# Curriculum Structure for M. Tech. Programmes

## (In light of NEP2020)

## NCrF Level 7

## For students admitted in 2023-24 onwards

# Govt. College of Engineering, Amravati

(*An Autonomous Institute of Govt. of Maharashtra*)

Near Kathora Naka, Amravati, Maharashtra

PIN 444 604

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Member Secretary | BoS Chairperson | Dean (Academics) | Principal

# Govt. College of Engineering, Amravati

*(An Autonomous Institute of Govt. of Maharashtra)*

## Curriculum Structure for M. Tech. (Electronics Systems and Communication)

## (In light of NEP 2020)

## Category wise credit distribution:

| Semester | PC | PE | OE | RM | OJT / FP | ISS | RP / DI | Total |
|---|---|---|---|---|---|---|---|---|
| I | 15 | 03 | --- | --- | --- | 02 | --- | 20 |
| II | 12 | 03 | --- | 02 | 04 | 02 | --- | 23 |
| III | --- | 03 | 03 | --- | --- | --- | 13 | 19 |
| IV | --- | --- | --- | --- | --- | --- | 18 | 18 |
| **Total** | **27** | **09** | **03** | **02** | **04** | **04** | **31** | **80** |

| SN | Abbreviation | Meaning | Credits | Percentage |
|---|---|---|---|---|
| 01 | PC | Programme Core | 27 | 33.75 |
| 02 | PE | Programme Elective | 09 | 11.25 |
| 03 | OE | Open Elective | 03 | 03.75 |
| 04 | RM | Research Methodology | 02 | 02.50 |
| 05 | OJT | On-Job Training/ Internship | 04 | 05.00 |
| 06 | FP | Field Projects | | |
| 07 | ISS | Independent Study & Seminar | 04 | 05.00 |
| 08 | RP | Research Project | 31 | 38.75 |
| 09 | DI | Dissertation | | |
| | | Total | 80 | 100.00 |

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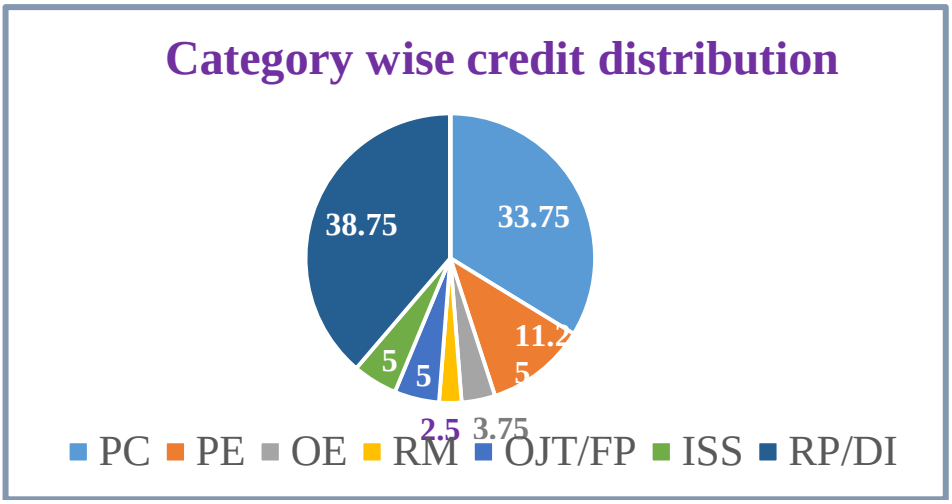


## General Instructions:

**1)** 10% content of syllabus of each theory course of first, second and third semesters shall be completed by the students with self-study. The 10% portion of each course (for self-study) shall be declared by the concerned course-coordinator at the beginning of teaching of the course.

**2)** Student can complete any two theory courses of second semester, if desired, in "online" mode, offered through SWAYAM/ NPTEL. In this case –

i) Students can register and complete these online courses any time after beginning of first semester, however, the student must successfully complete and pass the course, and submit the score card/ certificate before declaration of result of second semester.

ii) In case if a student registers for a course in online mode but fails in the course the student will have to register for the course in the institute whenever it is offered. In this case, the student will have to attend the classes of the course (in order to satisfy the minimum attendance criteria), appear for all the examinations (MSE, TA, ICA, ESE etc) of the course, and successfully complete the course with at least D grade.

**3)** Student can complete the two theory courses of third semester, if desired, in "online" mode, offered through SWAYAM/ NPTEL. In this case –

i) Students can register and complete these online courses any time after beginning of first semester, however, the student must successfully complete and pass the course, and submit the score card/ certificate before declaration of result of third semester.

ii) In case if a student registers for a course in online mode but fails in the course the student will have to register for the course in the institute whenever it is offered. In this case, the student will have to attend the classes of the course (in order to satisfy the minimum attendance criteria), appear for all the examinations (MSE, TA, ICA, ESE etc) of the course, and successfully complete the course with at least D grade.

**4)** Students must complete On-the-job training/ Internship/ Field work for a duration of minimum four weeks during summer break, after completion of second semester of first year in the respective major

subject. The company/ organization for On-job training/ Internship/ Field work must be approved by the DFB

**5)** Students going for industrial project or going for dissertation at some other institute (approved by DFB), during third and fourth semester, shall complete the courses Programme Elective – III and Open Elective in any one of the two modes –

i) Online courses offered through SWAYAM/ NPTEL: In this case the student must complete the course and submit the score card/ certificate before commencement of fourth semester. Students can register and complete these courses any time after beginning of first semester

In case if a student registers for a course in online mode but fails in the course the student will have to register for the course in the institute whenever it is offered. In this case, the student will have to attend the classes of the course (in order to satisfy the minimum attendance criteria), appear for all the examinations (MSE, TA, ICA, ESE etc) of the course, and successfully complete the course with at least D grade.

ii) Self-study mode: In this case the student will have to study the course of his/her own. The student shall appear for all the college assessments/ examinations (MSE, TA and ESE) personally as per the schedule declared by the institute.

**6) Maximum period for completion of M. Tech. programme:**

The maximum duration for completion of the PG full time programme is eight semesters from the date of initial registration. The maximum duration of the programme includes the period of withdrawal, absence and different kinds of leaves permissible to a student but it shall exclude the period of rustication of the student from the institute and it shall also exclude the period lapsed between exit after first year (second semester) and re-entry at second year (third semester). However, genuine cases on confirmation of valid reasons may be referred to Academic Council for extending this limit by additional one year.

**PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

1. Students should have Core Competence in mathematical, scientific and engineering principles necessary to formulate, analyze and solve hardware/software engineering problems and also to pursue higher study or research.

2. Student should function effectively as an individual and in a team in industry and research activity.

3. Student should understand the social issues and should have ability to come up with remedial measures.

4. Students should have enough techno-scientific excellence to serve the rising demands in agricultural as well as industrial sectors and contribute to nation building.

5. Students should have enough analytical skills to visualize the applications of Electronics and Communication engineering concepts in real life situations.

6. Students should come up with entrepreneurship quality with ethical attitude.

## Program Outcomes (POs)

Students will be able to

1. Apply the knowledge of science, mathematics, and engineering principles for

   developing problem solving attitude.

2. Identify, formulate and solve engineering problems in the broad areas like System Design using communication and Networking platform, Applications in Signal Processing, Machine Vision.

3. Use different software tools in the domain of Communication; Signal processing, VLSI and Embedded Systems Design. Analysis and Verification such as Design entry, Synthesis, Functional and Timing Simulation, Platform specific EDA sets.

4. Design and conduct experiments, analyze and interpret data, imbibe programming skills for development of simulation experiments.

5. Function as a member of a multidisciplinary team with sense of ethics, integrity and responsibility.

# M. Tech. (Electronic Systems and Communication) Semester I

| Category | Course Code | Name of the course | Teaching Scheme | | | | Examination Scheme | | | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Theory | | | | Practical | | Total | |
| | | | Theory | Tut | Pract | Total | CT1 | CT2 | TA | ESE | ICA | ESE | | |
| PC | ET2131 | Advanced Digital Signal Processing | 04 | -- | -- | 04 | 15 | 15 | 10 | 60 | -- | -- | 100 | 04 |
| PC | ET2132 | Advanced Communication Networks | 04 | -- | -- | 04 | 15 | 15 | 10 | 60 | -- | -- | 100 | 04 |
| PC | ET2133 | Optoelectronics and Optical Communication Systems | 04 | -- | -- | 04 | 15 | 15 | 10 | 60 | -- | -- | 100 | 04 |
| PE | ET2134 | Program Elective- I | 03 | -- | -- | 03 | 15 | 15 | 10 | 60 | -- | -- | 100 | 03 |
| PC | ET2135 | System Design and Communication Laboratory -I | -- | -- | 06 | 06 | -- | -- | -- | -- | 50 | 50 | 100 | 03 |
| ISS | ET2136 | Seminar-I | -- | -- | 01 | 01 | -- | -- | -- | -- | 50 | -- | 50 | 02 |
| | | Total | 15 | -- | 07 | 22 | 60 | 60 | 40 | 240 | 100 | 50 | 550 | 20 |

| List Of Program Electives | |
|---|---|
| ET2134: Program Elective – I | |
| A | RF & Microwave circuit design |
| B | Embedded System Design |
| C | Soft Computing |
| D | Optical Network |

**Note:**

**i)** The contact hours for the students (with concerned supervisor) for Seminar – I shall be one hour per week per student, subject to maximum of four hours per week.

**ii)** The hours shown in the teaching scheme for Seminar I are the contact hours for the students with concerned supervisor. Each student is expected to devote at least four hours per week for Seminar I.

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# M. Tech. (Electronic Systems and Communication) Semester II

| Category | Course Code | Name of the course | Teaching Scheme | | | | Examination Scheme | | | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Theory | | | | Practical | | Total | |
| | | | Theory | Tut | Pract | Total | CT1 | CT2 | TA | ESE | ICA | ESE | | |
| PC | ET2231 | Antennas and Radiating Systems | 03 | -- | -- | 03 | 15 | 15 | 10 | 60 | -- | -- | 100 | 03 |
| PC | ET2232 | Analog and Digital CMOS VLSI Design | 03 | -- | -- | 03 | 15 | 15 | 10 | 60 | -- | -- | 100 | 03 |
| PC | ET2233 | Image and Video Processing | 03 | -- | -- | 03 | 15 | 15 | 10 | 60 | -- | -- | 100 | 03 |
| PE | ET2234 | Program elective- II | 03 | -- | -- | 03 | 15 | 15 | 10 | 60 | -- | -- | 100 | 03 |
| RM | SH2201 | Research Methodology | 02 | -- | -- | 02 | 15 | 15 | 20 | -- | -- | -- | 50 | 02 |
| PC | ET2235 | Systems Design and Communication Laboratory-II | -- | -- | 06 | 06 | -- | -- | -- | -- | 50 | 50 | 100 | 03 |
| ISS | ET2236 | Seminar –II | -- | -- | 01 | 01 | -- | -- | -- | -- | 50 | -- | 50 | 02 |
| OJT/ FP | ET2237 | On Job Training/ Internship/ Field Program | -- | -- | -- | -- | -- | -- | -- | -- | 50 | -- | 50 | 04 |
| | | Total | 14 | -- | 07 | 21 | 75 | 75 | 60 | 240 | 150 | 50 | 650 | 23 |

| List Of Programme Electives | |
|---|---|
| ET2234: Programme Elective – II | |
| A | Satellite Communication |
| B | Programming Language for Embedded Systems |
| C | Pattern Recognition and Machine Learning |
| D | Wireless Sensor Network |

Note:

i) The contact hours for the students (with concerned supervisor) for Seminar – II, shall be one hour per week per student, subject to maximum of four hours per week.

ii) The hours shown in the teaching scheme for Seminar II are the contact hours for the students with concerned supervisor. Each student is expected to devote at least four hours per week for Seminar II.

iii) Individual students are required to choose a topic of their interest for Seminar II. They shall acquire state-of-the art knowledge in that area and shall define the grey area related to topic (gap analysis) so as to carry dissertation in that area. The students are required to review literature on the topic and deliver seminar.

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**Exit option:**

- The exit option at the end of one year of the Master's degree program will commence from AY 2024-25.
- Students who have joined a two-year Master's degree program may opt for exit at the end of the first year and he/ she shall be eligible for M. Voc. Degree (Level 6.5)
- The M. Voc. Degree may be awarded to a student provided they have earned all 43 credits of first year (first and second semester). The On-job training / Internship/ Field work shall be completed during summer break, after completion of the second semester of the first year in the respective Major Subject.
- Even if, a student exits after third semester, the M. Voc. Degree may be awarded to him/ her provided he/ she have earned all 43 credits of first year (first and second semester).The On-job training / Internship/ Field work shall be completed during summer break, after completion of the second semester of the first year in the respective Major Subject.
- The student must submit the report of On-job training / Internship/ Field work, in the format prescribed by the institute, as partial fulfilment of award of M. Voc. degree.
- Re-entry to complete the PG degree, after taking the exit option, will be permissible up to 05 years from the date of admission to the PG programme. Such students, shall have to surrender the M. Voc. Degree, at the time of re-entry. There shall be a gap of at least six months between exit after first year and re-entry to PG degree at third semester

# M. Tech. (Electronic Systems and Communication) Semester III

| Category | Course Code | Name of the course | Teaching Scheme | | | | Examination Scheme | | | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Theory | | | | Practical | | Total | |
| | | | Theory | Tut | Pract | Total | CT1 | CT2 | TA | ESE | ICA | ESE | | |
| PE | ET2331 | Programme Elective –III | 03 | -- | -- | 3 | 15 | 15 | 10 | 60 | -- | -- | 100 | 03 |
| OE | SH2301 | Open Elective | 03 | -- | -- | 3 | 15 | 15 | 10 | 60 | -- | -- | 100 | 03 |
| RP / DI | ET2332 | Dissertation Stage I | -- | -- | 04 | 04 | -- | -- | -- | -- | 150 | -- | 150 | 13 |
| | | Total | 06 | -- | 04 | 10 | 30 | 30 | 20 | 120 | 150 | -- | 350 | 19 |

Note: The hours shown in the teaching scheme for Dissertation Stage I are the contact hours for the students with concerned supervisor. The student is expected to devote at least twenty-six hours per week for Dissertation Stage I.

| List Of Programme Electives | | List Of Open Electives | |
|---|---|---|---|
| ET2331: Programme Elective – III | | SH2301: Open Elective | |
| A | Artificial Intelligence and Machine Learning | A | Industrial Safety |
| B | Wireless communication | B | Operation Research |
| C | VLSI Design verification and testing | C | Project Management |
| D | Computer Vision | D | Data Structure and Algorithms |
| E | Network security and Cryptography | E | Nano Technology |

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# M. Tech. (Electronic Systems and Communication) Semester IV

| Category | Course Code | Name of the course | Teaching Scheme | | | | Examination Scheme | | | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Theory | | | | Practical | | Total | |
| | | | Theory | Tut | Pract | Total | CT1 | CT2 | TA | ESE | ICA | ESE | | |
| RP/DI | ET2431 | Dissertation Stage – II | -- | -- | 04 | 04 | -- | -- | -- | -- | 100 | 200 | 300 | 18 |
| | | Total | -- | -- | 04 | 04 | -- | -- | -- | -- | 100 | 200 | 300 | 18 |

Note:

i) Dissertation Stage – I is pre-requisite for Dissertation Stage – II

ii) The hours shown in the teaching scheme for Dissertation Stage II are the contact hours for the students with concerned supervisor. The student is expected to devote at least thirty-six hours per week for Dissertation Stage II.

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# Comparison of existing and new programme structure:

## i) On the basis of Marks and Credit:

| Semester | Marks | | Credits | |
|---|---|---|---|---|
| | **Existing** | **New** | **Existing** | **New** |
| I | 610 | 550 | 17 | 20 |
| II | 600 | 650 | 19 | 23 |
| III | 300 | 350 | 16 | 19 |
| IV | 400 | 300 | 16 | 18 |
| **Total** | **1910** | **1850** | **68** | **80** |

## ii) On the basis of semester wise number of courses:

| | Number of courses | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Semester I | | Semester II | | Semester III | | Semester IV | | Total | |
| | Existing | New | Existing | New | Existing | New | Existing | New | Existing | New |
| Theory | 05 | 04 | 05 | 05 | 02 | 02 | --- | --- | 12 | 11 |
| Practical | 01 | 01 | 01 | 01 | --- | --- | --- | --- | 02 | 02 |
| Seminar | 01 | 01 | 01 | 01 | --- | --- | --- | --- | 02 | 02 |
| Internship | --- | --- | --- | 01 | --- | --- | --- | --- | --- | 01 |
| Dissertation | --- | --- | --- | --- | 01 | 01 | 01 | 01 | 02 | 02 |

## iii) On the basis of course category:

| Course category | Number of courses | | Credits | |
|---|---|---|---|---|
| | **Existing** | **New** | **Existing** | **New** |
| PC | 08 | 08 | 24 | 27 |
| PE | 03 | 03 | 09 | 09 |
| OE | 02 | 01 | 03 | 03 |
| RM | 01 | 01 | 02 | 02 |
| OJT / FP | --- | 01 | --- | 04 |
| ISS | 02 | 02 | 04 | 04 |
| RP / DI | 02 | 02 | 26 | 31 |
| **Total** | **18** | **18** | **68** | **80** |

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# Department of Electronics and Telecommunication Engineering

## Equivalence Scheme

## Programme Name:-M. Tech.

## (Electronic Systems and Communication)

| Sr. No. | Course code with Name of course(old) | | Credit | Course code with Name of course (new) | | Credit |
|---|---|---|---|---|---|---|
| 1 | ETP121 | Advanced Digital Signal Processing | 3 | ET2131 | Advanced Digital Signal Processing | 4 |
| 2 | ETP122 | Advanced Communication Networks | 3 | ET2132 | Advanced Communication Networks | 4 |
| 3 | ETP123 | Optoelectronics and Optical Communication Systems | 3 | ET2133 | Optoelectronics and Optical Communication Systems | 4 |
| 4 | ETP124 | Program Elective I | 3 | ET2134 | Program Elective I | 3 |
| 5 | ETP124(A) | RF & Microwave circuit design | 3 | ET2134(A) | RF & Microwave circuit design | 3 |
| 6 | ETP124(B) | Embedded System Design | 3 | ET2134(B) | Embedded System Design | 3 |
| 7 | ETP124(C) | Soft Computing | 3 | ET2134(C) | Soft Computing | 3 |
| 8 | ETP124(D) | Optical Network | 3 | ET2134(D) | Optical Network | 3 |
| 9 | ETP125 | Systems and Communication Lab-I | 3 | ET2135 | System Design and Communication Lab-I | 3 |
| 10 | ETP126 | Seminar-I | 2 | ET2136 | Seminar-I | 2 |
| 11 | SHP221 | Audit Course | 0 | -- | Omitted from syllabus | -- |
| 12 | ETP221 | Antennas and Radiating Systems | 3 | ET2231 | Antennas and Radiating Systems | 3 |
| 13 | ETP222 | Analog and Digital CMOSVLSI Design | 3 | ET2232 | Analog and Digital CMOSVLSI Design | 3 |

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| | | | | | | |
|---|---|---|---|---|---|---|
| 14 | ETP223 | Image and Video Processing | 3 | ET2233 | Image and Video Processing | 3 |
| 15 | ETP224 | Program elective II | 3 | ET2234 | Program elective II | 3 |
| 17 | ETP224(A) | Satellite Communication | 3 | ET2234(A) | Satellite Communication | 3 |
| 18 | ETP224(B) | Programming Language for Embedded Systems | 3 | ET2234(B) | Programming Language for Embedded Systems | 3 |
| 19 | ETP224(C) | Pattern Recognition and Machine Learning | 3 | ET2234(C) | Pattern Recognition and Machine Learning | 3 |
| 20 | ETP224(D) | Wireless Sensor Network | 3 | ET2234(D) | Wireless Sensor Network | 3 |
| 21 | SHP221 | Research Methodology | 2 | SH2221 | Research Methodology | 3 |
| 22 | ETP225 | Systems and Communication Lab-II | 3 | ET2235 | Systems and Communication Lab-II | 4 |
| 23 | ETP226 | Seminar II | 2 | ET2236 | Seminar II | 2 |
| 24 | | Newly Added | | ET2237 | On-job Training /Internship / Field work | Newly added |
| 25 | ETP321 | Program Elective III | 3 | ET2331 | Program Elective III | 3 |
| 26 | ETP321(A) | Wireless Communication | 3 | ET2331(A) | Artificial Intelligence and Machine Learning | 3 |
| 27 | ETP321(B) | VLSI Design Verificati and testing | 3 | ET2331(B) | Wireless Communication | 3 |
| 28 | ETP321(C) | Computer Vision | 3 | ET2331(C) | VLSI Design Verificati and testing | 3 |
| 29 | ETP321(D) | Network Security and Cryptography | 3 | ET2331(D) | Computer Vision | 3 |
| 30 | | Newly Added | | ET2331(E) | Network Security and Cryptography | 3 |
| 31 | SHP321 | Open Elective | 3 | SH2301 | Open Elective | 2 |
| 32 | ETP322 | Dissertation Stage I | 10 | ET2332 | Dissertation Stage I | 13 |
| 33 | ETP421 | Dissertation Stage II | 16 | ET2431 | Dissertation Stage II | 18 |

**Course Objectives:**

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| **Course Code** | **ET2131** | | | | | | | **Course category** | | | **PC** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Name** | **ADVANCED DIGITAL SIGNAL PROCESSING** | | | | | | | | | | |
| **Teaching Scheme** | | | | **Examination Scheme** | | | | | | | **Credits** |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 04 | - | - | 04 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 04 |

To make the student understand

1. The use of various transforms in digital signals and systems analysis.
2. Spectrum estimation of discrete random signals.
3. Optimum filters and adaptive filters.
4. Multirate digital signal processing.

**Course Contents:**

Transforms and their applications: Review of Z Transform, Discrete Fourier Transform, Discrete Time Fourier Transform, Discrete Fourier series. Introduction to Discrete Wavelet Transform, Haar wavelet. Application of transforms to discrete signals.

Discrete Time Random Processes and Spectrum Estimation: Deterministic process, Stochastic( random ) process, Auto correlation and auto covariance of random processes, Cross correlation of random variables, Ergodic random process, Gaussian random process, Stationary and WSS random process, Power spectrum, Parseval's theorem, Wiener-Khintchine theorem, Spectral factorization, Periodogram - Modified periodograms using Bartlett, Welch, Blackman and Tukey windows, AR, MA, ARMA model based spectral estimation, Yule-Walker Equations, Durbin's algorithm.

Adaptive Filters: FIR adaptive filters, Stepest descent method, Window-Hoff LMS algorithm, Normalized LMS method, Adaptive channel equalization, Adaptive noise cancellation, IIR adaptive filters, RLS filters.

Multirate Digital Signal Processing: Need for multirate sampling, Decimation, Interpolation, Poly-phase filters, Multistage implementation, Phase shifters, Sub-band coders Transmultiplexers, Quadrature mirror filters.

**References:**

1. Monson H. Hayes, Statistical digital signal processing and modeling, John Wiley and Sons, 2005.
2. John G.Proakis& Dimitris G. Maolakis, DSP principles, algorithms and Applications, 4th edition, Pearson Education, 2007.
3. R. E. Crochiere and L. R. Rabiner. Multirate Digital Signal Processing

**Reference Books and website links:**

1. Openheim AV & Schafer RW, Discrete Time Signal Processing PHI. simulation text books 2/e 1999
2. Samuel D Stearns, "Digital Signal Processing with examples in Matlab. " CRC Press. 2/e, 2012
3. ES Gopi. "Algorithm collections for Digital Signal Processing Applications using Matlab, Springer. e/1 2007
4. Taan S.Elali, "Discrete Systems and Digital Signal Processing with Matlab, " CRC Press,2005
5. NPTEL course on **Foundations of Wavelets and Multirate Digital Signal Processing**
   Link: NOC | Foundations of Wavelets and Multirate Digital Signal Processing (nptel.ac.in)
   URL: https://archive.nptel.ac.in/noc/courses/noc17/SEM1/noc17-ee05/
6. NPTEL course on **Fundamentals of Wavelets, filter bsnks and Time Frequency Analysis and Wavelet Transform**
   Link: NPTEL :: Electrical Engineering - NOC:Fundamentals of Wavelets, Filter Banks and Time Frequency Analysis
   URL: ttps://archive.nptel.ac.in/courses/108/101/108101093/
7. NPTEL course on Adv. Digital Processing- Multirate and Wavelet
   Link: NPTEL :: Electronics & Communication Engineering - Adv. Digital Signal Processing - Multirate and wavelets
   URL: https://archive.nptel.ac.in/courses/117/101/117101001/
8. NPTEL course on Introduction to Time Frequency Analysis and Wavelet Transform
   Link: NOC | Introduction to Time-Frequency Analysis and Wavelet Transforms (nptel.ac.in)
   URL: https://archive.nptel.ac.in/noc/courses/noc16/SEM2/noc16-ch05/
9. Steven W. Smith. Online text., The Scientist and Engineer's Guide to Digital Signal Processing 2/e, 1999

**Course Outcomes:**

After Completion of Course students shall be able to

**ET2131.1** Understand Deterministic and Random processes in Signal Processing
**ET2131.2** Know the analysis of discrete time signals.
**ET2131.3** Design Optimum filters & adaptive filters.
**ET2131.4** Have sound knowledge to use DSP systems in real time applications
**ET2131.5** Understand multirate digital signal processing with its applications

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 |
| ET2131.1 | 3 | 2 | - | - | - |
| ET2131.2 | 2 | 3 | 2 | - | - |
| ET2131.3 | 1 | 3 | 3 | 3 | - |
| ET2131.4 | - | 2 | 1 | 3 | - |
| ET2131.5 | 3 | 1 | 1 | 1 | - |

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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| **Course Code** | **ET2132** | | | | | | | **Course category** | | | **PC** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Name** | **ADVANCE COMMUNICATION NETWORKS** | | | | | | | | | | |
| **Teaching Scheme** | | | | **Examination Scheme** | | | | | | | **Credits** |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 04 | - | - | 04 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 04 |

**Course Objectives:**

To make the student able

1. To study the concept of Layered Architectures.
2. To study the principles of wired and wireless networks, Mobile Ad-hoc Networks.
3. To study the different TCP/IP based networks.
4. To study High Performance networks based WiMax and UWB.

**Course Contents:**

Introduction: Overview of Communication Networks: Telephone networks, Computer networks, Cable television networks, Wireless networks, Networking principles, Digitalization, Network externalities, Service integration; Network Services and Layered Architecture: Traffic characterization and QoS, Network services, Network elements, Network mechanisms, Layered architecture, Network bottlenecks.

Broadband Networks Introduction: Multihop wireless broadband networks, Mesh networks, MANET importance of routing protocols, Classification of routing protocols in MANET, Routing metrics, Packet scheduling algorithms, Admission control mechanism

Internet and TCP / IP Networks Internet: Internet protocol, Technology trends in IP networks, IP packet communications in mobile communication networks; TCP and UDP, Internet success and limitation, Performance of TCP/ IP networks; Circuits Switched Networks: SONET, DWDM, Fiber to home, DSL, Intelligent Network (IN) scheme, Comparison with conventional systems, Merits of the IN scheme, CATV and layered network, Services over CATV.

ATM Networks Introduction: ATM reference model, Addressing, Signaling, Routing, ATM Adaptation Layer (AAL), Traffic classes, Traffic management and quality of service, Traffic descriptor, Traffic shaping, Management and control, Traffic and congestion control, Network status monitoring and control, User/ network signaling, Internetworking with ATM, IP over ATM, Multiprotocol over ATM.

High Performance Networks Introduction: WiMAX overview, Competing technologies, Overview of the physical layer, PMP mode, Mesh mode, Multihop relay mode; Introduction: UWB overview, Time hopping UWB, Direct sequence UWB, Multiband UWB; Introduction: LTE and LTE, A overview, System model, Specifications, Frame structure, Comparison with broadband technologies.

**Reference Books and website links:**

1. Amitabha Ghosh and Rapeepat Ratasuk, "Essentials ofLTE and LTE-A", Cambridge University, 2011.
2. David Tung Chong Wong, Peng-Yong Kong, Ying-Chang Liang, Kee Chaing Chua and Jon W. Mark, "Wireless Broadband Networks", John Wiley and Sons.
3. Jean Warland and Pravin Varaiya, "High Performance Communication Networks", 2nd Edition, Harcourt and Morgan Kanffman Publishers, London, 2008.
4. Leon Gracia and Widjaja, "Communication Networks", Tata McGraw Hill, 2008.
5. Lumit Kasera and Pankaj Sethi, "ATM Networks: Concepts and Protocols", Tata McGraw Hill, 2007.
6. Jeffrey G. Andrews, Arunabha Ghosh and Rias Muhamed, "Fundamentals of WiMAX understanding Broadband Wireless Networking", Prentice Hall of India, 2008.
7. https://onlinecourses.nptel.ac.in/noc23_cs35/preview
8. https://www.mooc-list.com/tags/network-communication

**Course Outcome:**

**ET2132.1** Understand the requirement of theoretical and practical aspect of computer network.
**ET2132.2** Describe various protocols used in High Performance based network.
**ET2132.3** Design the network
**ET2132.4** Design MANET based applications.
**ET2132.5** Understand ATM Network

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 |
| ET2132.1 | 2 | - | - | 2 | - |
| ET2132.2 | 2 | - | - | 1 | - |
| ET2132.3 | 1 | - | - | 1 | - |
| ET2132.4 | 1 | - | - | 3 | - |
| ET2132.5 | - | - | 3 | - | - |

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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| Course Code | ET2133 | Course category | PC |
|---|---|---|---|
| Course Name | OPTOELECTRONICS AND OPTICAL COMMUNICATION SYSTEMS | | |

| Teaching Scheme | | | | Examination Scheme | | | | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 04 | - | - | 04 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 04 |

**Course Objectives:**

Students shall be able to

1. To study the concept of designing parameters for optical transmitter and receiver.
2. To study the implementation of digital system.
3. To study the principles of direct and coherent detection systems.
4. To study the nonlinear properties of light propagation through optical.

**Course Contents:**

Integrated optics and photonics technologies; Planar waveguides: Some integrated optical devices, Beam splitters, directional couplers and switches, Modulators, Periodic structures for filters and injection lasers, Polarization transformers and wavelength converters; Optoelectronic integration; Photonic integrated circuits; Optical bistability and digital optics; Optical computation.

The optical transmitter circuit: Source limitations, LED drive circuits, Laser drive circuits; The optical receiver circuit: The preamplifier, Automatic gain control, Equalization; System design considerations, Component choice, Multiplexing; Digital systems; Digital system planning considerations, The optoelectronic regenerative repeater, The optical transmitter and modulation formats, The optical receiver, Channel losses, Temporal response Optical power budgeting, Line coding and forward error correction.

Analog systems: Direct intensity modulation (D–IM), System planning, Subcarrier intensity modulation, Subcarrier double-sideband modulation (DSB–IM),Subcarrier frequency modulation (FM–IM), Subcarrier phase modulation (PM–IM), Pulse analog techniques; Distribution systems; Multiplexing strategies: Optical time division multiplexing, Subcarrier multiplexing, Orthogonal frequency division

multiplexing, Wavelength division multiplexing, Optical code division multiplexing, Hybrid multiplexing, Application of optical amplifier.

Basic coherent system, Coherent detection principles, Practical constraints of coherent transmission: Injection laser line width, State of polarization, Local oscillator power, Transmission medium limitations; Modulation formats: Amplitude shift keying, Frequency shift keying, Phase shift keying, Polarization shift keying; Demodulation schemes: Heterodyne synchronous detection, Heterodyne asynchronous detection, Homodyne detection, Intradyne detection, Phase diversity reception, Polarization diversity reception and polarization scrambling, Differential phase shift keying, Receiver sensitivities: ASK heterodyne detection, FSK heterodyne detection, PSK heterodyne detection, ASK and PSK homodyne detection, Dual-filter direct detection FSK, Interferometric direct detection DPSK, Comparison of sensitivities; Multicarrier systems, Polarization multiplexing, High-capacity transmission.

Fiber Soliton, Nonlinear Schrodinger Equation, Bright Solitons, Dark Solitons; Soliton-Based Communications, Information Transmission with Solitons, Soliton Interaction3, Frequency Chirp, Soliton Transmitters; Loss-Managed Solitons, Loss-Induced Soliton Broadening ,Lumped Amplification, Distributed Amplification, Experimental Progress.

Dispersion-Managed Solitons, Dispersion-Decreasing Fibers, Periodic Dispersion Maps, Design Issues; Impact of Amplifier Noise, Moment Method, Energy and Frequency Fluctuations, Timing Jitter, Control of Timing Jitter; High-Speed Soliton Systems, System Design Issues, Soliton Interaction, Impact of Higher-Order Effects, Timing Jitter; WDM Soliton Systems, Interchannel Collisions, Effect of Lumped Amplification, Timing Jitter, Dispersion Management.

**Reference Books and website links:**

1. Senior J.M, “Optical Fiber Communications Principles and Practice”, 3rd edition, Pearson Education, 2009.
2. Govind P. Agrawal, “Fiber- Optic Communication Systems”, 3rd edition John Wiley and Sons, 2002.

**Course Outcomes:**

On completion of the course, students will be able to:

**ET2133.1** Understand integrated optics and photonics, various optical signal manipulating and processing components and devices to facilitate high performance optical communication systems and networks.

**ET2133.2** Describe and design transmitters and receivers for a digital optical communication system.

**ET2133.3** Understand and analyze various modulation and multiplexing schemes for analog optical communication systems.

**ET2133.4** Comprehend and analyze direct detection, coherent transmission and detection system.

**ET2133.5** Understand how to use nonlinear property of light propagation in optical fiber in the form of Soliton.

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 |
| ET2133.1 | 1 | 2 | 1 | - | - |
| ET2133.2 | 1 | 2 | 2 | - | - |
| ET2133.3 | 1 | 2 | 2 | - | - |
| ET2133.4 | 1 | 1 | 2 | - | - |
| ET2133.5 | 1 | 2 | - | - | - |

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

| **Course Code** | **ET2134 (A)** | **Course category** | **PE** |
|---|---|---|---|
| **Course Name** | **RF AND MICROWAVE CIRCUIT DESIGN** | | |

| **Teaching Scheme** | | | | **Examination Scheme** | | | | | | | | **Credits** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 04 | - | - | 04 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 04 |

**Course Objectives:**

To make the student understand

1. Different passive and active components.
2. Various parameters of transmission line and use of Smith chart.
3. Choosing Optimum components.
4. Application of RF circuit design.

**Course Contents:**

Transmission Line Theory: Lumped element circuit model for transmission line, Field analysis, Smith chart, Quarter wave transformer, Generator and load mismatch, Impedance matching and tuning.

Microwave Network Analysis: Impedance and equivalent voltage and current, Impedance and admittance matrix, The scattering matrix, Transmission matrix, Signal flow graph.

Microwave Components: Microwave resonators, Microwave filters, Power dividers and directional couplers, Ferromagnetic devices and components.

Nonlinearity and Time Variance Inter-symbol interference, Random process & noise, Definition of sensitivity and Dynamic range, Conversion gain and distortion.

Microwave Semiconductor Devices and Modeling: PIN diode, Tunnel diodes, Varactor diode, Schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and power GaAs FETs, MESFET, MOSFET, and HEMT.

Amplifiers Design: Power gain equations, Stability, Impedance matching, Constant gain and noise figure circles, Small signal, Low noise, High power and Broadband amplifier, Oscillators, Mixers design.

**Reference Books and website links:**

1. Matthew M. Radmanesh, “Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design”, Author House, 2009.
2. D.M.Pozar, “Microwave engineering”, Wiley, 4th edition, 2011.
3. R.Ludwig and P.Bretchko, “R. F. Circuit Design”, Pearson Education Inc, 2009.
4. G.D. Vendelin, A.M. Pavoi, U. L. Rohde, “Microwave Circuit Design Using Linear and Non Linear Techniques”, John Wiley 1990.
5. S.Y. Liao, “Microwave circuit Analysis and Amplifier Design”, Prentice Hall 1987.

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6. Radmanesh, "RF and Microwave Electronics Illustrated", Pearson Education, 2004.

**Course Outcomes**:
At the end of this course, students shall be able

**ET2134(A).1** Perform transmission line analysis and demonstrate use of Smith Chart for high frequency circuit design.

**ET2134(A).2** To analyze Microwave network by using various matrices and signal flow graph.

**ET2134(A).3** To understand the behaviour of RF passive components and model active components.

**ET2134(A).4** Justify the choice/selection of components from the design aspects.

**ET2134(A).5** Contribute in the areas of RF circuit design.

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 |
| ET2134(A).1 | 3 | 2 | 1 | - | - |
| ET2134(A).2 | 3 | 2 | 1 | - | - |
| ET2134(A).3 | 2 | 2 | - | - | - |
| ET2134(A).4 | 2 | 2 | - | - | - |
| ET2134(A).5 | 2 | 3 | - | - | - |

0 – Not correlated 1 – Weakly Correlated 2 – Moderately Correlated 3 – Strongly Correlated

| Course Code | ET2134 (B) | Course category | PE |
|---|---|---|---|
| Course Name | EMBEDDED SYSTEM DESIGN | | |

| Teaching Scheme | | | | Examination Scheme | | | | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 04 | - | - | 04 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 04 |

**Course Objectives:**

To make the student able

1. To understand basics of embedded systems.
2. To study the architecture of Microcontroller.
3. To understand need and application of Microcontroller in embedded system.
4. To learn external interfacing of real world input and output devices with Microcontroller.

**Course Contents:**

Introduction to Embedded System, Applications and Scope
32 bit Microcontroller architecture, Assembly Language and C language programming, Microcontroller based development boards
Introduction to Arduino boards, Sketching in code
Working with variables, Making decisions and repetitive operations
Digital Ins and Outs, Analog Ins and Outs, Interfacing switches, buzzer, seven segment displays
Timings functions, Random Functions, Writing new functions, Hardware Interrupts
Arrays and Memory, Hardware Libraries Using Serial and I2C bus
Case studies of a few projects using Arduino boards and Shields

**Reference Books and website links:**

1. Joseph Yiu, “The definitive guide to ARM Cortex-M3”, Elsevier, 2nd Edition
2. Brian Evans, “Beginning Arduino Programming”, Springer, 2011
3. Michael J. Pont, “Embedded C”, Pearson Education, 2nd Edition, 2008
4. Raj Kamal, “Embedded Systems – Architecture: Programming and Design”, TMH
5. Frank Vahid and Tony Givargis, “Embedded System Design”, Wiley

**Course Outcomes:**

At the end of this course, students shall be able to

**ET2134(B).1** Deploy low end applications using low and high level languages on

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microcontroller platform.

**ET2134(B).2** Implement simple sketches on the Arduino boards involving several Peripherals.

**ET2134(B).3** Identify, design and implement applications on the Arduino boards producing custom shields.

**ET2134(B).4** Implement timing function for different applications

**ET2134(B).5** Implement I2C application for any one application

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **ET2134(B).1** | 3 | - | - | 1 | - |
| **ET2134(B).2** | - | 3 | - | - | - |
| **ET2134(B).3** | - | 3 | 1 | - | - |
| **ET2134(B).4** | - | - | 3 | - | - |
| **ET2134(B).5** | - | - | - | 2 | 3 |

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

| Course Code | ET2134 (C) | | | | | | | | Course category | | | PE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Name | SOFT COMPUTING | | | | | | | | | | | |
| Teaching Scheme | | | | Examination Scheme | | | | | | | | Credits |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 04 | - | - | 04 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 04 |

**Course Objectives:**

To make the student able

1. To understand the fundamentals of soft computing.
2. To understand the concepts of Fuzzy logic and Artificial Neural Networks and optimization techniques using Genetic algorithm.
3. To solve single and multi-objective optimization problems.
4. To solve real time applications based on soft computing techniques.

**Course Contents:**

Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques

Fuzzy logic: Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques, Fuzzy logic controller design, Some applications of Fuzzy logic.

Genetic Algorithms: Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation, etc, Solving single-objective optimization problems using GAs.

Multi-objective Optimization Problem Solving: Concept of multi-objective optimization problems (MOOPs) and issues of solving them, Multi-Objective Evolutionary Algorithm (MOEA),Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs, Some applications with MOEAs

Artificial Neural Networks: Biological neurons and its working, Simulation of biological neurons to problem solving, Different ANNs architectures, Training techniques for ANNs, Applications of ANNs

to solve some real life problems.

**Reference Books and website links:**

1. Soft Computing and Its Applications: R.A. Aliev, R.R. Aliev
2. Neuro-Fuzzy and Soft Computing: A computational Approach to Learning & Machine Intelligence; Roger Jang, Tsai Sun, Eiji Mizutani, PHI.
3. Neural Network: A Comprehensive Foundation; Simon Haykin, PHI.
4. Elements of artificial Neural Networks; Kishan Mehtrotra, S. Ranka, Penram International Publishing (India).
5. Fuzzy Logic with Engineering Applications; Timothy Ross, McGraw-Hill.
6. http://onlinecourses.nptel.ac.in/noc22/preview

**Course Outcomes:**

After completing this course, Students shall be able to learn:

**ET2134(C).1** Fuzzy logic and its applications

**ET2134(C).2** Artificial neural network and its applications

**ET2134(C).3** Solve single and multi-objective optimization problems

**ET2134(C).4** Applications of soft computing to solve any real life problem.

**ET2134(C).5** Applications with Multi-Objective Evolutionary Algorithm (MOEA )

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 |
| ET2134(C).1 | 3 | - | 1 | 3 | - |
| ET2134(C).2 | 3 | - | 1 | 3 | - |
| ET2134(C).3 | - | 3 | - | 3 | - |
| ET2134(C).4 | - | - | 1 | 3 | - |
| ET2134(C).5 | - | - | 1 | 3 | - |

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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| Course Code | ET2134(D) | | | | | | | Course category | | | PE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Name | OPTICAL NETWORKS | | | | | | | | | | |
| Teaching Scheme | | | | Examination Scheme | | | | | | | Credits |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 04 | - | - | 04 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 04 |

**Course Objectives:**

1. To make the student able
2. To understand various issues in designing an optical network.
3. To study WDM network design.
4. To study optical network

**Course Contents:**

SONET/SDH: Optical transport network, IP, Routing and forwarding, Multiprotocol label switching.

WDM network elements: Optical line terminals and amplifiers, Optical add/drop multiplexers, OADM architectures, Reconfigurable OADM, Optical cross connects.

Control and management: Network management functions, Optical layer services and interfacing, Performance and fault management, Configuration management, Optical safety.

Network Survivability: Protection in SONET/SDH & client layer, Optical layer protection schemes.

WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models.

Division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON.

**Reference Books and website links:**

1. Rajiv Ramaswami, Sivarajan, Sasaki, “Optical Networks: A Practical Perspective”, MK, Elsevier, 3 rd edition, 2010.
2. Siva Ram Murthy and Mohan Gurusamy, “WDM Optical Networks: Concepts Design, and Algorithms”, PHI, EEE, 2001.

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**Course Outcomes**:
At the end of this course, students shall be able to

**ETP124(D).1** Contribute in the areas of optical network

**ETP124(D).2** Understand and design WDM network

**ETP124(D).3** Deal with optical network survivability.

**ETP124(D).4** Implement and manage simple optical network.

**ET2134(D).5** Understand further technology developments for future enhanced network.

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | | |
|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
| **ET2134(D).1** | 1 | 2 | - | - | 3 | 1 |
| **ET2134(D).2** | 2 | 2 | - | - | 2 | 2 |
| **ET2134(D).3** | 1 | 1 | - | - | 2 | 1 |
| **ET2134(D).4** | 1 | 2 | - | - | 2 | 1 |
| **ET2134(D).5** | 1 | 2 | 1 | - | 2 | 1 |

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

| Course Code | ET2135 | | | | | | | Course category | | PC |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Name | SYSTEM DESIGN AND COMMUNICATION LABORATORY | | | | | | | | | |
| Teaching Scheme | | | | Examination Scheme | | | | | | Credits |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 00 | 00 | 06 | 06 | -- | -- | -- | -- | -- | 50 | 50 | 100 | 03 |

**The instructor may choose experiments as per his/her requirements, so as to cover entire course contents of ET2131, ET2132, ET2133 and/or ET2134. Minimum 10 experiments should be performed.**

**Note :**

**ICA -** Internal Continuous Assessment shall be based on the practical record and knowledge /skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

**ESE -** The End Semester Exam for practical shall be based on performance in one of experiments and may be followed by sample questions.

**Course Outcomes:**

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

**ET2135.1** Using Network software analyze the various protocols used in High Performance based network.

**ET2135.2** To analyze Microwave network by using various matrices and signal flow graph.

**ET2135.3** Identify, design and implement applications on the Arduino boards

**CO-PO Mapping:**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| ET2135.1 | 2 | 1 | - | 1 | 1 |
| ET2135.2 | 2 | 3 | - | 1 | 1 |
| ET2135.3 | 3 | 2 | 2 | 2 | 1 |

0- Not correlated 1 - Weakly Correlate 2- Moderately Correlated 3- Strongly Correlated

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| Course Code | ET2136 | Course category | ISS |
|---|---|---|---|
| Course Name | SEMINAR I | | |

| Teaching Scheme | | | | Examination Scheme | | | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Th | Tu | Pr | Total | Theory | | | | Practical | | Total | |
| | | | | MSE | TA | ESE | ESE Duration | ICA | ESE | | |
| 00 | 00 | 01 | 01 | -- | -- | -- | -- | 50 | -- | 50 | 02 |

**Course Objectives:**

To make the students competent:

1. To select a topic for seminar based on latest technological advancements and carry out literature review
2. Write seminar report
3. Prepare and present Power Point Presentation for Seminar

**Course Contents:**

Student has to select a topic for Seminar based on literature review on advanced topics / recent developments in the field of Electronics and Telecommunication Engineering and submit the report and deliver the seminar based on it. It is to be evaluated internally by panel of examiners headed by HOD (if possible) wherein guide should be one of the members of the panel

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to:

**ET2136.1:** Select a topic for seminar based on latest technological advancements and collect related literature

**ET2136.2:** Prepare seminar report and power point presentation based on information collected related to the selected topic

**ET2136.3:** Deliver seminar

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 |
| ET2136.1 | 1 | 1 | 1 | 1 | 1 |
| ET2136.2 | 1 | 1 | 1 | 1 | 1 |
| ET2136.3 | 1 | 1 | 1 | 1 | 1 |

0- Not correlated 1 - Weakly Correlate 2- Moderately Correlated 3- Strongly Correlated

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| **Course Code** | **ET2231** | | | | | | **Course category** | | | **PC** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Course Name** | **ANTENNAS AND RADIATING SYSTEMS** | | | | | | | | | |
| **Teaching Scheme** | | | | **Examination Scheme** | | | | | | **Credits** |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

**Course Objectives:**

The students shall

1. Be acquainted with various types of antennas and different methods of their analysis.
2. Develop the concepts of antenna arrays and their applications.
3. Be able to appreciate the role of aperture antennas in communication systems
4. Be able to understand radiation pattern, how to design antenna and antenna arrays.

**Course Contents:**

**Types of Antennas:** Wire antennas, Aperture antennas, Micro strip antennas, Array antennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna.

**Fundamental Parameters of Antennas**: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.

**Linear Wire Antennas:** Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects. Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non uniform current.

**Linear Arrays:** Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, Design consideration.

**Aperture Antennas:** Huygen's Field Equivalence principle, radiation equations, Rectangular Aperture,

Circular Aperture. Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns.

**Micro strip Antennas**: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch. Reflector Antennas: Plane reflector, parabolic reflector, Cass grain reflectors, Introduction to MIMO.

**Reference Books and web link :**

1. Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 4th edition, 2016. 21
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for All Applications", Tata McGraw-Hill, 2002.
3. R. C.Johnson and H.Jasik, "Antenna Engineering hand book", Mc-Grew Hill, 1984. R. I. J. Bhal and P. Bhartia, "Micro-strip antennas", Artech house, 1980.
4. Antenna Theory and Design W. L. Stutzman, G. A. Thiele, 2nd edition, John Wiley and Sons, 1998
5. https://archive.nptel.ac.in/courses/108/101/108101092/
6. https://ieeeaps.org/online-course-introduction-to-antennas-theory-design-fabrication-and-measurement/486

**Course Outcomes:**

At the end of this course, students shall be able to

**ET2231.1** Compute the far field distance, radiation pattern and gain of an antenna for given current distribution.

**ET2231.2** Estimate the input impedance, efficiency and ease of match for antennas.

**ET2231.3** Compute the array factor for an array of identical antennas.

**ET2231.4** Design antennas and antenna arrays for various desired radiation pattern Characteristics

**ET2231.5** Calculate performance parameters of antennas using software.

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 |
| ET2231.1 | 2 | - | - | 2 | - |
| ET2231.2 | 2 | - | - | 1 | - |
| ET2231.3 | 1 | - | - | 1 | - |
| ET2231.4 | 1 | - | - | 3 | - |
| ET2231.5 | - | - | 3 | - | - |

0 – Not correlated 1 – Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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| Course Code | ET2232 | Course category | PC |
|---|---|---|---|
| Course Name | ANALOG AND DIGITAL CMOS VLSI DESIGN | | |

| Teaching Scheme | | | | Examination Scheme | | | | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

**Course Objectives:**

1. To understand the operation of MOS devices.
2. To analyze MOS devices in small and large signal conditions.
3. To understand back-end design tools.
4. To impart in-depth knowledge about switched capacitors and Op-AMP using MOS devices.

**Course Contents:**

Review: Basic MOS structure and its static behavior, Quality metrics of a digital design: Cost, Functionality, Robustness, Power, and Delay, Stick diagram and Layout, Wire delay models. Inverter: Static CMOS inverter, Switching threshold and noise margin concepts and their evaluation, Dynamic behavior, Power consumption.

Physical design flow: Floor planning, Placement, Routing, CTS, Power analysis and IR drop estimation-static and dynamic, ESD protection-human body model, Machine model. Combinational logic: Static CMOS design, Logic effort, Ratioed logic, Pass transistor logic, Dynamic logic, Speed and power dissipation in dynamic logic, Cascading dynamic gates, CMOS transmission gate logic.

Sequential logic: Static latches and registers, Bi-stability principle, MUX based latches, Static SR flip-flops, Master-slave edge-triggered register, Dynamic latches and registers, Concept of pipelining, Pulse registers, Non-bistable sequential circuit. Advanced technologies: Giga-scale dilemma, Short channel effects, High–k, Metal Gate Technology, FinFET, TFET etc.

Analog CMOS Design: Single Stage Amplifier: CS stage with resistance load, Divide connected load, Current source load, Triode load, CS stage with source degeneration, Source follower, Common gate stage, Cascade stage, Choice of device models. Differential Amplifiers: Basic difference pair, Common mode response, Differential pair with MOS loads, Gilbert cell.

Passive and active current mirrors: Basic current mirrors, Cascade mirrors, Active current mirrors. Frequency response of CS stage: Source follower, Common gate stage, Cascade stage and difference pair, Noise

Operational amplifiers: One stage OPAMP, Two stage OPAMP, Gain boosting, Common mode feedback, Slew rate, PSRR, Compensation of 2 stage OPAMP, Other compensation techniques.

**Reference Books and Websites:**

1. J P Rabaey, A P Chandrakasan, B Nikolic, "Digital Integrated circuits: A design perspective", Prentice Hall electronics and VLSI series, 2nd Edition.
2. Baker, Li, Boyce, "CMOS Circuit Design, Layout, and Simulation", Wiley, 2nd Edition.
3. Behzad Razavi , "Design of Analog CMOS Integrated Circuits", TMH, 2007.
4. Phillip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford, 3rd Edition.
5. R J Baker, "CMOS circuit Design, Layout and Simulation", IEEE Inc., 2008.
6. Kang, S. and Leblebici, Y., "CMOS Digital Integrated Circuits, Analysis and Design", TMH, 3rdEdition.
7. Pucknell, D.A. and Eshraghian, K., "Basic VLSI Design", PHI, 3rd Edition.
8. https://nptel.ac.in/courses/108107129
9. https://nptel.ac.in/courses/117101105

**Course Outcome:**

On completion of the course, students will be able to:

**ET2232.1** Develop insight into the working of MOS transistors

**ET2232.2** Apply principles of digital CMOS VLSI from transistor up to the system level

**ET2232.3** Design and simulate analog and digital CMOS circuits

**ET2232.4** Analyze analog and digital circuits using CMOS constrained by the design metrics

**ET2232.5** Use EDA tools like Cadence, Mentor Graphics and other open source software tools like Ngspice

**CO – PO Mapping:**

| Course Outcomes | Programme Outcomes | | | | |
|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 |
| ET2232.1 | 1 | - | - | - | - |
| ET2232.2 | 1 | 2 | - | 1 | - |
| ET2232.3 | - | 1 | 2 | 2 | - |
| ET2232.4 | - | - | | 2 | - |
| ET2232.5 | - | - | 3 | - | - |

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| Course Code | ET2233 | Course category | PC |
|---|---|---|---|
| Course Name | IMAGE AND VIDEO PROCESSING | | |

| Teaching Scheme | | | | Examination Scheme | | | | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

0 – Not correlated 2 – Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

**Course Objectives:**

Students will be able to understand,

1. Basic concepts of image processing, fundamentals and mathematical models in digital image and video processing.
2. Different types of image transforms for image processing
3. Image enhancement and develop time and frequency domain techniques for it.
4. Image segmentation, restoration, and morphological signal processing with applications.

**Course Contents:**

Introduction to Digital Image Processing & Applications: elements of visual perception, Mach band effect, sampling, quantization, basic relationship between pixels, color image fundamentals-RGB-HSI models, image transforms - two dimensional orthogonal and unitary transforms, separable unitary transforms, basis images, DFT, WHT, KLT, DCT and SVD

Image compression: lossy and lossless compression, image compression standards, Application in various fields

Image Enhancement: filters in spatial and frequency domains, histogram-based processing, homomorphic filtering, image restoration: degradation models, PSF, circulant and block-circulant matrices, deconvolution, restoration using inverse filtering, Wiener filtering and maximum entropy based methods, image segmentation: pixel classification, bi-level thresholding, multilevel thresholding, adaptive thresholding, spectral & spatial classification, edge detection, Hough transform, region growing.

Boundary Representation: chain codes, polygonal approximation, boundary segments, boundary descriptors, regional descriptors, relational descriptors, object recognition, pattern and pattern classes, recognition based on decision theoretic methods, matching, optimum statistical classifiers, structural

methods, matching shape numbers, string methods, morphological image processing, erosion and dilation, opening or closing, HIT or MISS transformation, basic morphological algorithms, grey scale morphology.

Video Processing: display enhancement, video mixing, video scaling, scan rate conversion, representation of digital video, Spatio-temporal sampling, video compression-motion estimation, intra and interframe prediction, perceptual coding, standards - MPEG, H.264.

**Reference Books and websites:**

1. Fundamentals of Digital Image processing, A. K. Jain, Pearson Education, 2989
2. Digital Image Processing using MATLAB, R. C. Gonzalez , R. E. Woods and S. L. Eddins: Pearson Education, 2004
3. Digital Image Processing; G. A. Baxes: John Wiley, 2994
4. Digital Image Processing and Computer Vision; R.J. Schalkoff: John Wiley, 2989.
5. Image Processing; Sid Ahmed: McGraw - Hill, 2994.
6. Digital Video and Audio Compression; S.J. Solari: McGraw - Hill, 2996.
7. Video Processing and Communications" by Yao Wang, Joern Ostermann, and Ya - Qin Zhang, Prentice Hall, 2002, ISBN 0 - 23 - 027547 - 2
8. Digital Video Processing , M. Tekalp Prentice Hall, 2995, ISBN 0 - 23 - 290075 - 7
9. The Art of Digital Video, J. Watkinson, 3rd edition, Focal Press, 2000. 22. "Video Demystified", K. Jack, 3rd edition, Llh Technology Publishing, 2002.
10. Motion Analysis and Image Sequence Processing, edited by M.I. Sezan and R.L. Lagendijk, Kluwer Academic Publishers, 2993.
11. Image and Video Compression Standards: Algorithms and Architectures, V. Bhaskaran and K. Konstantinides, Kluwer Academic Publishers, 2nd edition, 2997.
12. NPTEL on https://onlinecourses.nptel.ac.in/noc19_ee55 Digital Image Processing
13. NPTEL on https://archive.nptel.ac.in/courses/117/104/117104020/ Digital Video Processing

**Course Outcomes:**

At the end of the course student will be able to:

**ET2233.1** Understand theory and models in Image Processing.

**ET2233.2** Interpret and analyze 2D signals in frequency domain through image transforms.

**ET2233.3** Apply quantitative models of image processing for various engineering applications

**ET2233.4** Develop innovative design for practical applications in various fields.

**ET2233.5** Understand theory and models in Video Processing

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 |
| ET2233.1 | 2 | 1 | - | 2 | - |
| ET2233.2 | 2 | 1 | - | 3 | - |
| ET2233.3 | 1 | - | 1 | 2 | - |
| ET2233.4 | 1 | - | 1 | 3 | 1 |

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| Course Code | ET2234(A) | | | | | | Course category | | PE |
|---|---|---|---|---|---|---|---|---|---|
| Course Name | SATELLITE COMMUNICATION | | | | | | | | |
| Teaching Scheme | | | | Examination Scheme | | | | | Credits |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

| | | | | | | |
|---|---|---|---|---|---|---|
| ET2233.5 | 1 | - | - | - | - |

0 - Not correlated 2 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

**Course Objectives:**

To make the student understand

1. The architecture of satellite systems.
2. Various aspects like orbital equations, different sub systems of satellite, parameter to be considered while designing link budget, modulation and multiple access schemes.
3. How to design link budget and solve numerical of orbital motions.

**Course Contents:**

Architecture of Satellite Communication System: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications, and frequency bands used for satellite communication and their advantages/drawbacks.

Orbital Analysis: Orbital equations, Kepler's laws of planetary motion, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc of a satellite, concepts of Solar day and Sidereal day.

Satellite sub-systems: Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems, antenna sub-system.

Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

Satellite link budget: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio

calculations in clear air and rainy conditions, Case study of Personal Communication system (satellite telephony) using LEO.

Modulation and Multiple Access Schemes: Modulation and Multiple Access Schemes used in satellite communication. Typical case studies of VSAT, DBS-TV satellites and few recent communication satellites launched by NASA/ ISRO. GPS system.

**Reference Books and websites:**

1 Timothy Pratt and Others, "Satellite Communications", Wiley India, 2nd edition, 2010.

2 S. K. Raman, "Fundamentals of Satellite Communication", Pearson Education India, 2011.

3. Tri T. Ha, "Digital Satellite Communications", Tata McGraw Hill, 2009.

4. Dennis Roddy, "Satellite Communication", McGraw Hill, 4th Edition, 2008.

5. https://archive.nptel.ac.in/courses/117/105/117105131/

6. https://coursesity.com/course-detail/introduction-to-satellite-communications

7. https://www.imt.fr/en/mooc-introduction-to-satellite-communications-on-coursera/

**Course Outcomes**:

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

**ET2234(A)**.1 learn the dynamics of the satellite and understand the communication satellite design

**ET2234(A)**.2 Understand the design of Earth station and tracking of the satellites

**ET2234(A)**.3 State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.

**ET2234(A)**.4 Solve numerical problems related to orbital motion.

**ET2234(A)**.5 Design of link budget for the given parameters and conditions

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | PO2 | PO2 | PO3 | PO4 | PO5 |
| ET2234(A).1 | 1 | 1 | - | 2 | - |
| ET2234(A).2 | 1 | 1 | - | 1 | - |
| ET2234(A).3 | 1 | 1 | - | 1 | - |
| ET2234(A).4 | - | 2 | - | 1 | - |

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| Course Code | ET2234(B) | | | | | | Course category | | PE |
|---|---|---|---|---|---|---|---|---|---|
| Course Name | PROGRAMMING LANGUAGE FOR EMBEDDED SYSTEMS | | | | | | | | |
| Teaching Scheme | | | | Examination Scheme | | | | | Credits |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |
| ET2234(A).5 | | | | - | | 1 | | - | | 2 | | - |

0 - Not correlated 2 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

**Course Objective:**
To make the student able

1. To understand fundamental of embedded C programming
2. To learn how to develop and analyze algorithms in C++
3. To comprehend Object oriented programming
4. To study various scripting languages

**Course Contents:**
Embedded 'C' Programming - Bitwise operations, Dynamic memory allocation, OS services - Linked stack and queue, Sparse matrices, Binary tree - Interrupt handling in C, Code optimization issues - Writing LCD drives, LED drivers, Drivers for serial port communication - Embedded Software Development Cycle and Methods (Waterfall, Agile)

Object Oriented Programming - Introduction to procedural, modular, object-oriented and generic programming techniques, Limitations of procedural programming, objects, classes, data members, methods, data encapsulation, data abstraction and information hiding, inheritance, polymorphism

CPP Programming: 'cin', 'cout', formatting and I/O manipulators, new and delete operators, Defining a class, data members and methods, 'this' pointer, constructors, destructors, friend function, dynamic memory allocation

Overloading and Inheritance: Need of operator overloading, overloading the assignment, overloading using friends, type conversions, single inheritance, base and derived classes, friend classes, types of inheritance, hybrid inheritance, multiple inheritance, virtual base class, polymorphism, virtual functions.

Templates: Function template and class template, member function templates and template arguments, Exception Handling: syntax for exception handling code: try-catch- throw, Multiple Exceptions.

Scripting Languages Overview of Scripting Languages – PERL, CGI, VB Script, Java Script. PERL: Operators, Statements Pattern Matching etc. Data Structures, Modules, Objects, Tied Variables, Inter process Communication Threads, Compilation & Line Interfacing.

**Reference Books and websites:**

2. Michael J. Pont, "Embedded C", Pearson Education, 2nd Edition, 2008 .
2. Randal L. Schwartz, "Learning Perl", O'Reilly Publications, 6th Edition 2022
3. A. Michael Berman, "Data structures via C++", Oxford University Press, 2002
4. Robert Sedgewick, "Algorithms in C++", Addison Wesley Publishing Company,2995
5. Abraham Silberschatz, Peter B, Greg Gagne, "Operating System Concepts", John,Willey &Sons, 2005

**Course Outcomes:**

At the end of this course, students shall be able to

**ET2234(B).1** Write an embedded C application of moderate complexity.
**ET2234(B).2** Develop and analyze algorithms in C++.
**ET2234(B).3** Differentiate interpreted languages from compiled languages.
**ET2234(B).4** Able to apply scripting language for different applications.
**ET2234(B).5** Differentiate among various interposes communication

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | PO2 | PO2 | PO3 | PO4 | PO5 |
| ET2234(B).1 | 3 | - | - | 2 | - |
| ET2234(B).2 | - | 2 | - | - | - |
| ET2234(B).3 | - | - | 2 | 2 | 2 |
| ET2234(B).4 | 3 | - | - | - | - |
| ET2234(B).5 | 3 | - | - | - | 2 |

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0- Not correlated 2 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

| Course Code | ET2234(C) | | | | | | | Course category | | PE |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Name | PATTERN RECOGNITION AND MACHINE LEARNING | | | | | | | | | |
| Teaching Scheme | | | | Examination Scheme | | | | | | Credits |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

**Course Objectives:**

To make the student able

I. To Understand the concept of a pattern and the basic approach to the development of pattern recognition and machine intelligence algorithms.
II. To Understand the basic methods of Neural Network along with new training Methods.
III. To understand deep learning and apply unsupervised classification methods to detect and characterize patterns in real-world data.
IV. To Develop prototype pattern recognition algorithms that can be used to study algorithm behaviour and performance against real-world multivariate data.

**Course Contents:**

Introduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis

Linear models: Linear Models for Regression, linear regression, logistic regression Linear Models for Classification

Neural Network: Perceptron, multi-layer perceptron, backpropagation algorithm, error surfaces, practical techniques for improving back propagation, additional networks and training methods, Adaboost, Deep Learning

Linear discriminant functions-Decision surfaces, two-category, multi-category, minimum- squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

Algorithm independent machine learning-lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers

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Unsupervised learning and clustering-k-means clustering, fuzzy k-means clustering, hierarchical clustering

**Reference Books and websites:**

1. RichardO.Duda,DavidG.Stork,"PatternClassification",2nd Edition John Wiley & Sons, 2002.
2. Trevor Hasti, Robert Tibshirani, Jerome H. Friedman, "The Elements of Statistical Learning", 2nd Edition, Springer, 2009.
3. C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
4. NPTEL video on Pattern Recognition and Machine Learning http://archive.nptel.ac.in/courses/117/105/117105101/

**Course Outcomes**

At the end of this course, students shall be able

**ET2234(C).1** To study the parametric and linear models for classification.

**ET2234(C).2** To design neural network and SVM for classification.

**ET2234(C).3** To develop machine independent and unsupervised learning techniques.

**ET2234(C).4** To study algorithm independent machine learning.

**ET2234(C).5** To study Unsupervised learning

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | PO2 | PO2 | PO3 | PO4 | PO5 |
| ET2234(C).1 | 3 | - | - | 2 | - |
| ET2234(C).2 | - | 2 | - | - | - |
| ET2234(C).3 | - | - | 2 | 2 | 2 |
| ET2234(C).4 | 3 | - | - | - | - |
| ET2234(C).5 | - | - | 2 | 2 | - |

0- Not correlated 2 – Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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| Course Code | ET2234(D) | | | | | | | Course category | | | PE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Name | WIRELESS SENSOR NETWORKS | | | | | | | | | | |
| Teaching Scheme | | | | Examination Scheme | | | | | | | Credits |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

**Course Objectives:** To make the student understand

1. Various parameters for designing wireless sensor network.
2. How to select optimum sensors depending on application.
3. Different standards and protocols of wireless sensor network.
4. What are different energy and security challenges involved in wireless sensors

Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.

Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

Overview of sensor network protocols (details of atleast 2 important protocol per layer): Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.25.4, Bluetooth, BLE (Bluetooth low energy), UWB.

Data Management: Data dissemination and processing; differences compared with other database management systems, data storage; query processing.

Specialized features: Energy preservation and efficiency; security challenges; fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.

**Reference Books and websites:**

1. H. Karl and A. Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, India, 2022.
2. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, “Wireless Sensor

Networks", Springer Verlag, 2st Indian reprint, 2020.
3. F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 2st Indian reprint, 2023.
4. Yingshu Li, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technology, 2008.

**Course Outcomes**:

At the end of this course, students shall be able to

**ET2234(D).1** Design wireless sensor network system for different applications under consideration.
**ET2234(D).2** Understand the hardware details of different types of sensors and select right type of sensor for various applications.
**ET2234(D).3** Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.
**ET2234(D).4** Analyse the performance of related database management systems
**ET2234(D).5** Handle special issues related to sensors like energy conservation and security challenges.

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | PO2 | PO2 | PO3 | PO4 | PO5 |
| ET2234(D).1 | 3 | - | - | 2 | - |
| ET2234(D).2 | - | 2 | - | - | - |
| ET2234(D).3 | - | - | 2 | 2 | 2 |
| ET2234(D).4 | - | 1 | 3 | 3 | - |
| ET2234(D).5 | 3 | - | - | - | - |

0- Not correlated 2 – Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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| Course Code | SH2201 | | | | | | | Course category | | RM |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Name | RESEARCH METHODOLOGY | | | | | | | | | |
| Teaching Scheme | | | | Examination Scheme | | | | | | Credits |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 02 | - | - | 02 | 15 | 15 | 10 | -- | -- | - | - | 50 | 02 |

**Course Objectives:**

To make the students aware and understand:

1. Research problem formulation and methods
2. Data collection methods and analyze research related information
3. Research reports, and thesis writing
4. Research Ethics and Intellectual Property Right
5. Research paper writing and publishing

**Course Contents:**

**Introduction to Research**: Definition of research, Characteristics of research, Types of research- Descriptive *vs.* Analytical, Applied *vs.* Fundamental, Quantitative *vs.* Qualitative, Conceptual *vs.* Empirical, Steps of research methodology

**Research Problem Formulation and Methods:**

Literature review, sources of literature, various referencing procedures, maintain literature data using Endnote2, Identifying the research areas from the literature review and research database, Problem Formulation, Identifying variables to be studied, determining the scope, objectives, limitations and or assumptions of the identified research problem, Justify basis for assumption, Formulate time plan for achieving targeted problem solution. Important steps in research methods: Observation and Facts, Laws and Theories, Development of Models. Developing a research plan: Exploration, Description, Diagnosis and Experimentation

**Data collection**:

Sampling methods, methods of data collection, Basic Concepts concerning testing of hypotheses, procedures of hypothesis testing, generalization and interpretation Applied statistics: Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis Software tools for modeling, Simulation and analysis.

**Research reports and Thesis writing**

Introduction: Structure and components of scientific reports, types of report, Thesis writing: different steps and software tools in the design andpreparation of thesis, layout, structure and language of typical reports, Illustrations and tables, bibliography, referencing and footnotes, Oral presentation: planning, software tools, creating and making effective presentation, use of visual aids, importance of effective communication.

**Research Ethics, IPR and Publishing**:

Ethics: Ethical issues.

IPR: intellectual property rights and patent law, techniques of writing a Patent, filing procedure, technology transfer, copy right, royalty, trade related aspects of intellectual propertyrights,

Publishing: design of research paper, citation and acknowledgement, plagiarism tools, reproducibility and accountability.

**Reference Books and websites:**

1. Ranjit Kumar, "Research Methodology: A Step by Step Guide for Beginners", SAGE Publications Ltd., 2022
2. C.R. Kothari ,"Research Methodology: Methods and Trends", New Age International,2004
3. Wayne Goddard, Stuart Melville, "Research Methodology: An Introduction" JUTA and Company Ltd,2004.
4. S.D. Sharma , "Operational Research", KedarNath Ram Nath&Co.,2972
5. B.L. Wadehra, "Law Relating to Patents, Trademarks, Copyright Designs and Geographical Indications", Universal Law Publishing,2024.

**Course Outcomes:**

On completion of the course, students will be able to:

**SH2201.1** Differentiate between various methods / types of research.
**SH2201.2** Formulate research problem
**SH2201.3** Collect and analyze research related information
**SH2201.4** Describe ethics and IPR and its significance.
**SH2201.5** Describe thesis report and research paper writing and publishing

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | **PO2** | **PO2** | **PO3** | **PO4** | **PO5** |
| **SH2201.1** | 3 | 1 | 1 | 3 | 1 |
| **SH2201.2** | 1 | 3 | 1 | 1 | - |
| **SH2201.3** | 1 | 1 | 3 | 1 | - |

| | | | | | |
|---|---|---|---|---|---|
| **SH2201.4** | 1 | 1 | 1 | 1 | 3 |
| **SH2201.5** | 1 | 1 | 1 | 1 | 2 |

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

| **Course Code** | **ET2235** | **Course category** | **PC** |
|---|---|---|---|
| **Course Name** | **SYSTEM DESIGN AND COMMUNICATION LABORTORY- II** | | |

| **Teaching Scheme** | | | | **Examination Scheme** | | | | | | | | **Credits** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 00 | 00 | 06 | 06 | -- | -- | -- | -- | -- | -- | 50 | 50 | 100 |

**The instructor may choose experiments as per his requirements, so as to cover entire contents of the courses ET2232, ET2232, ET2233 and/or ET2234. Minimum 20 experiments should be performed**

**Note :**

**ICA -** Internal Continuous Assessment shall be based on the practical record and knowledge /skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

**ESE -** The End Semester Exam for practical shall be based on performance in one of experiments and may be followed by sample questions.

**Course Outcomes:**

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

ET2235.1 Write a code for understanding front end and back-end VLSI design tools.

ET2235.2 Write MATLAB program for Image and video processing

ET2235.3 Write an embedded C application of moderate complexity

**CO-PO Mapping:**

| **CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
|---|---|---|---|---|---|
| **ET2235.1** | 2 | 1 | - | 1 | 1 |
| **ET2235.2** | 2 | 3 | - | 1 | 1 |
| **ET2235.3** | 3 | 2 | 2 | 2 | 1 |

0- Not correlated 1 - Weakly Correlate 2- Moderately Correlated 3- Strongly Correlated

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| **Course Code** | **ET2236** | | | | | | | **Course category** | | | **ISS** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Name** | **SEMINAR II** | | | | | | | | | | |
| **Teaching Scheme** | | | | **Examination Scheme** | | | | | | | **Credits** |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| - | - | 01 | 01 | - | - | - | - | - | 50 | - | 50 | 02 |

**Course Objectives:**

To make the students competent:

1. To select a topic for seminar based on latest technological advancements and carry out literature review, with a focus on selecting a topic for dissertation
2. Write seminar report and prepare and present Power Point Presentation for Seminar
3. Deliver seminar

**Course Contents:**

Student has to select a topic for Seminar based on literature review on advanced topics / recent developments in the field of Electronics and telecommunication Engineering and submit the report and deliver the seminar based on it. It is to be evaluated internally by panel of examiners headed by HOD (if possible) wherein guide should be one of the members of the panel

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to:

**ET2236.1**: Select a topic for seminar based on latest technological advancements
**ET2236.2**: Prepare seminar report and power point presentation based on information collected related to the selected topic
**ET2236.3**: Deliver seminar

**CO – PO Mapping:**

| **Course Outcomes** | **Program Outcomes** | | | | |
|---|---|---|---|---|---|
| | **PO2** | **PO2** | **PO3** | **PO4** | **PO5** |
| **ET2236.1** | 2 | 2 | 2 | 2 | 2 |
| **ET2236.2** | 2 | 2 | 2 | 2 | 2 |
| **ET2236.3** | 2 | 2 | 2 | 2 | 2 |

0- Not correlated 2 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

| Course Code | ET2331(A) | | | | | | | Course category | | | PE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Name | ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING | | | | | | | | | | |
| Teaching Scheme | | | | Examination Scheme | | | | | | | Credits |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

**Course Objectives:**

**The objectives of this course is**

1. To understand the basic concept of AI & ML.
2. To understand strength and weakness of problem solving and search algorithms.
3. To know about basic concepts of knowledge, and reasoning, Machine Learning.
4. To optimize the different linear methods of regression and classification.
5. To interpret the different supervised classification methods of support vector machine and tree based models.

**Course Contents:**

Basic Definitions and terminology, Foundation and History of AI, Overview of AI problems, Evolution of AI,- Applications of AI, Classification/Types of AI. Artificial Intelligence vs Machine Learning, Intelligent Agent: Types of AI Agent, Concept of Rationality, nature of environment, structure of agents, Turing Test in AI.

Search Algorithms in Artificial Intelligence: Terminologies, Properties of search Algorithms, Types of search algorithms: uninformed search and informed search, State Space search Heuristic Search Techniques: Generate-and-Test; Hill Climbing; Properties of A* algorithm

Knowledge-Based Agent in Artificial intelligence: Architecture, Approaches to designing a knowledge-based agent, knowledge representation: Techniques of knowledge representation, Propositional logic, Rules of Inference, First-Order Logic, Forward Chaining and backward chaining in AI, Reasoning in Artificial intelligence: Types of Reasoning and Probabilistic reasoning, Uncertainty.

Introduction to Machine Learning: History of ML Examples of Machine Learning Applications, Learning Types, ML Life cycle, AI & ML, dataset for ML, Data Pre-processing, Training versus Testing, Positive and Negative Class, Cross-validation.

Types of Learning: Supervised, Unsupervised and Semi-Supervised Learning. Supervised: Learning a Class from Examples, Types of supervised Machine learning Algorithms, Unsupervised: Types of

Unsupervised Learning Algorithm, Dimensionality Reduction: Introduction to Dimensionality Reduction, Subset Selection, and Introduction to Principal Component Analysis.
Classification: Binary and Multiclass Classification: , Assessing Classification Performance, Handling more than two classes, Multiclass Classification-One vs One, One vs Rest ,Regression: Assessing performance of Regression – Error measures, Overfitting and Underfitting,

**Reference Books and websites**

1. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall

2. J. Gabriel, Artificial Intelligence: Artificial Intelligence for Humans (Artificial Intelligence, Machine Learning), Create Space Independent Publishing Platform, First edition , 2016

3. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.

4. Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI., 2010 2. S Kaushik, Artificial Intelligence, Cengage Learning, 1st ed.2011.

5. Ric, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill.

6. Luger, G.F. 2008. Artificial Intelligence -Structures and Strategies for Complex Problem Solving, 6th edition, Pearson.

7. Alpaydin, E. 2010. Introduction to Machine Learning. 2nd edition, MIT.

8. Ethem Alpaydin: Introduction to Machine Learning, PHI 2nd Edition-2013.

9. Nilsson Nils J, "Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4.

**Course Outcomes:**

**On completion of this course student will be able to –**

**ET2331(A).1** Evaluate Artificial Intelligence (AI) methods and describe their foundations.

**ET2331(A).2** Analyze and illustrate how search algorithms play vital role in problem solving, inference, perception, knowledge representation and learning.

**ET2331(A).3** Demonstrate knowledge of reasoning and knowledge representation for solving real world problems

**ET2331(A).4** Recognize the characteristics of machine learning that makes it useful to real-world problems

**ET2331(A).5** Apply the different supervised learning methods of support vector machine and tree based models.

**CO-PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | PO2 | PO2 | PO3 | PO4 | PO5 |
| ET2331(A).1 | 1 | - | - | 1 | - |
| ET2331(A).2 | 2 | 1 | 1 | 2 | - |
| ET2331(A).3 | 2 | 1 | 1 | 2 | - |
| ET2331(A).4 | 1 | - | - | 1 | - |
| ET2331(A).5 | 1 | - | - | - | 2 |

0- Not correlated 2 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

| Course Code | ET2331(B) | | | | | | | Course category | | | PE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Name | WIRELESS COMMUNICATION | | | | | | | | | | |
| Teaching Scheme | | | | Examination Scheme | | | | | | | Credits |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

**Course Objectives:**

To make the student understand

1. Various parameters for designing wireless communication system.
2. How to make use of frequency reuse and its analysis.
3. Different multiple access techniques and design procedure.
4. About path loss, interference occurs and different contemporary wireless system and protocols.

**Course Contents:**

Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channelassignment.GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS),2.75 G Standards: EDGE.

Spectral efficiency analysis based on calculations for Multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas. Wireless network planning (Link budget and power spectrum calculations).

Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading. Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

Code Division Multiple Access: Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.

Higher Generation Cellular Standards:3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, Introduction to 5G.

**Reference Books and websites:**

1. H. V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.
2. T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI, 2002.
3. William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.
4. V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.
5. Asha Mehrotra, "A GSM system Engineering" Artech House Publishers Bosten, London, 1997.
6. https://archive.nptel.ac.in/courses/117/102/117102062/
7. https://onlinecourses.nptel.ac.in/noc21_ee66/preview
8. https://www.coursera.org/learn/wireless-communications
9. https://www.my-mooc.com/en/mooc/wireless-communications-for-everybody/

**Course Outcomes:**

At the end of this course, students shall be able to

**ET2331 (B).1** Demonstrate their understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards.

**ET2331(B).2** Apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques.

**ET2331(B).3** Analyze and design receiver and transmitter diversity techniques.

**ET2331(B). 4** Analyze and design CDMA system functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using the technology

**ET2331(B).5** Understanding upcoming technologies.

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | **PO2** | **PO2** | **PO3** | **PO4** | **PO5** |
| **ET2331(B).1** | 2 | 1 | - | - | - |
| **ET2331(B).2** | 2 | - | - | 1 | - |
| **ET2331(B).3** | 1 | - | - | 1 | - |
| **ET2331(B).4** | 2 | - | - | 1 | - |
| **ET2331(B).5** | - | - | 3 | - | - |

0- Not correlated 2 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

| Course Code | ET2331(C) | Course category | PE |
|---|---|---|---|
| Course Name | VLSI DESIGN VERIFICATION AND TESTING | | |

| Teaching Scheme | | | | Examination Scheme | | | | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

**Course Objectives:**
To make the student able

1. To understand fundamental Verilog concepts of today's most advanced digital design techniques.
2. To study gate, dataflow (RTL), behavioral, and switch level modeling, describes leading logic synthesis methodologies.
3. To learn timing and delay simulation.
4. To introduces essential techniques and to develop complex digital designs using EDA tools.

**Course Contents:**
Verification guidelines: Verification Process, Basic testbench functionality, directed testing, Methodology basics, Constrained-Random stimulus, Functional coverage, Testbench components, Layered testbench, Building layered testbench, Simulation environment phases, Maximum code reuse, Testbench performance.

Data types: Built-in data types, Fixed-size arrays, Dynamic arrays, Queues, Associative arrays, Linked lists, Array methods, Choosing a storage type, Creating new types with type def , Creating user-defined structures, Type conversion, Enumerated types, Constants strings, Expression width.

Procedural statements and routines: Procedural statements, tasks, functions and void functions, Routine arguments, Returning from a routine, Local data storage, Time values Connecting the testbench and design: Separating the testbench and design, Interface constructs, Stimulus timing, Interface driving and sampling, Connecting it all together, Top-level scope Program – Module interactions.

SystemVerilog Assertions: Basic OOP: Introduction, think of nouns, Not verbs, your first class, where to define a class, OOP terminology, Creating new objects, Object de-allocation, Using objects, Static variables vs. Global variables, Class methods, Defining methods outside of the class, Scoping rules, Using

one class inside another, Understanding dynamic objects, Copying objects, Public vs. Local, Straying off course building a testbench.

Randomization: Introduction, What to randomize, Randomization in SystemVerilog, Constraint details solution probabilities, Controlling multiple constraint blocks, Valid constraints, In-line constraints, The pre_randomize and post randomize functions,
Random number functions, Constraints tips and techniques, Common randomization problems, Iterative and array constraints, Atomic stimulus generation vs. Scenario generation, Random control, Random number generators, Random device configuration.

**Reference Books and websites:**

1. Chris Spears, "System Verilog for Verification", Springer, 2nd Edition
2. Stuart Sutherland, Simon Davidmann, Peter Flake "A Guide to Using SystemVerilog for Hardware design and modeling" Springer

2. System Verilog website – www.systemverilog.org

3. IEEE 1800-2009 standard (IEEE Standard for SystemVerilog-Unified Hardware Design, Specification, and Verification Language).

4. MOOC course on Fundamental of Verification and System Verilog

**Course Outcomes:**

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

**ET2331(C).1** Understand the fundamentals of VLSI testing and verification process
**ET2331(C).2** Familiar of front end design and verification techniques for digital systems
**ET2331(C).3** Design and simulate System Verilog model for digital systems
**ET2331(C) .4** Create reusable test environments using System Verilog for digital systems
**ET2331(C).5** Verify increasingly complex designs more efficiently and effectively using EDA tools

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | PO2 | PO2 | PO3 | PO4 | PO5 |
| ET2331(C).1 | 1 | - | 1 | - | - |
| ET2331(C).2 | - | - | 1 | 1 | - |
| ET2331(C).3 | - | - | 2 | 1 | - |
| ET2331(C).4 | - | - | 1 | 1 | - |
| ET2331(C).5 | - | - | 2 | 1 | |

0- Not correlated 2 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

| Course Code | ET2331(D) | | | | | | | Course category | | | PE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Name | COMPUTER VISION | | | | | | | | | | |
| Teaching Scheme | | | | Examination Scheme | | | | | | | Credits |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

**Course Objectives:**

To make the student able

1. To understand the image formation models and feature extraction for computer vision.
2. To Study and Identify the segmentation and motion detection.
3. To understand estimation techniques.
4. To Study Develop small applications and detect the objects in various applications.

**Course Contents:**

Image Formation Models, Monocular imaging system, Orthographic & Perspective Projection

Camera model and Camera calibration , Binocular imaging systems Image Processing and Feature Extraction , Image representations (continuous and discrete), Edge detection, Motion Estimation

Regularization theory, Optical computation , Stereo Vision , Motion estimation , Structure from motion Shape Representation and Segmentation , Deformable curves and surfaces , Snakes and active contours

Level set representations , Fourier and wavelet descriptors, Medial representations , Multi-resolution analysis

Object recognition, Hough transforms and other simple object recognition methods

Shape correspondence and shape matching , Principal component analysis, Shape priors for recognition

Member Secretary BoS Chairperson Dean (Academics) Principal

**Reference Books and websites:**

1. Computer Vision-A modern approach, D. Forsyth and J. Ponce, Prentice Hall , 2002
2. Introductory Techniques for 3D Computer Vision, by E. Trucco and A.Verri, Publisher: Prentice Hall,2998.
3. Robot Vision, by B. K. P. Horn, McGraw - Hill,2986
5. NPTEL on Computer Vision https://onlinecourses.nptel.ac.in/noc19_cs58/preview

**Course Outcomes:**

At the end of this course, Students shall be able to

**ET2331(D).1** Study the image formation models and feature extraction for computer vision

**ET2331(D)**.2 Identify the segmentation and motion detection

**ET2331(D). 3** Identify estimation techniques

**ET2331(D).4** Develop small applications and detect the objects in various Applications

**ET2331(D).5** Develop and evaluate solutions to problems in computer vision

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **ET2331(D).1** | 1 | 2 | - | 1 | - |
| **ET2331(D).2** | 1 | 3 | 1 | 1 | - |
| **ET2331(D).3** | 1 | 3 | 1 | - | - |
| **ET2331(D).4** | 2 | 3 | 3 | 3 | - |
| **ET2331(D).5** | 1 | 2 | 3 | 3 | - |

0- Not correlated 2 - Weakly Correlate 2- Moderately Correlated 3- Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

| **Course Code** | **ET2331(E)** | **Course category** | **PE** |
|---|---|---|---|
| **Course Name** | **NETWORK SECURITY AND CRYPTOGRAPHY** | | |

| **Teaching Scheme** | | | | **Examination Scheme** | | | | | | | | **Credits** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

**Course Objectives:**
To make the student able

1. To understand the fundamentals of Cryptography and acquire knowledge on standard algorithms.
2. To understand the various key distribution and management schemes.
3. To understand how to deploy encryption techniques to secure data in transit across data networks
4. To design security applications in the field of Information technology

**Course Content:**
Security- Need, security services, Attacks, OSI Security Architecture, one time passwords, Model for Network security, Classical Encryption Techniques like substitution ciphers, Transposition ciphers, Cryptanalysis of Classical Encryption Techniques.

Number Theory- Introduction, Fermat's and Euler's Theorem, The Chinese Remainder Theorem, Euclidean Algorithm, Extended Euclidean Algorithm, and Modular Arithmetic.

Private-Key (Symmetric) Cryptography- Block Ciphers, Stream Ciphers, RC4 Stream cipher, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Triple DES, RC5, IDEA, Linear and Differential Cryptanalysis.

Public-Key (Asymmetric) Cryptography- RSA, Key Distribution and Management Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message Authentication Code, hash functions, message digest algorithms:MD4 MD5, Secure Hash algorithm, RIPEMD-260, HMAC.

Authentication- IP and Web Security Digital Signatures, Digital Signature Standards, Authentication Protocols, Kerberos, IP security Architecture, Encapsulating Security Payload, Key Management, Web

Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction.

System Security- Intruders, Intrusion Detection, Password Management, Worms, viruses, Trojans, Virus Counter measures, Firewalls, Firewall Design Principles, Trusted Systems.

**Reference Books and websites:**

1. William Stallings, "Cryptography and Network Security, Principles and Practices", Pearson Education, 3rd Edition.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security, Private Communication in a Public World", Prentice Hall, 2nd Edition.
3. Christopher M. King, Ertem Osmanoglu, Curtis Dalton, "Security Architecture, Design Deployment and Operations", RSA Pres,
4. Stephen Northcutt, Leny Zeltser, Scott Winters, Karen Kent, and Ronald W. Ritchey,"Inside Network Perimeter Security", Pearson Education, 2nd Edition
5. Richard Bejtlich, "The Practice of Network Security Monitoring:Understanding Incident Detection and Response", William Pollock Publisher, 2023.
6. NPTEL on Cryptography and Network Security https://onlinecourses.nptel.ac.in/noc22_cs90/preview

**Course Outcomes:**

At the end of the course students shall be able to:

**ET2331(E).1** Analyze the vulnerabilities in any computing system and hence be able to Eesign a security solution.
**ET2331(E).2** Identify the security issues in the network and resolve it.
**ET2331(E).3** Evaluate security mechanisms using rigorous approaches, including theoretical
**ET2331(E).4** Compare and Contrast different IEEE standards and electronic mail Security
**ET2331(E).5** Compare and Contrast different public key algorithm for any one application.

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 |
| ET2331(E).1 | 3 | - | - | 2 | - |
| ET2331(E).2 | 3 | - | - | - | - |
| ET2331(E).3 | - | 2 | - | - | 3 |
| ET2331(E).4 | - | - | - | 2 | - |
| ET2331(E).5 | 2 | - | 2 | - | - |

0- Not correlated 2 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

| Course Code | SH2301(A) | | | | | | Course category | | | OE |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Name | INDUSTRIAL SAFETY | | | | | | | | | |
| Teaching Scheme | | | | Examination Scheme | | | | | | Credits |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

**Course Objectives:**

To make the students aware and understand:

1. Importance of Industrial safety
2. Fundamental of maintenance engineering
3. Prevention of wear and corrosion
4. Fault tracing
5. Periodic and preventive maintenance

**Course Contents:**

**Industrial safety:** Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 2948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.

**Fundamentals of maintenance engineering:** Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

**Wear and Corrosion and their prevention:** Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

**Fault tracing:** Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's

like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

**Periodic and preventive maintenance:** Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

**Reference Books:**

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London

| **Course Code** | **SH2301(B)** | | | | | | **Course category** | | | **OE** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Course Name** | **OPERATION RESEARCH** | | | | | | | | | |
| **Teaching Scheme** | | | | **Examination Scheme** | | | | | | **Credits** |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

**Course Objectives:**

To make the students aware and understand:

**Course Contents:**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

**Reference Books and websites:**

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 2982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2020
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2020

**Course Outcomes:**

On completion of the course, students will be able to:

**SH2301(B).1**:apply the dynamic programming to solve problems of discreet and continuous variables.
**SH2301(B).2**:apply the concept of non-linear programming.
**SH2301(B).3**:carry out sensitivity analysis.
**SH2301(B).4**:model the real world problem and simulate it

| Course Code | SH2301(C) | | | | | | | Course category | | | OE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Name | PROJECT MANAGEMENT | | | | | | | | | | |
| Teaching Scheme | | | | Examination Scheme | | | | | | | Credits |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

**Course Objectives:**

To make the students aware and understand:

**Course Contents:**

**Introduction:** Human Factors and Systems, Information Input and Processing, Visual Displays of Dynamic Information, Human Output and Control: Physical Work and Manual Materials Handling, Motor Skills, Human Control of Systems, Hand Tools and Devices.

Definition of Ergonomics and its significance in designing workplace layout and detailed motion plan of work, Man-Machine Symbiosis, Human Factors in design & manufacturing, Viz. pressure of the environment, temperature, humidity etc., Principles of motion economy, anthropometric condition, stability criterion etc. Biodynamic analysis for design of products & its concept of learning by man and machine;

Measurement of Learning Index and training for each job and each man, Product design – various aspects including ergonomic design and reliability based design.

Dynamic consideration in design of product using vibration stability in biomechanisms, Safety in manufacturing, Considerations of human stress, Allowable limit of stress, stress adjustment.

Estimation of human error and human reliability, combining various forms of human error by random number simulation, Human Error, Accidents and safety, Human Factors and the Automobile, Human Factors in Systems Design.

Dynamic consideration in project operations, leadership, requirement, communication process, motivating a diverse workflow, facilitating team decisions, resolving interpersonal conflicts, managing different people, strengthening team accountability

**Reference Books and websites:**

1. HSanders, M.M. &McCormick, E.J., Human Factors in Engineering & Design, McGraw-Hill, 7th ed. (2993)
2. S. K. Basu, K.C. Sahu and Rajiv B, Industrial Organisation and Management –, PHI New Delhi, Nov 2022

| Course Code | SH2301(D) | | | | | | Course category | | OE |
|---|---|---|---|---|---|---|---|---|---|
| Course Name | DATA STRUCTURES AND ALGORITHMS | | | | | | | | |
| Teaching Scheme | | | | Examination Scheme | | | | | Credits |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

**Course Objectives:**

1. Write neat code by selecting appropriate data structure and demonstrate a working solution for a given Problem.
2. Think of all possible inputs to an application and handle all possible errors properly.
3. Analyze "Clearly different possible solutions to a program and select the most efficient one.
4. Write an application requiring an effort to fat least l000 lines of code to demonstrate a good working solution.
5. Demonstrate the ability to write reusable code and abstract data types in C, using object-based way of thinking

**Course Contents:**

**Introduction**:

Data, Data types. Object, data structure and abstract data types (ADT). Characteristics of an algorithm' Analyzing progams Frequency count Time and space complexity, Big 'O' and Ω notation. Best, average and worst cases. Dangling pointers and garbage memory

Arrays, Files and Searching: Searching: linear and binary search algorithm. Hashing: hashing functions, chaining, overflow handling with and without chaining, open addressing: linear. Quadratic Teaching Scheme: Examination Scheme: probing. Files handling: text and binary files, use of various libraries for handling files.

**Stacks and Queues**:

Stack and queue. as ADT. Operations on stack and queue, Implementations using arrays and dynamic memory allocation, Application of stack for expression evaluation, expression conversion, Recursion and stacks, Problems like maze and knight's tour.

**Lists:**

List as ADT. Concept of linked organization of data against linked list. Singly linked list, doubly linked list, circular linked list. Representation & manipulations of polynomials/ sets using linked lists. Dynamic memory management, Representation of sparse matrix, Addition and transpose of sparse matrix

**Trees and Graphs**:

Basic terminology, Binary trees and its representation, Binary tree traversals (recursive and non-recusive) and various operations, Insertion and deletion of nodes in binary search tree, Representation of graphs using adjacency matrix, adjacency list, Implementation of algorithms for traversals; implementing Kruskal's. Prim's algorithms, Single source shortest paths using Djkstra's algorithm, Applications of graphs and trees

**Time Complexity Analysis**, **Algorithm Design**:

Verification of programs, invariants, assertions, proof of termination. Best, Average and Worst case analysis of binary search, quick sort, merge sort, insertion sort, hashing techniques, sparse matrix algorithms. Designing data structures for specific applications

**Reference Books and websites:**

1. E. Horowitz, S. Sahni, S.Anderson-freed, "Fundamentals of Data Structures in C", Second Edition,University Press, ISBN 978-82-7372-605-8
2. B. Kernighan, D. futchie, "The C Programming Language", Prentice Hall of India, Second Edition,ISBN 8 2 -203-0596-5
3. Y. Langsam, M. Augenstin and A. Tarmenbaum, "Data Structues using C", Pearson Education Asia, First Edition, 2002, ISBN 978-82-327-0229-2
4. Ellis Horowitz, S. Sahni, D. Mehta "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi 2995 ISBN 26782928
5. Jean-Paul Tremblay, Paul. G. Soresan, "An introduction to data structures with Applications",Tata Mc-Graw Hill Interactional Editions, 2nd edition 2984, ISBN-O07-462472-7

| Course Code | SH2301(E) | | | | | | | Course category | | | OE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Name | NANOTECHNOLOGY | | | | | | | | | | |
| Teaching Scheme | | | | Examination Scheme | | | | | | | Credits |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| 03 | - | - | 03 | 15 | 15 | 10 | 60 | 2 hrs 30 min | - | - | 100 | 03 |

**Course Objectives:**

Students will be able to:

1. To understand the history, background and nature of nanoscience and nanotechnology as well as the quantum and nanosized scale effect on materials.
2. To acquire theoretical understanding of different types of materials and their application in nanotechnology.
3. To understand the physics behind the unusual properties of nanomaterials and its applications.
4. To learn the method of synthesis & characterization of graphene and graphene oxide.
5. For developing a strong background if he/she chooses to pursue research in Nanoscience and Nanotechnology as a career.

**Course Contents:**

**Basics and scale of Nanotechnology:**

Scientific revolutions –Time and length scale in structures – Definition of a nano system – Dimensionality and size dependent phenomena – Surface to volume ratio -Fraction of surface atoms – Surface energy and surface stress- surface defects-Properties at nanoscale (optical, mechanical, electronic, and magnetic).

**Different classes of Nanomaterials:**

Classification based on dimensionality-Quantum Dots, Wells and Wires, preparation of quantum nanostructures, size effects, conduction electrons and dimensionality, Fermi gas

and density of states, potential wells, partial confinement, properties dependent on density of states, exitons, single electron tunnelling.

**Material Synthesis Method:**

Nanostructures of one dimension: Crystalline growth, Template based synthesis. Nanostructures of two dimensions: Fundamentals of thin film growth, physical vapour deposition, chemical vapour deposition, atomic layer deposition, self-assembly, Langmuir-Blodgett films, Sol-Gel films, electrochemical deposition.

Nanostructures of three dimensions: Nanocomposites, Severe plastic deformation process: Fric-tion stir processing (FSP) and equi-channel angular pressi.

**Material Characterization Methods:**

UV visible microscopy; scanning electron microscopy (SEM); transmission electron microscopy/diffraction (TEM); x-ray diffraction (XRD); neutron diffraction; scanning probe microscopy.

**Advance Nanomaterials:**

Graphene; brief history of graphene, structure of graphene, Types of graphene, synthesis methods of graphene and graphene oxide, applications of graphene

**Reference Books and website links:**

1. Introduction to Nanotechnology by C.P. Poole Jr. and F.J. Oweus, Wiley Interscience
2. Nano-Technology by Gregory Timp (Editior), AIP Press, Springer.
3. Pradeep T., “A Textbook of Nanoscience and Nanotechnology”, Tata McGraw Hill Education Pvt. Ltd.
4. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press
5. Graphene: Synthesis and applications, edited by Wonbong Choi and Jo-won Lee.
6. Semiconductor Nanostructures and Nanodevices Vol 1-5-A. A. Balandin, K. L.Wang.
7. Springer Handbook of Nanotechnology: Bharat Bhushan
8. Nanofabrication towards biomedical application: Techniques, tools, Application and impact: Ed. Challa S., S. R. Kumar, J. H. Carola

9. A. S. Edelstein and R. C. Cammarata, "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Pub., 1998.
10. G. Cao, Nanostructures & Nanomaterials: Synthesis, Properties & Applications , Imperial College Press, 2004.
11. G.A. Ozin and A.C. Arsenault, "Nano chemistry : A chemical approach to nanomaterials", Royal Society of Chemistry, 2005.
12. Joel I. Gersten, "The Physics and Chemistry of Materials", Wiley, 2001.
13. K.W. Kolasinski, "Surface Science: Foundations of Catalysis and Nanoscience", Wiley, 2002.
14. Physical Chemistry – Atkins Peter, Paula Julio.
15. Nanotechnology in Biology and Medicine: Methods, Devices, and Applications.

**Course Outcomes:**

On completion of the course, students will be able to:

SH2301(E).1: To learn basic material science with special, emphasize on nanomaterials.

SH2301(E).2: Correlate physical behavior of materials at the nanoscale with quantum mechanics

SH2301(E).3: Understand the physical, chemical and biological methods for synthesis of nanoparticles.

SH2301(E).4: Understand the various characterization techniques of nano materials.

SH2301(E).5 Apply the knowledge gained to suggest different applications of nanoscience and technology.

**CO – PO Mapping:**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **SH2301(E).1** | 3 | - | - | - | - |
| **SH2301(E).2** | 2 | 3 | 3 | 2 | - |
| **SH2301(E).3** | 3 | - | - | - | 3 |
| **SH2301(E).4** | 3 | - | 2 | - | - |
| **SH2301(E).5** | 3 | - | - | 3 | 3 |

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

| Course Code | ET2332 | Course category | RP / DI |
|---|---|---|---|
| Course Name | DISSERTATION STAGE I | | |

| Teaching Scheme | | | | Examination Scheme | | | | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| - | - | 04 | 04 | - | - | - | - | - | 150 | - | 150 | 13 |

**Course Objectives:**

To make the students competent for:

1. Carry out literature survey based on latest technological advancements
2. Select a topic for dissertation based on literature survey
3. Development of a system to carry out analysis/experimental investigation for the selected area/problem.

**Course Contents:**

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

1. Relevance to social needs of society
2. Relevance to value addition to existing facilities in the institute
3. Relevance to industry need
4. Problems of national importance
5. Research and development in various domain

Student shall complete dissertation work in III, & IV semesters individually. In III semester, student shall complete Literature survey and decide the dissertation topic. He/She shall complete conceptual study and design part of dissertation topic and submit the progress report in proper format. Student has to deliver a seminar on the selected topic (covering 25% or more work). It is to be evaluated internally by three member's panel of examiners headed by HoD wherein guide should be one of the members of the panel. Last date of submission of report shall be two weeks before the end of semester.

**Course Outcomes:**

On completion of the course, students will be able to:

**ET2332.1** Carry out analysis/experimental investigation for the selected area/problem and derive conclusions based on results of investigations carried out.

**ET2332.2** Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.

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**ET2332.3** Write dissertation report.

**ET2332.4** Prepare and deliver presentation

**ET2332.5** Presenting the work in International/ National conference or reputed journals.

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | **PO2** | **PO2** | **PO3** | **PO4** | **PO5** |
| **ET2332.1** | 3 | - | - | 2 | - |
| **ET2332.2** | 3 | - | - | - | - |
| **ET2332.3** | - | 2 | - | - | 3 |
| **ET2332.4** | - | - | - | 2 | - |
| **ET2332.5** | 2 | - | 2 | - | - |

0-Not correlated 2 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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| **Course Code** | **ET2431** | | | | | | **Course category** | | | **RP / DI** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Course Name** | **DISSERTATION STAGE II** | | | | | | | | | |
| **Teaching Scheme** | | | | **Examination Scheme** | | | | | | **Credits** |
| Th | Tu | Pr | Total | Theory | | | | | Practical | | Total | |
| | | | | CT1 | CT2 | TA | ESE | ESE Duration | ICA | ESE | | |
| - | - | 04 | 04 | - | - | - | - | - | 100 | 200 | 300 | 18 |

**Course Objectives:**

To make the students competent for:

1. Make the students competent to carry out analysis/ experimental investigation for the selected area/problem and derive conclusions based on results of investigations carried out.
2. Make the students competent to write dissertation report.
3. Make the students competent to prepare and deliver presentation.

**Course Contents:**

Syllabus Dissertation (Phase II):

1. Student shall complete dissertation work in IV semester, and submit a progress report in proper format.
2. Dissertation (Phase-II): Internal assessment of dissertation (complete work) is to be carried out by three members panel of examiners headed by HOD wherein guide should be one of the members of the panel, for 200 marks. The external assessment of dissertation work is to be carried out by panel of examiners consisting of internal (guide) and external examiner for 200 marks.

Candidate shall present the entire work on Dissertation, followed by viva-voce. Last date of submission of dissertation will be the end of the semester. Please see Appendix-C of Rules & Regulation for Further information.

* Note: (ET2333) Dissertation Phase I & Seminar as prerequisite for (ET2431) Dissertation Phase II
In case of unsatisfactory performance, committee may recommend for extension or repeating the work

**Course Outcomes:**

On completion of the course, students will be able to:

At the end of this course, students shall be able to

**ET2431.1** Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.

**ET2431.2** Capable to select from different methodologies, methods and forms of

analysis to produce a suitable research design, and justify their design.

**ET2431.3** Develop a system to carry out analysis/experimental investigation for the selected area/problem.

**ET2431.4** Ability to present the findings of their technical solution in a written report.

**ET2431.5** Presenting the work in International/ National conference or reputed journals.

**CO – PO Mapping:**

| Course Outcomes | Program Outcomes | | | | |
|---|---|---|---|---|---|
| | **PO2** | **PO2** | **PO3** | **PO4** | **PO5** |
| **ET2431.1** | 3 | - | - | 2 | - |
| **ET2431.2** | 3 | - | - | - | - |
| **ET2431.3** | - | 2 | - | - | 3 |
| **ET2431.4** | - | - | - | 2 | - |
| **ET2431.5** | 2 | - | 2 | - | - |

0- Not correlated 2 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated