   | -   | -  |  | -   | -  |                                    |
|  |  | tents / S  | yllabus  |  |  |  |  |  |  |  |   |   |  |  |   |  |                                    |
| Module   |  |  |  |  |  |  |  |  |  |  | al Conce  |   |  |  |   | hour   |                                    |
|  | -  | ystem F  |  |  |  |  |  | -  | -  |  |   |   |  | -  | _   |  |                                    |
| _  |  | 1 17   | dations  |  | puting:  | Sets, Re   | lations,   | and Fund   | ctions: de                                 | efinitions                                     | s and app   | lications   | , Prin   | ciple  | of Ma                                     | themat   | iica                               |
| Mathen   |  |  |  |  |  |  |  |  |  |  |   |   |  |  |   |  |                                    |
| Mathen<br>Inductio   | n and  |  | in proof   |  |  |  |  |  |  |  |   |   |  |  |   |  | 5                                  |
| _  | n and  |  | in proof   |  | ware Do  | evelopm  | ent Fun  | damenta  | ıls  |  |   |   |  |  | 6   | hour   |                                    |
| Mathen<br>Inductio<br>Module<br>Introduc   | n and  2 tion  | d its use  | are Dev  | Soft<br>elopmen  | t Life Cy  | cle, Step  | -by-step   | solution   | to simp                                    | le proble                                      | ms, Dev   | eloping l   | ogic/f   | lowc   |   |  | ode                                |
| Mathen<br>Inductio<br>Module<br>Introduc<br>simple g   | n and  2 tion  | d its use  | are Dev  | Soft<br>elopmen  | t Life Cy  | cle, Step  | -by-step   | solution   | to simp                                    | le proble                                      | ems, Dev  | eloping l   | ogic/f   | lowcl  |   |  | ode                                |
| Mathen<br>Inductio<br>Module<br>Introduc<br>simple g<br>Module   | tion tames   | d its use<br>to Softw<br>s, puzzle   | are Deves, Step-v  | Soft elopmen wise refine Pro   | t Life Cy<br>nement a<br><b>ject-Bas</b>   | cle, Step<br>and Proce<br>ed Lear  | o-by-step<br>edural A<br>ning  | solution<br>bstractio  | n to simp                                  | -  |   |   |  |  | hart/ps                                   | eudoc  | rs                                 |
| Mathem<br>Inductio<br>Module<br>Introduc<br>simple g<br>Module<br>Introduc   | tion tames  3  | to Softw<br>s, puzzle  | are Deves, Step-vasics of  | Soft<br>elopmen<br>wise refin<br>Pro<br>C++, Im                                | t Life Cy<br>nement a<br><b>ject-Bas</b><br>aplement   | ccle, Step<br>and Proce<br>ed Learn<br>ation of  | o-by-step<br>edural A<br>ning<br>control s   | solution<br>bstractio  | n to simp                                  | h practic                                      | al tasks  | such as o   | creatir  | ng a r   | hart/ps                                   | eudoc<br><b>0 hou</b><br>r gues                          | rs<br>sing                         |
| Mathem<br>Induction<br>Module<br>Introduction<br>Module<br>Introduction<br>game us   | tion to ames 3   | to Softw<br>s, puzzle<br>to the baloops and  | rare Deve<br>es, Step-vasics of<br>d condit  | Soft<br>elopmen<br>wise refin<br>Pro<br>C++, Im<br>ions, Fu                    | t Life Cynement a ject-Bas aplement a  | vcle, Step<br>and Proce<br>ed Learn<br>ation of<br>and scop  | o-by-step<br>edural A<br>ning<br>control s<br>e demon  | solution<br>bstraction<br>structure<br>strated b                             | n to simple<br>n<br>s through              | h practic                                      | al tasks<br>nenu-dri  | such as o   | creatir  | ng a r   | hart/ps  1  numbersing us                 | eudoc<br><b>0 hou</b><br>r gues<br>er-def                | rs<br>sing                         |
| Mathen<br>Inductio<br>Module<br>Introduc<br>simple g<br>Module<br>Introduc<br>game us<br>function  | tion tames  3  tion ing 1 s, im  | to Softw<br>s, puzzle<br>to the baloops and  | are Developes, Step-vasics of d condite simple   | Soft<br>elopmen<br>wise refin<br>Pro<br>C++, Imi<br>ions, Fur<br>logic-ba      | t Life Cynement a ject-Bas uplement nctions a sed gam  | rcle, Step<br>and Proce<br>ed Learn<br>ation of<br>and scop-<br>des include                                      | o-by-step<br>edural A<br>ning<br>control s<br>e demon<br>ding puz                              | structure<br>strated by<br>zles, tic-  | s through                                  | h practic<br>oping a 1<br>Hangma               | al tasks<br>menu-dri<br>m etc., th  | such as oven appl   | creatir<br>lication  | ng a r<br>ns us  | hart/ps  1 numbersing users and           | eudoce  O hou  r gues  er-def  d dyna                    | rs<br>sing                         |
| Mathen<br>Inductio<br>Module<br>Introduc<br>simple g<br>Module<br>Introduc<br>game us<br>function<br>memory                                    | tion to ames  3  tion ing 1 s, im allocation   | to Softw<br>s, puzzle<br>to the baloops and<br>applement<br>cation is  | are Deve<br>es, Step-vasics of<br>d condit<br>c simple<br>introduc   | Soft<br>elopmen<br>wise refin<br>Pro<br>C++, Imi<br>ions, Fur<br>logic-ba      | t Life Cynement a ject-Bas uplement nctions a sed gam  | rcle, Step<br>and Proce<br>ed Learn<br>ation of<br>and scop-<br>des include                                      | o-by-step<br>edural A<br>ning<br>control s<br>e demon<br>ding puz                              | structure<br>strated by<br>zles, tic-  | s through                                  | h practic<br>oping a 1<br>Hangma               | al tasks<br>menu-dri<br>m etc., th  | such as oven appl   | creatir<br>lication  | ng a r<br>ns us  | hart/ps  1 numbersing users and           | eudoce  O hou  r gues  er-def  d dyna                    | rs<br>sing                         |
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| Pre-requisite  |  | diate le   | vel (CE   | FR) and  | d above  |                         |                   |                 |           |            |                           |            |                                   |                         |
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| and  | effectively  | in remo  | ote or hy   | brid wo  | rk envir   | onment                  | s.                |                 |           |            |                           |            |                                   |                         |
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|  | trate their u  |  |   |  |  |                         |                   |                 |           |            |                           |            |                                   |                         |
| CO-PO Map  | ping (Sca  | le 1: Lo   | w, 2: M   | edium,   | 3: High  | )                       |                   |                 |           |            |                           |            |                                   |                         |
| СО-РО  | DO1  | DO2  | DO2   | DO4  | DO5  | DO.                     | DO7               | DOG             | DOG       | DO10       | DO11                      | DCO1       | DCO1                              | PGG                     |
| Mapping  | PO1  | PO2  | PO3   | PO4  | PO5  | PO6                     | PO7               | PO8             | PO9       | PO10       | PO11                      | PSO1       | PSO2                              | PSO3                    |
| CO1  | 1  | 1  | 1   | 1  | 1  | 2                       | 1                 | 1               | 2         | 3          | 1                         | 2          | _                                 | _                       |
| CO2  | 1  | 1  | 1   | 1  | 1  | 1                       | 1                 | 1               | 2         | 3          | 1                         | 2          | _                                 | _                       |
| CO3  | 1  | 1  | 1   | 1  | 1  | 1                       | 1                 | 1               | 2         | 3          | 1                         | 2          | _                                 | _                       |
| CO4  | 1  | 1  | 1   | 1  | 1  | 1                       | 1                 | 1               | 2         | 3          | 1                         | 2          |                                   |                         |
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| Module 1   |  |  | intro   | auction  | to Tech  | ınıcaı C                | ommur             | ucation         |           |            |                           |            | 4 Hours                           |                         |
| Technical Co   | ommunica   | tion: De   | efinition   | , Proces   | ss, Type   | s, Level                | s, and F          | low; <b>Ba</b>  | rriers t  | o Techni   | cal Com                   | municat    | ion: em                           | phasis on               |
| gender neutra  |  |  |   |  |  |                         |                   |                 |           |            |                           |            |                                   | •                       |
| Module 2   |  |  | Tech  | nical W  | riting 1   |                         |                   |                 |           |            |                           |            | 5 Hours                           |                         |
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| Technical w  | _  |  | Tach  | nical W  | riting 2   |                         |                   |                 |           |            |                           |            | 5 Haure                           |                         |
| Technical wi<br>Minutes of M<br>Module 3   | Meetings   |  |   |  | riting 2   |                         |                   |                 |           |            |                           |            | 5 Hours                           |                         |
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| Technical wi<br>Minutes of M<br>Module 3<br>Job applicat<br>Plagiarism   | Meetings   |  | ort, pr   | oposal;  | Technic  |                         | e <b>r</b> : Abst | ract; <b>Et</b> | hical W   | riting: C  | opy Edit                  | ing, Refe  | erencing                          | and                     |
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- 1. Technical Communication, 15<sup>th</sup> Edition by John M. Lannon & Laura J. Gurak, Pearson, 2021.
- 2. Spoken English- A Manual of Speech and Phonetics (5<sup>th</sup> Edition) by R K Bansal & J B Harrison, Orient Blackswan, 2024, New Delhi.
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| inter-cartarar c | Sommanication in Virtual Exchange of Transcoscationin, Cambridge Cinv. 11655, 2021.         |
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| NPTEL/ You       | tube/ Faculty Video Link:   |
| Module 1         | https://onlinecourses.nptel.ac.in/noc24_ge37/preview  |
| Module 2         | https://archive.nptel.ac.in/courses/109/106/109106094/                                      |
| Module 3         | https://www.youtube.com/watch?v=kOJlwMJxEG0&t=8s  |
| Module 4         | https://www.youtube.com/watch?v=Sg7Q_dC_fWU&list=PLPuC5CMHiqmuzq_KQ4aw0V9Q7xJY6aezb         |
| Module 5         | https://www.youtube.com/watch?v=ymLFJDpjgCk&list=PLPuC5CMHiqmuzq_KQ4aw0V9Q7xJY6aezb&index=6 |
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| 2        | "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition ,2006. | W.H. Gothmann  |
|----------|--|----------------|
| 3        | Theory and Logic Design", PHI, 2013.   | A. Anand Kumar |
| NPTEL/Y  | Youtube/ Faculty Video Link:   |                |
| Module 1 | https://www.youtube.com/watch?v=juJR_JDJRa0  |                |
| Module 2 | https://www.youtube.com/watch?v=sUutDs7FFeA  |                |
| Module 3 | https://www.youtube.com/watch?v=ibQBb5yEDlQ  |                |
| Module 4 | https://www.youtube.com/watch?v=ntiv1g7G_C4  |                |
| Module 5 | https://www.youtube.com/watch?v=4GpWA_hmRhw  |                |
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|  | Design and   |  |  |  |  |  |  |  |  |  | systems.   |  |  |                                  | ζ4   |   |
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| CO1  | 3  | 3  | 2  | -  | -  | -  | -  | -  | -  | -  | -  | 1  | 2  |                                  | 1  |   |
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| 3                                   | Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition | Paul R.Gray & Robert G.Meyer |  |  |  |  |  |  |  |  |  |
|-------------------------------------|--|------------------------------|--|--|--|--|--|--|--|--|--|
| NPTEL/ Youtube/ Faculty Video Link: |  |                              |  |  |  |  |  |  |  |  |  |
| Module 1                            | https://www.youtube.com/watch?v=2bprLH4cUSo                                |                              |  |  |  |  |  |  |  |  |  |
| Module 2                            | https://www.youtube.com/watch?v=XDy-rD5AJI0                                |                              |  |  |  |  |  |  |  |  |  |
| Module 3                            | https://www.youtube.com/watch?v=dHSaPhQIQqE                                |                              |  |  |  |  |  |  |  |  |  |
| Module 4                            | https://nptel.ac.in/courses/117101106                                      |                              |  |  |  |  |  |  |  |  |  |
| Module 5                            | https://www.youtube.com/watch?v=2bprLH4cUSo                                |                              |  |  |  |  |  |  |  |  |  |
|                                     |  |                              |  |  |  |  |  |  |  |  |  |

| Course Code: BEC0306   | Course Name: Data Structure | L | T | P | C |
|------------------------|-----------------------------|---|---|---|---|
| Course Offered in: ECE |                             | 2 | 0 | 0 | 2 |

**Pr-requisite:** Knowledge of C, data types and their organization.

**Course Objectives:** This course focuses on the basic concepts of algorithm analysis, along with implementation of linear and non-linear data structures and file structures.

| Course | Outcome: After completion of the course, the student will be able to                           | Bloom's Knowledge |  |  |  |
|--------|--|-------------------|--|--|--|
|        |  | Level (KL)        |  |  |  |
| CO1    | Understand the concept of time and space complexity along with the linear data structure array | K2                |  |  |  |
| CO1    | and linked lists.  | 1.72              |  |  |  |
| CO2    | Understand the concept of stack and queue with their memory representations.                   | K2                |  |  |  |
| CO3    | Apply the knowledge of the nonlinear data structure- tree and their operation.                 | K3                |  |  |  |
| CO4    | Analyze the basics of graph with their different traversal ways.                               | K4                |  |  |  |
| CO5    | Apply the concepts of searching, sorting and file structure.                                   | K3                |  |  |  |

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

| CO-PO<br>Mapping | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1              | 3   | 3   | 2   | 2   | 2   | -   | -   | -   | -   | 2    | -    | 3    | 2    | 1    |
| CO2              | 3   | 3   | 3   | 1   | 2   | -   | -   | -   | -   | 1    | -    | 3    | 2    | 1    |
| CO3              | 3   | 3   | 3   | 2   | 2   | -   | -   | -   | -   | 1    | -    | 3    | 3    | 1    |
| CO4              | 3   | 3   | 2   | 2   | 2   | -   | -   | -   | -   | 1    | 1    | 3    | 3    | 2    |
| CO5              | 3   | 3   | 3   | 3   | 2   | -   | -   | -   | -   | 2    | 1    | 3    | 3    | 2    |

**Course Contents / Syllabus** 

UNIT 1 Introduction to data structures, Arrays and Linked lists 8 hours

Introduction: Basic Terminology, Elementary Data Organization, Built in Data Types in C/python. Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic notations: Big Oh, Big Theta and Big Omega, Abstract Data Types (ADT) Arrays: Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Index Formulae for 1-D,2-D,3-D and n-D Array Application of arrays, Sparse Matrices and their representations.

Linked lists: Array Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal. Polynomial Representation and Addition Subtraction & Multiplications of Single variable.

UNIT 2 Stack and Queues 8 hours

Stacks: Abstract Data Type, Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Iteration and Recursion- Principles of recursion, Tail recursion, Removal of recursion Problem solving using iteration and recursion with examples of binary search, Fibonacci numbers, and Hanoi towers. Tradeoffs between iteration and recursion.

Queues: Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Dequeue and Priority Queue.

UNIT 3 Trees 8 hours

Basic terminology used with Tree, Binary Trees, Binary Tree Representation: Array Representation and Pointer (Linked List) Representation, Binary Search Tree, Strictly Binary Tree, Complete Binary Tree, An Extended Binary Trees. Tree Traversal algorithms: In-order, Pre-order and Post-order. Constructing Binary Tree from given Tree Traversal, Operation of Insertion, Deletion, Searching & Modification of data in Binary Search tree, Introduction of Binary Heaps, Threaded Binary trees, Traversing Threaded Binary trees, AVL Tree, B-Tree.

UNIT 4 Graphs 8 hours

Graphs: Terminology used with Graph, Data Structure for Graph Representations, Adjacency matrices, Adjacency List. Graph Traversal: Depth First Search and Breadth First Search. Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prim's and Kruskal's algorithm. Shortest Path algorithms: Dijkstra Algorithm.

UNIT 5 Searching and Sorting 8 hours

Searching: Concept of Searching, Sequential search, Index Sequential Search, Binary Search, Concept of Hashing.

Sorting: Insertion Sort, Selection, Bubble Sort, Quick Sort, Merge Sort, Heap Sort and Radix Sort.

File Structure: Concepts of files, records and files, Sequential, Indexed and Random File.

|           | To  | otal Lecture Hours 40 hours              |  |  |  |  |  |
|-----------|---|--|--|--|--|--|--|
| Textbook  | :   | <u> </u>                                 |  |  |  |  |  |
| S.No      | Book Title with publication agency & year                                     | Author                                   |  |  |  |  |  |
| 1         | Book Title with publication agency & year                                     | Michael T. Goodrich, Roberto<br>Tamassia |  |  |  |  |  |
| 2         | "Fundamentals of Data Structures", Computer Science Press, 1st Edition, 1993. | Horowitz and Sahani                      |  |  |  |  |  |
| 3         |   | Lipschutz                                |  |  |  |  |  |
| Reference | Books:  |  |  |  |  |  |  |
| S.No      | Book Title with publication agency & year                                     | Author                                   |  |  |  |  |  |
| 1         | "Data Structure Using C", Oxford University Press, 2nd Edition, 2014.         | Reema Thareja                            |  |  |  |  |  |
| 2         | "Data Structure Using C", Pearson Education India, 2nd Edition,2011.          | AK Sharma                                |  |  |  |  |  |
| 3         | "C and Data structure", Wiley Dreamtech Publication, 1st Edition, 2004.       | P. S. Deshpandey                         |  |  |  |  |  |
| NPTEL/    | Youtube/ Faculty Video Link:  |  |  |  |  |  |  |
| Module 1  | https://www.youtube.com/watch?v=LQx9E2p5c&pp=ygUMYXJyYXlzIG5wdGV              | s  |  |  |  |  |  |
| Module 2  | https://www.youtube.com/watch?v=g1USSZVWDsY&list=PLBF3763AF2E1C572F           | F&index=2                                |  |  |  |  |  |
| Module 3  | 1   | zindex=6                                 |  |  |  |  |  |
| Module 4  | https://www.youtube.com/watch?v=9zpSs845wf8&list=PLBF3763AF2E1C572F&ir        | ndex=24                                  |  |  |  |  |  |
| Module 5  |   |  |  |  |  |  |  |
|           |   |  |  |  |  |  |  |
|           | https://www.youtube.com/watch?v=KW0UvOW0XIo&list=PLBF3763AF2E1C572I           | F&index=5                                |  |  |  |  |  |

| Course Code: BEC0304  | L   | T      | P     | С      |       |  |  |  |  |  |
|---|---|--------|-------|--------|-------|--|--|--|--|--|
| Course Offered in: B.Tech ECE   | 3   | 0      | 0     | 3      |       |  |  |  |  |  |
| Pre-requisite: Students must have logical an  | d practical skill set towards analyzing various problems related to a | lgorit | hms.  |        |       |  |  |  |  |  |
| Course Objectives: The purpose of this course is to provide an introductory understanding of the fundamental principles, techniques,    |   |        |       |        |       |  |  |  |  |  |
| and applications of Computational Intelligence. By the end of the course, students will gain knowledge in designing intelligent systems |   |        |       |        |       |  |  |  |  |  |
| and grasp the key concepts in areas such as A   | Artificial Neural Networks, Fuzzy Logic, and Genetic Algorithms.      | Additi | onall | y, stu | dents |  |  |  |  |  |

will acquire the necessary mathematical skills to optimize neural network learning. Moreover, through engaging in a research or design project, students will develop familiarity with current research problems and gain experience in utilizing research methods within the

| 11010 01 | Computational Interngence.   |                   |
|----------|--|-------------------|
| Course   | Outcome: After completion of the course, the student will be able to   | Bloom's Knowledge |
|          |  | Level (KL)        |
| CO1      | Identify Computational Intelligence techniques and their applications.   | K1                |
| CO2      | Apply neural networks using various learning techniques and Formulate the artificial neural network with their different layers. | K4                |
| CO3      | Compare the fuzzy sets and crisp sets and apply fuzzy operations in real life problems.  | K4                |
| CO4      | Design fuzzy controller with the help of fuzzy rules, fuzzifications and defuzzification.  | K5                |
| CO5      | Discuss the concept of genetic algorithm and its various applications.   | K2                |

#### CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

| CO-PO<br>Mapping | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1              | 2   | 2   | -   | 1   | 1   | -   | -   | ı   | -   | 2    | 1    | 2    | 2    | 1    |
| CO2              | 3   | 3   | 3   | 2   | 2   | -   | -   | -   | -   | 2    | 1    | 3    | 3    | 2    |
| CO3              | 2   | 2   | 2   | 1   | 1   | -   | -   | -   | -   | 1    | 1    | 2    | 3    | 2    |
| CO4              | 3   | 3   | 3   | 2   | 2   | -   | -   | -   | -   | 1    | 1    | 3    | 3    | 2    |
| CO5              | 3   | 2   | 2   | 2   | 2   | -   | -   | -   | -   | 2    | 2    | 3    | 3    | 3    |

#### **Course Contents / Syllabus**

field of Computational Intelligence.

#### Module 1 Introduction to Computational Intelligence

8 hours

Introduction to Computational Intelligence, Various types of Computational Intelligence Techniques, Characteristics of Computational Intelligence, Major Areas of Computational Intelligence, Applications of Computational Intelligence. Introduction to MATLAB / Python Environment for Computational Intelligence Techniques.

#### Module 2 Neural Networks 8hours

Neuron, Biological neurons and its working, Model of Artificial Neuron, Architectures, Taxonomy of ANN Systems, Various Activation Functions, Single Layer ANN System, Multi-Layer ANN System, Recurrent networks. Supervised Learning, Unsupervised Learning, Reinforcement Learning, Perceptron, Adaline, Madaline, and Applications of ANN in research. MATLAB Neural Network Toolbox / Python.

#### Module 3 Fuzzy Logic-I

8 hours

Fuzzy Set theory, Operations on sets, Properties, Fuzzy versus Crisp set, Fuzzy Relation, Operations on Fuzzy Relation, Properties, Fuzzy versus Crisp Relations, Introduction & features of membership functions, Max-Min Composition.

#### Module 4 Fuzzy Logic-II

8 hours

Introduction to Fuzzy logic, Propositions, If-Then Rules, implications and inferences. Rule based systems, Predicate logic, Fuzzy Inference Systems, Fuzzification, Defuzzification Method, logic controller design, Some applications of Fuzzy logic. Fuzzy Logic MATLAB Toolbox/Python

#### Module 5 Genetic Algorithm (GA)

8 hours

40 hours

Fundamentals of Genetic Algorithms, Basic concepts, Working Principle, Various Encoding methods, Fitness function, GA Operators-Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Optimization of traveling salesman problem using Genetic Algorithm, Genetic Algorithm MATLAB Toolbox/Python, Hybrid Computational Intelligence

## Total Lecture Hours

| Textbook |
|----------|
|----------|

| S.No | Book Title with publication agency & year                             | Author                 |
|------|---|------------------------|
| 1    | "Computational Intelligence: An Introduction", Wiley Publication.Data |                        |
|      | Structures and Algorithms in Python (An Indian Adaptation), Wiley     | Andries P. Engelbrecht |
|      | Publication (15 July 2014)  |                        |

| 2        | "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications", Prentice Hall of India. | S. Rajsekaran & GA Vijayalakshmi Pai          |  |  |  |  |  |  |  |  |  |
|----------|---|---|--|--|--|--|--|--|--|--|--|
| 3        | "Neural Netowrks", Prentice Hall of India   | Siman Haykin                                  |  |  |  |  |  |  |  |  |  |
| 4        | - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1   |   |  |  |  |  |  |  |  |  |  |
| Refere   | Reference Books:  |   |  |  |  |  |  |  |  |  |  |
|          |   |   |  |  |  |  |  |  |  |  |  |
| S.No     | Book Title with publication agency & year   | Author  |  |  |  |  |  |  |  |  |  |
| 1        | "Neural Networks", Tata Mc Graw Hill.   | Kumar Satish                                  |  |  |  |  |  |  |  |  |  |
| 2        | "Computational Intelligence and Intelligent System Design: Theory Tools and applications", Pearson.       | Fakhreddin O. Karray, Clarence W. De<br>Silva |  |  |  |  |  |  |  |  |  |
| NPTEL/   | Youtube/ Faculty Video Link:  |   |  |  |  |  |  |  |  |  |  |
| Module 1 | https://youtu.be/fgtUFzxNztA?si=DiEQ7L2PNrQvgC5y  |   |  |  |  |  |  |  |  |  |  |
| Module 2 | https://www.youtube.com/watch?v=xbYgKoG4x2g&list=PL53BE265CE  | 4A6C056                                       |  |  |  |  |  |  |  |  |  |
| Module 3 | https://www.youtube.com/watch?v=K7S3TgfqnX0&list=PLFW6lRTa1g8   | 31F7CJ-CdlsyWKKAa43T62j                       |  |  |  |  |  |  |  |  |  |
| Module 4 | https://www.youtube.com/watch?v=JrRWdPvG7yk&list=PLFW6lRTa1gt   | 81F7CJ-CdlsyWKKAa43T62j&index=2               |  |  |  |  |  |  |  |  |  |
| Module 5 | https://www.youtube.com/watch?v=d86McbWXh4E&list=PLwdnzlV3og  | oWyi7exLIe26JhueiVQXq_S                       |  |  |  |  |  |  |  |  |  |
|          |   |   |  |  |  |  |  |  |  |  |  |

| LAB Cour                    | rse Code:            | BEC03                                | 51                   |                    | LA              | B Cou    | rse Na    | me: Dig    | ital Syst  | em Desigr   | Lab        |             | L       | T    | P               | C          |
|-----------------------------|----------------------|--------------------------------------|----------------------|--------------------|-----------------|----------|-----------|------------|------------|-------------|------------|-------------|---------|------|-----------------|------------|
| Course Of                   | fered in: 1          | B.Tech                               | ECE/\                | /LSI               |                 |          |           |            |            |             |            |             | 0       | 0    | 4               | 2          |
| Pre-requis                  |                      |                                      |                      |                    | c opera         | tions,   | Basics of | of decim   | al numbe   | er system   |            |             |         |      |                 |            |
| Course Ol                   |                      | •                                    |                      |                    | •               |          |           |            |            | -           |            |             |         |      |                 |            |
| The studer                  |                      |                                      |                      |                    |                 |          |           |            |            |             |            |             |         |      |                 |            |
| combination                 |                      |                                      |                      |                    | d verif         | ication  | of truth  | table o    | f various  | type of fli | p-flops. I | Designing   | and im  | plem | entati          | on of      |
| different ty                |                      |                                      |                      |                    |                 |          |           |            |            |             |            |             |         |      |                 |            |
| Course O                    | utcome: A            | fter con                             | pletion              | n of the           | course          | e, the s | tudent v  | vill be al | ole to     |             |            |             |         |      | Knowl           | edge       |
| Level (K                    |                      |                                      |                      |                    |                 |          |           |            |            |             |            |             |         |      |                 |            |
| CO1                         | 71 6                 |                                      |                      |                    |                 |          |           |            |            |             |            | <u> </u>    |         |      |                 |            |
| CO2                         |                      |                                      |                      |                    |                 |          |           |            |            |             |            | <u> </u>    |         |      |                 |            |
| CO3                         | Design a             |                                      |                      |                    |                 |          |           |            |            |             |            |             |         |      | <u>ζ3</u><br>ζ4 |            |
| CO-PO M                     |                      |                                      |                      |                    |                 |          |           | logic cir  | cuits.     |             |            |             |         | Г    | <u>.</u> 4      |            |
|                             |                      |                                      | LOW, 2               | . Wicus            | <u> </u>        | lingin   |           |            |            |             |            |             |         |      |                 |            |
| CO-PO<br>Mappin             | 1 201                | PO2                                  | PO3                  | PO4                | PO5             | PO6      | PO7       | PO8        | PO9        | PO10        | PO11       | PSO1        | PSC     | 2    | PSO             | 13         |
|                             |                      |                                      |                      |                    |                 |          |           |            | 2          |             |            |             | 2       |      |                 |            |
| CO1                         | 3                    | 3                                    | 3                    | -                  | 2               | -        | _         | 3          | 2 2        | -           | 2          | 1           | 2 2     |      | 2               |            |
| CO2                         | 3                    | 2                                    | 3                    | _                  | 2               | _        | _         | 3          | 2          | _           | 2          | 1           | 2       |      | 2               |            |
| CO4                         | 3                    | 3                                    | 3                    | _                  | 2               | _        | _         | 3          | 2          | _           | 2          | 1           | 2       |      | 2               |            |
|                             |                      |                                      |                      |                    |                 |          |           |            |            |             |            | 1           |         |      |                 |            |
| List of Pra                 | actical's (I         | ndicati                              | ve & N               | ot Lin             | nited T         | (o)      |           |            |            |             |            |             |         |      |                 |            |
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|                             | ND (7408)            |                                      | 0105 01              | Dusic              | Logic (         | Juics u  | na cinv   | CISUI DC   | gie Guie   | s using 11  | L ICs.     |             |         |      |                 |            |
|                             | R (7432)             | ,                                    |                      |                    |                 |          |           |            |            |             |            |             |         |      |                 |            |
| 1                           | OT (7404)            | 1                                    |                      |                    |                 |          |           |            |            |             |            |             |         |      | C               | )1         |
|                             | AND (740             |                                      |                      |                    |                 |          |           |            |            |             |            |             |         |      |                 |            |
|                             | OR (7402)            | · ·                                  |                      |                    |                 |          |           |            |            |             |            |             |         |      |                 |            |
| 2. Impleme                  |                      |                                      | en Boo               | lean fu            | nction          | using 7  | TTL Los   | gic Gate   | s (NOT.    | AND and     | OR Gates   | ) in SOP fo | or      |      |                 |            |
| following 1                 |                      | _                                    |                      |                    |                 | 0        | - (       | ,          | ,          |             |            | ,           |         |      |                 |            |
| _                           | 1 = AB' +            | -                                    |                      |                    |                 |          |           |            |            |             |            |             |         |      | CO              | <b>)</b> 1 |
| b) Y                        | 2 = ABC +            | A'B'C                                | ' + A'               | C                  |                 |          |           |            |            |             |            |             |         |      |                 |            |
| c) F                        | (A, B, C, I          | $\Sigma(0) = \sum_{i=1}^{n} (0)^{i}$ | ,2,5,7,              | 8,10,13            | ,15)            |          |           |            |            |             |            |             |         |      |                 |            |
| 3. Impleme                  |                      |                                      |                      |                    |                 | using 7  | TL Log    | gic Gate   | s (NOT,    | AND and     | OR Gates)  | ) in POS fo | orms    |      |                 |            |
| for followi                 | ng Boolean           | n expres                             | sions:               |                    |                 |          |           |            |            |             |            |             |         |      |                 |            |
| a) Y                        | 1 = (A' + B)         | )(A+B')                              | )                    |                    |                 |          |           |            |            |             |            |             |         |      | CO              | <b>)</b> 1 |
| b) Y                        | 2 = (A + B +         | +C)(A'+                              | B'+C'                | )(A'+C             | <b>(</b> )      |          |           |            |            |             |            |             |         |      |                 |            |
|                             | (A, B, C, E)         |                                      | ),2,5,7,             | 8,10,12            | 2,15)           |          |           |            |            |             |            |             |         |      |                 |            |
| 4. Impleme                  |                      | •                                    |                      |                    |                 |          |           |            |            |             |            |             |         |      | C               | <b>7</b> 1 |
| 4-bit Binar                 |                      |                                      |                      |                    |                 |          |           |            |            |             |            |             |         |      |                 | <i>J</i> 1 |
| 5. Impleme<br>AND-7408      |                      |                                      |                      |                    |                 | Full-ad  | der usin  | ig two H   | lalf – add | ler with TT | L Logic (  | Gates (EX   | OR-74   | 86,  | CO              | 02         |
| 6. Impleme                  | entation of          | Half-su                              | btracto              | r, Full-           | -subtra         |          |           |            | r using tv | wo Half-su  | btractor w | vith TTL L  | ogic    |      | CO              | )2         |
| Gates (EX)                  | OR-7486, entation of | AND-74<br>4-bit Pa                   | 408, Ol<br>trallel a | K-7432<br>adder 11 | () and v        | erify it | s truth t | able.      | utput for  | the given   | inputs.    |             |         |      |                 |            |
|                             | = 1011, B            |                                      |                      | u                  | <sub>6</sub> /= |          | , (1)     | , 0        |            | 51,011      | P 440.     |             |         |      | C               | <b>)</b> 2 |
| b) A                        | = 0011, B            | = 0010                               |                      |                    |                 |          |           |            |            |             |            |             |         |      |                 |            |
| 8. Implements its truth tal |                      | 2:4 Dec                              | coder, 1             | :4 Der             | nultiple        | exer us  | ing Log   | ic Gates   | (NOT g     | ate- 7404,  | AND gate   | e- 7408) aı | nd veri | fy   | C               | )2         |

| 9. Implementation of 4:2 Encoder , 4:1 multiplexer using logic gate (OR gate-7432) and verify its truth table. | CO2 |
|--|-----|
| 10. Implement and verify $F(A,B,C) = \sum (3, 5, 6, 7)$ using  |     |
| a) 8:1 multiplexer.  | CO2 |
| b) 4:1 multiplexer.  |     |
| 11. Implement 2 Bit magnitude comparator using logic gates and verify the truth table.                         | CO2 |
| 12. Verification of truth table of flip-flop using NAND gate (7400) & NOR gates (7402).                        |     |
| a) RS Flip Flop  |     |
| b) JK Flip Flop  | CO3 |
| c) D Flip Flop   |     |
| d) T Flip Flop   |     |
| 13. Implement D flip flop using SR flip flop and verify the truth table.                                       | CO3 |
| 14. Design and implement 4-bit ring counter using D flip flop and verify the result.                           | CO3 |
| 15. Design MOD 5 asynchronous counter using T flip flop and verify the truth table.                            | CO3 |
| 16. Design MOD 5 synchronous counter using T flip flop and verify the truth table.                             | CO4 |
| 17. Realize  |     |
| a) Design Mod – N Synchronous Up Counter & Down Counter using 7476 JK Flip-flop                                | CO4 |
| b) Mod-N Counter using IC7490 / 7476   | CO4 |
| c) Synchronous counter using IC74192   |     |
| 18. Design Pseudo Random Sequence generator using 7495.  | CO4 |
|  |     |

| Lab Course Offered in: B.Tech ECEVISI   Course Offered in: B.Tech ECEVISI   Pre-requisite: The operation and characteristics of semiconductor devices.  |               |             |           |            |            |             |                |           |                  |           |            |            |                  |        |                |       |            |
|---|---------------|-------------|-----------|------------|------------|-------------|----------------|-----------|------------------|-----------|------------|------------|------------------|--------|----------------|-------|------------|
| Pre-requisite: The operation and characteristics of semiconductor devices. Course Objectives: The course aims to equip students with knowledge and hands-on experience in designing, implementing, and verifying various characteristics of transistor amplifiers. It also focuses on the design and implementation of diverse applications of operational amplificrs. Qn-amplificrs. Qn-amplificrs. Additionally, students with learn to simulate cletronic circuits using simulation software and gain an introduction to circuit design using PCB design software such as PCB Express and KiCad.  COID   Design and profession of the course, the student will be able to   Evel (KL)    CO2  Design and verify Op-Amp base circuits   K4   CO3  Design and verify Op-Amp base circuits   K4   CO3  Design and unplementation of oscillators.   K4   CO3  Design and unplementation of oscillators.   K4   CO4  Simulate the Electronic circuits on simulation software.   K3   CO5  Design and implement electronics circuits by PCB design software (PCB Express. Ki cad).   K4   CO6  Design and implement electronics circuits by PCB design software (PCB Express. Ki cad).   K4   CO7  OMapping   PO1    PO2    PO3    PO4    PO5    PO6    PO7    PO8    PO9    PO1    PO1    PS01    PS02    PS03    CO1  OMapping   Scale I: Low. Ver. Medium. 3: High)   CO2  Design and implement electronics circuits by PCB design software (PCB Express. Ki cad).   K4   CO3    Solidation   Solidat   | LAB Cou       | rse Code:   | BEC03     | 52         |            | LAB Co      | ourse Na       | me: An    | alog Cir         | cuit Lal  | b          |            |                  | L      | T              | P     | С          |
| Course Objectives: The course aims to equip students with knowledge and hunds-on experience in designing, implementing, and verifying various characteristics of transistor amplifiers. It also focuses on the design and implementation of diverse applications of operational amplifiers (Op-amps) and oscillators. Additionally, students will learn to simulate electronic circuits using simulation software and gain an introduction to circuit design using PCB design software such as PCB Express and KiCad.    Course Outcome: After completion of the course, the student will be able to   Bloom's Knowledge Level (KL)   | Course Of     | ffered in:  | B.Tech    | ECE/VI     | SI         |             |                |           |                  |           |            |            |                  | 0      | 0              | 4     | 2          |
| verifying various characteristics of transistor amplifiers. It also focuses on the design and implementation of diverse applications of operational amplifiers (Op-amps) and oscillators. Additionally, sudents will learn to simulate electronic circuits using simulation software and gain an introduction to circuit design using PCB design software such as PCB Express and KiCad.  Course Outcome: After completion of the course, the student will be able to Bloom's Knowledge Level (KL)  CO1 Design and plot frequency response of amplifiers   K4  CO2 Design and reify Op- Amp base circuits by PCB design software such as PCB Express, Ki and   K4  CO3 Design and implementation of oscillators.  CO4 Simulate the Electronic circuits on simulation software.  CO3 Design and implement electronics circuits by PCB design software (PCB Express, Ki cad).  CO4 Simulate the Electronic circuits on simulation software.  CO3 Design and implement electronics circuits by PCB design software (PCB Express, Ki cad).  CO4 Simulate the Electronics circuits by PCB design software (PCB Express, Ki cad).  K4  CO5 Design and implement electronics circuits by PCB design software (PCB Express, Ki cad).  K4  CO5 Design and implement electronics circuits by PCB design software (PCB Express, Ki cad).  K4  CO6 Design and implement electronics circuits by PCB design software (PCB Express, Ki cad).  K4  CO7 Design and implement electronics circuits on simulation software.  CO8 Design and implement electronics circuits by PCB design software (PCB Express, Ki cad).  K4  CO9 Design and implement electronics circuits on simulation software.  CO9 Design and software (PCB Express, Ki cad).  K4  CO9 Design and position (PCB Express, Ki cad).  K4  CO9 Design and position (PCB Express, Ki cad).  K4  CO9 Design and software (PCB Express, Ki cad).  K4  CO9 Design and software (PCB Express, Ki cad).  CO9 Design and software (P | Pre-requis    | site: The o | peration  | and cha    | racteristi | cs of ser   | nicondu        | ctor devi | ces.             |           |            |            |                  |        |                |       |            |
| Operational amplifiers (Op-amps) and oscillators. Additionally, students will learn to simulate electronic circuits using simulation software such as PCB Express and KiCad.    Course Outcome: After completion of the course, the student will be able to   Design and verify Op- Amp base circuits   State   Sta   | Course O      | bjectives:  | The cou   | ırse aims  | s to equi  | p studer    | nts with       | knowled   | ge and h         | ands-on   | experier   | nce in de  | esigning         | g, im  | pleme          | nting | , and      |
| Software and gain an introduction to circuit design using PCB design software such as PCB Express and KiCad.           Course Outcome: After completion of the course, the student will be able to Bloom's Knowledge Level (KL)           CO1         Design and plot frequency response of amplifiers         K4           CO2         Design and plot frequency response of amplifiers         K4           CO3         Design and plot frequency response of of scillators.         K4           CO4         Simulate the Electronic circuits on simulation of scillators.         K3           CO5         Design and implement electronics circuits by PCB design software (PCB Express, Ki cad).         K4           CO5         Design and implement electronics circuits by PCB design software (PCB Express, Ki cad).         K4           CO-PO Mapping (Scale I: Low, 2: Medium, 3: High)         This post of PCB  |               |             |           |            |            |             |                |           |                  |           |            |            |                  |        |                |       |            |
| Colimage   |               |             |           |            |            |             |                |           |                  |           |            |            |                  | uits u | ısing          | simul | ation      |
| CO1   |               |             |           |            |            |             |                |           |                  | ich as Po | CB Expre   | ess and k  | KiCad.           |        |                |       |            |
| CO2   | Course O      | utcome: A   | After com | ipletion o | of the co  | urse, the   | student        | will be a | ble to           |           |            |            |                  |        |                |       | edge       |
| CO2   | CO1           | Design a    | nd plot f | requency   | respons    | se of amı   | plifiers       |           |                  |           |            |            |                  |        | K              | 4     |            |
| CO5   Design and implement electronic circuits by PCB design software (PCB Express, Ki cad).   K4   |               |             |           |            |            |             |                |           |                  |           |            |            |                  |        |                |       |            |
| CO-PO   Design and implement electronics circuits by PCB design software (PCB Express, Ki cad).   K4  | CO3           | Design a    | nd imple  | ementatio  | on of osc  | illators.   |                |           |                  |           |            |            |                  |        | K              | 4     |            |
| CO-PO   Mapping (Scale 1: Low, 2: Medium, 3: High)  | CO4           | Simulate    | the Elec  | tronic ci  | rcuits on  | simulat     | ion softv      | vare.     |                  |           |            |            |                  |        | K              | 3     |            |
| PO1   PO2   PO3   PO4   PO5   PO6   PO7   PO8   PO9   PO10   PO11   PSO1   PSO2   PSO3  |               |             |           |            |            |             |                | design s  | oftware (        | PCB Ex    | press, Ki  | cad).      |                  |        | K              | 4     |            |
| Mapping   PO1   PO2   PO3   PO3   PO5   PO6   PO7   PO8   PO7   PO7   PO8   PO7   PO7   PO8   PO7     | CO-PO M       | lapping (S  | cale 1:   | Low, 2:    | Medium     | , 3: Hig    | <u>h)</u>      |           | _                | _         | _          |            |                  |        |                |       |            |
| CO1 3 3 3 1 - 2 2 2 - 2 2 2 2 1 2 2 2 2 2 2 2 2 2   |               | PO1         | PO2       | PO3        | PO4        | PO5         | PO6            | PO7       | PO8              | PO0       | PO10       | PO11       | PSO              | 1 D    | SO2            | DC    | 03         |
| CO2   | Mapping       | 101         | 102       | 103        | 104        | 103         | 100            | 107       | 100              | 10)       | 1010       | 1011       | 150              | 1 1    | 302            | 10    | 03         |
| CO3       3       3       2       -       2       2       -       2       2       2       2       1       2       2         CO4       3       3       2       -       3       2       -       2       2       2       2       2       2       1       2       2         List of Practical's (Indicative & Not Limited To)       List of Practical's (Indicative & Not Limited To)         1. Design and implement a CE (BC-107) amplifier with potential divider biasing (for Vi = 20 mV, R1=100KΩ R2=10KΩ, RC= 4.7 KΩ, RE=1KΩ). Verify the following parameters with the theoretical values: <ul> <li>a) Voltage gain Av</li> <li>b) Current gain Ai</li> <li>c) Input Resistance (Ri)</li> <li>d) Output Resistance (Ri)</li> <li>d) Output Resistance (Ri)</li> <li>d) Output Resistance (Ri)</li> </ul> CO1         a) Bandwidth       b) Input impedance       c) Maximum signal handling capacity (MSHC).         c) Maximum signal handling capacity (MSHC).       c) Maximum signal handling capacity (MSHC).         3. Design a single-stage CE and a multistage (CE-CE) amplifiers with Voltage Divider Bias for 10 mV input ac signal and plot the Frequency Response curves using BC 547, VCC = 12V, Stability factor (S) =10 and RL= 10 KΩ. Observe the effect on gain and bandwidth input and output impedance.       CO1         5. Design voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 a  | CO1           | 3           | 3         | 1          | -          | 2           | 2              | -         | 2                | 2         | 2          | 2          | 1                |        | 2              |       | 2          |
| CO4   | l <del></del> |             |           | 1          | -          | +           | -              | -         |                  | -         | -          | 1          | 1                |        |                |       | 2          |
| List of Practical's (Indicative & Not Limited To)   |               |             | +         |            | -          | 1           | +              | -         | -                | -         |            |            |                  |        |                |       |            |
| List of Practical's (Indicative & Not Limited To)  1. Design and implement a CE (BC-107) amplifier with potential divider biasing (for Vi = 20 mV, R1=100KΩ R2= 10KΩ, RC= 4.7 KΩ, RE= 1KΩ). Verify the following parameters with the theoretical values:  a) Voltage gain AV b) Current gain Ai c) Input Resistance (Ri) d) Output Resistance (Ro)  2. Design and analysis of Single stage common source MOSFET amplifier with potential divider biasing (for Vi = 20 mV, R1=1MΩ R2= 1KΩ, RD= 4.7 KΩ, Rs= 1KΩ) and Plot Gain (dB) Vs frequency curve, also measure following parameters a) Bandwidth b) Input impedance c) Maximum signal handling capacity (MSHC). 3. Design a single-stage CE and a multistage (CE-CE) amplifiers with Voltage Divider Bias for 10 mV input ac signal and plot the Frequency Response curves using BC 547, VCC = 12V, Stability factor (S) =10 and RL= 10 KΩ. Observe the effect on gain and bandwidth.  4. Design current series/Voltage shunt Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth input and output impedance. 5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance. 6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as: a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ. b) Voltage follower circuits for input voltage 1V. 7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate. 8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.   |               | _           | -         |            | -          | -           |                | -         |                  |           | +          |            |                  |        |                |       | -          |
| 1. Design and implement a CE (BC-107) amplifier with potential divider biasing (for Vi = 20 mV, R1=100KΩ R2= 10KΩ, RC= 4.7 KΩ, RE= 1KΩ). Verify the following parameters with the theoretical values:  a) Voltage gain Av b) Current gain Ai c) Input Resistance (Ri) d) Output Resistance (Ro)  2. Design and analysis of Single stage common source MOSFET amplifier with potential divider biasing (for Vi = 20 mV, R1=1MΩ R2= 1KΩ, RD= 4.7 KΩ, Rs= 1KΩ) and Plot Gain (dB) Vs frequency curve, also measure following parameters a) Bandwidth b) Input impedance c) Maximum signal handling capacity (MSHC).  3. Design a single-stage CE and a multistage (CE-CE) amplifiers with Voltage Divider Bias for 10 mV input ac signal and plot the Frequency Response curves using BC 547, VCC = 12V, Stability factor (S) =10 and RL= 10 KΩ. Observe the effect on gain and bandwidth. 4. Design current series/Voltage shunt Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth input and output impedance. 5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance. 6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as: a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Ri) of 100 KΩ. b) Voltage follower circuits for input voltage 1V. 7. Design and differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate. 8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.  | CO5           | 3           | 3         | 3          | -          | 2           | 2              | -         | 2                | 2         | 2          | 2          | 1                |        | 2              |       | 2          |
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| b) Current gain Ai c) Input Resistance (Ri) d) Output Resistance (Ro)  2. Design and analysis of Single stage common source MOSFET amplifier with potential divider biasing (for Vi = 20 mV, Rl=1MΩ R2=1 KΩ, RD= 4.7 KΩ, Rs=1 KΩ) and Plot Gain (dB) Vs frequency curve, also measure following parameters a) Bandwidth b) Input impedance c) Maximum signal handling capacity (MSHC). 3. Design a single-stage CE and a multistage (CE-CE) amplifiers with Voltage Divider Bias for 10 mV input ac signal and plot the Frequency Response curves using BC 547, VCC = 12V, Stability factor (S) =10 and RL=10 KΩ. Observe the effect on gain and bandwidth.  4. Design current series/Voltage shunt Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth input and output impedance. 5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance. 6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as: a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ. b) Voltage follower circuits for input voltage 1V. 7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.  | · ·           |             |           | ,          | J          |             | <i>J</i> 1     |           |                  |           |            |            |                  |        |                |       |            |
| c) Input Resistance (Ri) d) Output Resistance (Ro)  2. Design and analysis of Single stage common source MOSFET amplifier with potential divider biasing (for Vi = 20 mV, R1=1MΩ R2= 1KΩ, RD= 4.7 KΩ, Rs= 1KΩ) and Plot Gain (dB) Vs frequency curve, also measure following parameters  a) Bandwidth b) Input impedance c) Maximum signal handling capacity (MSHC).  3. Design a single-stage CE and a multistage (CE-CE) amplifiers with Voltage Divider Bias for 10 mV input ac signal and plot the Frequency Response curves using BC 547, VCC = 12V, Stability factor (S) =10 and RL = 10 KΩ. Observe the effect on gain and bandwidth.  4. Design current series/Voltage shunt Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth input and output impedance.  5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance.  6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as:  a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.  |               |             |           |            |            |             |                |           |                  |           |            |            |                  |        |                | C     | <b>)</b> 1 |
| d) Output Resistance (Ro)  2. Design and analysis of Single stage common source MOSFET amplifier with potential divider biasing (for Vi = 20 mV, R1=1MΩ R2=1KΩ, RD= 4.7 KΩ, Rs= 1KΩ) and Plot Gain (dB) Vs frequency curve, also measure following parameters  a) Bandwidth b) Input impedance c) Maximum signal handling capacity (MSHC).  3. Design a single-stage CE and a multistage (CE-CE) amplifiers with Voltage Divider Bias for 10 mV input ac signal and plot the Frequency Response curves using BC 547, VCC = 12V, Stability factor (S) =10 and RL= 10 KΩ. Observe the effect on gain and bandwidth.  4. Design current series/Voltage shunt Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth input and output impedance.  5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance.  6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as:  a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.   |               | _           |           | 6)         |            |             |                |           |                  |           |            |            |                  |        |                |       |            |
| 2. Design and analysis of Single stage common source MOSFET amplifier with potential divider biasing (for Vi = 20 mV, R1=1MΩ R2= 1KΩ, RD= 4.7 KΩ, Rs= 1KΩ) and Plot Gain (dB) Vs frequency curve, also measure following parameters  a) Bandwidth b) Input impedance c) Maximum signal handling capacity (MSHC).  3. Design a single-stage CE and a multistage (CE-CE) amplifiers with Voltage Divider Bias for 10 mV input ac signal and plot the Frequency Response curves using BC 547, VCC = 12V, Stability factor (S) =10 and RL= 10 KΩ. Observe the effect on gain and bandwidth.  4. Design current series/Voltage shunt Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth input and output impedance.  5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance.  6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as: a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ. b) Voltage follower circuits for input voltage 1V.  CO2  TO3  CO3  CO4  SD8 Sign and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.  | · ·           | -           |           |            |            |             |                |           |                  |           |            |            |                  |        |                |       |            |
| mV, R1=1MΩ R2= 1KΩ, RD= 4.7 KΩ, Rs= 1KΩ) and Plot Gain (dB) Vs frequency curve, also measure following parameters  a) Bandwidth b) Input impedance c) Maximum signal handling capacity (MSHC).  3. Design a single-stage CE and a multistage (CE-CE) amplifiers with Voltage Divider Bias for 10 mV input ac signal and plot the Frequency Response curves using BC 547, VCC = 12V, Stability factor (S) =10 and RL= 10 KΩ. Observe the effect on gain and bandwidth.  4. Design current series/Voltage shunt Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth input and output impedance.  5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance.  6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as:  a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.   |               |             |           |            | e comm     | on sourc    | e MOSF         | ET amp    | lifier wit       | h potenti | ial divide | er biasing | (for V           | 7i = 2 | 0              |       |            |
| parameters  a) Bandwidth  b) Input impedance  c) Maximum signal handling capacity (MSHC).  3. Design a single-stage CE and a multistage (CE-CE) amplifiers with Voltage Divider Bias for 10 mV input ac signal and plot the Frequency Response curves using BC 547, VCC = 12V, Stability factor (S) =10 and RL= 10 KΩ. Observe the effect on gain and bandwidth.  4. Design current series/Voltage shunt Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth input and output impedance.  5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance.  6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as:  a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.  | _             | •           |           |            |            |             |                |           |                  |           |            |            | - 1              |        |                |       |            |
| a) Bandwidth b) Input impedance c) Maximum signal handling capacity (MSHC).  3. Design a single-stage CE and a multistage (CE-CE) amplifiers with Voltage Divider Bias for 10 mV input ac signal and plot the Frequency Response curves using BC 547, VCC = 12V, Stability factor (S) =10 and RL= 10 KΩ. Observe the effect on gain and bandwidth.  4. Design current series/Voltage shunt Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth input and output impedance.  5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance.  6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as: a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.   | ,             |             | 11122, 1  | ,          | 1111, 113  | 11122) (    | <b>.</b> 1 101 | ouiii (u  | <i>b)</i> (5 ii) | quency    | our (e, ur | oo iiicas  | ur <b>c</b> 1011 |        | 5              |       |            |
| b) Input impedance c) Maximum signal handling capacity (MSHC).  3. Design a single-stage CE and a multistage (CE-CE) amplifiers with Voltage Divider Bias for 10 mV input ac signal and plot the Frequency Response curves using BC 547, VCC = 12V, Stability factor (S) =10 and RL= 10 KΩ. Observe the effect on gain and bandwidth.  4. Design current series/Voltage shunt Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth input and output impedance.  5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance.  6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as:  a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.   |               |             |           |            |            |             |                |           |                  |           |            |            |                  |        |                | C     | )1         |
| c) Maximum signal handling capacity (MSHC).  3. Design a single-stage CE and a multistage (CE-CE) amplifiers with Voltage Divider Bias for 10 mV input ac signal and plot the Frequency Response curves using BC 547, VCC = 12V, Stability factor (S) =10 and RL= 10 KΩ. Observe the effect on gain and bandwidth.  4. Design current series/Voltage shunt Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth input and output impedance.  5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance.  6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as:  a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.  | *             |             | lance     |            |            |             |                |           |                  |           |            |            |                  |        |                |       |            |
| 3. Design a single-stage CE and a multistage (CE-CE) amplifiers with Voltage Divider Bias for 10 mV input ac signal and plot the Frequency Response curves using BC 547, VCC = 12V, Stability factor (S) =10 and RL= 10 KΩ. Observe the effect on gain and bandwidth.  4. Design current series/Voltage shunt Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth input and output impedance.  5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance.  6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as:  a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.   |               |             |           | ndling co  | nacity (   | MSHC)       |                |           |                  |           |            |            |                  |        |                |       |            |
| and plot the Frequency Response curves using BC 547, VCC = 12V, Stability factor (S) =10 and RL= 10 KΩ. Observe the effect on gain and bandwidth.  4. Design current series/Voltage shunt Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth input and output impedance.  5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance.  6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as:  a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.   | 3 Design      | a single-st | age CE    | and a mi   | iltistage  | (CE-CE      | ) amplifi      | ers with  | Voltage          | Divider   | · Rias for | · 10 mV    | innut            | ac sio | nal            |       |            |
| the effect on gain and bandwidth.  4. Design current series/Voltage shunt Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth input and output impedance.  5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance.  6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as:  a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.   |               |             |           |            |            |             |                |           |                  |           |            |            |                  |        |                | C     | <b>D</b> 1 |
| analyze the effect of feedback on gain, bandwidth input and output impedance.  5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance.  6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as:  a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.   |               |             |           |            |            |             | ,              | ,         | ,                |           | ,          |            |                  |        |                |       | _          |
| 5. Design Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain, bandwidth, input and output impedance.  6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as:  a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.  |               |             |           |            |            |             |                |           |                  | ain 100   | and feed   | back fac   | tor 0.1          | -0.2 a | lso            | C     | <u></u>    |
| 6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as:  a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.   |               |             |           |            |            |             |                |           |                  |           |            |            |                  |        |                |       | <i>J</i> 1 |
| 6. Design and analyze the output voltage V0 for OP-AMP (IC 741) as:  a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.   |               |             |           |            |            |             |                |           | 0 and fee        | dback fa  | actor 0.1- | 0.2 also   | analyz           | e the  |                | C     | <b>D</b> 1 |
| a) Inverting and Non-inverting amplifier for input voltage 0.5V with input Resistance (Ri) of 10 KΩ and feedback Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.  |               |             |           |            |            |             |                |           |                  |           |            |            |                  |        |                |       |            |
| Resistance (Rf) of 100 KΩ.  b) Voltage follower circuits for input voltage 1V.  7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.  CO2  | _             | •           |           | -          | _          |             |                |           | ith input        | Recietar  | oce (Ri) o | £10 KO     | and fee          | adbac  | l <sub>r</sub> |       |            |
| 7. Design a differential amplifier with ±12V DC power supply and calculate Common mode gain, differential mode gain, CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.   |               | _           |           | _          | ampime     | i ioi ilipe | it voitage     | . 0.5 v w | ıııı input       | icoistai. | icc (Ri) 0 | 1 10 1822  | and ice          | cuoac  | K              | C     | )2         |
| CMRR and slew-rate.  8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.  CO2   | b) V          | oltage foll | ower cir  | cuits for  | input vo   | ltage 1V    | <i>7</i> .     | , -       | 1 . ~            |           | 1 .        | 1:00       |                  |        |                |       |            |
| 8. Design and analyze OP-AMP applications as a difference amplifier, integrator and differentiator Circuits for 1 KHz input signal.   |               |             |           | tier with  | ±12V D     | C power     | r supply a     | and calc  | ulate Cor        | nmon m    | ode gain,  | differen   | itial mo         | ode ga | un,            | C     | )2         |
|   | 8. Design     | and analyz  |           | MP appl    | ications   | as a diff   | ference a      | mplifier  | , integrat       | or and o  | lifferenti | ator Circ  | uits fo          | r 1 K  | Hz             | C     | )2         |
|   |               |             | d output  | wavefor    | ms of a g  | given ful   | l wave p       | recision  | rectifier.       |           |            |            |                  |        |                | C     | <u></u>    |

| 10. Design and implement of 2nd order Active Low pass filter for cut-off frequency 1KHz and pass band gain of 1.586, also draw the frequency response curve and verify cutoff frequency.  | CO2          |
|---|--------------|
| 11. Design and implement of 2nd order Active High pass filter for cut-off frequency 1KHz and pass band gain of 1.586, also draw the frequency response curve and verify the cutoff frequency.                                   | CO2          |
| 12. Design the following RC sinusoidal oscillators; Also verify the theoretical and practical Oscillating frequency.  |              |
| a) RC phase shift oscillator, if its frequency of oscillation is 955 Hz and R1=R2=R3 =680K $\Omega$ .   | CO3          |
| b) Wien bridge oscillator uses $R=4.7K\Omega$ , $C=0.01\mu F$ , and $RF=2R1$  | CO3          |
| 13. Design the following LC oscillators; Also verify the theoretical and practical Oscillating frequency.   |              |
| a) For a Hartley oscillator, self-inductance of the two coils are L1=100mH, L2=1mH and mutual inductance  |              |
| between the two coils is 20µH. its output for a capacitor of value 20pF.  | CO3          |
| b) For a Colpitts oscillator in which feedback network consists of two capacitors of 100 pF and 20 pF with 100 mH coil across these capacitors.   |              |
| 14. Design and implement square wave generator (Astable Multivibrator) for 1 MHz using,   |              |
| a) Op-amp   | CO3          |
| b) IC 555.  |              |
| 15. Design and implement a triangular wave generator using dual op-amp, for oscillation frequency $f_0 = 1.5$ KHz and Vout $(P-P) = 6V$ , use Vsat = 13.5 V.  | CO3          |
| 16. Design and simulate single-stage CE amplifiers with Voltage Divider Bias for 10mV input ac signal and plot the  |              |
| Frequency Response curves using BC 547, VCC= 12V, Stability factor (S)=10 and RL= 10 KΩ. (TARGET, PSPICE-   | CO4          |
| letc.)  |              |
| 17. Simulation of Multistage stage (CE-CE) amplifier (designed in experiment1) using any available simulation software and also find the Voltage gain, Input impedance, Output impedance, and bandwidth. (TARGET, PSPICE-1etc.) | CO4          |
| 18. Design and simulate current series/Voltage shunt Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain and bandwidth.                                      | CO4          |
| 19. Design and simulate Voltage series Feedback amplifier with basic voltage gain 100 and feedback factor 0.1-0.2 also analyze the effect of feedback on gain and bandwidth.  | CO4          |
| 20. Design and simulate of 2nd order Active Low pass filter for cut-off frequency 1KHz and pass band gain of 1.586, also draw the frequency response curve and verify the cutoff frequency.                                     | CO4          |
| 21. Design and simulate of 2nd order Active High pass filter for cut-off frequency 1KHz and pass band gain of 1.586, also draw the frequency response curve and verify the cutoff frequency.                                    | CO4          |
| 22. Identification of various types of Printed Circuit Boards (PCB) and soldering Techniques.   | CO5          |
| 23. PCB Lab: Artwork & printing of a simple PCB.  | CO5          |
| 24. Etching & drilling of PCB.  | CO5          |
| 25. Wiring & fitting shop: Fitting of power supply along with a meter in cabinet.   | CO5          |
| 26. Mini Project: Design a mini project using the applications of this Lab.   | CO5          |
| 27. Identification of various types of Printed Circuit Boards (PCB) and soldering Techniques.   | CO5          |
| Total Hou   | ırs: 40 hrs. |
|   |              |

| LAB C     | ourse   | Code: B                  | EC0356    | 6         |                | LAB C     | ourse I   | Name: 1    | Data St   | ructure     | Lab        |   |             | L    | T      | P          | C     |
|-----------|---------|--------------------------|-----------|-----------|----------------|-----------|-----------|------------|-----------|-------------|------------|---|-------------|------|--------|------------|-------|
| Course    | Offer   | ed in: B.                | Tech. F   | ECE/VI    | .SI            |           |           |            |           |             |            |   |             | 0    | 0      | 2          | 1     |
|           |         |                          |           |           |                | ing con   | cepts us  | sing C/C   | C++ and   | underst     | tanding o  | f fundan                                | nental algo | ·    |        |            |       |
|           |         |                          |           |           |                |           |           |            |           |             |            |   | ays, linked |      |        | s, que     | ues,  |
| trees, ar | ıd grap | hs. It ain               | ns to en  | hance p   | roblem-        | solving   | abilitie  | s throug   | h effici  | ent algo    |            |   | code opti   |      |        |            |       |
| Course    | Outco   | ome: Afte                | er comp   | oletion o | f the co       | urse, the | e studer  | t will b   | e able to | )           |            |   |             | Bloc | m's I  | Know       | ledge |
|           |         |                          |           |           |                |           |           |            |           |             |            |   |             | Leve | el (KI | ر)         |       |
| CO1       | _       | lementin<br>niques.      | g Single  | e and M   | ulti-dim       | ensiona   | l array   | with the   | ir appli  | cations     | like searc | ching and                               | d Sorting   |      | k      | <b>C</b> 3 |       |
| CO2       |         | lement L                 | ink list, | Stack a   | nd Que         | ues with  | their a   | pplication | ons.      |             |            |   |             |      | k      | <b>K</b> 3 |       |
| CO3       |         | lementati                |           |           |                |           |           |            |           | insertior   | n, deletio | n, searcl                               | ning and    |      | L      | 7.1        |       |
| COS       |         | ersal.                   |           |           |                |           |           |            |           |             |            |   |             |      | r      | (4         |       |
| CO4       |         | lementati                |           |           |                | ious ope  | eration 1 | like sear  | ching,    | sorting,    | hashing    | in data s                               | tructures   |      | k      | <b>K</b> 4 |       |
|           |         | solving re               |           |           |                |           | • .       |            |           |             |            |   |             |      |        | • •        |       |
|           |         | ping (Sca                | de 1: L   | ow, 2: N  | <u> ledium</u> | 1, 3: Hig | gh)       | 1          | 1         | 1           | 1          | 1                                       |             |      |        |            |       |
| CO-Po     |         |                          |           |           |                |           |           |            |           |             |            |   |             | PS   | 03     |            |       |
| CO1       |         | 3                        | 2         | 3         | 2              | 3         | -         | -          | -         | -           | 2          | -                                       | 3           | 3    | 3      | 1          |       |
| CO2       |         | 3                        | 3         | 3         | 2              | 3         | -         | -          | -         | -           | 1          | -                                       | 3           | 3    | 3      | 1          |       |
| CO3       |         | 3                        | 3         | 3         | 2              | 3         | -         | -          | -         | -           | 1          | -                                       | 3           | 3    | 3      | 1          |       |
| CO4       |         | 3                        | 3         | 3         | 3              | 3         | -         | -          | -         | -           | 2          | 1                                       | 3           | 3    | 3      | 2          |       |
| List Of   | Pract   | ical's (In               | dicativ   | e & Not   | t Limite       | ed To)    |           |            |           |             |            |   |             |      |        |            |       |
| S.No      |         |                          |           |           |                |           | Progr     | am Des     | criptio   | n           |            |   |             |      |        |            | CO    |
| 1         | Cons    | truct a co               | de to fi  | nd the n  | naximur        | n eleme   |           |            |           | <del></del> |            |   |             |      |        | _          | CO1   |
| 2         |         | truct a co               |           |           |                |           |           |            | rray.     |             |            |   |             |      |        |            | CO1   |
| 3         | Cons    | truct a co               | de to re  | verse th  | e eleme        | nts of a  | n array.  |            | -         |             |            |   |             |      |        | (          | CO1   |
| 4         | Cons    | truct a co               | de to co  | ount the  | occurre        | nce of a  | specifi   | c eleme    | nt in an  | array.      |            |   |             |      |        | (          | CO1   |
| 5         |         | truct a co               |           |           |                |           |           |            |           |             | lumn ma    | jor order                               | •           |      |        |            | CO1   |
| 6         |         | am to fin                |           |           |                |           |           |            |           | atrix.      |            |   |             |      |        |            | CO1   |
| 7         |         | truct a co               |           |           |                |           |           |            |           |             |            |   |             |      |        |            | CO1   |
| 8         |         | truct a Py               |           |           |                |           |           | s using 1  | ecursio   | n.          |            |   |             |      |        |            | CO2   |
| 9         |         | truct a co               |           | _         |                |           |           |            |           |             |            |   |             |      |        | _          | CO2   |
| 10<br>11  |         | truct a pr<br>truct a pr |           |           |                |           |           | ,          |           |             |            |   |             |      |        |            | CO2   |
| 12        |         | truct a pr               |           |           |                |           |           | <u>′·</u>  |           |             |            |   |             |      |        |            | CO2   |
| 13        |         | truct a co               |           |           |                |           |           |            |           |             |            |   |             |      |        |            | CO2   |
| 14        |         | e a single               | _         |           |                |           | _         |            | ertion d  | eletion     | travercal  | )                                       |             |      |        |            | CO2   |
| 15        |         | e a doubl                |           |           | •              |           | •         |            |           |             |            |   |             |      |        |            | CO2   |
| 16        |         | e a circul               |           |           |                |           |           | •          |           |             |            |   |             |      |        | _          | CO2   |
| 17        | XX :    | a circui                 |           | 1         | poi 10         | 1         | - operai  |            |           | 1 .         | .,         | • |             |      |        |            | 202   |

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Write a program to implement an in-order traversal of a binary tree and print the nodes.

Write a program to implement a pre-order traversal of a binary tree and print the nodes.

Write a program to implement a post-order traversal of a binary tree and print the nodes.

Write a program to count number of nodes in a binary tree.

Write a Program to search a number in Binary Search Tree (BST).

Write a program to delete a node from a Binary Search Tree (BST).

Write a program to perform Depth-First Search (DFS) on a graph.

Write a program to perform Breadth-First Search (BFS) on a graph.

Construct a program to implement merge sort with recursion and iteration.

Write a program to insert a node in a Binary Search Tree (BST).

Write a program to find the height of the tree.

Write a program to implement Prims Algorithm.

Write a program to implement Kruskal Algorithm.

Write a program to implement Dijkstra Algorithm.

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|    | Total Hour   | s: 48 hrs. |
|----|--|------------|
| 35 | Write a program to implement a max-heap and perform heap sort on an array of integers. | CO4        |
| 34 | Construct a program to implement bubble sort.  | CO4        |
| 33 | Construct a code to implement binary search.   | CO4        |
| 32 | Construct a code to implement linear search.   | CO4        |
| 31 | Construct a program to implement quick sort with recursion and iteration.              | CO4        |

|   | : BEC0                     | 355          |                                 |   | Cour  | se Nam                                 | e: IoT V                                      | V <mark>orkshop</mark>             | I                                 | , <u> </u>   | Т             |  |                         | P       |  |  |
|---|----------------------------|--------------|---------------------------------|---|---|--|---|------------------------------------|-----------------------------------|--|---------------|--|-------------------------|---------|--|--|
|   |                            |              |                                 |   | (Woı  | rkshop N                               | Mode)   |                                    |                                   |  |               |  |                         |         |  |  |
| Course Offer  |                            |              |                                 |   |   |  |   |                                    | (                                 | )  | 0             |  | (                       | 6       |  |  |
| Pre-requisite   |                            |              |                                 |   |   |  |   |                                    |                                   |  |               |  |                         |         |  |  |
| Course Obje   | ectives:                   | To prov      | ide stud                        | lents wit                                 | th a goo  | d depth                                | of know                                       | wledge o                           | f Desig                           | ning Indi  | ustrial Io    | T System                                     | ms for v                | arious  |  |  |
| applications.   |                            |              |                                 |   |   |  |   |                                    |                                   |  |               |  |                         |         |  |  |
| Course Outc   | ome: A                     | ter comp     | oletion of                      | f the cou                                 | rse, the s  | tudent w                               | ill be ab                                     | le to                              |                                   |  | Bloon<br>(KL) | n's Know                                     | ledge Le                | vel     |  |  |
| CO1   |                            |              |                                 |   | •   |  | pportMo                                       | duleies                            | and be                            | nefits in  | _ ` ′         | K  | <br>[1                  |         |  |  |
| CO2   |                            |              |                                 | Appl                                      |   | network                                | to demo                                       | nstrate th                         | e use of                          | Cloud in   |               | K  |                         |         |  |  |
| CO3   |                            |              |                                 | To ar                                     | Industrial IoT.  To analyze ADC/DAC techniques and IIAF components for efficient industrial IoT system design  K4                     |  |   |                                    |                                   |  |               |  |                         |         |  |  |
| CO4   |                            |              |                                 | Expla                                     | for efficient industrial IoT system design.  Explain the concept and use of various IoT protocols and communication technologies.  K2 |  |   |                                    |                                   |  |               |  |                         |         |  |  |
| CO5   |                            |              |                                 | Anal                                      | yze chall   |  | nd issues                                     |                                    | IoT Sec                           | curity and   |               | K  | [4                      |         |  |  |
| CO-PO Map   | ping (So                   | cale 1: L    | ow, 2: N                        |   |   |  | cicty pro                                     | oiciis.                            |                                   |  |               |  |                         |         |  |  |
| СО-РО   |                            |              | <u> </u>                        |   |   |  | DO#   | DOG                                | DOG                               | DO10   | DO11          | DGO1   | DG O A                  | DG 0.2  |  |  |
| Mapping   | PO1                        | PO2          | PO3                             | PO4                                       | PO5   | PO6                                    | PO7   | PO8                                | PO9                               | PO10   | PO11          | PSO1   | PSO2                    | PSO3    |  |  |
| BEC0355.1   | 3                          | 2            | 2                               | -   | -   | -                                      | -   | -                                  | -                                 | -  | -             | 3  | 2                       | 2       |  |  |
| BEC0355.2   | 3                          | 3            | 3                               | _   | _   | _                                      | _   | _                                  | _                                 | _  | _             | 3  | 2                       | -       |  |  |
| BEC0355.3   | 3                          | 2            | 3                               | _   | _   | _                                      | _   | _                                  | _                                 | _  | _             | 3  | 2                       | -       |  |  |
| BEC0355.4   | 3                          | 2            | 1                               | -   | -   | -                                      | -   | -                                  | _                                 | -  | -             | 3  | 2                       | _       |  |  |
| BEC0355.5   | 3                          | 2            | 1                               | -   | -   | -                                      | -   | -                                  | _                                 | -  | -             | 3  | 2                       | -       |  |  |
| Course Cont   | ents / Sy                  | llabus       |                                 |   |   |  | I.  | <u> </u>                           |                                   | I I  |               | I.   | I.                      | l       |  |  |
| Module 1  |                            |              |                                 |   | Introd  | uction to                              | o IoT an                                      | d IIoT ar                          | nd its ba                         | asic funda   | amental       | s: 8 ho                                      | ours                    |         |  |  |
| Introduction t  |                            |              |                                 |   |   |  |   |                                    |                                   |  |               |  |                         |         |  |  |
| and Benefits  |                            |              |                                 | Workfor                                   | ce – Lo   | gistics ar                             | nd the In                                     | dustrial I                         | nternet-                          | IoT Inno   | vations i     | n Retail.                                    | Introduct               | tion to |  |  |
| Integrated De Module 2  | veloped                    | Environ      | ments.                          |   | Common  | Networ                                 | 1   |                                    |                                   |  |               | 8ho  |                         |         |  |  |
|   | or Notu                    | orka, Ui     | stom: on                        | d Contav                                  |   |  |   | odas Na                            | tuvorlein                         | a Modos  | WCN on        |  |                         | iool    |  |  |
| Wireless Sens<br>Systems (CPS   |                            |              |                                 |   |   |  |   |                                    |                                   |  |               |  |                         |         |  |  |
| bystems (Cr   | ,                          | -            |                                 |   |   | BDIT (E                                | onware  | Defined i                          | 10000011                          | us) The C  | oroug une     | .105 1                                       | tole of Bi              | 5       |  |  |
| •   |                            |              |                                 |   |   | o and R                                | aspberr                                       | y pi Prog                          | grammi                            | ng   |               | 8 hc   | ours                    |         |  |  |
| Data in HoT -   |                            | T.           |                                 |   |   |  |   |                                    | •                                 | *  |               |  | dvanced                 | data    |  |  |
| Data in HoT - Module 3  ADC and DA Viewpoints   |                            |              | pology:                         |   |   |  |   |                                    |                                   |  |               |  |                         |         |  |  |
| Data in IIoT - Module 3  ADC and DA  Viewpoints - analytics.  |                            |              | pology:                         |   | IoT Se  | curity a                               | nd Proto                                      | ocols                              |                                   |  |               | 8 ha   | ours                    |         |  |  |
| Data in HoT - Module 3  ADC and DA Viewpoints - analytics.  Module 4  | Archite                    | ctural To    |                                 |   |   | curity a                               |   |                                    | RT NF                             | C Z-Way  | ve. Bacne     | 8 ho   |                         |         |  |  |
| Data in HoT - Module 3  ADC and DA Viewpoints - analytics.  Module 4  Wireless Tecl   | Archite                    | ctural To    | : WPAN                          | I Techno                                  | logies fo   | r IoT: IE                              | EEE 802.                                      | 15.4, HA                           |                                   |  |               | et, Modbu                                    | ıs.                     | curity, |  |  |
| Data in HoT - Module 3  ADC and DA Viewpoints - analytics.  Module 4  Wireless Tecl IP Based Pro Threat Model   | Archite                    | ctural To    | : WPAN                          | I Techno                                  | logies fo<br>RPL, RE  | or IoT: IE<br>ST, AM                   | EEE 802.<br>PQ, CoA                           | 15.4, HA                           |                                   |  |               | et, Modbu                                    | ıs.                     | curity, |  |  |
| Data in HoT - Module 3  ADC and DA Viewpoints - analytics.  Module 4  Wireless Tecl IP Based Pro Threat Model   | Archite                    | ctural To    | : WPAN                          | I Techno                                  | logies fo<br>RPL, RE  | r IoT: IE                              | EEE 802.<br>PQ, CoA                           | 15.4, HA                           |                                   |  |               | et, Modbu                                    | is.<br>s, IoT Sec       | curity, |  |  |
| Data in HoT - Module 3  ADC and DA Viewpoints - analytics.  Module 4  Wireless Tecl IP Based Pro Threat Model Module 5  Smart Cities,                 | Archite hnologie tocols fo | s for IoT IP | T: WPAN<br>Pv6, 6Lov<br>Managen | I Techno<br>wPAN, I                       | logies for RPL, RE  Applice gistics, A  | or IoT: IE ST, AM  ations of Agricultu | EEE 802.<br>PQ, CoA                           | 15.4, HA                           | Γ. Edge                           | connecti   | vity and      | et, Modbu<br>protocols                       | is. s, IoT Secours      |         |  |  |
| Data in HoT - Module 3  ADC and DA Viewpoints - analytics.  Module 4  Wireless Tecl IP Based Pro Threat Model Module 5  Smart Cities,                 | Archite hnologie tocols fo | s for IoT IP | T: WPAN<br>Pv6, 6Lov<br>Managen | I Techno<br>wPAN, I                       | logies for RPL, RE  Applice gistics, A  | or IoT: IE ST, AM  ations of Agricultu | EEE 802.<br>PQ, CoA                           | 15.4, HA                           | Γ. Edge                           | Robot su   | vity and      | et, Modbu<br>protocols<br>8 ho<br>ee, Indust | os, IoT Secondrial IoT, |         |  |  |
| Data in IIoT - Module 3  ADC and DA Viewpoints - analytics.  Module 4   | Archite hnologie tocols fo | s for IoT IP | T: WPAN<br>Pv6, 6Lov<br>Managen | I Techno<br>wPAN, I                       | logies for RPL, RE  Applice gistics, A  | or IoT: IE ST, AM  ations of Agricultu | EEE 802.<br>PQ, CoA                           | 15.4, HA                           | Γ. Edge                           | connecti   | vity and      | et, Modbu<br>protocols<br>8 ho<br>ee, Indust | is. s, IoT Secours      |         |  |  |
| Data in HoT - Module 3  ADC and DA Viewpoints - analytics.  Module 4  Wireless Tecl IP Based Pro Threat Model Module 5  Smart Cities, challenges, Ice | Archite hnologie tocols fo | s for IoT IP | T: WPAN<br>Pv6, 6Lov<br>Managen | Techno<br>wPAN, I<br>ment, Lo<br>chvironm | Applic gistics, Aental Produino Cargolis,   | ations of Agricultustection.           | EEE 802. PQ, CoA  f IoT re, Heal k, 3rd ed Ap | 15.4, HA AP, MQT th and Li Edition | Γ. Edge festyle,  T by M 0.Publis | Robot su  Cotal Lect  Sichael   Cotal Lect  Cotal Lect  Cotal Lect  Cotal Lect  Cotal Lect  Cotal Lect  Cotal Lect | vity and      | et, Modbu<br>protocols<br>8 ho<br>ee, Indust | ours trial IoT,         | Legal   |  |  |

|                               | Communications", Cambridge University Press,     |                            |
|-------------------------------|--|----------------------------|
|                               | 2005.  |                            |
| 2                             | Raspberry Pi Cookbook, 4th Edition Released      | Cina an Manila             |
|                               | December 2022.Publisher(s): O'Reilly Media, Inc. | Simon Monk                 |
| Reference Books:              |  |                            |
| 1                             | Internet of Things: Principles and               | Rajkumar Buyya, Amir Vahid |
|                               | Paradigms, Morgan Kaufmann, 2016.                | Dastjerdi                  |
| NPTEL/ Youtube/ Faculty Video | Link:  |                            |
| Module 1                      | https://www.youtube.com/watch?v=om-5QTb          | <u>LCCs</u>                |
| Module 2                      | https://www.youtube.com/watch?v=BBvG7uz          | mOV0&t=51s                 |
| Module 3                      | https://www.youtube.com/watch?v=HicZcgdC         | 5xZY&t=39s                 |
| Module 4                      | https://www.youtube.com/watch?v=-7dAFWF          | <u>RjCoA</u>               |
| Module 5                      | https://www.youtube.com/watch?v=SW3Ia5x          | <u>LmuU</u>                |
|                               |  |                            |

| List of Practical's ( | Indicative & Not Limited To)  |      |
|-----------------------|---|------|
| S.NO                  | Name of Experiment  | Cos  |
| 1                     | Study of IDE and practice of its installation.  | CO1  |
| 2                     | Create a traffic light signal with three coloured lights (Red, Orange and Green) with a duty cycle of 5-2-10 seconds.   | CO 2 |
| 3                     | Simulation of 4-Way Traffic Light with Arduino  | CO 2 |
| 4                     | Working with Adafruit Libraries in Arduino.   | CO 2 |
| 5                     | Connect an LED to GPIO pin 25 and control it through the command line.  | CO 2 |
| 6                     | The state of LED should toggle with every press of the switch Use DHT11 temperature sensor and print the temperature and humidity of the room with an interval of 15 seconds. | CO 2 |
| 7                     | To study Libraries and their installation.  | CO 3 |
| 8                     | To interface a servo motor with an Arduino board and control its position using PWM signals.  | CO 3 |
| 9                     | To learn how to interface a DC motor with an Arduino board and control its speed and direction.   | CO 3 |
| 10                    | To understand how to interface a relay with an Arduino board and control external devices.  | CO 3 |
| 11                    | To understand how to interface a stepper motor with an Arduino board and control its rotation.  | CO 3 |
| 12                    | To detect the presence of LPG or propane gas using the MQ-6 gas sensor and Arduino.   | CO 3 |
| 13                    | Study and Installation of Raspberry Pi.   | CO 3 |
| 14                    | Displaying different LED Patterns with Raspberry Pi.  | CO 3 |
| 15                    | Programming of available GPIO Pins of the corresponding device using native programming language. Interfacing LED and testing the functionality.                              | CO 3 |
| 16                    | To explore BLE communication and data exchange.   | CO 4 |
| 17                    | Home automation system  | CO 5 |
| 18                    | Health care system  | CO 5 |
| 19                    | Smart Irrigation System   | CO 5 |

| 20 | Electric Piano   | CO 5                 |
|----|--|----------------------|
| 21 | Design and simulate of 2nd order Active High pass filter for cut-off frequency 1KHz and pass band gain of 1.586, also draw the frequency response curve and verify the cutoff frequency. | CO4                  |
| 22 | Identification of various types of Printed Circuit Boards (PCB) and soldering Techniques.  | CO5                  |
| 23 | PCB Lab: Artwork & printing of a simple PCB.   | CO5                  |
| 24 | Etching & drilling of PCB.   | CO5                  |
| 25 | Wiring & fitting shop: Fitting of power supply along with a meter in cabinet.  | CO5                  |
| 26 | Mini Project: Design a mini project using the applications of this Lab.  | CO5                  |
| 27 | Identification of various types of Printed Circuit Boards (PCB) and soldering Techniques.  | CO5                  |
|    |  | Total Hours: 40 hrs. |

| Course Co                 |                      |  |           |                     | (                   | Course N                     | ame: A    | <mark>artifici</mark> a | al Intellg          | gence and  | l Cyber E   | thics      | L        | T       | P     | C      |
|---------------------------|----------------------|--|-----------|---------------------|---------------------|------------------------------|-----------|-------------------------|---------------------|------------|-------------|------------|----------|---------|-------|--------|
| Course O                  |                      |  |           |                     |                     |                              |           |                         |                     |            |             |            | 2        | 0       | 0     | 2      |
| Pre-requi                 |                      |  |           |                     |                     |                              |           |                         |                     |            |             |            |          |         |       |        |
| Course O                  | -                    |  |           |                     |                     |                              |           | _                       |                     |            |             | _          |          |         |       | 7,     |
| and ensur                 |                      |  |           | • •                 |                     |                              |           |                         |                     | Artificia  | l Intellige | nce and o  | <u> </u> |         |       |        |
| Course O                  | utcome:              | After c  | omplet    | ion of t            | he cou              | se, the st                   | tudent v  | will be a               | able to             |            |             |            |          |         |       | ledge  |
|                           | r 1                  |  | . 1       | CAT                 | .1.1                |                              |           | .1 ' 1                  | • 1                 |            | 1 1         |            |          | el (KL  | ر.)   |        |
|                           | Learn ke<br>developn |  |           |                     | ethics,             | summar                       | ızıng e   | thical                  | considera           | ations an  | d applicat  | ions in A  | A1       | K       | 2     |        |
|                           | Apply po             |  |           |                     | for Fai             | rness in                     | AI and    | Machir                  | ne Learni           | ing.       |             |            |          | k       | 3     |        |
| ( ( ) )                   | Apply prand Cybe     | •  |           | irity co            | ncepts,             | risk man                     | ageme     | nt and r                | egulator            | y complia  | ance in the | field of A | AI       | K       | 3     |        |
| CO4                       | Understa             | tand the nature of cybercrimes, the principles of intellectual property rights (IPR), and easures necessary to address and prevent these issues. |           |                     |                     |                              |           |                         |                     |            |             |            | ne       | K       | [2    |        |
| CO-PO N                   |                      |  |           |                     |                     |                              |           | 100000                  | <u> </u>            |            |             |            | ·        |         |       |        |
| CO-PO<br>Mapping          | PO1                  | PO2  | PO3       | PO4                 | PO5                 | PO6                          | PO7       | PO8                     | PO9                 | PO10       | PO11        | PSO1       | PSO2     | PSO     | 03    |        |
| CO1                       | -                    | 1  | _         | _                   | _                   | 1                            | 2         | _                       | _                   | _          | 2           | 1          | 1        | 1       |       |        |
| CO2                       | 2                    | 3  | 2         | _                   | 2                   | 1                            | 2         | _                       | 2                   | 1          | 2           | 2          | 1        | 1       |       |        |
| CO3                       | 2                    | 3  | 2         | 1                   | 2                   | 3                            | 3         | _                       | 2                   | 2          | 2           | 2          | 2        | 1       |       |        |
| CO4                       | 2                    | 2  | -         | -                   | 1                   | 3                            | 3         | -                       | 2                   | 2          | 2           | 2          | 1        | 1       |       |        |
| Course Co                 | ontents /            | Syllab   | us        |                     | I                   |                              |           |                         | <u>I</u>            | ı          |             | <u> </u>   |          | 1       |       |        |
| Module 1                  |                      | -  |           | An Ov               | erview              | to AI E                      | thics     |                         |                     |            |             |            |          | (       | 6 hou | ırs    |
| Definition                | of AI Et             | hical pr   | inciple   | s in AI,            | Source              | es of AI                     | lata, Le  | gal imp                 | olications          | of AI Se   | curity Bre  | aches, Pri | vacy and | I AI R  | egula | tions, |
| Key Princ                 | iples of             | Respon   | sible A   | AI, Trai            | nsparen             | cy and A                     | Accoun    | tability,               | , Dual-U            | se Dilem   | ma, Huma    | an-Centric | Design   | , Intro | ducti | on to  |
| Cyber Lav                 | vs and Et            | hics, H  | istorica  | l Deve              | lopmen              | t of Cybe                    | er laws,  | Legal                   | framewo             | rks.       |             |            |          |         |       |        |
| Module 2                  |                      |  |           |                     |                     | Favorit                      |           |                         |                     |            |             |            |          |         | 3 hou |        |
| Introduction              |                      |  |           |                     |                     |                              |           |                         |                     |            |             |            |          |         |       |        |
| Fairness a<br>Fairness ir |                      |  |           |                     |                     |                              |           |                         |                     | neworks    | for Fairne  | ess in AI, | Bias in  | Data    | Colle | ction, |
| Module 3                  | I Data I I           | occssiii   | g, Gen    |                     |                     | d Cybers                     |           |                         |                     |            |             |            |          |         | 3 hou | ırs    |
| Importanc<br>and Privac   | y-Preser             | ving Da  | ata Min   | ity in A<br>ing (PF | I, AI sp<br>PDM), I | ecific Se<br>Risk Mar        | curity a  | Tools a<br>nt: Risk     | nd Softw<br>Assessr | nent and   | Incident R  | lesponse,  | Regulato | rning   | (PPM  | IL)    |
| GDPR, HI  Module 4        | PAA, Ca              | ise Stuc   | lies: Im  |                     |                     | of Al Eth<br>, <b>IPR an</b> |           |                         |                     | practices  | s in engine | ering proj | ects.    |         | 3 hou | ırs    |
| Types of C                | Cybercrir            | nes and  | l their   |                     |                     |                              |           |                         |                     | ention and | d Prosecut  | ion, IPR:  | Copyrig  |         |       |        |
| Patents, an               |                      |  |           |                     |                     |                              |           |                         |                     |            |             |            |          |         |       |        |
| and Digita                |                      |  |           | -                   |                     |                              |           |                         | •                   | -          | -           |            | •        |         | _     |        |
| Global Cy                 | ber Laws             | s, Case  | Study:    | The A               | ГМ Неі              | st – Cosı                    | mos Ba    | nk Cyb                  | er Attack           | (India, 2  | 2018).      |            |          |         |       |        |
|                           |                      |  |           |                     |                     |                              |           |                         |                     |            | 7           | Total Lec  | ture Ho  | ırs .   | 30 ho | urs    |
| Textbook                  | :                    | Day  | .l. T:41. | o vvith v           | nublica             | tion oco                     | mar: 0-   |                         |                     |            |             | Anth       |          |         |       |        |
| S.No                      | T                    |  |           |                     |                     | tion age                     |           |                         |                     | T _        |             | Autho      | )r<br>   |         |       |        |
| 1.                        | Artifici<br>Books,   |  | ligence   | : A Gu              | ide for             | Thinking                     | Huma      | ns by P                 | enguin              | M          | Ielanie Mi  | tchell     |          |         |       |        |
| 2.                        |                      | Ethics:  | Moralit   | ty and I            | Law in              | Cyberspa                     | ace, 7th  | Edition                 | n (2023)            | R          | ichard Spi  | nello, Jon | es & Baı | tlett L | earni | ng     |
| Reference                 | Books:               |  |           |                     |                     |                              |           |                         |                     |            |             |            |          |         |       |        |
| S.No                      |                      | Boo  | ok Title  | e with ]            | publica             | tion age                     | ency &    | year                    |                     | A          | uthor       |            |          |         |       |        |
| 1.                        | Artifici             | al Intel   | ligence   | and Et              | hics by             | , BPB Pu                     | ıblicatio | ons, 202                | 23.                 | S.         | B. Kisho    | , Debajit  | Biswas   |         |       |        |
| 2.                        | Cyber S              | Security   | and C     | yber La             | aws by,             | Cengago                      | e India,  | 2022.                   |                     | A          | lfred Basta | a, Nadine  | Basta, S | attwik  | Pand  | la     |
|                           |                      |  |           |                     |                     |                              |           |                         |                     | •          |             |            |          |         |       |        |

| NPTEL/ Y | ouTube/ Faculty Video Link:                 |
|----------|---|
| 1.       | https://www.youtube.com/watch?v=VqFqWIqOB1g |
| 2.       | https://www.youtube.com/watch?v=hVJqHgqF59A |
| 3.       | https://www.youtube.com/watch?v=O5RX_T4Tg24 |
| 4.       | https://www.youtube.com/watch?v=RJZ0pxcZsSQ |
|          |   |

| <b>Course Cod</b> | e: BASC     | C0401                             |           | C        | ourse l   | Name:    | <b>Emplo</b> | yabilit <u>y</u> | y <mark>Skill</mark> l | Develo    | pment -   | II                   | L          | T         | P         | С     |  |
|-------------------|-------------|-----------------------------------|-----------|----------|-----------|----------|--------------|------------------|------------------------|-----------|-----------|----------------------|------------|-----------|-----------|-------|--|
| Course Offe       | red in: B   | .Tech                             |           | •        |           |          |              |                  |                        |           |           |                      | 2          | 0         | 0         | 2     |  |
| Pre-requisit      | e: Basic ı  | ındersta                          | anding o  | of elem  | entary 1  | mathem   | atics        |                  |                        |           |           |                      | '          | •         |           |       |  |
| Course Obj        | ectives:    |                                   |           |          |           |          |              |                  |                        |           |           |                      |            |           |           |       |  |
| The objective     | e of this c | ourse is                          | s to dev  | elop stu | idents' d | quantita | ative ap     | titude a         | nd logi                | cal reas  | oning sk  | ills throu           | gh numbe   | er theory | , anal    | ytica |  |
| puzzles, and      | business    | mathem                            | atics, e  | nabling  | them to   | solve i  | real-wo      | rld and          | compet                 | titive ex | am prob   | lems with            | speed, a   | ccuracy,  | and lo    | gica  |  |
| thinking.         |             |                                   |           |          |           |          |              |                  |                        |           |           |                      |            |           |           |       |  |
| Course Out        | come: Af    | ter com                           | pletion   | of the o | course,   | the stud | dent wil     | l be ab          | le to                  |           |           |                      |            | n's Knov  | vledge    | 3     |  |
|                   | T           |                                   |           |          |           |          |              |                  |                        |           |           |                      | Level      | (KL)      |           |       |  |
| CO1               |             |                                   |           |          |           |          |              |                  |                        |           | LCM, r    | emainder             |            | K2, K     | (3        |       |  |
|                   |             | m, and                            |           |          |           |          |              |                  |                        |           | cluding   | direction            |            |           |           |       |  |
| CO2               |             |                                   |           |          |           |          |              |                  |                        |           | s and cal |                      |            | K3        |           |       |  |
| CO3               |             |                                   |           |          |           |          |              |                  |                        |           |           | liscounts,           |            | K2, K     | 7.2       |       |  |
| <del></del>       |             | t averaș                          |           |          |           |          |              |                  |                        |           |           |                      |            | K2, N     |           |       |  |
| CO4               | l l         |                                   |           |          |           | lems in  | volving      | g aver           | ages, m                | ixtures   | , and rat | ios using            |            | K2, K     | [3        |       |  |
| CO-PO Maj         |             | oriate m                          |           |          |           | Tigh)    |              |                  |                        |           |           |                      |            |           |           |       |  |
| CO-1 O Maj        | pping (Sc   | ale 1. I                          | LUW, 2.   | Mediu    | un, 3. 1  | ligii)   |              |                  |                        |           |           |                      |            |           |           |       |  |
| со-ро м           | apping      | PO1                               | PO2       | PO3      | PO4       | PO5      | PO6          | PO7              | PO8                    | PO9       | PO10      | PO11                 | PO12       | PSO1      | PS        | O2    |  |
|                   |             |                                   |           |          |           |          |              |                  |                        |           |           |                      |            |           |           |       |  |
| CO1               |             | 1                                 | 1         | 1        | 1         | -        | -            | -                | -                      | -         | -         | -                    | -          | -         |           | -     |  |
| CO2               |             | 1 1 1 1                           |           |          |           |          |              |                  |                        |           |           |                      | -          | -         |           | -     |  |
| CO3               |             | 1 1 1 1                           |           |          |           |          |              |                  |                        |           |           | -                    | -          | -         |           |       |  |
| CO4               |             | 1                                 | 1         | 1        | 1         | -        | -            | -                | -                      | -         | -         | -                    | -          | -         |           | _     |  |
| <b>Course Con</b> | tents / Sy  | llabus                            | <u> </u>  | 1        |           | <u> </u> | <u> </u>     | <u>I</u>         | <u> </u>               | <u> </u>  | l         | 1                    |            | 1         |           |       |  |
| Module 1          |             |                                   |           | Spee     | d Matl    | and N    | lumber       | Syster           | n                      |           |           |                      |            |           | 8 hou     | ırs   |  |
| Classification    | n of num    | ber, Di                           | visibilit | y Rule,  | , Factor  | rization | , HCF        | & LCN            | I, It's                | Applica   | tion, Mo  | dule digi            | it(Cyclici | ty), Last | two       | digi  |  |
| Remainder tl      | neorem, F   | actoria                           | l and N   | umber (  | of zeroe  | es, High | nest pov     | ver              |                        |           |           |                      |            |           |           |       |  |
| Module 2          |             |                                   |           | A a 1    | 41        |          | ai aal D     |                  |                        |           |           |                      |            |           | 8 hou     |       |  |
|                   |             |                                   |           | 1        |           |          | gical R      |                  |                        |           |           |                      |            |           | 8 nou     | irs   |  |
| Direction and     | d Sense, I  | 3lood R                           | elation   | , Numb   | er Serie  | es and I | Letter S     | eries, C         | oding I                | Decodir   | ıg,       |                      |            |           |           |       |  |
| Module 3          |             |                                   |           | Busin    | ness M    | ath I    |              |                  |                        |           |           |                      |            |           | 8 hou     | ırs   |  |
| Percentage, l     | Profit and  | Loss. I                           | Discour   |          |           |          | Compo        | ound In          | terest. A              | Average   | 3         |                      |            |           |           |       |  |
| Module 4          | 10110 0110  | 2000, 1                           | 2100041   |          | ness M    |          | Comp         | 7 (411 (4 111    |                        | 1,0108    |           |                      |            |           | 8 hou     | ırs   |  |
| Ratio & Prop      | ortion, P   | artnersh                          | nip, Mix  | kture &  | Allega    | tion, Cl | ock, C       | alendar          |                        |           |           |                      |            | •         |           |       |  |
|                   |             |                                   |           |          |           |          |              |                  |                        |           |           | Total l              | Lecture 1  | Hours 3   | 32 hou    | urs   |  |
| Ref               | erence B    | ooks:                             |           |          |           |          |              |                  |                        |           |           |                      |            |           |           |       |  |
| S.No              | Boo         | k Title                           |           |          |           |          |              |                  |                        |           | Aut       | hor                  |            |           |           |       |  |
|                   |             | cker ma                           |           |          |           |          |              |                  |                        |           |           | Гуга (BSC            | C publica  | tion co   | Pvt I     | td)   |  |
| ı                 | Zui         |                                   |           | 1        |           |          |              |                  |                        |           |           | <u> </u>             |            |           | - · • · L |       |  |
| 1<br>2            | One         | Quantitative Aptitude RS Aggarwal |           |          |           |          |              |                  |                        |           |           |                      |            |           |           |       |  |
| 2 3               |             | ntitativ<br>bal & N               |           |          | asoning   | <u> </u> |              |                  |                        |           |           | Aggarwal<br>Aggarwal |            |           |           |       |  |

| Course Co                      | de: BEC04  | 401                |            | C        | <mark>Course</mark> I  | Name:     | <mark>Analog</mark> | and D    | <mark>igital (</mark> | C <mark>ommu</mark> | nication                             | l          | L          | T                | P      | C          |  |  |  |  |
|--------------------------------|--|--------------------|------------|----------|--|-----------|---------------------|----------|-----------------------|---------------------|--------------------------------------|------------|------------|------------------|--------|------------|--|--|--|--|
| Course Of                      | fered in: B  | .Tech              |            |          |  |           |                     |          |                       |                     |                                      |            | 3          | 0                | 0      | 3          |  |  |  |  |
| Pre-requis                     | ite: Basic ı   | ındersta           | anding o   | of signa | al and sy  | ystems    | & math              | ematics  | S.                    |                     |                                      |            |            |                  |        |            |  |  |  |  |
| Course Ob                      | jectives:  |                    |            |          |  |           |                     |          |                       |                     |                                      |            |            |                  |        |            |  |  |  |  |
| The objecti                    | ve of this c   | ourse is           | the fur    | ndamen   | tal of d   | ifferent  | analog              | and dig  | gital mo              | dulatio             | n and de                             | modulati   | on techni  | ques (Al         | И, FM  | I, PM      |  |  |  |  |
| ASK, FSK,                      | PSK, DPS   | K and (            | QPSK).     | The per  | rformar  | ice of d  | igital m            | odulati  | on tech               | niques i            | n terms o                            | of noise a | nd basic   | s of sprea       | d spe  | ctrun      |  |  |  |  |
| techniques.                    | Also, the  | concept            | of info    | rmatior  | theory   | and va    | rious so            | ource e  | ncoding               | technic             | ques and                             | error co   | rrecting o | odes.            |        |            |  |  |  |  |
| Course Ou                      | itcome: Af   | ter com            | pletion    | of the   | course,  | the stud  | lent wil            | l be ab  | le to                 |                     |                                      |            | l l        | n's Knov<br>(KL) | vledge | e          |  |  |  |  |
| CO 1                           | Explain various modulation and demodulation methods of Amplitude Modulation and Angle Modulation.  Level (KL)  K |                    |            |          |  |           |                     |          |                       | K2                  | K2                                   |            |            |                  |        |            |  |  |  |  |
| CO 2                           |  | nent va            |            | igital m | odulatio   | on techi  | niques.             |          |                       |                     |                                      |            |            | K3               |        |            |  |  |  |  |
| CO 3                           | Analyz<br>system   |                    | effect of  | f noise  | and ex   | plain th  | e conce             | ept of s | spread s              | spectrur            | n comm                               | unication  | 1          | K4               |        |            |  |  |  |  |
| CO 4                           |  | the fun<br>evaluat |            |          |  |           |                     | eory to  | design                | various             | source                               | encoding   | 5          | K5               |        |            |  |  |  |  |
| CO 5                           |  |                    |            |          |  |           | the enc             | oding a  | and dec               | oding p             | rocesses.                            |            |            | K5               | •      |            |  |  |  |  |
| СО-РО М                        | apping (Sc   | ale 1: I           | Low, 2:    | Mediu    | ım, 3: I   | High)     | 1                   |          |                       | •                   |                                      | T          | T          | Ī                |        |            |  |  |  |  |
| со-ро                          | Mapping  | PO1                | PO2        | РО3      | PO4  | PO5       | PO6                 | PO7      | PO8                   | PO9                 | PO10                                 | PO11       | PSO1       | PSO2             | PS     | SO3        |  |  |  |  |
| CO1                            |  | 3                  | 2          | -        | -  | -         | -                   | -        | -                     |                     | -                                    | -          | 3          | -                |        | 3          |  |  |  |  |
| CO2                            |  | 3                  | 3          | 2        | -  | -         | -                   | -        | -                     | -                   | -                                    | -          | 2          | -                |        | 3          |  |  |  |  |
| CO3                            |  | 2                  | 3          | 2        | 2  | -         | -                   | -        | -                     | -                   | -                                    | -          | 2          | -                |        | 3          |  |  |  |  |
| CO4                            |  | 3                  | 3          | 3        | 2  | -         | -                   | _        | -                     | -                   | -                                    | _          | 2          | -                |        | 3          |  |  |  |  |
| CO5                            |  | 3                  | 2          | 1        | -  | -         | -                   | _        | -                     | -                   | -                                    | _          | 2          | -                |        | 3          |  |  |  |  |
| Course Co                      | ntents / Sy  | llabus             |            |          |  |           |                     |          |                       |                     | I.                                   | I          | I          | I.               |        |            |  |  |  |  |
| Module 1                       |  |                    |            | Anal     | log Mo   | dulatio   | n                   |          |                       |                     |                                      |            |            |                  | 8 hot  | ırs        |  |  |  |  |
|                                | n to Comi<br>and Phase   |                    |            |          |  |           |                     |          |                       |                     |                                      | Demodu     | lation, A  | angle Mo         | odulat | tion:      |  |  |  |  |
| Module 2                       |  |                    |            | Digit    | tal Mod  | lulation  | <u> </u>            |          |                       |                     |                                      |            |            |                  | 8 hou  | ırs        |  |  |  |  |
| Sampling 7                     | Theorem, P   | ulse Co            | de Mod     |          |  |           |                     | n Mult   | iplexing              | g (TDM              | ()                                   |            |            | <u> </u>         |        |            |  |  |  |  |
|                                | mmunicat   |                    |            |          |  |           | SK, FS              | K & PS   | SK Mod                | dulation            | and De                               | modulati   | on, Diffe  | erential p       | hase   | shift      |  |  |  |  |
| Keying (DF<br><b>Module 3</b>  | PSK), Quad   | rature p           | nase sn    | _        | ing (QP<br>tal Rec   |           |                     |          |                       |                     |                                      |            |            |                  | 8 hou  | ırc        |  |  |  |  |
|                                | nal to Nois  | a Patio            | (SMP)      |          |  |           | ica Fig             | ura Co   | ncent c               | of Mate             | had Filta                            | re REP     | analycic   |                  |        |            |  |  |  |  |
| BPSK.                          | iai to ivois   | c Kano             | (SIVIC)    | , riguit | C OI IVIC  | JIII, INO | isc rig             | urc, co  | псері с               | n maic              | neu rine                             | 15, DEK    | anarysis   | or DAS           | x, Di  | ых,        |  |  |  |  |
|                                | ectrum Co  | mmuni              | ication    | : Freque | ency Ho  | opping    | Spread              | Spectru  | ım (FH                | SS), Di             | rect Sequ                            | ience Sp   | read Spe   | etrum (D         | SSS).  |            |  |  |  |  |
| Module 4                       |  |                    |            |          | rmatio   |           |                     |          |                       |                     |                                      |            |            |                  | 8 hou  |            |  |  |  |  |
|                                | f informati  |                    |            |          |  |           |                     |          |                       |                     | g: Shann                             | on Fano    | Coding     | , Huffma         | an Co  | ding       |  |  |  |  |
| Capacity of<br><b>Module 5</b> | f Additive \   | white C            | aussiar    | 1        |  |           |                     | nannon   | Hartley               | y Law.              |                                      |            |            | 1.               | 8 hou  | rc.        |  |  |  |  |
|                                | ecting code  | s: hamn            | ning en    |          | r corre  |           |                     | ammin    | o houn                | d relati            | on hetwa                             | en mini    | num diet   |                  |        |            |  |  |  |  |
|                                | nd correction  |                    |            |          |  |           |                     |          |                       |                     |                                      |            |            |                  |        |            |  |  |  |  |
|                                |  | <u> </u>           | <b>J</b> 7 |          |  |           | <u> </u>            | - , , -  |                       |                     |                                      |            |            | Hours            | _      | ours       |  |  |  |  |
| Text Book                      | s:   |                    |            |          |  |           |                     |          |                       |                     |                                      |            |            |                  |        |            |  |  |  |  |
|                                | Book Tit   | le                 |            |          |  |           |                     |          |                       |                     | Autl                                 | nor        |            |                  |        |            |  |  |  |  |
| S.No                           | Principles of Communication  |                    |            |          | vstems'  | '. Tata   | McGrav              | v Hill.  |                       | Herh                | Herbert Taub and Donald L. Schilling |            |            |                  | ng     |            |  |  |  |  |
| S.No                           | -  |                    |            |          | Modern Digital and Analog communication Systems", 4th Edition, Oxford University Press,2010. |           |                     |          |                       |                     |                                      |            |            |                  |        | B.P. Lathi |  |  |  |  |
|                                | Modern I   | Digital a          | nd Ana     |          | -  |           |                     |          | dition,               | Oxford              |                                      |            |            |                  |        |            |  |  |  |  |

| S.No                                | Book Title   | Author            |  |  |  |  |  |  |
|-------------------------------------|--|-------------------|--|--|--|--|--|--|
| 1                                   | Communication Systems", 4th Edition, Wiley India.  | Simon Haykin      |  |  |  |  |  |  |
| 2                                   | Analog and Digital Communications", 2nd Edition, Tata McGraw-Hill.                       | H.P.Hsu& D. Mitra |  |  |  |  |  |  |
| NPTEL/ Youtube/ Faculty Video Link: |  |                   |  |  |  |  |  |  |
| 1                                   | https://nptel.ac.in/courses/117/101/117101051/   |                   |  |  |  |  |  |  |
| 2                                   | https://www.youtube.com/channel/UCnWGGUyQOZkXylsoI5w-J4Q                                 |                   |  |  |  |  |  |  |
| 3                                   | https://youtube.com/playlist?list=PLbtX56KUSNwTB 27m6HI52rjk8Mz7v23f&si=0-OZ5ktNwpf0MQ7D |                   |  |  |  |  |  |  |
|                                     |  |                   |  |  |  |  |  |  |

|  |   |  |  |   |  | 20.01.  |  |  |   |  |  |  |  |   |  |
|--|---|--|--|---|--|---|--|--|---|--|--|--|--|---|--|
| CO1  | Describe the basics of MOS device and CMOS fabrication steps.  K1   |  |  |   |  |   |  |  |   |  |  |  |  |   |  |
| CO2  | Explain CMOS inverter and its switching characteristics.  |  |  |   |  |   |  |  |   |  | К3   |  |  |   |  |
| CO3  | Design of Combinational and Sequential MOS logic circuits.  |  |  |   |  |   |  |  |   |  | K4   |  |  |   |  |
| CO4  | Explain ar  | d design   | dynamic  | c logic ci  | rcuits.  |   |  |  |   |  |  |  | K4   |   |  |
| CO5  |   |  |  |   |  |   |  |  |   |  |  | K  | 4  |   |  |
| CO-PO  | Mapping (S  | cale 1: I  | Low, 2: I  | Medium  | , 3: High  | 1)  |  |  |   |  |  |  |  |   |  |
| CO-PO<br>Mappin  | 1 201   | PO2  | PO3  | PO4   | PO5  | PO6   | PO7  | PO8  | PO9   | PO10   | PO11   | PSO1   | PSO2   | PSO3  |  |
| CO1  | 3   | 3  | 2  | -   | -  | -   | -  | -  | -   | -  | -  | 3  | -  | -   |  |
| CO2  | 3   | 2  | 3  | -   | -  | -   | -  | -  | -   | -  | -  | 3  | -  | -   |  |
| CO3  | 3   | 3  | 2  | -   | -  | -   | -  | -  | -   | -  | -  | 3  | 2  | -   |  |
| CO4  | 3   | 1  | 2  | -   | -  | -   | -  | -  | -   | -  | -  | 3  | -  | 2   |  |
| CO5  | 3   | 3  | 3  | -   | -  | -   | -  | -  | -   | -  | -  | 3  | -  | 2   |  |
|  | Contents / S  | Syllabus   |  | TID !   | T21  | 1.03.6  | 00.6.1   | •  |   |  |  |  |  | ,   |  |
| Module   | sign flow: V  | H OI D   |  |   |  | and CM  |  |  | • •   | D 1 3.5  | 20.5 :   |  |  | hours   |  |
|  | Γ capacitano on Process   |  |  | , The Cl  | MOS n-V  | Vell Proc   | cess,SOI   | •  | tics  |  |  |  | 8  | hours   |  |
| Module 2   |   |  |  | OS inve   |  |   |  |  |   | CXXXX  | *****  |  |  |   |  |
| CMOS in  | nverter: Circ   | uit opera  | tion, DC   | transfe   | characte   | eristics, l   | Noise ma   | argin: ca  | lculation   |  |  |  | n of CMO   | S   |  |
| CMOS ir inverter,  |   | uit opera  | tion, DC   | transfer<br>ce sizing   | characte<br>Switch   | eristics, l<br>ing chara  | Noise ma   | argin: ca  | lculation   |  |  |  | n of CMO   | S   |  |
| CMOS in<br>inverter,<br>design w<br>Module   | nverter: Circ<br>Supply volt<br>ith delay co  | euit opera<br>age scali<br>nstraints,  | ng, Devi<br>Power o  | C transfer<br>ce sizing<br>lissipation<br>bination  | characte<br>Switch<br>on of CM   | eristics, I<br>ing chara<br>IOS inve<br>sequent   | Noise ma<br>acteristic<br>erter.<br>ial MOS  | argin: ca<br>:: Delay t  | lculation<br>time defi  | inition, c   | alculatio  | n of dela  | n of CMO<br>y times, in  | os<br>nverter<br>hours                                    |  |
| CMOS ir<br>inverter,<br>design w<br>Module :<br>Combina<br>OAI gate<br>Sequentia   | nverter: Circ<br>Supply volt<br>ith delay co  | euit opera<br>age scali<br>nstraints,<br>Logic C<br>f Half Ac<br>gic Circu   | ng, Devi<br>Power of<br>Cor<br>ircuits: O  | c transfer<br>ce sizing<br>dissipation<br>nbination<br>Complex<br>I Adder,  | characters. Switch on of CM on al and Logic circum.  | eristics, No ing chara IOS inversequent ircuits de exers, De  | Noise ma<br>acteristic<br>erter.<br>ial MOS<br>esign — Remultiple  | argin: calc: Delay (Since Control Cont | lculation<br>time defi<br>ircuits<br>Boolear<br>ng CMO  | n express  | alculatio  | n of dela  | n of CMO<br>y times, in<br>8<br>S gates, A   | nverter hours OI and                                      |  |
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**Course Name: CMOS Digital Integrated Circuit** 

Course Objectives: The students will learn about the basics of MOS device, CMOS fabrication steps, CMOS characteristics. They will learn to apply the knowledge of basic CMOS cell to implement and design combinational and sequential circuits and will understand the concepts of dynamic CMOS logics and semiconductor memories. Students will also be introduced with the concept of

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Bloom's Knowledge

Level (KL)

 $\mathbf{C}$ 

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**Course Code: BEC0403** 

Course Offered in: B.Tech ECE/VLSI

Pre-requisite: Basis knowledge of MOSFET and Digital Electronics

FPGA implementation of all the logics covered during the full course.

Course Outcome: After completion of the course, the student will be able to

| 3        | "Principles of CMOS VLSI Design" Addison Wesley, Latest Edition.   | Weste and Eshraghian |  |  |  |  |  |  |  |  |
|----------|--|----------------------|--|--|--|--|--|--|--|--|
| Refer    | Reference Books:   |                      |  |  |  |  |  |  |  |  |
| G.M.     | D. 1 790   |                      |  |  |  |  |  |  |  |  |
| S.No     | Book Title   | Author               |  |  |  |  |  |  |  |  |
| 1        | "CMOS VLSI Design".  | Weste and Harris     |  |  |  |  |  |  |  |  |
| 2        | "Essentials of VLSI Testing for digital, memory and mixed-signal VLSI Circuits", Kluwer Academic Publishers. | Bushnell and Agrawal |  |  |  |  |  |  |  |  |
| NPTEL/   | Youtube/ Faculty Video Link:   |                      |  |  |  |  |  |  |  |  |
| Module 1 | https://onlinecourses.nptel.ac.in/noc20_ee29/preview   |                      |  |  |  |  |  |  |  |  |
| Module 2 | https://www.youtube.com/watch?v=MuBiC9yz2fc  |                      |  |  |  |  |  |  |  |  |
| Module 3 | https://nptel.ac.in/courses/108/106/108106158  |                      |  |  |  |  |  |  |  |  |
| Module 4 | https://www.youtube.com/watch?v=UuafwIJAKhY  |                      |  |  |  |  |  |  |  |  |
|          |  |                      |  |  |  |  |  |  |  |  |

Course Offered in: B.Tech ECE/VLSI 3 0 0 3 **Pre-requisite:** Basics of digital electronics Course Objectives: Students will learn about The fundamentals of general microprocessor & microcontroller, The fundamentals of 8086 microprocessor, The architecture of 8051 microcontroller with real time application, The fundamentals of ARM Processor and embedded systems, The knowledge of ARM Instruction Set for programming. **Course Outcome:** After completion of the course, the student will be able to Bloom's Knowledge Level (KL) CO<sub>1</sub> Explain the fundamentals of general microprocessor & microcontroller. K2 CO<sub>2</sub> Explain the fundamentals of 8086 microprocessor. K5 CO<sub>3</sub> Implement 8051 microcontroller for designing various applications. K3 Illustrate the fundamentals of ARM Cortex M0 Processor. **CO4** K4 **CO5** Apply the knowledge of ARM Instruction Set for programming. K4 CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High) PO1 PO2 PO3 COs PO4 | PO5 | PO6 **PO7** PO8 **PO9 PO10** PO11 PSO<sub>1</sub> PSO<sub>2</sub> PSO<sub>3</sub> 3 2 3 2 BEC0402.1 3 1 3 2 3 BEC0402.2 3 1 3 2 3 3 BEC0402.3 3 3 2 2 -\_ 3 3 3 3 BEC0402.4 1 2 2 BEC0402.5 3 3 3 2 2 2 Course Contents / Syllabus Module 1 **Basics of Microprocessor and microcontrollers** 8 hours History and Evolution of Microprocessor and microcontrollers, Computer architecture: Harvard & Von Neumann architecture, RISC & CISC architecture, Different Layers of computer architecture, Buses, types of buses, bus architecture, Microprocessor architecture and its operations, address and data bus Multiplexing and Demultiplexing, Instruction format and size. Module 2 **Introduction to 8086** 8hours Introduction to 8086 - Microprocessor architecture, Pipelining Concept, Memory Segmentation, General Purpose Registers, Pointer and Index Registers, Flag Register, Bus Interface Module, 8086 Pin Description, addressing modes, Instruction set and assembler directives, 8086 Interrupt -Software and Hardware Interrupts. **Introduction to 8051** Module 3 8 hours Overview of the 8051, Inside the 8051, Addressing modes, 8051 data types and directives, Instruction set and assembly language programming of 8051 microcontrollers, Programming the 8051 timers, Interfacing of I/O devices (keypad & display) with 8051. Application of 8051 microcontroller. Module 4 **ARM Processor1** 8 hours Arm Processor Families, Arm Cortex-M Series Family, Cortex-M0 Processor: Cortex-M0 Overview, Cortex-M0 Block Diagram, Cortex-M0 Three-stage Pipeline, Cortex-M0 Registers, Cortex-M0 LR, Cortex-M0 PSRs, Cortex-M0 Memory Map, Cortex-M0 Executable Memory Space, Cortex-M0 Device Memory Space, Cortex-M0 Private Peripheral Bus, Cortex-M0 Reserved Memory Space, Cortex-M0 Memory Map Example, Cortex-M0 Endianness. **ARM Processor2** Thumb Instruction Set, Thumb-2 Instruction Set, Cortex-M0 Instruction Set, Register Access: The Move Instruction, Memory Access: The LOAD Instruction, The STORE Instruction, Stack Access: PUSH and POP, Arithmetic instructions (ADD, SUB, MUL, CMP), Logic Operation, Arithmetic Shift Operation, Logical Shift Operation, Rotate Operation, Reverse Ordering Operation, Sleep Mode Related Instructions, CortexM0 Low Power Features: Sleep Mode, Sleep-on-Exit Feature, How to Enable Sleep Features, Processor Wakeup Conditions, Wakeup Interrupt Controller, Enter and Exit Deep Sleep Mode.

"Microprocessor Architecture, Programming, and Applications with the

8085", 5th Edition, Penram International Publication (India) Pvt. Ltd.

Course Name: Microprocessor & Microcontroller

 $\mathbf{C}$ 

**Total Lecture Hours** 

Author

Ramesh Gaonkar

40 hours

Course Code: BEC0402N

Textbook:

S.No

| 2        | "Microprocessors and Interfacing", Tata McGraw Hill                              | Douglas V. Hall   |  |  |  |
|----------|--|---|--|--|--|
| 3        | "The 8051".  | Mazidi Ali Muhammad, Mazidi Gillispie                                 |  |  |  |
|          |  | Janice, and McKinlay Rolin D  |  |  |  |
| Refe     | rence Books:   |   |  |  |  |
| S.No     | Book Title   | Author  |  |  |  |
| 1        | Microcontroller and Embedded Systems using Assembly and C", Pearson Publication. | Mazidi Ali Muhammad, Mazidi Gillispie<br>Janice, and McKinlay Rolin D |  |  |  |
| 2        | ARM system developers guide, Elsevier, Morgan Kaufman publishers, 2008.          | Andrew N Sloss, Dominic Symes and<br>Chris Wright                     |  |  |  |
| NPTEL/   | Youtube/ Faculty Video Link:   |   |  |  |  |
| Module   | 1 https://www.youtube.com/watch?v=xBYhHC8_A6o                                    |   |  |  |  |
| Module   | 2 https://www.youtube.com/watch?v=cNN_tTXABUA                                    |   |  |  |  |
| Module   | 3 https://www.youtube.com/watch?v=sLW1TptEJBQ                                    |   |  |  |  |
| Module 4 | 4 https://www.youtube.com/watch?v=9zOo4JkZgSI                                    |   |  |  |  |
| Module   | https://www.youtube.com/watch?v=pphUIgjvqJ8                                      |   |  |  |  |
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| robotics  |  |   |  |   |  |  |  |  |  |   |  |  |   |   |   |  |  |
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| СО-РО   | _  |   |  |   |  |  |  |  |  |   |  |  |   |   |   |  |  |
| Mappin  |  | PO1   | PO2  | PO3   | PO4  | PO5  | PO6  | PO7  | PO8  | PO9   | PO10   | PO11   | PSO1  | P                                       | SO <sub>2</sub>   | PS   | <b>O3</b>  |
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| CO3   |  | 3   | 1  | 1   | -  | 2  | 2  | -  | -  | -   | 3  | 2  | 2   |   | 2   | 2  | 2  |
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| CO5   |  | 3   | -  | -   | -  | -  | 2  | -  | -  | _   | 3  | 2  | 2   |   | 2   | 2  | 2  |
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| <b>Module</b><br>Classifica<br>Robot Co   | atio<br>oord   |   |  | vantages<br>ference l   | and Dis  | advanta<br>Program   | ming M   |  |  |   |  |  |   |   | n, Rol<br>Langu   | ot Jo  | ints   |
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| 2        | Robotics, Addison-Wesley, 1986.                             | J.J. Craig                        |
|----------|---|-----------------------------------|
| 3        | Robotics, McGraw Hill, 1987.                                | K.S Fu, R.C. Gonzalez, C.S.G. Lee |
| NPTEL/ Y | outube/ Faculty Video Link:                                 |                                   |
| Module 1 | https://www.youtube.com/watch?v=P_PP76flZfw                 |                                   |
| Module 2 | https://www.youtube.com/watch?v=XOg1KT6xD04&list=PLyqSpQzTF | E6M_XM9cvjLLO_Azt1FkgPhpH&index=5 |
| Module 3 | https://www.youtube.com/watch?v=ksOgvhYdqX8                 |                                   |
| Module 4 | https://www.youtube.com/watch?v=Gc4BiUGiV-Q                 |                                   |
| Module 5 | https://www.youtube.com/watch?v=pSEjWxqE3R0                 |                                   |
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| assembling  |  |  | ncrete co  | omputati  | onal pro   | oblems.   | They  | will acq                               | uire the   | knowled  | ge of var   | rious forn   | ns of lea  | rning a   |  |
| computation   |  |  |  |   |  |   |   |  |  |  |   |  |  |   |  |
| Course Out  | come: A  | fter con   | npletion   | of the co   | ourse, the   | e student   | t will be   | able to                                |  |  |   | Bloom's Knowledge<br>Level (KL)                    |  |   |  |
| CO1   | Elabora  | ate histo  | rical per  | spective  | of AI ar   | nd its fou  | ındation  | s.                                     |  |  |   |  | K1   |   |  |
| CO2   |  |  | es of AI   |   |  |   |   |  | rence the  | ereof.   |   |  | K4   |   |  |
| CO3   |  |  |  |   |  |   |   |  |  |  |   |  | K3   |   |  |
| C <b>O4</b>   | Describe perception, knowledge representation, and different learning techniques.  Implement architecture of knowledge-Based System, Rule-based systems, and other expressions.  |  |  |   |  |   |   |  |  | her expert   |   | K5   |  |   |  |
| CO5   |  |  | nary con   |   |  |   | nd differ   | ent searc                              | ch algori  | thms.  |   |  | K5   |   |  |
| CO-PO Maj   | pping (S   | cale 1:  | Low, 2:  | Mediun  | n, 3: Hig  | gh)   |   |  |  |  |   |  |  |   |  |
| со-ро   | PO1  | PO2  | PO3  | PO4   | PO5  | PO6   | PO7   | PO8                                    | PO9  | PO10   | PO11  | PSO1   | PSO2   | PSO:  |  |
| Mapping   |  |  | 100  |   |  | 100   |   | 100                                    | 2 0 )  |  | 1 0 1 1   |  | 1002   | 1000  |  |
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| CO4   | 3  | 2  | 2  | -   | -  | -   | -   | -                                      | -  | -  | -   | 3  | 3  | -   |  |
| CO5   | 3  | 3  | 3  | 3   | -  | -   | -   | -                                      | -  | -  | -   | 3  | 3  | -   |  |
| Course Con  | tents / S  | yllabus  |  |   |  |   |   |  |  |  |   |  |  |   |  |
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| S.No Book Title Author  1 "Artificial Intelligence", Pearson Education Inc., Third edition. Patrick Henry Winston  2 Python Machine Learning: Learn Python in a Week and Master It. A Hands-On Introduction to Artificial Intelligence Coding, a Project Based Guide with Practical Exercises (7 Days Crash Course, Book2) 2020.  NPTEL/ Youtube/ Faculty Video Link:  Module 1 https://nptel.ac.in/courses/106102220  Module 2 https://nptel.ac.in/courses/106102220  Module 3 https://nptel.ac.in/courses/106102220  Module 4 https://nptel.ac.in/courses/106102220  Module 5 https://nptel.ac.in/courses/106102220 | Referen   | ce Books:   |                              |
|---|-----------|---|------------------------------|
| Python Machine Learning: Learn Python in a Week and Master It. A Hands-On Introduction to Artificial Intelligence Coding, a Project Based Guide with Practical Exercises (7 Days Crash Course, Book2) 2020.  NPTEL/ Youtube/ Faculty Video Link:  Module 1 https://nptel.ac.in/courses/106102220  Module 2 https://nptel.ac.in/courses/106102220  Module 3 https://nptel.ac.in/courses/106102220  Module 4 https://nptel.ac.in/courses/106102220  | S.No      | Book Title  | Author                       |
| Hands-On Introduction to Artificial Intelligence Coding, a Project Based Guide with Practical Exercises (7 Days Crash Course, Book2) 2020.  NPTEL/ Youtube/ Faculty Video Link:  Module 1 https://nptel.ac.in/courses/106102220  Module 2 https://nptel.ac.in/courses/106102220  Module 3 https://nptel.ac.in/courses/106102220  Module 4 https://nptel.ac.in/courses/106102220   | 1         | "Artificial Intelligence", Pearson Education Inc., Third edition.   | Patrick Henry Winston        |
| Module 1 https://nptel.ac.in/courses/106102220  Module 2 https://nptel.ac.in/courses/106102220  Module 3 https://nptel.ac.in/courses/106102220  Module 4 https://nptel.ac.in/courses/106102220  | 2         | Hands-On Introduction to Artificial Intelligence Coding, a Project<br>Based Guide with Practical Exercises (7 Days Crash Course, Book2) | Computer programming Academy |
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|   | Module 5  | https://nptel.ac.in/courses/106102220   |                              |

| <b>Course Code: BEC0</b>  | 413   |   |  |   | Cour   | se Nam  | e: VLS   | I Techn   | ology  |  | I   | . T                              | P   | C   |
|---|---|---|--|---|--|---|--|---|--|--|---|----------------------------------|---|---|
| Course Offered in: B  | .Tech   |   |  |   |  |   |  |   |  |  | 3   | 3 0                              | 0   | 3   |
| Pre-requisite: Basic l  | knowled   | lge of S  | emicond  | luctor d  | levices  |   |  |   |  |  | •   | •                                | •   | •   |
| Course Objectives:  | This co   | ourse p   | rovides  | an inti   | oductio  | n to the  | e princ  | iples an  | d proce  | esses of   | microfab  | rication,                        | with a f  | ocus on   |
| semiconductor materi  | als and   | devices   | . Studei   | nts will  | learn a  | bout the  | e key st   | eps in 1  | microfat   | rication,  | such as   | photolith                        | ography,  | etching   |
| deposition, and diffusi   | on. The   | y will al   | so learn   | about t   | he prope   | erties of   | semico   | ductor  | material   | s and hov  | v they are  | used to f                        | abricate e  | lectronic   |
| devices.  |   |   |  |   |  |   |  |   |  |  |   |                                  |   |   |
| Course Outcome: Af  | ter com   | pletion   | of the co  | ourse, tl   | ne stude   | nt will b   | e able t   | 0   |  |  | Bloom   | 's Knowl                         | edge Lev  | el (KL)   |
| CO1   |   |   |  |   | asic prin  |   |  |   |  |  |   | ]                                | K4  |   |
| CO2   |   |   |  |   | ment mi  |   |  |   |  |  |   |                                  | K3  |   |
| CO3   |   |   |  |   | conduct  |   |  |   |  |  |   | ]                                | K4  |   |
| CO4   |   | _   | pply m<br>vices.   | icrofab   | rication   | techni  | ques t   | o fabri   | cate el  | ectronic   |   | ]                                | K3  |   |
| CO5   |   |   |  |   | ssues in   | volved i  | n the fa   | bricatio  | n proces   | SS.  |   | ]                                | K4  |   |
| CO-PO Mapping (So   | ale 1: I  | Low, 2:   | Mediun   | n, 3: H   | igh)   |   |  |   |  |  |   |                                  |   |   |
| CO-PO Mapping   | PO1   | PO2   | PO3  | PO4   | PO5  | PO6   | PO7  | PO8   | PO9  | PO10   | PO11  | PSO1                             | PSO2  | PSO3  |
| BEC0413.1   | 3   | 2   | 1  | 2   | 2  | 1   | 2  | 1   | -  | 2  | 1   | 2                                | 3   | 2   |
| BEC0413.2   | 3   | 2   | 3  | 2   | 3  | 2   | 2  | 2   | 1  | 2  | 2   | 3                                | 3   | 2   |
| BEC0413.3   | 3   | 2   | 2  | 3   | 3  | 2   | 1  | 1   | -  | 1  | 1   | 2                                | 3   | 2   |
| BEC0413.4   | 3   | 2   | 3  | 3   | 3  | 2   | 2  | 2   | 1  | 2  | 2   | 2                                | 3   | 2   |
| BEC0413.5   | 2   | 1   | 1  | 1   | 2  | 3   | 3  | 2   | 1  | 1  | 1   | 2                                | 2   | 2   |
| Course Contents / Sy  | llabus  |   |  |   |  | ·   |  |   | •  |  | •   |                                  |   | •   |
|   |   |   |  |   |  |   |  |   |  |  |   |                                  |   |   |
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| 2                         | Fundamentals of microfabrication (2nd ed.).<br>Boca Raton,FL: CRC Press. (2002).                      | Madou, M. J.   |
|---------------------------|---|--|
| 3                         | Introduction to microelectronic fabrication (2nd ed.). Upper Saddle River, NJ: Prentice Hall. (2002). | Jaeger, R. C.  |
| 4                         | Physics of semiconductor devices (3rd ed.).<br>Hoboken, NJ: Wiley. (2006).                            | Sze, S. M., & Kwok, K. N.  |
| NPTEL/ Youtube/ Faculty V | Video Link:   |  |
| Module 1                  | https://archive.nptel.ac.in/noc/courses/noc15/SI  | EM1/noc15-ec02/  |
| Module 2                  | wNncTEEcG9zAzEEdnRpZAMEc2VjA3Bpdn   | lt=AwrjbCfLAhtoPicCgpRXNyoA;_ylu=Y29sb<br>M-?p=VLSI+Technology&fr2=piv-<br>vid=5e694387d34857a70efe44d25f2595c7&actio  |
| Module 3                  | wNncTEEcG9zAzEEdnRpZAMEc2VjA3Bpdn   | rlt=AwrjbCfLAhtoPicCgpRXNyoA;_ylu=Y29sb<br>M-?p=VLSI+Technology&fr2=piv-<br>&vid=5fa3bdf0373ac3724665542bdfb6fb3d&acti |
| Module 4                  | https://nptel.ac.in/courses/117101106   |  |
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| Course Co              | ode: BAS              | 0403                   |            |             | Course      | Name: A    | Advance    | ed Engin    | eering N  | <b>Tathema</b> | tics       |          | L      | Т               | P        | С      |
|------------------------|-----------------------|------------------------|------------|-------------|-------------|------------|------------|-------------|-----------|----------------|------------|----------|--------|-----------------|----------|--------|
| Course O               | ffered in:            | B.Tech.                |            | <u> </u>    |             |            |            |             |           |                |            |          | 3      | 1               | 0        | 4      |
| Pre-requi              | site: B.Te            | ch 1st ve              | ear        |             |             |            |            |             |           |                |            | <u>l</u> |        |                 |          |        |
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| and Fourie             | er Transfo            | rm. It ain             | ns to sho  | w case t    | he stude    | nts with   | standard   | concept     | s and to  | ols from       | B. Tech    | to deal  | with   | adva            | nced     | level  |
| of mathem              | atics and             | application            | ons that v | would be    | essentia    | al for the | ir discipl | lines.      |           |                |            |          |        |                 |          |        |
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|                        |                       |                        |            |             |             |            |            |             |           |                |            |          | Leve   | el (KL          | .)       |        |
|                        | Apply the             |                        |            |             |             |            |            |             |           |                |            |          |        | K               | [3       |        |
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|                        | Apply the of definite |                        |            | olex func   | tions for   | finding    | l aylor's  | series, L   | aurent's  | series ar      | id evalua  | ation    |        | K               | [3       |        |
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| CO-PO M                |                       |                        |            |             |             |            | meering    | proorem     | ·         |                |            | l .      |        |                 |          |        |
| СО-РО                  |                       |                        |            |             |             | Ĺ          |            |             |           |                |            |          |        |                 |          |        |
| Mapping                | PO1                   | PO2                    | PO3        | PO4         | PO5         | PO6        | PO7        | PO8         | PO9       | PO10           | PO11       | PSO1     | P      | SO <sub>2</sub> | PS       | SO3    |
| CO1                    | 3                     | 2                      | 2          | 3           | 1           | 1          | -          | 1           | 2         | 2              | 2          | 2        |        | 1               |          | -      |
| CO2                    | 3                     | 2                      | 2          | 3           | 1           | 1          | _          | 1           | 2         | 2              | 2          | 2        |        | 1               | +        | _      |
|                        |                       |                        |            |             |             |            |            |             |           |                |            |          |        |                 | -        |        |
| CO3                    | 3                     | 2                      | 1          | 2           | -           | -          | -          | -           | 1         | 1              | 1          | 2        |        | 1               |          | -      |
| CO4                    | 3                     | 2                      | 2          | 3           | -           | -          | -          | -           | 2         | 1              | 1          | 2        |        | 1               |          | -      |
| CO5                    | 3                     | 2                      | 2          | 3           | 1           | -          | -          | -           | 2         | 1              | 1          | 2        |        | 1               |          | -      |
| Course Co              | ontents / S           | Syllabus               |            |             |             |            |            |             |           |                |            |          |        |                 |          |        |
| Module 1               |                       |                        | Sta        | tistical T  | echniqu'    | ıes-I      |            |             |           |                |            |          |        |                 | 3 hou    | rs     |
|                        |                       |                        |            |             |             |            |            | ~           |           |                |            |          |        |                 | ~-       |        |
| Introduction Kurtosis. | on: Measu             | ires of c              | entral te  | ndency:     | Mean,       | Median,    | Mode,      | Standard    | deviati   | on, Quar       | tile dev   | iation,  | Mon    | nent,           | Skew     | ness,  |
| Module 2               |                       |                        | Rat        | ndom Va     | riables     | and dist   | ribution   | <u> </u>    |           |                |            |          |        |                 | 10 ho    | urs    |
| Random V               | /ariable: Γ           | )efinition             |            |             |             |            |            |             | Contin    | none Rai       | ndom Vs    | riable   | Evn    |                 |          |        |
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| Module 3               |                       |                        |            | nplex Va    |             |            |            |             |           |                |            |          |        |                 | 10 ho    | urs    |
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| Methods o              | f finding i           | esidues,               |            |             |             |            |            |             |           |                |            |          |        |                 | 10.1     |        |
| Module 5               |                       | -                      |            | egral Tra   |             |            |            |             |           |                |            |          |        |                 | 10 ho    | urs    |
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| m 41 1                 |                       |                        |            |             |             |            |            |             |           |                | Total L    | ecture   | Hou    | ırs 4           | 48 ho    | urs    |
| Textbook               |                       | <b>4</b> 10            |            |             |             |            |            |             |           | A 41:          |            |          |        |                 |          |        |
| S.No                   | Book Ti               |                        | inace!     | Mo41- · · · | tion III    | ,          |            |             |           | Autho          |            |          |        |                 |          |        |
| 1                      |                       | k of Engi              |            |             |             |            |            |             |           | Bali, N        |            |          |        |                 |          |        |
| 2                      |                       | ed engine              |            |             | S           |            |            |             |           | Jain, F        |            |          |        |                 |          |        |
| 3                      | _                     | ngineerii<br>al methoo |            | maucs       |             |            |            |             |           | Grewa          |            |          |        |                 |          |        |
| 5                      |                       |                        |            | thomati-    | 90          |            |            |             |           | Gupta          |            | S C-     |        |                 |          |        |
| Reference              |                       | ed engine              | ering ma   | шетанс      | 3           |            |            |             |           | ZILL,          | DENNI      | o U.     |        |                 |          |        |
| Keierence              | DUUKS:                |                        |            |             |             |            |            |             |           |                |            |          |        |                 |          |        |
| S.No                   | Book Ti               | tle                    |            |             |             |            |            |             |           | Autho          | r          |          |        |                 |          |        |
| 501 10                 | DOOK 11               |                        |            |             |             |            |            |             |           | 1144110        |            |          |        |                 |          |        |

| 1        | Introduction to Probability Models   | Ross, Sheldon M      |
|----------|--|----------------------|
| 2        | Probability, Random Variables and Stochastic Processes   | Papoulis, Athanasios |
| 3        | Advanced engineering mathematics   | Kreyszig, E.         |
| NPTEL/   | Youtube/ Faculty Video Link:   |                      |
| Module 1 | https://youtu.be/1MiT06JFNo4?si=zVH-5AdAeu7Qcs9x<br>https://youtu.be/6lQn1hdG43o?si=2WJXQHXJE-ByAghk<br>https://archive.nptel.ac.in/courses/110/107/110107114/ |                      |
| Module 2 | https://archive.nptel.ac.in/courses/111/104/111104032/   |                      |
| Module 3 | https://archive.nptel.ac.in/courses/111/107/111107056/   |                      |
| Module 4 | https://archive.nptel.ac.in/courses/111/103/111103070/   |                      |
| Module 5 | NPTEL :: Mathematics - NOC:Integral Transforms And Their Ap  | pplications          |
|          |  |                      |

| LAB Cou          | <mark>rse Code:</mark> | BEC04     | 52         |           | LAB Co            | ourse Na   | me: Mi     | <mark>croproc</mark> | essor &   | Microco     | ntroller  | Lab   | L     | Т       | P      | С          |
|------------------|------------------------|-----------|------------|-----------|-------------------|------------|------------|----------------------|-----------|-------------|-----------|-------|-------|---------|--------|------------|
| Course O         | ffered in:             | B.Tech    | ECE/VI     | SI        |                   |            |            |                      |           |             |           |       | 0     | 0       | 4      | 2          |
| Pre-requi        | site: Basic            | Knowle    | edge of n  | nicroproc | cessor an         | d micro    | controlle  | r                    |           |             |           |       |       |         |        |            |
| Course O         | bjectives:             |           |            | •         |                   |            |            |                      |           |             |           |       |       |         |        |            |
| 8086 Micr        |                        |           |            |           |                   |            |            |                      |           | oller for g | generatin | g wav | eforn | ns, Int | erfaci | ing o      |
| various I/O      |                        |           |            |           |                   |            |            |                      | m.        |             |           |       |       |         |        |            |
| Course O         | utcome: A              | After con | npletion ( | of the co | urse, the         | student    | will be a  | ble to               |           |             |           |       | Bloo  | m's k   | Cnow   | ledge      |
|                  |                        |           |            |           |                   |            |            |                      |           |             |           |       | Leve  | el (KL  | .)     |            |
| CO1              | Apply th               | e knowle  | edge of 8  | 3086 Mic  | roproces          | ssor for v | vriting as | ssembly              | level lan | guage.      |           |       |       | K       | [3     |            |
| CO2              | Analyze                |           |            |           |                   |            |            |                      |           |             |           |       |       | K       | [4     |            |
| CO3              | Impleme                |           |            |           |                   |            |            |                      |           |             |           |       |       |         | 6      |            |
| CO4              |                        |           |            |           |                   |            | rite the p | rogram f             | for given | applicati   | ion.      |       |       | K       | [3     |            |
| CO-PO M          | lapping (S             | Scale 1:  | Low, 2:    | Medium    | , <b>3: Hig</b> l | <u>h)</u>  |            |                      |           | _           |           |       |       |         |        |            |
| CO-PO<br>Mapping | PO1                    | PO2       | PO3        | PO4       | PO5               | PO6        | PO7        | PO8                  | PO9       | PO10        | PO11      | PSO   | 1   I | SO2     | PS     | <b>SO3</b> |
| CO1              | 3                      | 3         | 3          | -         | 3                 | -          | -          | -                    | -         | -           | -         | 3     |       | 3       |        | 2          |
| CO2              | 3                      | 3         | 3          | -         | 3                 | -          | -          | -                    | -         | -           | -         | 3     |       | 3       |        | 2          |
| CO3              | 3                      | 3         | 3          | -         | 3                 | -          | -          | -                    | -         | -           | -         | 3     |       | 3       |        | 2          |
| CO4              | 3                      | 3         | 3          | -         | 3                 | -          | -          | -                    | -         | -           | -         | 3     |       | 3       |        | 2          |
|                  |                        |           |            |           |                   |            |            |                      |           |             |           |       |       |         |        |            |
| List of Pr       | actical's (            | Indicati  | ve & No    | t Limite  | d To)             |            |            |                      |           |             |           |       |       |         |        |            |
| Module 2         | To study               | 8086 m    | icroproce  | essor sys | tem.              |            |            |                      |           |             |           |       |       |         | C      | O2         |
| Module 2         | Write a p              | orogram   | using 80   | 86 Micro  | processo          | or for He  | exadecim   | al additi            | on of tw  | o 8-bit N   | umbers.   |       |       |         | C      | O2         |
| Module 2         | Write a p              | orogram   | using 80   | 86 Micro  | processo          | or for He  | exadecim   | al subtra            | ection of | two 8-bi    | t Numbe   | rs.   |       |         | C      | O2         |
| Module 2         | Write a p              | orogram   | using 80   | 86 Micro  | processo          | or for He  | exadecim   | al additi            | on of tw  | o 16-bit 1  | Numbers   |       |       |         | C      | O2         |
| Module 2         | Write a p              | orogram   | using 80   | 86 Micro  | processo          | or for He  | exadecim   | al subtra            | action of | two 16-b    | oit Numb  | ers.  |       |         | C      | O2         |
| Module 2         | Write a p              | orogram   | using 80   | 86 Micro  | processo          | or for ad  | dition of  | two BC               | D numbe   | ers.        |           | _     |       |         | C      | O2         |

CO2

CO2

CO2

CO2

CO2

CO2

CO<sub>2</sub>

CO2

CO<sub>2</sub>

CO3

Write a program using 8086 Microprocessor for subtraction of two BCD numbers.

To find the smallest number in an array of data using 8086 instructions set.

To find the largest number in an array of data using 8086 instructions set.

To write a program to arrange an array of data in ascending order using 8086.

To write a program to arrange an array of data in descending order using 8086.

To convert given ASCII number in to its equivalent Hexadecimal number using 8086 instructions set.

To convert given Hexadecimal number in to its equivalent ASCII number using 8086 instructions set.

Write a program to find smallest and largest number in the array using 8051 microcontroller.

To perform multiplication of two 8-bit numbers using 8086.

To perform division of two 8-bit numbers using 8086.

Module

2 Module

2 Module

Module

2 Module

2 Module

2 Module

2 Module

2 Module

Module

3

| Module 3 Write a program to arrange numbers in ascending and descending order using 8051 microcontrolle   | er. CO3              |
|---|----------------------|
|   |                      |
| Module  3 Write a program to find addition and subtraction of two 8 bit numbers using 8051 microcontroller.   | : СОЗ                |
| Module 3 Write a program to find multiplication and division of two 8 bit numbers using 8051 microcontrol   | ller. CO3            |
| Module 3 Write a program to square of a 8 bit numbers using 8051 microcontroller.   | CO3                  |
| Module 3 Write a program to cube of a 8 bit numbers using 8051 microcontroller.   | CO3                  |
| Module 3 Write a program of flashing LED connected to port of the 8051 microcontroller.   | CO3                  |
| Module 3 Write a program to generate 10 kHz square wave using 8051 microcontroller.   | CO3                  |
| Module 3 Write a program to generate a Ramp waveform of 1 KHz using DAC with 8051 micro controller.   | CO3                  |
| Module 3 Write a program to show the use of INT0 and INT1 of 8051 microcontrollers.   | CO3                  |
| Module Interfacing of sensors and display devices like Serial Communication Code, Bluetooth, seven seg with 8051 microcontrollers.  | gments CO3           |
| Module 3 Interfacing of Relay & Stepper Motor with 8051 microcontrollers.   | CO3                  |
| Module 4 Write and simulate a program for data transfer using ARM freedom board.  | CO4                  |
| Module 4 Write and simulate a program for arithmetic operations using ARM freedom board.  | CO4                  |
| Module 4 Write and simulate a program for logical operations using ARM freedom board.   | CO4                  |
| Module Write a program for Interfacing of temperature sensor with ARM freedom board (or any other AR microprocessor board) and display object temperature on LCD.   | CO4                  |
| Module 4 Write an embedded C program to blink the LED with time delay intervals using LPC2148 ARM microcontroller.  | CO4                  |
| Module Write an embedded C program to read switch status and display in LED using LPC2148 ARM microcontroller.  | CO4                  |
| Module Write an embedded C program to ON/OFF buzzer with time delay intervals using LPC2148 ARM microcontroller.  | 1 CO5                |
| Module 5 Write an embedded C program generate a square wave using internal 10 bit DAC using LPC2148 microcontroller.  | ARM CO5              |
| Module Write an embedded C program generate a triangular wave using internal 10 bit DAC using LPC21 microcontroller.  | 148 ARM CO5          |
| Module 5 Write an embedded C program generate a PWM waveform using LPC2148 ARM microcontroller.   | CO5                  |
| Module 5 Write an embedded C program to transmit and receive data from PC using UART serial port using ARM microcontroller.   | g LPC2148 CO5        |
| Module 5 Write an embedded C program to read on-chip ADC value of temperature sensor LM35 and displaterminal using UART1 using LPC2148 ARM microcontroller.   | ay in hyper CO5      |
| Module  Write an embedded C program to read the external interrupts INT1 and INT2 and display in hyper using UART1 using LPC2148 ARM microcontroller.   | r-terminal CO5       |
| Module 5 Write an embedded C program to toggle relays with delay intervals using LPC2148 ARM microcol  The string CART I using LI C2148 ARM microcol  The string CART | ontroller. CO5       |
| Module 5 Write an embedded C program to control the stepper motor using LPC2148 ARM microcontroller   | r. CO5               |
|   | Total Hours: 40 hrs. |
|   |                      |

| LAB Course C              | Code: B       | EC045               | 51N                   |                       | LAB (<br>Lab          | Course               | Name:               | Analo                | g and l | Digital ( | Commun     | ication    | L                       | T         | P     | C        |
|---------------------------|---------------|---------------------|-----------------------|-----------------------|-----------------------|----------------------|---------------------|----------------------|---------|-----------|------------|------------|-------------------------|-----------|-------|----------|
| Course Offere             | d in: B       | .Tech               |                       | <u> </u>              |                       |                      |                     |                      |         |           |            |            | 0                       | 0         | 2     | 1        |
| Pre-requisite:            | Basic k       | nowled              | dge of a              | nalog a               | nd digit              | tal com              | munica              | tion co              | ncepts  |           |            |            |                         | •         |       |          |
| Course Object             |               |                     |                       |                       |                       |                      |                     |                      |         |           |            |            |                         |           |       |          |
| Amplitude mod             |               |                     |                       |                       |                       |                      |                     |                      |         |           |            |            |                         |           |       |          |
| converters like           |               |                     |                       |                       |                       |                      |                     |                      |         |           |            |            |                         |           |       |          |
| communication software.   | systen        | n and v             | arious b              | and-pa                | ss digit              | al modi              | ilation             | technic              | ues, Ir | ne simula | ation of c | convoluti  | onal codi               | ing using | MAI   | .LAI     |
| Course Outco              | me: Af        | ter com             | pletion               | of the c              | ourse,                | the stud             | ent wil             | l be ab              | e to    |           |            |            | Bloom                   | 's Know   | ledge |          |
| CO1                       |               | onstrate<br>modula  | -                     | rform a               | mplitu                | de mod               | ulation             | (AM),                | frequer | ncy mod   | ulation (  | FM) and    |                         | K3        |       |          |
| CO2                       | Demo          | onstrate            | and per               | rform P               | ulse Co               | ode Mo               | dulation            | ı (PCM               | [).     |           |            |            |                         | K4        |       |          |
| CO3                       |               |                     | decode (              |                       |                       |                      | ent data            | ı forma              | ts.     |           |            |            |                         | K3        |       |          |
| CO4                       |               |                     | ital mod              |                       |                       |                      |                     |                      |         |           |            |            |                         | K4        |       |          |
| CO5                       |               |                     | volution              |                       |                       |                      | AB.                 |                      |         |           |            |            |                         | K4        |       |          |
| CO-PO Mapp                | ing (Sc       | ale 1: l            | Low, 2:               | Mediu                 | m, 3: F               | Iigh)                | ı                   |                      | 1       | 1         | 1          | ı          | Ι                       | T         |       |          |
| CO-PO<br>Mapping          |               |                     | PO3                   |                       | PO5                   | PO6                  | PO7                 | PO8                  | PO9     | PO10      | PO11       | PO12       | PSO 1                   | PSO 2     | P     | SO 3     |
| AEC 0451.1                | 3             | 2                   | 1                     | 2                     | -                     | -                    | -                   | -                    | -       | -         | -          | 3          | 2                       | 2         | -     | 1        |
| AEC 0451.2                | 3             | 2                   | 1                     | 2                     | -                     | -                    | -                   | -                    | -       | -         | -          | 3          | 2                       | 2         |       | 1        |
| AEC 0451.3<br>AEC 0451.4  | 3             | 2 2                 | 1                     | 2                     | -                     | -                    | -                   | -                    | -       | -         | -          | 3          | 2                       | 2         |       | 1        |
| AEC 0451.4<br>AEC 0451.5  | 3             | 2                   | 1                     | 2                     | -                     | -                    | -                   | -                    | -       | -         | -          | 3          | 2 2                     | 2 2       | -     | 1        |
| List of Practic  Module 1 | Demo          | onstrate<br>diode   | e amplitu<br>detector | ide mo                | dulation<br>nodulat   | n by usi<br>ing freq | uency               | $f_{\mathbf{m}} = 1$ | KHz - 3 | 3 KHz aı  | nd carrie  | r frequen  | tion by us              | 0         | CC    | <br>D1   |
|                           | and T<br>Demo | ransmi<br>onstrate  | tted Pover            | ver (Pt)              | dulatio               | n and de             | emodul              | ation (ı             | sing PI | LL 565)   | with mod   | dulating t | Power (F                | fm        |       |          |
| Module 1  Module 2        | frequ         | ency de             | eviation              | (iii)Mo               | dulatio               | n index              | (β).                |                      |         |           |            |            | Determine ulation wi    |           | CC    | )1<br>—— |
| Module 2                  | modu          | lating 1            | frequenc              | y fm=                 | 80 KH                 | z.                   |                     |                      |         |           |            |            | ZZ & NRZ                |           | CC    |          |
| Module 2                  | Line          | Coding              | <u>.</u>              |                       | -                     |                      |                     | •                    |         |           |            | -          | & NRZ Li                |           | CC    |          |
| Module 2                  | Codin         | ıg.                 |                       |                       | •                     |                      |                     | •                    |         |           |            |            | r line cod              |           | CC    |          |
|                           | techn         |                     |                       |                       | 1                     |                      |                     | 1                    |         |           |            |            |                         | 8         | CC    | 12       |
| Module 2                  | 1010<br>Deter | 1010 w<br>mine E    | ith carri<br>Energy p | er frequ<br>er bit (I | iency fo<br>Eb) (iii) | c = 20  k Bandw      | :Hz – 1<br>vidth (B | MHz. (<br>W)         | i) Draw | v and obs | serve its  |            | aveform (               |           | CC    | )2       |
| Module 2                  | with o        | carrier<br>(iii) Ba | frequence<br>ndwidth  | ey fc = (BW)          | 940Hz.<br>for FSI     | (i) Dra              | w its ou            | ıtput w              | aveforn | n (ii) De | termine l  | Energy p   | nal 10101<br>er bit (Eb | ) for     | CC    | )2       |
| Module 2                  | carrie        | r frequ             |                       | = 1.44N               | ИНz. (i               | ) Draw               |                     |                      |         |           |            |            | 0101010<br>bit (Eb) f   |           | CC    | )2       |

Demonstrate Quadrature Phase Shift Keying (QPSK) modulator and demodulator for message signal

10101010 with carrier frequency fc = 960kHz. (i) Draw its output waveform (ii) Determine Energy per bit (Eb) for QPSK (iii) Bandwidth (BW) for QPSK

Calculation of BER of BASK using MATLAB.

CO2

CO3

Module 2

Module 3

| Module 3 | Calculation of BER of BFSK using MATLAB.   | CO3            |
|----------|--|----------------|
| Module 3 | Calculation of BER of BPSK using MATLAB.   | CO3            |
| Module 4 | Perform Huffman Coding for given symbols using MATLAB and calculate efficiency.                      | CO4            |
| Module 4 | Perform encoder of (7, 4) Hamming code using MATLAB  | CO4            |
| Module 5 | Analysis and performance evaluation of convolutional codes using MATLAB for message code = [1 0 1 1] | CO5            |
|          | Total H  | lours: 40 hrs. |
|          |  |                |

| LAB C  | B Course : Code BEC0455  LAB Course Name: Verilog-HDL (Departmental Workshop II) |                       |                |                |                         |           | T      | P                 | C |  |  |  |
|--|--|-----------------------|----------------|----------------|-------------------------|-----------|--------|-------------------|---|--|--|--|
| Course   | Offered in: VLSI   |                       |                |                |                         | 0         | 0      | 6                 | 3 |  |  |  |
| Pre-rec  | quisite: Hardware coding language  | <del>)</del>          |                |                |                         |           |        |                   |   |  |  |  |
| Course   | Objectives: The course will intro  | duce the participa    | nts to the ver | ilog hardwar   | e description language. | It will h | elp th | em to             | 1 |  |  |  |
| learn va   | arious digital circuit modeling issu   | es using verilog, w   | riting test be | nches, and so  | ome case studies.       |           | _      |                   |   |  |  |  |
| <b>Course Outcome:</b> After completion of the course, the student will be able to |  |                       |                |                |                         |           |        | Bloom's Knowledge |   |  |  |  |
|  |  |                       |                |                |                         | Leve      | el (KL | ر)                |   |  |  |  |
| CO1  | Develop and identify the suitab  | le abstraction level  | for a particu  | lar digital de | sign                    |           | K3     |                   |   |  |  |  |
| CO2  | Develop verilog codes in gate,   | dataflow (RTL) mo     | deling level   | of abstraction | on.                     |           | K3     |                   |   |  |  |  |
| CO3  | Develop verilog codes in behav   | ioral (RTL) model     | ing levels of  | abstraction    |                         |           | K4     |                   |   |  |  |  |
| CO4  | Design and verify the functional   | lity of digital circu | it/system usi  | ng test bench  | nes                     |           | K4     |                   |   |  |  |  |
| CO5  | Design and simulate basic modules using switch level modeling.  K5               |                       |                |                |                         |           |        |                   |   |  |  |  |
|  | Mapping (Scale 1: Low, 2: Med  |                       | <u> </u>       | D              |                         |           |        |                   |   |  |  |  |

| CO-PO<br>Mapping | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1              | 3   | 2   | 2   | -   | 3   | -   | -   | -   | -   | 2    | 1    | 3    | -    | 2    |
| CO2              | 3   | 3   | 2   | -   | 3   | -   | -   | -   | -   | 2    | 1    | 3    | -    | -    |
| CO3              | 3   | 2   | 2   | -   | 3   | -   | -   | -   | -   | 2    | 1    | 3    | 2    | -    |
| CO4              | 3   | 2   | -   | -   | 3   | -   | -   | -   | -   | 2    | 1    | 3    | -    | 2    |
| CO5              | 2   | 3   | 2   | -   | 2   | -   | -   | -   | -   | 2    | 1    | 3    | -    | 2    |

| Evolution of CAD, emergence of HDLs, typical HDL-flow, trends in HDLs, Verilog vs VHDL, Verilog oding vs Software Programming.  Cop-down and bottom-up design methodology, differences between modules and module instances, parts of simulation, design block, stimulus block.  Lexical conventions, data types: value set, registers, vectors, arrays, strings, system tasks, compiler lirectives.  Module definition, port declaration, connecting ports, hierarchical name referencing  Modeling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays.  Continuous assignments, delay specification, expressions, operators, operands, operator types. | 15 Hour  |
|---|--|
| off delays, min, max, and typical delays.   |  |
| continuous assignments, detay specification, expressions, operators, operator types.  |  |
| Structured procedures, initial and always, blocking and non-blocking statements, delay control, generate statement, event control, conditional statements, Multiway branching, loops, sequential and parallel blocks.   | 20 11  |
| Timing and Delays, Switch-Level Modeling, Logic Synthesis with Verilog HDL, Specify block and Timing checks, Verification and Writing test benches, Timing Analysis of Logic circuits, Downloading of verilog code in FPGA and CPLD.  |  |
| Concept of switch level abstraction, MOS Transistor as Switch, Modeling NMOS and PMOS transistors as switches in Verilog, Switch ON/OFF conditions and control signals, Verilog Switch-Level Primitives, Understanding Verilog switch primitives: nmos, pmos, Syntax and usage of switch primitives in Verilog code.  | 20 Hour  |
| Fin<br>Co<br>Mo<br>Sw   | ming and Delays, Switch-Level Modeling, Logic Synthesis with Verilog HDL, Specify block and Timing ecks, Verification and Writing test benches, Timing Analysis of Logic circuits, Downloading of verilog de in FPGA and CPLD. Incept of switch level abstraction, MOS Transistor as Switch, odeling NMOS and PMOS transistors as switches in Verilog, witch ON/OFF conditions and control signals, Verilog Switch-Level Primitives, Understanding Verilog |

| Lab<br>No. |   | Program Logic Building   | CO<br>Mapping |
|------------|---|--|---------------|
| 1          | Simulate and synthesize f a) AND Gate b) OR Gate c) NOT Gate d) EX-OR Gate e) NAND Gate f) NOR Gate   | ollowing logic gates using gate level modeling   | CO1           |
| 2          | Simulate and synthesize f a) Half adder b) Full adder c) Half subtractor d) Full subtractor e) 4:1 Multiplexer f) 4:2 Encoder g) 1:4 Demultiplexer h) 2:4 Decoder i) 1 Bit Comparator j) 2*2 Bit Multiplier | ollowing combinational circuits using gate level modeling  | CO2           |
| 3          |   | size binary to gray code converter using gate level modeling.  size gray to binary code converter using gate level modeling. | CO 2          |
| 4          | a) Half adder b) Full adder c) Half subtractor d) Full subtractor e) 4:1 Multiplexer f) 4:2 Encoder g) 1:4 Demultiplexer h) 2:4 Decoder i) 1 Bit Comparator j) 2*2 Bit Multiplier                           | ollowing combinational circuits using data flow modeling   | CO 2          |
| 5          |   | bit parallel adder/subtractor using data flow modeling.  | CO 2          |
| 6          | OPCODE  1. 2. 3. 4.   | ALU Operation  A+B  A-B  A Complement  A*B   | CO 2          |
| 7          |   | size binary to gray code converter using data flow modeling. size gray to binary code converter using data flow modeling.    | CO 2          |
| 8          | Simulate and synthesize f a) SR Flip Flop b) JK Flip Flop c) D Flip Flop T Flip Flop  | ollowing flip flops using behavioral modeling  | СОЗ           |
| 9          | Simulate and synthesize f a) Using positive edge  | lip flops using behavioral modeling and negative edge. nd asynchronous reset   | CO3           |

| 10 | Simulate and synthesize following shift registers using behavioral modeling          |           |
|----|--|-----------|
|    | a) Serial input serial output  |           |
|    | b) Serial input parallel output  | CO3       |
|    | c) Parallel input serial output  |           |
| 11 | d) Parallel input parallel output  |           |
| 11 | Simulate and synthesize following universal shift register using behavioral modeling | CO3       |
| 12 | Simulate and synthesize following counters using behavioral modeling                 |           |
|    | a) 2 Bit Counter   |           |
|    | b) Mod 5 Counter   | CO3       |
|    | c) Decade Counter  |           |
|    | d) Ring Counter  |           |
| 10 | e) Johnson Counter   |           |
| 13 | Simulate and synthesize array multiplier using behavioral modeling                   | CO3       |
| 14 | Simulate and synthesize 4:1 MUX by using 2:1 MUX                                     |           |
|    | a) Using a wire  | CO3       |
|    | b) Using a reg   |           |
| 15 | Simulate and synthesize Moore sequence   | COA       |
|    | a) 1010<br>b) 1011   | CO3       |
| 16 | Simulate and synthesize Mealy sequence   |           |
| 10 | a) 1010  | CO3       |
|    | b) 1011  |           |
| 17 | Implementation of logic gates on an FPGA and verify gates functionality.             | CO 4      |
| 18 | Implementation of 4:1 multiplexer on a FPGA  | CO 4      |
| 19 | Implementation of 2*2 multiplier on a FPGA   | CO 4      |
| 20 | Implementation of D flip flop on a FPGA  |           |
| 20 | Implementation of B mp nop on all Fort   | CO 4      |
| 21 | Design and simulation of CMOS inverter using switch level modeling                   | CO 5      |
| 22 | Simulate and synthesize following logic gates using switch level modeling            |           |
|    | a) AND Gate  |           |
|    | b) OR Gate   |           |
|    | c) NOT Gate  | GO =      |
|    | d) EX-OR Gate  | CO 5      |
|    | e) NAND Gate   |           |
|    | f) NOR Gate  |           |
|    | Required Software and Tools (Any one)  |           |
| •  | ISE Simulator (Xilinx) / Xilinx Vivado   |           |
| •  | Verilog-XL (Cadence)   |           |
| •  | VCS ('big 3') (Synopsys)   |           |
|    |  | 70 4 1 40 |

Total: 40 hrs

| LAB Course Code: BCSCC0452 | LAB Course Name: Problem Solving Approaches | L | T | P | С |
|----------------------------|---|---|---|---|---|
| Course Offered in: IV SEM  |   | 0 | 0 | 2 | 1 |

**Pre-requisite:** Programming Language C/C++ or Java or Python

### **Course Objectives:**

Problem-solving in computer programming involves a structured approach to identifying, analyzing, and resolving coding challenges. The process typically includes thoroughly understanding the problem, decomposing it into smaller, manageable parts, designing an appropriate algorithm, implementing the solution through code, and performing testing and debugging to ensure correctness and efficiency

|        | - J  |                   |
|--------|--|-------------------|
| Course | Outcome: After completion of the course, the student will be able to   | Bloom's Knowledge |
|        |  | Level (KL)        |
| CO1    | Develop logic-based solutions using control statements and recursion to solve basic and intermediate computational problems.                     | K6                |
| CO2    | Apply bit manipulation techniques to find efficient solutions for binary and low-level operations.   | K3                |
| CO3    | Implement and manipulate arrays and strings using fundamental and advanced searching sorting techniques.   | K3                |
| CO4    | Utilize algorithmic strategies to optimize solutions for complex problem scenarios.  | K3                |
| CO5    | Analyze and debug code for logical errors and improve the efficiency of the solution using appropriate data structures and algorithmic patterns. | K4                |

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

| CO-PO<br>Mapping | PO1 |   | PO3 | PO4 |   | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|------------------|-----|---|-----|-----|---|-----|-----|-----|-----|------|------|------|------|------|
| CO1              | 3   | 3 | 3   | 3   | - | -   | -   | 2   | -   | -    | -    | -    | -    | -    |
| CO2              | 3   | 3 | 2   | 2   | - | -   | -   | 2   | -   | -    | -    | -    | -    | -    |
| CO3              | 3   | 3 | 2   | 2   | - | -   | -   | 2   | -   | -    | -    | -    | -    | -    |
| CO4              | 3   | 3 | 2   | 2   | - | -   | -   | 2   | -   | -    | -    | -    | -    | -    |
| CO5              | 3   | 3 | 2   | 2   | - | -   | -   | 2   | -   | -    | =    | -    | -    | -    |

**List Of Practical's (Indicative & Not Limited To)** 

# Problem Statements need to be discussed in lab session: Control Statements

## 1. Secure Password Generator

A company wants to create a secure password generator for their employees. The password must be based on specific numeric properties to enhance its complexity and security. Write a program to validate and generate a secure password according to the following rules:

## 1. Prime Number Validation:

- The user must input a 3-digit number. The program should first check if the number is a prime number.
- If it is not a prime number, the user should be prompted to enter another number until a valid prime number is provided.

# 2. Sum of Digits Check:

• Once a valid prime number is entered, calculate the sum of its digits. If the sum of the digits is not divisible by 3, ask the user to enter another prime number until a valid one is found.

### 3. Armstrong Number Check:

• Check entered prime number is Armstrong or not? If Armstrong are found, prompt the user to enter another prime number and repeat the process.

## **Password Generation:**

Concatenate the 1 if entered prime number is Armstrong otherwise 2 with the sum of the digits of the valid prime number to form the secure password.

### **Example Scenario:**

# Sample Input

Enter a 3-digit prime number: 153

Sum of digits of 153 = 9The sum is divisible by 3. 153 is Armstrong number

# Sample Output

Secure Password: 19

2. Write a function to input electricity unit charges and calculate total electricity bill according to the given condition:

For first 50 units Rs. 0.50/unit For next 100 units Rs. 0.75/unit For next 100 units Rs. 1.20/unit For unit above 250 Rs. 1.50/unit

An additional surcharge of 20% is added to the bill

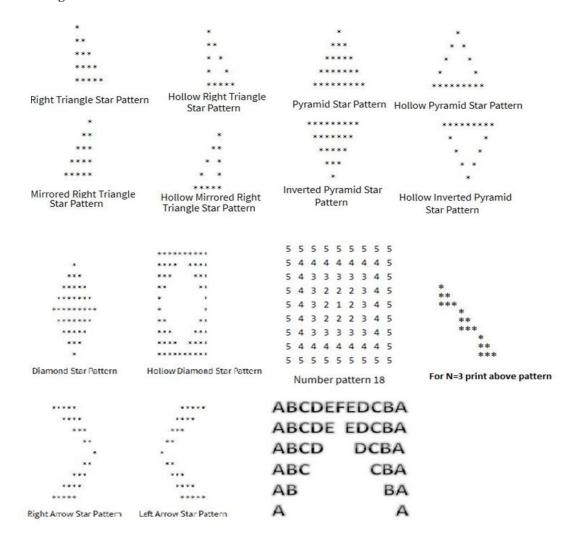
3. Write a method to generate a secure code which the sum of all possible palindrome numbers between given two numbers.

For Example: **Input**: 10, 80 **Output**: 308

**Explanation**: All palindrome numbers between 10 & 80 are: 11,22,33,44,55,66,77

Password= 11+22+33+44+55+66+77 = 308

## 4. Draw the following Patterns for N=5



# **Problem Statements need to be discussed in lab session:** Recursive Approach (Basic)

1. Write a program that takes an integer n as input and prints the multiplication table of n from n \* 1 to n \* 10. The output should clearly show each multiplication step.

2. Write a program to calculate the sum of all integers from 1 to a given number N. The program should take N as input and output the total sum using iteration or recursion.

# 3. Find the GCD of Two Numbers Using Recursion:

Write a recursive function to calculate the Greatest Common Divisor (GCD) of two numbers using Euclid's algorithm. The function should take two integers as input and return their GCD.

## 4. Find the LCM of Two Numbers Using Recursion:

Write a program to compute the Least Common Multiple (LCM) of two numbers using recursion. You may use the relationship LCM(a, b) = |a \* b| / GCD(a, b) and a recursive function for GCD.

# Problem Statements need to be discussed in lab session: Bit Manipulation

- 1. Write a program to count the number of set bits (1s) in the binary representation of a given integer. The program should efficiently use bitwise operations to perform the task without converting the number to a string.
- 2. Write a program that takes a number and a bit position as input and checks whether the bit at that position is set (1) or clear (0). Use bitwise operators to perform the check
- **3.** Given a number and a position, write a program to toggle (invert) the bit at the given position using bitwise operations. The result should reflect the updated value of the number after flipping the bit.
- **4.** Write a program to compute the XOR of all numbers from 1 to n using a mathematical pattern (not a loop). Use bitwise XOR properties to achieve an efficient solution.
- **5.** Given an array of size n-1 containing unique elements from 1 to n, find the missing number using bit manipulation (preferably XOR approach) without sorting or using extra space.
- **6.** Given an array where all elements repeat twice except two elements that appear only once, write a program to find the two non-repeating elements using bitwise operations in linear time and constant space.
- 7. Write a program to check if a given number is a power of two using bit manipulation. A number is a power of two if it has exactly one set bit in its binary representation.
- **8.** Given two integers A and B, write a program to count how many bits need to be flipped to convert A to B. Use XOR to find differing bits and count the number of set bits.
- **9.** Write an efficient program to count the total number of set bits in binary representations of all numbers from 1 to n. Optimize the approach using bitwise logic and recursion.
- **10.** Write a program to calculate the square of a number using only bitwise operations and addition. Do not use multiplication, division, or any power functions.
- 11. Write a function to add two integers using bitwise operations only. Avoid using the + or operators. Implement logic using XOR and AND operations for binary addition.
- **12.** Write a program to generate the power set (all subsets) of a given set using bitwise representation. Each subset can be represented by a binary number where each bit indicates inclusion of the corresponding element.

**Problem Statements need to be discussed in lab session:** Arrays (Try to use sliding window, prefix sum, cadence, recursion, bit manipulation, two pointer approaches)

- 1. Sarah is assisting the "MathMinds Club" in creating passwords for their online platform. They have a list of numbers, some stable and some unstable. Define a function that can help Sarah calculate the password according to the given scenario. Scenario:
  - There are N numbers provided.
  - A number is stable if each digit appears the same number of times.
  - A number is unstable if the frequency of its digits is not the same.
  - The password is computed as the sum of all stable numbers minus the sum of all unstable numbers.
  - Consider only those numbers in the list that have more than equal to three digits.

For example:

Input: N=5 List: 12, 1313, 122, 678, 898

Output: Password: 971

2. Given an array of integers, including possible negative values, you are allowed to modify at most one element by doubling its value. The goal is to find the maximum possible sum of any subarray after making this modification.

# Input:

arr = [-2, 1, -3, 4, -1, 2, 1, -5, 4]

**Expected Output:** 

- Original Maximum Subarray Sum: 6 (achieved from [4, -1, 2, 1])
- Maximum Sum After Modification: 10(achieved from [8, -1, 2, 1], where the value 4 is doubled to 8).
- **3.** For a given string, generate a pattern based on the following rules:

**Input:** A string of characters (e.g., "HAT").

*Output:* Generate patterns by replacing characters with the numeric value 1 and process the patterns as described below:

- 1. Replace one character at a time with 1:
  - o For each character in the string, replace it with 1, keeping the other characters unchanged.
  - Example for "HAT": 1AT, H1T, HA1
- 2. Replace two characters at a time with 1:
  - o Replace every combination of two characters with 1, keeping the remaining character unchanged.
  - o If 1s are consecutive, replace them with their sum (e.g., 11T becomes 2T).
  - Example for "HAT":

 $11T \rightarrow 2T$ ,  $H11 \rightarrow H2$ , 1A1

- 3. Replace all characters with 1:
  - o Replace all characters in the string with 1.
  - o If there are consecutive 1s, sum them up (e.g., 111 becomes 3).
  - o Example for "HAT":

 $111 \rightarrow 3$ 

Final Output

For the string "HAT", the output should be:

1AT, H1T, HA1, 2T, H2, 1A1, 3.

**4.** Given a sorted array arr [] and a target value, the task is to count triplets (i, j, k) of valid indices, such that arr[i] + arr[j] + arr[k] = target and i < j < k.

# **Examples:**

Input: arr[] = [-3, -1, -1, 0, 1, 2], target = -2

Output: 4

- 5. You are given an array prices[] where prices[i] represents the price of a given stock on day i. You want to maximize your profit by choosing a single day to buy one stock and choosing a different day in the future to sell that stock. Write a program to return the maximum profit you can achieve from this transaction. If no profit is possible, return 0.
- 6. Find the "Kth" max and min element of an array:

Given k, find the k-th smallest and k-th largest element in the array.

Input: arr = [7, 10, 4, 3, 20, 15], k = 3Output: Kth Smallest: 7, Kth Largest: 10

7. Sort a binary array with values 0, 1, and 2 using constant space and one pass (Dutch National Flag algorithm).

Input: [0, 2, 1, 2, 0]Output: [0, 0, 1, 2, 2]

**8.** Find **longest consecutive subsequence:** 

Return the length of the longest consecutive elements sequence.

Input: [1, 9, 3, 10, 4, 20, 2] Output: 4 (Sequence: 1, 2, 3, 4)

**9.** Given a number of bits and a number K. In one flip you can toggle exactly K consecutive bits. With only this flip operation available, convert the string into all 1.

Input String: 0000110000 and K=3

Following are four flip operations by using which all bits converted into 1's.

Flip1-1110110000 Flip2-1110110111 Flip3-1111000111 Flip4-111111111

If it is not possible to convert all bits into one's then print "IMPOSSIBLE".

10. Given a list of non-negative integers, arrange them in such a way that they form the largest possible number. Since the result can be very large, return it as a string in O(N log N) time complexity.

| Example-1                 | Example-2                  |
|---------------------------|----------------------------|
| Input:                    | Input:                     |
| N = 5                     | N = 4                      |
| Arr[] = {3, 30, 34, 5, 9} | Arr[] = {54, 546, 548, 60} |
| Output: 9534330           | Output: 6054854654         |

11. Given an array arr[] of size n containing distinct integers within the range [1, n+2], find the two missing numbers from the first n+2 natural numbers.

#### **Constraints:**

- The solution must run in O(N) time and use O(1) extra space.
- The array does not contain duplicate values.

### **Examples:**

**Input:** arr[] = [1, 2, 4, 6, 3, 8], n = 6

**Output:** 5, 7

12. Given a string str of lowercase alphabets and a number k, the task is to print the minimum value of the string after removal of k characters. The value of a string is defined as the sum of squares of the count of each distinct character present in the string. Return the minimum possible required value. **Examples:** 

**Input:** str = "abccc", k = 1

Output: 6

**Input**: str = "aabcbcbcabcc", k = 3

Output: 27

**Expected Time Complexity:** O(n+klog(p))

Note: Here n is the length of string and p is number of distinct alphabets and k number of alphabets to be removed.

**13.** Given a non-negative integer **S** represented as a string, remove **K** digits from the number so that the new number is the smallest possible.

**Note:** The given *num* does not contain any leading zero.

Expected Time Complexity: O(|S|).

| Example 1:          | Example 2:           |  |
|---------------------|----------------------|--|
| Input:              | Input:               |  |
| S = "149811", K = 3 | S = "1002991", K = 3 |  |
| Output:             | Output:              |  |
| 111                 | 21                   |  |

**14.** You are given a two-dimensional grid board[][] of size n \* m consisting of English letters and a string target. Your task is to determine whether the target word can be formed by sequentially connecting letters from the grid. You may move to adjacent cells **horizontally or vertically** (not diagonally), and **a cell may not be reused** once it is part of the current path.

# **Examples:**

## **Input:**

board[][] = [['C', 'A', 'T'], ['R', 'A', 'K'], ['T', 'O', 'N']],

target = "CART"

Output: true

Explanation:

You can trace the word "CART" through the path:  $C \to A \to R \to T$  (moving horizontally and vertically, without repeating cells).

- 15. Given an encoded string s, the task is to decode it. The encoding rule is:
  - k[encodedString], where the encodedString inside the square brackets is being repeated exactly k times. Note that k is guaranteed to be a positive integer, and encodedString contains only lowercase english alphabets.

**Note:** The test cases are generated so that the length of the output string will never exceed 10^5.

**Examples:** 

**Input:** s = "1[b]" **Output:** "b"

**Input:** s = "3[b2[ca]]" **Output:** "bcacabcacabcaca"

\*Competitive coding list will be shared with the students.

Total Hours: 30 hrs.

| Course (  | Code:   | BNC0402  | 2  | Co   | urse Namo  | e: Environ   | mental Sc  | ience  |  | L                             | T                                 | P   | С  |
|---|---|--|--|--|--|--|--|--|--|-------------------------------|-----------------------------------|---|--|
| Course (  | Offer   | ed in: All   | the branche  | es   |  |  |  |  |  | 2                             | 0                                 | 0   | 2  |
|   |   |  |  |  | hemistry, e  | cology, ge   | ology, mat   | hematics, a  | and unders   | tanding                       | of hu                             | ıman imp  | acts on  |
| natural s                                       |   |  |  |  |  |  |  |  |  |                               |                                   | ı   |  |
|   |   |  | _  |  |  | udent will   |  |  |  |                               |                                   |   | sloom's  |
|   |   | •  |  |  |  | environmen   | tal issues,  | conserve b   | iodiversity  | , and                         |                                   | Know  | ledge Leve                                       |
| ensure re                                       |   |  |  |  | r future ger   |  |  |  |  |                               |                                   |   | (KL)   |
| CO1   | Understand the basic principles of ecology and environment. Ecosystem: Basic concepts, components of ecosystem, food chains and food webs. Ecological pyramids, biodiversity. |  |  |  |  |  |  |  |  |                               |                                   |   |  |
| CO2   |   | lerstand the<br>servation.                                 | e different  | types of na  | atural recou   | ırses like fo  | ood, forest,   | Minerals a   | and energy   | and the                       | eir                               | K1,K2   |  |
| CO3   |   | lerstand the   | e different  | types of po  | ollution, po   | llutants, the  | eir sources  | , effects an   | d their con  | itrol                         |                                   | K1,K2   |  |
| CO4   |   |  |  | _  | ıstainable d   | evelopmen<br>t   | t, Environ   | mental Imp   | act Assess   | ment                          |                                   | K1,K2   |  |
| CO-   | PO  | PO1  | PO2  | PO3  | PO4  | PO5  | PO6  | PO7  | PO8  | РО                            | 9                                 | PO10  | PO11   |
| Mappi   | ng  | 3  | 3  | 2  | 2  |  | 3  | 3  | 2  | 2                             |                                   |   | 2  |
| CO1   |   | 3  | 3  | 2  | 2  |  | 3  | 3  | 2  | 2                             |                                   |   | 2  |
| CO2   | ,   | 3  | 3  | 2  | 2  |  | 3  | 3  | 2  | 2                             |                                   |   | 2  |
| CO3   |   | 3  | 3  | 2  | 2  |  | 3  | 3  | 2  | 2                             |                                   |   | 2  |
| CO4   |   | 3  | 3  | 2  | 2  |  | 3  | 3  | 3  | 2                             |                                   |   | 2  |
|   |   | ents / Sylla   |  |  |  |  |  |  |  |                               |                                   | •   |  |
| Module  |   |  |  |  |  | gy and Bio   |  |  |  |                               |                                   |   | nours  |
| and food<br>Cycles: I<br>importan<br>book. Str  | l. Wel<br>Importice, Ti   | bs. Ecologotance, gashreats to bies for biod               | ical pyramseous and iodiversity, iversity con  | iids, Energ<br>sedimenta<br>, major cau<br>nservation  | y flow in ory cycles. uses, extinciples                                | vironment. I<br>ecological a<br>Carbon, N<br>tion's, vuln<br>a of biodive<br>importance  | systems, C<br>itrogen, Pl<br>erability o<br>rsity conse          | Characterist<br>hosphorus<br>f species to                    | ics of diff<br>and Sulph<br>extinction                 | erent ed<br>ur Cyc<br>n, IUCN | cosysteles. I<br>threa            | tems. Bio<br>Biodivers<br>at categor                            | geochemic<br>ity and th<br>ries, Red d           |
| Module  | 2   |  | Nat  | ural Reso  | urces and  | Ecological   | succession   | n  |  |                               |                                   | 51  | nours  |
| Natural r<br>dams and<br>using min<br>agricultu | resourd their<br>neral<br>re, fer<br>landsl   | r effects on<br>resources.<br>rtilizer-pes<br>lides. Equit | sociated properties of the sociated problems o | oblems. For tribal peoper of the peoper of t | orest resour<br>ple. Minerald food pro<br>er logging,<br>s for sustain | rces: Use an all resources oblems, cha and salinity nable lifesty reserves, land wind en | nd over- ex<br>s: Use and<br>nges cause<br>/. Land res<br>//les. | exploitation,<br>exploitation<br>ed by agricu<br>ources: Lan | n, environal<br>ulture and ond as a reso<br>, uses and | mental over- grounder, l      | effect<br>razing<br>and d<br>Rene | extractions of extra<br>s of extra<br>g, effects<br>egradations | n, mining,<br>acting and<br>of modern<br>on, man |
| Resource  |   |  |  |  |  |  |  |  |  |                               |                                   |   |  |
| Resource  |   |  |  |  | ical success   | sion   |  |  |  |                               |                                   |   |  |

Hydrocarbon, control of air pollution. Water pollution: sources and types of water pollution, Effects of water pollution, Eutrophication, Soil pollution: Causes of soil pollution, Effects of soil pollution, Major sources of and effects of noise pollution on health, Radioactive and thermal pollution sources and their effects on surrounding environment. Solid waste disposal and its effects on surrounding environment, Introduction to E- Waste, Types and classification of E- Waste, Impacts of E- Waste on environment and human health, E-Waste management and recycling., Climate change, global warming, acid rain, ozone layer depletion. **Environmental Assessment and Legislation** 

Women education, Role of NGOs regarding environmental protection, Bio indicators and their role, Natural disasters and disasters

management, Aims and objectives of Environmental Impact Assessment (EIA). Salient features of following Acts: Environmental Protection Act, 1986, Wildlife (Protection) Act, 1972. Water (Prevention and control of pollution) Act, 1974. Forest (Conserving) Act, 1980.

Definition and concept of sustainability, impacted areas of sustainable development, Global initiative and issues on sustainable development UNSDsGs, System Thinking and Sustainability.

|         | Total Lecture Hours 20 hour  |                            |  |  |  |  |  |  |  |  |  |
|---------|--|----------------------------|--|--|--|--|--|--|--|--|--|
| Textboo | k:   |                            |  |  |  |  |  |  |  |  |  |
| S.No    | Book Title   | Author                     |  |  |  |  |  |  |  |  |  |
| 1       | Brady, N.C. 1990. The nature and properties of Soils, Tenth Edition. Mac Millan Publishing Co., New York   | Brady, N.C                 |  |  |  |  |  |  |  |  |  |
| 2       | Sodhi G.S. 2005, Fundamentals of Environmental Chemistry: Narosa Publishing House, New Delhi.  |                            |  |  |  |  |  |  |  |  |  |
| 3       | Dash, M.C. (1994), Fundamentals of Ecology, Tata Mc Graw Hill, New Delhi.  | Dash, M.C                  |  |  |  |  |  |  |  |  |  |
|         |  |                            |  |  |  |  |  |  |  |  |  |
| S.No    |  |                            |  |  |  |  |  |  |  |  |  |
| 1       | Rao M.N. and H.V.N. Rao, 1989 : Air Pollution, Tata McGraw Hill Publishing Co. Ltd., New Delhi   | Rao M.N. and H.V.N. Rao    |  |  |  |  |  |  |  |  |  |
| 2       | A Text Book of environmental Science By Shashi Chawla  | Shashi Chawla              |  |  |  |  |  |  |  |  |  |
|         |  |                            |  |  |  |  |  |  |  |  |  |
| Unit 1: | https://www.youtube.com/watch?v=T21OO0sBBfc, https://www.youtube.com/watch?v=T21OO0sBfc, https://www.youtube.com/watch?v=T21OO0sfc, https://www.youtube.com/watch?v=T21OO0sfc, https://www.youtube.com/watch?v=T21O | be.com/watch?v=qt8AMjKKPDo |  |  |  |  |  |  |  |  |  |
| Unit 2: | https://www.youtube.com/watch?v=mOwyPENHhbc,   |                            |  |  |  |  |  |  |  |  |  |
|         | https://www.youtube.com/watch?v=yqev1G2iy2   |                            |  |  |  |  |  |  |  |  |  |
|         | https://www.youtube.com/watch?v=_74S3z3IO_I,   |                            |  |  |  |  |  |  |  |  |  |
|         | https://www.youtube.com/watch?v=jXVw6M6m2  |                            |  |  |  |  |  |  |  |  |  |
| Unit 3: | https://www.youtube.com/watch?v=7qkaz8ChelI,   |                            |  |  |  |  |  |  |  |  |  |
|         | https://www.youtube.com/watch?v=NuQE5fKmfME  | /                          |  |  |  |  |  |  |  |  |  |
| TT 1. 6 | https://www.youtube.com/watch?v=9CpAjOVLHII, ttps://www.youtub   | e.com/watch?v=yEc161DkXYw  |  |  |  |  |  |  |  |  |  |
| Unit 4  | https://www.youtube.com/watch?v=ad9KhgGw5iA,   |                            |  |  |  |  |  |  |  |  |  |
|         | https://www.youtube.com/watch?v=nW5g83NSH9 M,  |                            |  |  |  |  |  |  |  |  |  |
|         | https://www.youtube.com/watch?v=xqSZL4Ka8xo  |                            |  |  |  |  |  |  |  |  |  |