# Dr. Babasaheb Ambedkar Technological University, Lonere

**Dr. Babasaheb Ambedkar Technological University (Established as a University of Technology in the State of Maharashtra)**
**(Under Maharashtra Act No. XXIX of 2014)**
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## Course Structure and Detailed Syllabus
## of
## B. Tech Programme
## for

## Electronics and Communication
## (Advanced Communication Technology)
## of
## Third Year Engineering
## In line with National Education Policy 2020
**(Effective from Academic year 2026-27 for Affiliated Colleges only)**

*Credit Framework under Four-Years UG Engineering Programme with Multiple Entry and Multiple Exit options:*

- The Four-year Bachelor's Multidisciplinary Engineering Degree Programme allows the students to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per their choices and the feasibility of exploring learning from different institutions.
- The minimum and maximum credit structure for different levels under the Four-year Bachelor's Multidisciplinary Engineering UG Programme with multiple entry and multiple exit options are as given below:

*Credit Framework*

| Levels | Qualification Title | Credit Requirements | | Semester | Year |
|---|---|---|---|---|---|
| | | Minimum | Maximum | | |
| **4.5** | One Year UG Certificate in Engg./ Tech. | 40 | 44 | 2 | 1 |
| **5.0** | Two Years UG Diploma in Engg./ Tech. | 80 | 88 | 4 | 2 |
| **5.5** | Three Years Bachelor's Degree in Vocation (B. Voc.) or B. Sc. (Engg./ Tech.) | 120 | 132 | 6 | 3 |
| | 4-Years Bachelor's degree | | | | |

| Levels | Qualification Title | Credit Requirements | | Semester | Year |
|---|---|---|---|---|---|
| | | Minimum | Maximum | | |
| 6.0 | (B.E./ B.Tech. or Equivalent) in Engg./ Tech. with Multidisciplinary Minor | 160 | 176 | 8 | 4 |
| 6.0 | 4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Honors and Multidisciplinary Minor | 180 | 194 | 8 | 4 |
| 6.0 | 4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Honors with Research and Multidisciplinary Minor | 180 | 194 | 8 | 4 |
| 6.0 | 4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Major Engg. Discipline with Double Minors (Multidisciplinary and Specialization Minors) | 180 | 194 | 8 | 4 |

- There are multiple exit options at each level. Student will be given a specific Qualification mentioned in the table depending on the level at which he/she decide to have an exit. Ex. If a student decides to exit after completion of two years (level 5.0) of the program, he will be given a Diploma in Engineering with specific exit condition mentioned in the syllabus of the specific branch. He/she can rejoin the program with the multiple entry option at the level next where he/she chose to exit previously. (Student can join at level 5.5 if successfully completed level 5.0 previously at the time of exit).

- Minimum credit requirements of each level are mentioned in the credit framework table.
- There are 4 distinct options available at level 6.0.
- First one is basic level 6.0 option where minimum 160-maximum 176 credits are mandatory which can be completed as per the Semester-wise Credit distribution structure mentioned in the table given below.
  Here, the Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with multidisciplinary minor (min.160-max.176 Credits) i.e. "**B. Tech in Electronics and communication(Advanced Communication Technology) Engineering with Computer Engineering**" (160-176 credits) enables students to take up five-six or required additional courses of 14 credits in the discipline other than Electronics and Telecommunication Engineering distributed over semesters III to VIII. Here in the case of "**B. Tech in Electronics and Communication(Advanced Communication Technology) Engineering with Computer Engineering**" (160-176 credits) student is supposed to take up 50% or more courses to complete the 50% or more credits (from assigned 14 credits) from **Computer Engineering minor bucket**. The remaining courses to complete the assigned 14 credits can be covered from other discipline's minor buckets.

- Remaining three level 6.0 options are the advanced options where the student is given an opportunity to get extra qualification by earning some extra credits(18-20 extra credits). These three options are given below:
- Level 6.0: The **Bachelor's Engineering Degree with Honours** in chosen Major Engg./ Tech. Discipline i.e. in Electronics and Telecommunication Engineering with Honours with Multidisciplinary Minor (180-194 credits) enables students of Electronics and Telecommunication Engineering to take up five-six additional courses of 18 to 20 credits in the Electronics and Telecommunication Engineering discipline distributed over semesters III to VIII. The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, which are over and above the min.160-max.176 Credits prescribed for the duration of four years will be taken by Academic Authorities of University. **Student must have CGPA equal to or greater than 7.5 at the end of second semester to go for this option**.
- Level 6.0: The **Bachelor's Engineering Degree with Research** in i.e. in Electronics and Telecommunication Engineering with Research with Multidisciplinary Minor (180-194 credits) enables students of Electronics and Telecommunication Engineering to take up a research project of 18 to 20 credits in the Electronics and Telecommunication Engineering discipline distributed over semesters VII to VIII. **Student must have CGPA equal to or greater than 7.5 at the end of sixth semester to go for this option**.
- Level 6.0: The **Bachelor's Engineering Degree in chosen Engg./ Tech. Discipline with Double Minor** (Multidisciplinary and Specialization Minor, 180-194 credits), i.e. "**B. Tech in Electronics and Communication(Advanced Communication Technology) Engineering with *other selected discipline in* Engineering (as MDM) with Specialization Minor in Computer Engineering**" (180-194 credits) enables students to take up five-six additional courses of 14 credits in the discipline other than Electronics and Telecommunication Engineering(for completion of multidisciplinary minor) and 1 8 to 20 extra credits in the **Computer Engineering**

**discipline** distributed over semesters III to VIII. Here, the ***other selected discipline* in Engineering should be different from Specialization Minor i.e. Computer Engineering**. This enables students to take up five-six or required additional courses of 18 to 20 credits in the **Computer Engineering** discipline distributed over semesters III to VIII, which are over and above the min.160-max.176 Credits. The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, prescribed for the duration of four years will be taken by Academic Authorities of University. **Student must have CGPA equal to or greater than 7.5 at the end of second semester to go for this option**.

*Semester-wise Credit distribution structure for Four Year UG Engineering Program - One Major, One Minor*

| **Semester** | | **I** | **II** | **III** | **IV** | **V** | **VI** | **VII** | **VIII** | **Total Credits** |
|---|---|---|---|---|---|---|---|---|---|---|
| Basic Science Course | BSC/ESC | 06-08 | 08-10 | | -- | -- | -- | -- | -- | 14-18 |
| Engineering Science Course | | 10-08 | 06-04 | | -- | -- | -- | -- | -- | 16-12 |
| Programme Core Course (PCC) | Program Courses | -- | 02 | 08-10 | 08-10 | 10-12 | 08-10 | 04-06 | 04-06 | 44-56 |
| Programme Elective Course (PEC) | | -- | -- | -- | -- | 04 | 08 | 02 | 06 | 20 |
| Multidisciplinary Minor (MD M) | Multidisciplinary Courses | | - | 02 | 02 | 04 | 02 | 02 | 02 | 14 |
| Open Elective (OE) Other than a particular program | | -- | -- | 04 | 02 | 02 | -- | -- | -- | 08 |
| Vocational and Skill Enhancement Course (VSEC) | Skill Courses | 02 | 02 | -- | 02 | -- | 02 | -- | -- | 08 |
| Ability Enhancement Course (AEC -01, AEC-02) | Humanities Social Science and Management (HSSM) | 02 | -- | -- | 02 | -- | -- | -- | -- | 04 |
| Entrepreneurship/Economics/ Management Courses | | -- | | 02 | 02 | -- | -- | -- | -- | 04 |
| Indian Knowledge System (IKS) | | | 02 | | -- | -- | -- | -- | -- | 02 |
| Value Education Course (VEC) | | -- | -- | 02 | 02 | -- | -- | -- | -- | 04 |
| Research Methodology | Experiential Learning Courses | -- | -- | -- | -- | -- | -- | | 04 | 04 |
| Comm. Engg. Project (CEP)/Field Project (FP) | | -- | -- | 02 | -- | -- | -- | - | - | 02 |
| Project | | -- | -- | -- | -- | -- | -- | | 04 | 04 |
| Internship/ OJT | | -- | --- | | | -- | -- | 12 | - | 12 |
| Co-curricular Courses (CC) | Liberal Learning Courses | 02 | 02 | | -- | -- | -- | -- | - | 04 |
| **Total Credits (Major)** | | **20-22** | **20-22** | **20-22** | **20-22** | **20-22** | **20-22** | **20-22** | **20-22** | **160-176** |

Student need to follow the Semester-wise Credit distribution structure for Four Year UG Engineering Program as prescribed in the table given above.

- There are seven vertical categories with specific credits distributed in specific semesters.
- Student can choose a Program Elective Course (PEC) in that specific semester from the given subjects.
- Multidisciplinary course (MDM) and Open Elective(OE) courses can be chosen from the MDM and OE Buckets depending on students choice. Completion of total credits given in the last column of the table for each vertical is mandatory.
- Students can complete 40% of the courses through online platforms like NPTEL/SWAYAM. The NPTEL SWAYAM course content should be at least 80% similar to the course content in the syllabus.

### *General Rules and Regulations*

1. The normal duration of the course leading to B.Tech degree will be EIGHT semesters.

2. The normal duration of the course leading to M.Tech. degree will be FOUR semesters.

3. Each academic year shall be divided into 2 semesters, each of 20 weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 Teaching Days, with at least 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically from Mid-July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. Academic Session may be scheduled for the Summer Session/Semester as well. For 1st year B. Tech and M. Tech the schedule will be decided as per the admission schedule declared by Government of Maharashtra.

4. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.

5. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra -curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

### *Registration:*

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PG Programme:
   A full time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maximum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.
2. Mandatory Pre-Registration for higher semesters: In order to facilitate proper planning of the academic activities of a semester, it is essential for the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.

3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.
4. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

*Course Pre-Requisites:*

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specified courses.
2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.
3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.
4. A student will be permitted to register in the next semester only if he fulfills the following conditions:
   i. Satisfied all the Academic Requirements to continue with the programme of Studies without termination
   ii. Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;
   iii. Paid all required advance payments of the Institute and hostel for the current semester;
   iv. Not been debarred from registering on any specific ground by the Institute.

*Evaluation System:*

1. Absolute grading system based on absolute marks as indicated below will be implemented from academic year 2023-24, from I year B. Tech.

| Percentage of marks | Letter Grade | Grade Point |
|---|---|---|
| 91-100 | EX | 10.0 |
| 86-90 | AA | 9.0 |
| 81-85 | AB | 8.5 |
| 76-80 | BB | 8.0 |
| 71-75 | BC | 7.5 |
| 66-70 | CC | 7.0 |
| 61-65 | CD | 6.5 |
| 56-60 | DD | 6.0 |
| 51-55 | DE | 5.5 |
| 40-50 | EE | 5.0 |
| <40 | EF | 0.0 |

| | | |
|---|---|---|
| 1. | Continuous Assessment Marks | 40 |
| 2. | End Semester Examination (ESE)Marks | 60 |

2. Class is awarded based on CGPA of all eighth semester of B.Tech Program.

| CGPA for pass is minimum 5.0 | |
|---|---|
| CGPA upto <5.50 | Pass class |
| CGPA ≥ 5.50&<6.00 | Second Class |
| CGPA ≥ 6.00&<7.5 | First Class |
| CGPA >7.50 | Distinction |
| [Percentage of Marks =CGPA*10.0] | |

3. A total of 100 Marks for each theory course are distributed as follows:

| | |
|---|---|
| Mid Semester Exam (MSE) Marks | 20 |
| Continuous Assessment Marks | 20 |
| End Semester Examination(ESE)Marks | 60 |

4. A total of 100 Marks for each practical course are distributed as follows

- It is mandatory for every student of B. Tech to score a minimum of 40 marks out of 100, M. Tech to score a minimum of 45 marks out of 100 with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.
- This will be implemented from the first year of B. Tech starting from Academic Year 2023-24

### *5. Description of Grades*

EX Grade: An 'EX' grade stands for outstanding achievement. EE
Grade: The 'EE' grade stands for minimum passing grade.
The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only.
If any of the students remain absent for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.
FF Grade: The 'FF' grade denotes very poor performance, i.e. failure in a course due to poor performance .The students who have been awarded 'FF' grade in a course in any semester must repeat the subject in next semester.

## 6. *Evaluation of Performance*

### a. Semester Grade Point Average (SGPA)

The performance of a student in a semester is indicated by Semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPI is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$SGPA = \frac{[\sum_{i=1}^{n} c_i g_i]}{[\sum_{i=1}^{n} c_i]}$$

Where

'$n$' is the number of subjects for the semester,
'$c_i$' is the number of credits allotted to a particular subject, and
'$g_i$' is the grade-points awarded to the student for the subject based on his performance as per the above table.
SGPA will be rounded off to the second place of decimal and recorded as such.

### b. *Cumulative Grade Point Average (CGPA):*

An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since s/he entered the Institute. CGPA is also calculated at the end of every semester (upto two decimal places).Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{[\sum_{i=1}^{m} c_i g_i]}{[\sum_{i=1}^{m} c_i]}$$

Where,

'm' is the total number of subjects from the first semester onwards up to and including the semester S,

'ci' is the number of credits allotted to a particular subject, and

'gi' is the grade-points awarded to the student for the subject based on his/her performance as per the above table.

CGPA will be rounded off to the second place of decimal and recorded as such.

## 7. *Attendance Requirements:*

a. All students must attend every lecture, tutorial and practical classes.

b. To account for approved leave of absence (eg. representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted. If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination. The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be. In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.

c. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.

d. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

### *8. Transfer of Credits:*

The courses credited elsewhere, in Indian or foreign University/Institutions/ Colleges/Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

a. 20 % of the total credit will be considered for respective calculations.

b. Credits transferred will be considered for overall credits requirements of the programme.

c. Credits transfer can be considered only for the course at same level i.e UG, PG etc.

d. A student must provide all details (original or attested authentic copies) such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.

e. A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.

f. Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.

g. In exceptional cases, the students may opt for higher credits than the prescribed.

# THIRD YEAR ( V SEMESTER)

| Course Category | Course Code | Course Name | Weekly Hours | | Examination Scheme | | | | Credit |
|---|---|---|---|---|---|---|---|---|---|
| | | | L | P | CA | M S E | E S E | Total | |
| PCC | 26AF1928PC501 | Electro Magnetic Field Theory | 3 | - | 20 | 20 | 60 | 100 | 3 |
| PCC | 26AF1928PC502 | Digital Signal & Image Processing | 3 | - | 20 | 20 | 60 | 100 | 3 |
| PCC Lab | 26AF1928PC503L | Digital Signal & Image Processing Lab | - | 2 | 60 | | 40 | 100 | 1 |
| PCC | 26AF1928PC504 | Wireless Communication | 3 | - | 20 | 20 | 60 | 100 | 3 |
| OE | 26AF1928OE505 | Open Elective Bucket** | 2 | - | 20 | 20 | 60 | 100 | 2 |
| MDM | 26AF1928MD506 | **MDM Bucket*** | 3 | - | 20 | 20 | 60 | 100 | 3 |
| PCC LAB | 26AF1928PC507L | Wireless Communication Lab | - | 2 | 60 | - | 40 | 100 | 1 |
| PEC | 26AF1928PE508A | A. Information Theory and Coding | 3 | - | 20 | 20 | 60 | 100 | 3 |
| | 26AF1928PE508B | B. Electronic Measurements & Instrumentation | | | | | | | |
| PEC Lab | 26AF1928PE509AL | A. Information Theory and Coding | | 2 | 60 | | 40 | 100 | 1 |
| | 26AF1928PE509BL | B. Electronic Measurements & Instrumentation | | | | | | | |
| | **Total** | | **17** | **6** | **300** | **120** | **480** | **900** | **20** |

**NOTE: * Refer to Multidisciplinary Minor Bucket of other departments**
****Refer to Open Elective Bucket**

# THIRD YEAR ( VI SEMESTER)

| Course Category | Course Code | Course Name | Weekly Hours | | Examination Scheme | | | | Credit |
|---|---|---|---|---|---|---|---|---|---|
| | | | L | P | CA | M S E | E S E | Total | |
| PCC | 26AF1928PC601 | Microwave & RADAR Engineering | 3 | - | 20 | 20 | 60 | 100 | 3 |
| PCC Lab | 26AF1928PC602L | Microwave & RADAR Engineering Lab | - | 2 | 60 | | 40 | 100 | 1 |
| PCC | 26AF1928PC603 | Optical Fiber Communication | 3 | - | 20 | 20 | 60 | 100 | 3 |
| PCC Lab | 26AF1928PC604L | Optical Fiber Communication Lab | - | 2 | 60 | | 40 | 100 | 1 |
| PCC | 26AF1928PC605 | Microcontroller & Embedded System | 3 | | 20 | 20 | 60 | 100 | 3 |
| MDM | **26AF1928MD606** | **MDM Bucket*** | 3 | - | 20 | 20 | 60 | 100 | 3 |
| PEC | 26AF1928PE607A | A. Control System Engineering | 3 | 0 | 20 | 20 | 60 | 100 | 3 |
| | 26AF1928PE607B | B. Antenna Wave Propagation & Design | | | | | | | |
| | 26AF1928PE607C | C. Consumer Electronics | | | | | | | |
| PEC | 26AF1928PE608A | A. Web Development | 3 | 0 | 20 | 20 | 60 | 100 | 3 |
| | 26AF1928PE608B | B. Industry 4.0 | | | | | | | |
| | 26AF1928PE608C | C. Internet of Things | | | | | | | |
| VSEC | 26AF1928VS609 | **Product Development** | - | 4 | 60 | - | 40 | 100 | 2 |
| **Total** | | | **18** | **8** | **300** | **120** | **480** | **900** | **22** |

**NOTE: * Refer to Multidisciplinary Minor Bucket of other departments**

****Refer to Open Elective Bucket**

# Third Year (Semester V)
# Electromagnetic Field Theory

| | | | | |
|---|---|---|---|---|
| **26AF1928PC501** | **Electromagnetic Field Theory** | PCC | 3L- 0T -0P | 3 Credits |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Course Objectives:**

| | |
|---|---|
| 1 | Students will gain knowledge in the area of EM Waves and its analysis. |
| 2 | Students will learn basic coordinate system, significance of divergence, gradient, curl and its applications to EM Waves. |
| 3 | To understand the boundary conditions for different materials/surfaces. |
| 4 | insight on finding solution for non-regular geometrical bodies using Finite Element Method, Method of Moments, Finite Difference Time Domain.. |
| 5 | To get the basics of microwave, transmission lines and antenna parameters. |

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Understand basic vector calculus, electrostatic fields and capacitance. |
| CO2 | Analyze steady electric currents and magnetic fields using fundamental laws. |
| CO3 | Apply Maxwell's equations to understand time-varying electromagnetic fields. |
| CO4 | Use transmission line theory and Smith charts for signal analysis and impedance matching. |
| CO5 | Explain electromagnetic wave propagation, reflection, and power flow in different media. |

**Course Contents:**

| **Unit No 1:** | **Mathematical Fundamentals and Static Electric Fields** | **[8Hours]** |
|---|---|---|
| Introduction, Vector Analysis, Coordinate systems and Transformations, Line, surface and volume integrals, Divergence Theorem, Stoke's theorem, Columb's Law, Electric Field, Electric flux density, Gauss's Law with Application, Electrostatic Potential and Equipotential Surfaces, Boundary conditions for Electrostatic fields, Capacitance and Capacitors, Electrostatic Energy and Energy Density. | | |
| **Unit No 2:** | **Steady Electric Currents and Static Magnetic Fields** | **[6 Hours]** |
| Current Density and Ohm's Law, Electromotive force and Kirchhoff's Voltage Law, Continuity | | |

| | | |
|---|---|---|
| Equation and Kirchhoff‟s Current Law, Power Dissipation and Joule's Law, Biot-Savart Law and its Application, Ampere's Circuital Law and its Application, Magnetic Flux Density, Magnetic Scalar and Vector Potentials, Boundary Condition Magnetic Fields, Inductance and Inductor, Energy stored in Magnetic Fiel | | |
| **Unit No 3:** | **Time Varying Field & Maxwell's Equations** | **[8 Hours]** |
| Introduction, Faraday's Law of electromagnetic Induction, Maxwell's Equation, Boundary Conditions for Electromagnetic fields, Time Harmonic Fields | | |
| **Unit No 4:** | **Transmission Lines** | **[7 Hours]** |
| Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements. | | |
| **Unit No 5:** | **Electromagnetic Waves** | **[8Hours]** |
| Maxwell Equations in phasor form, Wave Equation, Uniform Plane wave in Homogeneous, free space, dielectric, conducting medium. Polarization: Linear, circular & Elliptical polarization, unpolarized wave. Reflection of plane waves, Normal incidence, oblique incidence, Electromagnetic Power and Poynting theorem and vector. | | |

**Text Books**

| | |
|---|---|
| 1. | . R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India,2005 |
| 2. | E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India |
| 3. | Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall,1997. |
| 4. | David Cheng, “Electromagnetics”, PrenticeHall. |

**Reference Books**

| | |
|---|---|
| 1. | Sadiku, "Elements of Electromagnetics”, Oxford |
| 2. | Krauss, "Electromagnetics", McGraw Hill, New York, 4th edition. |
| 3. | W. H. Hayt, "Engineering Electromagnetics", McGraw Hill, New Delhi,1999. |

# Third Year (Semester – V)
# Digital Signal and Image Processing

| 26AF1928PC502 | Digital Signal and Image Processing | PCC | 3L- 0T - 0P | 3 Credits |
|---|---|---|---|---|

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment: 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites: Basics of communication system and related Mathematics.**

**Course Objectives**:

| | |
|---|---|
| 1 | Understand fundamentals of discrete time signals, sampling, reconstruction and representation of signals DSP processor system. |
| 2 | To understand the Discrete Fourier Transform and application |
| 3 | To understand the Discrete Fourier Transform and Z-Transform and its application |
| 4 | To use and understand implementation of digital filters |
| 5 | To understand concept of Image Processing using DSP. |

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Understand fundamentals of discrete time signals, sampling, reconstruction and representation of signals |
| CO2 | Analyze signals using Discrete Fourier Transform, its properties and FFT algorithms. |
| CO3 | Apply Z Transform techniques to analyze LTI systems and solve difference equations. |
| CO4 | Design Infinite Impulse Response Filter using analog filter transformations such as impulse invariance and bilinear transformation. |
| CO5 | Able to operate the image by using filtering in DSP. |

**Course Contents:**

| Unit No 1: | Introduction | [8 Hours] |
|---|---|---|
| Signals and systems as seen in everyday life. Continuous and discrete time sequences. Energy and power signals, System properties: linearity: additivity and homogeneity, shift invariance, causality, stability. Sampling and Reconstruction of signals, Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing. | | |

| Unit No 2: | Discrete Fourier Transform: | [7Hours] |
|---|---|---|
| DTFT, Definition, Frequency domain sampling, DFT, Properties of DFT, circular convolution, linear convolution, Computation of linear convolution using circular convolution, FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm. | | |
| **Unit No 3:** | **Laplace Transform and Z transform:** | **[7 Hours]** |
| Need for transform, relation between Laplace transform and Z transform, between Fourier transform and Z transform, Properties of ROC and properties of Z transform, causality and stability considerations for LTI systems, Inverse Laplace Inverse Z transform, Power series method, partial fraction expansion method, Solution of difference equations. | | |
| **Unit No 4:** | **IIR , FIR Filter Design and MDSP:** | **[7 Hours]** |
| Concept of analog filter design (required for digital filter design), Design of IIR filters from Analog filters, IIR filter design by impulse invariance method, bilinear transformation Method. IIR filter realization using direct form, cascade form and parallel form, FIR Filter design: Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows and frequency sampling method. Concept of Multirate DSP, Introduction to Up sampler, Application of Multirate signal processing in communication. | | |
| **Unit No 5:** | **Introduction to Image Processing** | **[7Hours]** |
| Introduction to image processing and its applications, Image representation, image processing operations, Image filtering & convolution.<br>Image enhancement: Contrast stretching, Histogram specification, Adaptive Histogram Equalization (AHE), Wavelet-based enhancement, Image Filtering: | | |

**Text Books**


| | |
|---|---|
| 1. | Simon Haykins and Barry Van Veen, “Signals and Systems”, 2nd Edition, Wiley India. |
| 2. | S. K. Mitra, Digital Signal Processing: A computer-based approach, TMH |
| 3. | A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall,1989. |
| 4 | John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms a. and Applications, Prentice Hall,1997. |
| 5 | Multiple View Geometry in Computer Vision: R. Hartley and A. Zisserman, Cambridge University Press |
| 6 | Computer Vision: Algorithms & Applications, R. Szeleski, Springer. Computer vision: A modern approach: Forsyth and Ponce, Pearson. |


**Reference Books**


| | |
|---|---|
| 1. | L. R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall,1992. |
| 2. | J. R. Johnson, Introduction to Digital Signal Processing, Prentice Hall,1992. |
| 3 | D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988. |
| 4 | Shaila Apte, “Signals and Systems-principles and applications”, Cambridge University press, 2016. |

# Third Year (Semester –V)
# Digital Signal and Image Processing Lab

| | | | | |
|---|---|---|---|---|
| **26AF1928PC503L** | **Digital Signal and Image Processing Lab** | **PCCL** | **0L-0T-2P** | **1Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lab : 2 hrs./week | Continuous Assessment: 60 Marks<br>End Semester Exam: 40 Marks |

**List of Practical's:**

1) Generation of standard test signals and basic signals
2) To study sampling process
3) Zero – pole analysis using transfer function, zero – pole – gain
4) Linear convolution.
5) Circular Convolution.
6) Compute the N-point DFT
7) Spectral analysis
8) Design IIR filters
9) FIR Filters
10) To study image filtering using convolution operation.
11) Image enhancement using Histogram Equalization Technique

# Third Year (Semester – V)
# Wireless Communication

| 26AF1928PC504 | Wireless Communication | PCC | 3L- 0T -0P | 3 Credits |
|---|---|---|---|---|

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites:** Knowledge of channel propagation modeling, antenna principles, and simulation tools like MATLAB is typically required to understand cellular design and wireless impairments.

**Course Objectives:**

| | |
|---|---|
| 1 | The objective of the course is to introduce the Concepts of basic wireless mobile communication systems. |
| 2 | To learn and understand the basic principles of Telecommunication switching, traffic and networks. |
| 3 | To learn and understand basic concepts of cellular system, wireless propagation and the techniques used to maximize the capacity of cellular network. |
| 4 | To learn and understand architecture of GSM and CDMA system. |
| 5 | To understand mobile management, voice signal processing and coding in GSM and CDMA system |

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Explain and apply the concepts telecommunication switching, traffic and networks |
| CO2 | Analyze the telecommunication traffic. |
| CO3 | Analyze radio channel and cellular capacity. |
| CO4 | Explain and apply concepts of GSM and CDMA system. |
| CO5 | Understand wireless communication standards |

**Course Contents:**

| **Unit No 1:** | **Introduction and Cellular Concept** | **[8Hours]** |
|---|---|---|
| Existing technology, Evolution in wireless systems, Trends in cellular system Frequency Reuse channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Cellular System, Design in worst case with an omni–Directional Antenna, Co-Channel Interference Reduction with use of Directional Antenna, Improving Coverage and Capacity in Cellular systems, Trunking and Grade of services. | | |
| **Unit No 2:** | **Wireless Communication Systems GSM** | **[6 Hours]** |
| GSM Services and features, GSM (Global system for mobile communication) Architecture and interfaces, GSM Radio Sub System, GSM Channel Types, Traffic Channels, Control Channels, Example of a GSM call, Frame structure for GSM , Signal Processing in GSM, GPRS ( General packet radio service). | | |

| Unit No 3: | Wideband Modulation Techniques and OFDM | [8 Hours] |
|---|---|---|
| Basic Principles, OFDM (Orthogonal Frequency Division Multiplexing) Signal Mathematical representation, Block Diagram, Selection Parameters for modulation, Pulse shaping, Windowing, Spectral Efficiency, Synchronization | | |
| **Unit No 4:** | **Wireless Communication Systems CDMA IS95** | **[7 Hours]** |
| Direct sequence Spread Spectrum, Spreading codes, Multipath Signal Propagation and RAKE receiver, Frame Quality and BER (Bit Error Rate) Requirements, Critical challenges of CDMA, TIA ( Telecommunication Industry Application ) IS95<br>(Communication Standard) System, Physical and Logical Channels of IS95, CDMA IS95 call processing, soft hand off and power control in CDMA, Access and Paging Channel Capacity, Reverse and Forward Link Capacity of a CDMA System. | | |
| **Unit No 5:** | **Wireless Communication Systems** | **[8Hours]** |
| CDMA 2000: CDMA layering structure, CDMA 2000 channels, logical channels, forward link physical, forward link features, reverse physical channels, CDMA 2000 Media Access control and LLC ( Logical Link Control) sub layer, Data services, Data services in CDMA 2000, mapping of logical channels to physicals, evolution of CDMA IS95 to CDMA 2000.<br>Bluetooth, Wi Fi Standards, Wireless Sensor Networks, Zigbee, IEEE 802.20 | | |

**Text Books**

| | |
|---|---|
| 1. | Wireless Communication: Principles and Practice ñ Theodare. S. Rappaport- Pearson Education. |
| 2. | Wireless Communication: Upena Dalal ñ Oxford Higher Education |
| 3. | Wireless Network Evolution: 2G to 3G ñ Vijay. K. Garg ñ Pearson Education. |
| 4. | Principles and Application of GSM ñ Vijay Garg, Joseph. E. Wilkes ñ Pearson Education. |

**Reference Books**

| | |
|---|---|
| 1. | Introduction to Wireless Telecommunication Systems and Networks-<br>Gary. J. Mullet |
| 2. | Wireless Communications and Networks: 3G and Beyond, ITI Saha Misra |
| 3. | Fundamentals of Wireless Communication: David Tse, Pramod Viswanath, CAMBRIDGE University Press. |

# Third Year (Semester – V)
# Wireless Communication Lab

| | | | | |
|---|---|---|---|---|
| **26AF1928PC507L** | **Wireless Communication Lab** | **PCCL** | **0L-0T-2P** | **1 Credits** |

| Teaching Scheme | Examination Scheme |
|---|---|
| Practical: 02 hrs./week | Continuous Assessment: 60 Marks<br>End Semester Exam: 40 Marks |

**List of Practical's:**

1. **T**o understand basic wireless communication System
2. To understand its performance, and exploring real-world applications of GSM technology
3. To design a model of wireless communication systems using Matlab (Two ray channel and Okumura –Hata model)
4. To design a Model and simulation of Multipath fading channel
5. Design, analyze and test Wireless standards and evaluate the performance measurements such as BER, PER, BLER, throughput, capacity, ACLR, EVM for 4G and 5G using MATLAB.
6. To design modulation: Spread Spectrum – DSSS Modulation & Demodulation
7. To design a wireless Channel equalization: Zero-Forcing Equalizer (ZFE)
8. To model and simulate TDMA, FDMA and CDMA for wireless communication
9. Studying Various Wireless Sensor Network
10. Study Orthogonal Frequency Division Multiplexing

# Third Year (Semester – V)
# Information Theory and Coding

| | | | | |
|---|---|---|---|---|
| **26AF1928PC508A** | **Information Theory and Coding.** | PEC | **3L- 0T - 0P** | **3 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3hrs./week | Continuous Assessment: 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Course Objectives:**

| | |
|---|---|
| 1 | To introduce the fundamentals of probability theory and random processes used in communication systems. |
| 2 | To explain the effect of noise in communication systems and the need for digital transmission. |
| 3 | To develop understanding of information theory concepts and channel capacity. |
| 4 | To familiarize students with source coding and channel coding techniques. |
| 5 | To study error detection and error correction methods using different coding schemes. |

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Apply probability and random process concepts in communication problems. |
| CO2 | Explain noise effects and compare analog and digital communication systems. |
| CO3 | Calculate entropy, mutual information, and channel capacity. |
| CO4 | Apply source coding and channel coding techniques. |
| CO5 | Analyze and implement basic error detection and error correction codes. |

**Course Contents:**

| **Unit No 1:** | **Theory of Probability and Random Processes** | **[4 Hours]** |
|---|---|---|
| Concept of probability, probability models, statistical averages, central limit theorem, correlation, random variables, random process. | | |
| **Unit No 2:** | **Noise in Communication Systems** | **[6 Hours]** |
| Sources of noise, Figure of merit, Comparison of Analog communication systems. Disadvantages of Analog communication, Capture effect, Threshold effect, Need of digitizing analog data. | | |

| | | |
|---|---|---|
| **Unit No 3:** | **Information Theory & Channel Capacity** | **[8 Hours]** |
| Measure of information, Joint entropy and conditional entropy, Relative entropy and mutual Information. Type of Channels & Channel Capacity Calculations – Discrete, Continuous. | | |
| **Unit No 4:** | **Source Coding & Channel Coding** | **[6 Hours]** |
| Need of source coding, Source coding theorem, Shannon-Fano coding, Huffman Coding. Need of Channel coding, Channel coding theorem. | | |
| **Unit No 5:** | **Error Correcting Codes** | **[8 Hours]** |
| Linear Block Codes: Matrix description, Error detection and correction. Cyclic Codes: cyclic polynomial codes, cyclic encoder and decoder. Convolutional Codes: convolution encoder, state diagram. | | |

**Text Books**

| | |
|---|---|
| 1. | R.P.Singh, S.D. Sapre; Communication systems: Analog and Digital; TMH. |
| 2. | N. Abramson, Information and Coding, McGraw Hill, 1963. |
| 3. | Taub, Schilling, Principles of Communication Engineering (2nd Edition), TMH. |

**Reference Books**

| | |
|---|---|
| 1. | B. P. Lathi; Modern Digital and Analog Communication Systems; Oxford Publication. |
| 2. | Theodore S. Rappaport; Wireless Communication: Principles and Practice (2nd Edition), Pearson India. |

# Third Year (Semester – V)
# Electronic Measurements & Instrumentation

| | | | | |
|---|---|---|---|---|
| **26AF1928PE508B** | **Electronic Measurements & Instrumentation** | **PEC** | **3L- T -0P** | **3 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Course Objectives:**

| | |
|---|---|
| 1 | Understand the fundamental concepts, principles, characteristics, errors, calibration methods, and standards used in electronic measurements and instrumentation. |
| 2 | Study the working principles and applications of analog and digital measuring instruments, bridges, CRO, DSO, multimeters, signal generators, and frequency counters |
| 3 | Understand different types of sensors and transducers, their characteristics, selection criteria, signal conditioning, telemetry, and data acquisition systems |
| 4 | Develop knowledge of industrial measurement techniques and applications including vibration, temperature, humidity, level, gas analysis, sound, speed, and safety measurements. |
| 5 | Familiarize students with biomedical instrumentation and modern measurement systems used in industrial, automation, and biomedical applications. |

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | **Explain** the fundamental principles of electronic measurements, measurement systems, standards, errors, accuracy, precision, calibration, and static and dynamic characteristics of measuring instruments. |
| CO2 | **Analyze and select** suitable analog and digital measuring instruments and bridge circuits for measurement of electrical and electronic quantities. |
| CO3 | **Demonstrate and interpret** measurements using electronic instruments such as multimeters, CRO, DSO, digital voltmeters, signal generators, signal analyzers, and frequency counters. |
| CO4 | **Troubleshoot and evaluate** the operation of electronic instruments, sensors, and transducers for given industrial, automation, and biomedical applications. |
| CO5 | **Estimate, analyze, and correct** measurement deviations due to instrument errors, accuracy limitations, and environmental factors, and apply appropriate measurement techniques for industrial applications. |

**Course Contents:**

| **Unit No 1:** | **Measurement Fundamentals** | **[6 Hours]** |
|---|---|---|
| Fundamental concepts (measurement systems, characteristics, errors, units) and components.. Error analysis, instrument classification, static and dynamic characteristics, Calibrations and international units/standards. Applications of Measurement System,. | | |
| **Unit No 2:** | **Analog Instruments & Bridge Circuits** | **[6 Hours]** |
| Analog instruments, meters (ammeters, voltmeters), power/energy measurement, bridges, and magnetic/optical measurements. Moving iron, PMMC, dynamometer-type meters, ammeters, voltmeters, wattmeters, and energy meters.<br>AC and DC bridges used to measure resistance, inductance, and capacitance. | | |
| **Unit No 3:** | **Electronic & Digital Measurements:** | **[5 Hours]** |
| Electronic instrumentation, multimeters,, CROs, DSO, Signal Generators / Analyzers, digital voltmeters, and frequency counters. | | |
| **Unit No 4:** | **Sensors and Transducers** | **[7 Hours]** |
| Sensors, modern sensors, chemical sensors, automation, and biomedical instruments, signal conditioning, telemetry, and data acquisition systems.<br>Classification selection criteria of transducers strain gauges, LVDT, Temperature transducers, piezoelectric, photosensitive transducers, Hall Effect transducers, proximity devices Digital transducers need of signal conditioning and types. | | |
| **Unit No 5:** | **Industrial Measurement and Applications** | **[6Hours]** |
| Measurement of vibration, electrical telemetry thickness, humidity, thermal conductivity and gas analysis emission computerized tomography, smoke and fire detection, burglar alarm, object counter level measurement, on /off timers, RTC, sound level meter, tachometer, VAW meter, Recorder X- Y plotters and its applications, optical oscillograph.<br>Biomedical Instruments & its Applications. | | |

**Text Books**

| | |
|---|---|
| 1. | **A.K. Sawhney:** *A Course in Electrical and Electronic Measurements and Instrumentation* (Dhanpat Rai & Co.) |
| 2. | **H.S. Kalsi:** *Electronic Instrumentation* (McGraw Hill Education) |
| 3. | **Albert D. Helfrick and William D. Cooper:** *Modern Electronic Instrumentation and Measurement Techniques* (Pearson) |
| 4. | **R.S. Sedha:** *Electronic Measurements and Instrumentation* (S. Chand) |

**Reference Books**


| | |
|---|---|
| 1. | **J.B. Gupta:** *A Course in Electrical & Electronics Measurement & Instrumentation* (S.K. Kataria & Sons) |
| 2. | **R.S. Sedha:** *Electronic Measurements and Instrumentation* (S. Chand) |
| 3. | **K. Lal Kishore:** *Electronic Measurements and Instrumentation* (Pearson Education) |

# Third Year (Semester –V)
# Information Theory and Coding Lab

| | | | | |
|---|---|---|---|---|
| **26AF1928PE509AL** | **Information Theory and Coding Lab** | **PECL** | **0L-0T-2P** | **1 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lab : 2 hrs./week | Continuous Assessment: 60 Marks<br>End Semester Exam: 40 Marks |

**List of Practical's:**

1. Simulate probability density and cumulative distribution functions for uniform, Gaussian, and exponential distributions.
2. Evaluate auto-correlation and cross-correlation functions of random sequences.
3. Calculate power spectral density of a stationary random process.
4. Evaluate signal-to-noise ratio performance of amplitude and frequency modulation under noise.
5. Calculate the effective noise bandwidth for various filter responses.
6. Calculate entropy and redundancy of discrete memoryless information sources.
7. Compute joint entropy, conditional entropy, and mutual information between two random variables.
8. Implement block encoding and decoding using Hamming code for single-bit error correction.
9. Generate cyclic redundancy check codes and verify error detection capabilities.
10. Detect and correct burst errors using interleaving or Reed–Solomon codes.
11. Model a first-order Markov information source and calculate source entropy.
12. Simulate noisy channel performance and demonstrate Shannon's channel coding theorem.

# Third Year (Semester –V)
# Electronic Measurements and Instrumentation Lab

| | | | | |
|---|---|---|---|---|
| **26AF1928PE509BL** | **Electronic Mesurements and Instrumentation Lab** | **PECL** | **0L-0T-2P** | **1 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lab : 2 hrs./week | Continuous Assessment: 60 Marks<br>End Semester Exam: 40 Marks |

**List of Practical's:**

1 To find Resolution, Accuracy & Precision for analog multi meter.

2 To Analyze Digital Multimeter for various measurements.

3 To study the front panel controls of CRO & DSO.

4 To find frequency, time and phase difference for waveforms of choice using Cathod Ray Oscilloscope / Digital Storage Oscilloscope.

5 To Study of Potentiometer Displacement Transducers.

6 To Study of Thermistors

7 To Study of Liquid Level Measurement

8 To study Strain Gauge.

9 To study Temperature measurement using thermocouple.

10 To Study Burglar Alarm.

11 To study the operation and characteristics of a Hall-effect transducer for magnetic field measurement.

12 To study a proximity sensor and implement an object-counting/application circuit.

# Third Year (Semester – VI)
# Microwave and Radar Engineering

| 26AF1928PC601 | Microwave and Radar Engineering | PCC | 3L- 0T -0P | 3 Credits |
|---|---|---|---|---|

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Course Objectives:**

| | |
|---|---|
| 1 | Radio-frequency spectrum space, microwave communication. |
| 2 | Microwave principles, working of microwave devices. |
| 3 | RADAR and their applications. |
| 4 | Understand semiconductor Microwave Devices. |

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Analyze the microwave passive circuit components and design the tunning and matching networks. |
| CO2 | Identify the state of art in microwave tubes and semiconductors and their uses in real life. |
| CO3 | Apply the microwave devices and RADAR for industrial and scientific purposes. |
| CO4 | Describe microwave semiconductor devices. |
| CO5 | Understand RADAR systems and their applications.. |

**Course Contents:**

| Unit No 1: | Waveguides and Microwave Components | [8Hours] |
|---|---|---|
| Frequency bands and characteristics of microwaves, Rectangular and circular waveguides, mode analysis, Resonators, reentrant cavities, scattering parameters, tees, hybrid ring, directional couplers, phase shifters, terminations attenuators, ferrite devices, such as isolators, gyrators, and circulators. | | |
| **Unit No 2:** | **Impedance Matching and Tuning** | **[6 Hours]** |
| Lumped element matching, Single stub tuning, double stub tuning, triple stub tuning, Quarter wave transformer. | | |

| Unit No 3: | Generation and Amplification of Microwaves | [8 Hours] |
|---|---|---|
| Two Cavity Klystron and Reflex Klystron, Helix Travelling Wave Tube and Backward Wave Oscillator, Cross Field Amplifier, Cylindrical Magnetron, and Gyrotrons. | | |
| **Unit No 4:** | **Semiconductor Microwave Device** | **[7 Hours]** |
| Varactor, PIN, Tunnel, Point Contact, SchottkyBarrier, Gunn, IMPATT, TRAPATT, and BARITT, BJT, Hetro junction BJT, MESFET, and HEMT Parametric Amplifiers. | | |
| **Unit No 5:** | **RADAR & Microwave Applications** | **[8Hours]** |
| Basics of RADAR and RADAR range equation, Types of RADAR: Pulsed, Continuous wave and FMCW, Doppler, MTI, and Phased Array, Types of displays and Clutter, Tracking RADAR: Mono pulse, Conical, Sequential lobbing. Microwave heating and bio-medical applications, Remote sensing RADAR, MSTRADAR, radiometer, instrumentation landing system, and RADAR based navigation.. | | |

**Text Books**

| | |
|---|---|
| 1. | Microwave Engineering – Annapurna Das, Sisir K Das TMH Publication, 2nd, 2010 |
| 2. | Microwave Devices and circuits- Liao / Pearson Education |
| 3. | David M Pozar, ―Microwave Engineering, John Wieley & Sons, Inc. Hobokenh, New Jersey, Fourth Edition, 2012. |

**Reference Books**

| | |
|---|---|
| 1. | Merill Skolnik, ―Introduction to RADAR Systems, Tata Mc graw Hill, Third Edition. |
| 2. | Annapurna Das and Sisir K Das, ―Microwave Engineering, Tata McGraw Hill, New Delhi, Second Edition, 2009.. |
| 3. | K. T. Matthew, ―Microwave Engineering, Wieley india, 2011. |

# Third Year (Semester – VI)
# Microwave Engineering Lab

| | | | | |
|---|---|---|---|---|
| **26AF1928PC602L** | **Microwave Engineering Lab** | **PCCL** | **0L- 0T -2P** | **1 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lab: 2 hrs./week | Continuous Assessment : 60 Marks<br>End Semester Exam: 40 Marks |

(Minimum 08 to 10 experiments are to be performed based on contents in syllabus)

**List of Practical:**

1. To study the characteristics of the Reflex Klystron tube and to determine its Electronic tuning range.
2. Study of V-I characteristics of Gunn diode.
3. To study the ATTENUATOR (fixed and variable type).
4. To study the function of multi hole directional coupler by measuring the following parameters. Coupling factor
5. Insertion loss and Directivity
6. To determine the Standing-Wave Ratio and Reflection Coefficient.
7. To measure unknown impedance using the Smith chart.
8. To determine the frequency and wave length in a Rectangular Waveguide working in TE10 mode.
9. To study the X-band Microwave circulator. 9. To study the X-band Microwave isolator.
10. To study Magic TEE.

# Third Year (Semester – VI)
# Optical Fiber Communication

| | | | | |
|---|---|---|---|---|
| **26AF1928PC603** | **Optical Fiber Communication** | PCC | 3L- 0T -0P | 3 Credits |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites: F**oundational understanding of electromagnetic theory (Maxwell's equations, wave propagation), basic semiconductor physics (pn-junctions, photonics), and core concepts of digital/analog communication systems.

**Course Objectives:**

| | |
|---|---|
| 1 | After learning OFC course, students will get advantage to pursue higher studies or employment in core engineering/communication engineering companies. |
| 2 | To explore the knowledge in the area of LASERs and electro-optics. |
| 3 | To get insight into different fiber types, fabrication methods, optical transmission characteristics, optical sources, optical detectors and optical amplifiers. |
| 4 | To understand different design considerations in optical links involving link power budget and rise time budget. |
| 5 | To mold students professionally and further it also acquaint with emerging trends in fiber, advanced optical systems, different optical sources and detectors. |

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Learner will apply knowledge of mathematics to solve numerical based on step index and graded index fibers pertaining to MSI and MGI, SMSI. |
| CO2 | Students will understand fiber performance parameters like NA, Group delay, Phase and Group velocity .They will understand optical transmission characteristics theoretically and practically. |
| CO3 | With the basic knowledge of OFC course, students can peruse higher studies in LASEERs and electro-optics |
| CO4 | Students will apply the knowledge of optical key elements to understand optical fiber communication systems. |
| CO5 | This course understanding will enforce students to work in communication engineering domain and will cope up the selves to work in professional environment. |

**Course Contents:**

| **Unit No 1:** | **Optical communication fundamentals** | **[8Hours]** |
|---|---|---|
| Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical | | |

| | | |
|---|---|---|
| dielectric rod, Ray model, wave model. Different types of optical fibers, Modal analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation. | | |
| **Unit No 2:** | **Optical sources** | **[6 Hours]** |
| LEDs: structure and its characteristics, Lasers: structure and its characteristics. | | |
| **Unit No 3:** | **Optical detectors** | **[8 Hours]** |
| Photo-detectors - pin- detectors, detector responsively, noise, optical receivers | | |
| **Unit No 4:** | Fabrication Techniques & Optical Modulation | **[7 Hours]** |
| Fabrication of fibers and measurement techniques like OTDR, Concept of self-phase modulation, group velocity dispersion and solution based communication. Optical amplifiers - EDFA, Raman amplifier, and WDM system | | |
| **Unit No 5:** | **Optical link design** | **[8Hours]** |
| BER calculation, quantum limit, power penalties, Optical switches - coupled mode analysis of directional couplers, electro-optic switches, nonlinear effects in fiber optic links. | | |

**Text Books**


| | |
|---|---|
| 1. | J. Keiser, Fiber Optic communication, McGraw-Hill, 2nd Ed. 1992. |
| 2. | J. E. Midwinter, Optical fibers for transmission, John Wiley, 1979 |
| 3. | T. Tamir, Integrated optics (Topics in Applied Physics Vol.7), Springer-Verlag, 1975. |
| 4. | J. Gowar, Optical communication systems, Prentice Hall India, 1987. |


**Reference Books**


| | |
|---|---|
| 1. | G. Agrawal, Nonlinear fiber optics, Academic Press, 2nd Ed, 1994. |
| 2. | G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1992. |
| 3. | Jhon Senior, "Optical Fiber Communications-Principles & Practices", 2nd Edition, PHI-2001. |

# Third Year (Semester – VI)
# Optical Fiber Communication Lab

| | | | | |
|---|---|---|---|---|
| **26AF1928PC604L** | **Optical Fiber Communication Lab** | **PCCL** | **0L-0T-2P** | **1 Credits** |

| Teaching Scheme | Examination Scheme |
|---|---|
| **Practical: 02 hrs./week** | Continuous Assessment : 60 Marks<br>End Semester Exam: 40 Marks |

**List of Practicals:**

1. Study of Optical Fiber Components – Identify core, cladding, jacket, numerical aperture.
2. Measurement of Numerical Aperture (NA) – Using laser source and fiber setup.
3. Light Propagation Experiments – Observing ray paths and total internal reflection in fibers.
4. Study of Fiber Types – Single-mode vs multi-mode, step-index vs graded-index fibers.
5. LED Characteristics – V-I characteristics, output power vs current, emission spectrum.
6. Laser Diode Characteristics – Threshold current, power vs current, and wavelength measurement.
7. PIN Photodiode Characteristics – Responsivity, output current vs optical input.
8. Noise Measurement in Photodetectors – Shot noise and thermal noise measurements.
9. Optical Receiver Setup – Study of basic receiver operation using LED/laser source and photodiode.
10. TDR Experiment – Measure attenuation and locate faults in fiber.
11. Fiber Splicing and Connectorization – Practice joining fibers and measuring insertion loss.
12. Study of Optical Amplifiers (EDFA/Raman) – Demonstrate signal amplification in lab setup (simulation if real amplifiers unavailable).

# Third Year (Semester –VI)
# Microcontroller & Embedded System

| | | | | |
|---|---|---|---|---|
| **26AF1928PC605** | **Microcontroller & Embedded System** | **PCC** | **3L- 0T - 0P** | **3 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Course Objectives:**

| | |
|---|---|
| 1 | To introduce 8051 microcontroller programming concepts and System design from a Hardware and software point of view. |
| 2 | To provide the basic concepts of an Embedded System. |
| 3 | To illustrate the tools and methodologies needed for embedded system design.. |

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Understand the basic architecture of 8051 micro controller |
| CO2 | Develop 8051 microcontroller programming system |
| CO3 | Develop code for interfacing various devices |
| CO4 | Understand the basics of Embedded system and the concepts of Real Time Operating Systems |
| CO5 | Compose simple embedded system with error free software to obtain target system |

**Course Contents:**

| **Unit No 1:** | **UNIT I: Fundamentals of Microcontrollers** | **[7Hours]** |
|---|---|---|
| Introduction: MCS-51 family, Harward & Von Neumann architecture, RISC & CISC processors, Comparison of microprocessor and microcontroller, architecture and pin functions of 8051, Port structure, memory organization, Interrupt structure, timers and its modes, serial communication modes. Overview of Instruction set, Addressing modes. | | |
| **Unit No 2:** | **UNIT II: Programming with 8051** | **[8Hours]** |
| Assembly Language Programming examples, Delay using Timer and interrupt, Programming Timer 0&1, Data transmission and reception using Serial port. Software and Hardware tools for development 28 With effective from academic year 2025-26 of microcontroller-based systems such as assemblers, compliers, IDE, Emulators, debuggers, programmers, development board. | | |

| Unit No 3: | UNIT III: Interfacing Of 8051 | [7 Hours] |
|---|---|---|
| Interfacing LED with and without interrupt, interrupt programming ,Seven Segment Display, LCD and keyboard interfacing, ADC and DAC interfacing, interfacing to external memory, Temperature sensors, Stepper motor, Motion detectors, Relay, Buzzer, Optoisolators | | |
| **Unit No 4:** | **UNIT IV: Introduction To Embedded Systems** | **[7 Hours]** |
| Introduction to Embedded Systems, Architecture of Embedded System, Design Methodology, Design Metrics, General Purpose Processor, System On chip. Embedded system design and development: Embedded system design, Life-Cycle Models, Problem solving, The design process, Requirement identification, Formulation of requirements specification. Development tools. | | |
| **Unit No 5:** | **UNIT V: Arm Processor Fundamentals And Instruction Set** | **[7Hours]** |
| Registers, Current Program Status Registers(CPSR), Pipeline, exceptions, Interrupts and the vector table, Data Processing Instruction, Branch Instruction, Load-Store Instructions, Software Interrupts instructions, Program Status Register Instructions, Loading Constants, Thumb register usage, ARM Thumb Interworking, other branch instructions, Data Processing instructions, Stack instructions, Single -register load -store instruction, multiple –register load- store instruction, software interrupt instructions | | |

**Text Books**


| | |
|---|---|
| 1. | "The 8051 Microcontroller"- Kenneth J.Ayala, Thomson |
| 2. | "The 8051 Microcontroller and Embedded Systems", Muhammad A Mazidi, Pearson Education. |
| 3. | An Embedded Software Primer- David E. Simon, Pearson Education. |


**Reference Books**


| | |
|---|---|
| 1. | 8051 Microcontrollers, Satish Shah, Oxford Higher Education. |
| 2. | Embedded Microcomputer Systems Real Time Interfacing, Jonathan W. Valvano, Cengage Learning. |
| 3. | Micro Controllers, Ajay V Deshmukhi, TMH. |
| 4. | Embedded System Design, Frank Vahid, Tony Givargis, John Wiley. 5. Microcontrollers, Raj kamal, Pearson Education. |

# Third Year (Semester –VI)
# Control System Engineering

| 26AF1928PE607A | Control System Engineering | PEC | 3L- 0T - 0P | 3 Credits |
|---|---|---|---|---|

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam:20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Course Objective :**

:

| | |
|---|---|
| 1 | To provide a clear view of Control System. |
| 2 | To get accustomed with Frequency and Time domain Analysis methods for industrial applications |
| 3 | To get familiarize with state space analysis with its Controllability and Observability of the Systems. |

**Course Outcomes**: After completion of the course, students will be able to

| | |
|---|---|
| CO1 | Classify the control systems and calculate transfer function. |
| CO2 | Determine the performance of system in time domain. |
| CO3 | Analyze system using R-H criteria and root locus. |
| CO4 | Able to do system analysis in frequency domain. |
| CO5 | Calculate controllability and observability for the given system. |

**Course Contents:**

| Unit No 1: | Introduction to Control Systems: | [8 Hours] |
|---|---|---|
| Introduction: Concepts of control systems. Examples of control systems, classification of control systems, Block diagram algebra, Representation by Signal flow graph. Reduction using Mason‟s gain formula. Feedback Characteristics, Effects of feedback. Mathematical modelling of systems – Electrical, mechanical translational and rotational systems. | | |
| **Unit No 2:** | **Time domain analysis** | **[7 Hours]** |
| Standard test signals, Time response of first and second order systems with standard input signals, Time domain specifications, Type of systems, steady state error and error constants. Effects of P, PI, PD and PID Controllers. | | |

| Unit No 3: | Stability Analysis in S-Domain | [7 Hours] |
|---|---|---|
| Concept of Stability, Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique. Construction of Root-loci, Dominant Poles, Effects of addition of poles and zeros. | | |
| **Unit No 4:** | **Frequency Response Analysis** | **[8 Hours]** |
| Relationship between time and frequency response, Polar plots, Bode plots. Gain and phase margin, Nyquist stability criterion, Relative stability using Nyquist criterion. | | |
| **Unit No 5:** | **State variable analysis:** | **[6Hours]** |
| State, State variables, State variable representation, State variable form from Transfer function (Diagonal form), transfer function from State variable form, State transition matrix, properties of state transition matrix, Controllability and Observability | | |

**Text Books**

| | |
|---|---|
| 1. | I. J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 05th Ed. |
| 2. | B. S. Manke, "Linear Control Systems", Khanna Publishers, New Delhi, 02nd Ed. |
| 3. | A. K. Jairath, "Problems and Solutions of Control Systems", CBS Publishes, New Delhi, 06th Ed. |

**Reference Books**

| | |
|---|---|
| 1. | K. Ogata, "Modern Control Engineering", PHI, New Delhi, 06th Ed.. |
| 2. | Norman S. Nise, "Control System Engineering", John Wiley and Sons, 07th Ed. |

# Third Year (Semester VI)
# Antenna Wave Propagation and Design

| 26AF1928PE607B | Antenna Wave Propagation and Design | PEC | 3L- 0T -0P | 3 Credits |
|---|---|---|---|---|

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Course Objectives:**

| | |
|---|---|
| 1 | To understand the applications of electromagnetic engineering. |
| 2 | To formulate and solve the Helmholtz wave equation and solve it for Uniform Plane Wave.. |
| 3 | To analyze and understand the Uniform plane wave propagation in variousmedia. |
| 4 | To solve the electric field and magnetic fields for a given wireantenna. |

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Understand wave propagation and ionospheric effects. |
| CO2 | Explain basics and types of wire antennas. |
| CO3 | Analyze antenna array types and patterns. |
| CO4 | Describe smart antenna concepts and beamforming. |
| CO5 | Identify and compare practical antenna types and uses. |

**Course Contents:**

| Unit No 1: | Wave Propagation | [8Hours] |
|---|---|---|
| Fundamental equations for free space propagation, Friis Transmission equation, Attenuation over reflecting surface, Effect of earth's curvature. Ground, sky & space wave propagations. Structure of atmosphere. Characteristics of ionized regions. Effects of earth's magnetic field. Virtual height, MUF, Skip distance. Ionospheric abnormalities. Multi-hop propagation. Space link geometry. Characteristics of Wireless Channel: Fading, Multipath delay spread, Coherence Bandwidth, and Coherence Time. | | |

| Unit No 2: | Antenna Fundamentals and Wire Antennas | [6 Hours] |
|---|---|---|
| Introduction, Types of Antenna, Radiation Mechanism, Antenna Terminology: Radiation pattern, radiation power density, radiation intensity, directivity, gain, antenna efficiency, half power beam width, bandwidth, antenna polarization, input impedance, antenna radiation efficiency, effective length, effective area, reciprocity. Radiation Integrals: Vector potentials A, J, F, M, Electric and magnetic fields electric and magnetic current sources, solution of inhomogeneous vector potential wave equation, far field radiation.<br>Wire Antennas: Analysis of Linear and Loop antennas: Infinitesimal dipole, small dipole, and finite length dipole half wave length dipole, small circular loop antenna. Complete Analytical treatment of all these elements. | | |
| **Unit No 3:** | **Antenna Arrays** | **[8 Hours]** |
| Antenna Arrays: Two element array, pattern multiplication N-element linear array, uniform amplitude and spacing, broad side and end-fire array, N-element array: Uniform spacing, non-uniform amplitude, array factor, binomial and Dolph Chebyshev array. Planar Array, Circular Array, Log Periodic Antenna, Yagi Uda Antenna Array. | | |
| **Unit No 4:** | **Concepts of Smart Antennas** | **[7 Hours]** |
| Introduction, Smart Antenna Analogy, Cellular Radio System Evolution, benefits and drawbacks of smart antennas, fixed weight beam forming basics, Antenna beamforming. | | |
| **Unit No 5:** | **Antennas and Applications** | **[8Hours]** |
| Structural details, dimensions, radiation pattern, specifications, features and applications of following Antennas: Hertz & Marconi antennas, V- Antenna, Rhombic antenna. TW antennas. Loop antenna, Whip antenna, Biconical, Helical, Horn, Slot, Microstrip, Turnstile, Super turnstile & Lens antennas. Antennas with parabolic reflectors. | | |

**Text Books**


| | |
|---|---|
| 1. | C. A. Balanis, “Antenna Theory - Analysis and Design", JohnWiley |
| 2. | Mathew N O Sadiku, “Elements of Electromagnetics” 3rd edition, Oxford University Press |
| 3. | John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas for All Applications, 3rdEdition, the McGraw Hill Companies |


**Reference Books**


| | |
|---|---|
| 1. | K. D. Prasad, “Antenna & Wave Propagation”, SatyaPrakashan, NewDelhi. |
| 2. | . John D Kraus, “Antenna& Wave Propagation”, 4th Edition, McGraw Hill,2010. |
| 3. | Vijay K Garg, Wireless Communications and Networking, Morgan Kaufmann Publishers, An Imprint of Elsevier, 2008. |

# Third Year (Semester VI)
# Consumer Electronics

| 26AF1928PE607C | Consumer Electronics | PEC | 3L- 0T -0P | 3 Credits |
|---|---|---|---|---|

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Course Objectives:**

| | |
|---|---|
| 1 | To acquaint students with the practical knowledge of designing and developing consumer electronic systems and products and introduce the latest trends and technologies |

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | List technical specification of electronics Audio system (microphone and speaker) 2. 3. 4. 5. |
| CO2 | Trouble shoots consumer electronics products like TV, washing machine and AC. |
| CO3 | Identify and explain working of various color TV transmission blocks. |
| CO4 | Adjust various controls of color TV receiver and troubleshoot it. |
| CO5 | Use various functions of Cam coder and shoot a video and take snapshots and save them in appropriate format. |

**Course Contents:**

| **Unit No 1:** | **Communication devices** | **[8Hours]** |
|---|---|---|
| Mobile handsets, Android technology, 2G, 3G Mobiles, i-phone, EPABX | | |
| **Unit No 2:** | **Mass Communication devices.** | **[6 Hours]** |
| Color Television, Antenna, HDTV, LCD TV,LED TV, 3D Technology In TV, Interactive TV, DTHTV, Plasma TV, Video Conferencing, FAX Machine, PA System, Dolby Digital Systems, Gesture Technology In TV. | | |

| | | |
|---|---|---|
| **Unit No 3:** | **Household e1cctronics devices** | **[8 Hours]** |
| Washing Machine, Microwave Oven, Types Applications, Electronics Weighing Balance Air Conditioner, Vacuum Cleaner. | | |
| **Unit No 4:** | **Printing and recording devices** | **[7 Hours]** |
| LASER printer, Inkjet Printers, Photocopiers, Scanner, DVD/CD Player, Blue ray DVD<br>Compliance: Product safety and liability issues, standards related to electrical safety and standard relate to fire hazards, e.g., UL and VDE. EM1/EMC requirements and design techniques for compliance, e.g. ESD, RF interference and immunity, line current harmonics and main voltage surg | | |
| **Unit No 5:** | **Special purpose machines:** | **[8Hours]** |
| Electronic Voting Machine, CFL, LED Lamps, Application and Advantages. Solar lamp, Water Purifier, Electronic Calculator, DVD Player, ATM. Security devices Biometric attendance Monitoring System, Working, Biometric Sensors, Home Automation System | | |

**Text Books**

| | |
|---|---|
| 1. | Television &Video Engineering-A. M. Dhake, TMH Publication. 2. 3. 4. a 5. 6. Arora C. P., "Refrigeration and Air conditioning", Tata McGraw-Hill, New Delhi, 1994 7. 8. . Basic TV &Video Systems-Bernard Grobb. 9. |
| 2. | Monochrome and Color TV - R. R. Gulati, Wiley Eastern publication. |
| 3. | Video demystified -Keith Jack, PI publication |

**Reference Books**

| | |
|---|---|
| 1. | Audio &Video Systems-R.G.Gupt |
| 2. | Audio and Video system - Principles, maintenance and Troubleshooting by R. Gupta |
| 3. | Arora C. P., "Refrigeration and Air conditioning", Tata McGraw-Hill, New Delhi, 1994 |
| 4. | Color TV Theory &Practice -S. P. Bali. TMG Hill Publication. |
| 5 | Basic TV &Video Systems-Bernard Grobb. |
| 6. | Electronic Communication Systems, Kennedy, TMH. |

# Third Year (Semester –VI)
# Web Development

| 26AF1928PPE608A | Web Development | PEC | 3L- 0T - 0P | 3 Credits |
|---|---|---|---|---|

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites:** None

**Course Objectives:**

| | |
|---|---|
| 1 | Fundamentals of web essentials and markup languages |
| 2 | Use of the Client-side technologies in web development |
| 3 | Use of the Server-side technologies in web development |
| 4 | Understand the web services and frameworks |
| 5 | Fundamentals of web essentials and markup languages |

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Implement and analyze behavior of web pages using HTML and CSS |
| CO2 | Apply the client-side technologies for web development |
| CO3 | Analyze the concepts of Servlet and JSP |
| CO4 | Analyze the Web services and frameworks |
| CO5 | Apply the server-side technologies for web development |

**Course Contents:**

| Unit No 1: | Introduction to Web Essentials | [6 Hours] |
|---|---|---|

The internet, basic internet protocols, the world wide web, HTTP Request message, HTTP response message, web clients, web servers. **HTML**: Introduction, history and versions. **HTML Elements**: heading, paragraphs, line break, colors and fonts, links, frames, list, tables, images and forms. Difference between HTML and HTML5. **CSS:** Introduction to style sheet, CSS features, CSS core syntax, Style sheets and HTML, Style rule cascading and inheritance, text properties. Bootstrap

| Unit No 2: | Client-Side Technologies: JavaScript and DOM | [6 Hours] |
|---|---|---|

JavaScript: Introduction to JavaScript, JavaScript in perspective, basic syntax, variables and data types, statements, operators, literals, functions, objects, arrays, built in objects, JavaScript debuggers. DOM: Introduction to Document Object Model, DOM history and levels, intrinsic event handling, modifying element style, the document tree, DOM event handling, jQuery, Overview of Angular JS.

| Unit No 3: | Java Servlets and XML | [5 Hours] |
|---|---|---|
| Servlet: Servlet architecture overview, A “Hello World” servlet, Servlet generating dynamic content, Servlet life cycle, parameter data, sessions, cookies, URL rewriting, other Servlet capabilities, data storage, Servlets concurrency, databases (MySQL) and Java Servlets. XML: XML documents and vocabularies, XML declaration, XML Namespaces, DOM based XML processing, transforming XML documents, DTD: Schema, elements, attributes. AJAX: Introduction, Working of AJAX. | | |

| Unit No 4: | JSP and Web Services | [7 Hours] |
|---|---|---|
| JSP: Introduction to Java Server Pages, JSP and Servlets, running JSP applications, Basic JSP, JavaBeans classes and JSP, Support for the Model-View-Controller paradigm, JSP related technologies. Web Services: Web Service concepts, writing a Java Web Service, Writing a Java web service client, Describing Web Services: WSDL, Communicating Object data: SOAP. Struts: Overview, architecture, configuration, actions, interceptors, result types, validations, localization, exception handling, annotations. | | |

| Unit No 5: | Server Side Scripting Languages | [6Hours] |
|---|---|---|
| PHP: Introduction to PHP, uses of PHP, general syntactic characteristics, Primitives, operations and expressions, output, control statements, arrays, functions, pattern matching, form handling, files, cookies, session tracking, using MySQL with PHP, WAP and WML. Introduction to ASP.NET: Overview of the .NET Framework, Overview of C#, Introduction to ASP.NET, ASP.NET Controls, Web Services. Overview of Node JS. | | |

**Text Books**


| | |
|---|---|
| 1. | Jeffrey C. Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035 |
| 2. | Robert W Sebesta, “Programming the World Wide Web , 4th Edition, Pearson education, 2008 |
| 3. | Marty Hall, Larry, “Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978-0130897930. |


**Reference Books**


| | |
|---|---|
| 1. | H.M. Deitel, P.J. Deitel and A.B. Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006, ISBN 978-0131752429. |
| 2. | Chris Bates, “Web Programming Building Internet Applications, 3rd Edition, Wiley India, 2006. |
| 3. | Xue Bai et al, “The web Warrior Guide to Web Programming, Thomson, 2003. |

# Third Year (Semester – VI)
# Industry 4.0

| | | | | |
|---|---|---|---|---|
| **26AF1928PE608B** | **Industry 4.0** | **PEC** | **3L- 0T - 0P** | **3 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites:** Basic knowledge of manufacturing systems / automation / computer fundamentals.

**Course Objectives:**

| | |
|---|---|
| 1 | To explain the evolution and fundamentals of Industry 4.0. |
| 2 | To introduce enabling digital and automation technologies used in smart industries. |
| 3 | To develop understanding of smart manufacturing and digital production systems. |
| 4 | To familiarize students with industrial integration, standards, and cybersecurity. |
| 5 | To create awareness about applications, challenges, and future trends of Industry 4.0 |

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

| | |
|---|---|
| CO1 | Explain the evolution, vision, and core principles of Industry 4.0. |
| CO2 | Describe enabling technologies used in Industry 4.0. |
| CO3 | Analyze smart manufacturing systems and digital production models. |
| CO4 | Apply Industry 4.0 concepts to industrial case studies. |
| CO5 | Evaluate challenges, standards, and future trends of Industry 4.0. |

**Course Contents:**

| **Unit No 1:** | **Introduction and Foundations of Industry 4.0** | **[6 Hours]** |
|---|---|---|
| Evolution of industrial revolutions (Industry 1.0 to Industry 4.0), Limitations of traditional manufacturing systems, Definition, vision, and objectives of Industry 4.0. Design principles: interoperability, real-time capability, decentralization, and information transparency. Smart factory concept and digital transformation. Economic and societal impact of Industry 4.0. | | |

| Unit No 2: | Enabling Technologies of Industry 4.0 | [6 Hours] |
|---|---|---|
| Cyber-Physical Systems (CPS): concept and architecture, Internet of Things (IoT) and Industrial IoT (IIoT). Smart sensors, actuators, and embedded systems, Cloud computing and edge computing in industrial applications, Big data sources and industrial data analytics overview, Introduction to Artificial Intelligence and Machine Learning for industry. | | |
| **Unit No 3:** | **Smart Manufacturing Systems** | **[6 Hours]** |
| Smart manufacturing and digital production planning, Industrial automation and control in Industry 4.0. Robotics and collaborative robots (Cobots), Additive manufacturing (3D printing) and mass customization, Predictive maintenance and asset management concepts. | | |
| **Unit No 4:** | **Industrial Communication and System Integration** | **[6 Hours]** |
| Industrial communication networks and requirements. Communication protocols: Modbus, PROFINET, EtherCAT, OPC-UA. Vertical and horizontal integration in manufacturing, Manufacturing Execution Systems (MES), Enterprise Resource Planning (ERP) integration, Smart supply chain and logistics integration, Introduction to cybersecurity issues in smart industries. | | |
| **Unit No 5:** | **Standards, Applications, and Future Trends** | **[6Hours]** |
| Industry 4.0 reference architectures: RAMI 4.0 and IIRA. Implementation challenges: technical, economic, and organizational. Applications in automotive, electronics, healthcare, and energy sectors. Case studies of smart manufacturing systems, Introduction to Industry 5.0 and human-centric manufacturing, Skill requirements, employability, and career opportunities. | | |

**Text Books**

| | |
|---|---|
| 1. | Klaus Schwab, *The Fourth Industrial Revolution*, Crown Business. |
| 2. | Alasdair Gilchrist, *Industry 4.0: The Industrial Internet of Things*, Apress. |
| 3. | Ovidiu Vermesan and Joern P. Woyke, *Internet of Things Applications*, River Publishers. |
| 4. | Lasi et al., *Industry 4.0*, Business & Information Systems Engineering. |

**Reference Books**

| | |
|---|---|
| 1. | V. Maheshwari, *Industry 4.0 and Advanced Manufacturing*, McGraw-Hill. |
| 2. | Shiyong Wang et al., *Cloud-Based Cyber-Physical Systems in Manufacturing*, Springer. |
| 3. | Frank Lamb, *Industrial Automation: Hands On*, McGraw-Hill. |

# Third Year (Semester – VI)
# Internet of Things

| 26AF1928PE608C | Internet of Things | PEC | 3L- 0T -0 P | 3 Credits |
|---|---|---|---|---|

| Teaching Scheme | Examination Scheme |
|---|---|
| Lecture: 3 hrs./week | Continuous Assessment : 20 Marks<br>Mid Semester Exam: 20 Marks<br>End Semester Exam: 60 Marks (Duration 03 hrs.) |

**Pre-Requisites:** Basics of microprocessor, microcontroller, C / Python language

**Course Objectives*:***

| | |
|---|---|
| 1 | Introduce fundamental concepts and architecture of IoT systems |
| 2 | Understand communication models, protocols, and data flow in IoT |
| 3 | Familiarize with cloud interaction and web-based IoT services |
| 4 | Provide awareness of IoT security, governance, and real-world applications |

**Course Outcomes:**

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

| | |
|---|---|
| CO1 | Explain IoT concepts, ecosystem, and system architecture |
| CO2 | Describe communication models and enabling technologies used in IoT |
| CO3 | Analyze IoT architectures and platform concepts |
| CO4 | Explain cloud integration and data visualization in IoT systems |
| CO5 | Identify IoT applications, security challenges, and real-world case studies |

**Course Contents:**

| Unit No 1: | Introduction to IoT | [6 Hours] |
|---|---|---|
| Definition, characteristics of IoT, IoT vs M2M, Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends, Challenges, Future scope | | |

| Unit No 2: | IoT Architecture & Design | [6 Hours] |
|---|---|---|
| Layered IoT architecture (Perception, Network, Processing, Application), Logical and physical design, Device-Cloud-Gateway interaction, Deployment models, Open IoT frameworks overview | | |
| **Unit No 3:** | **IoT Communication & Protocols** | **[5 Hours]** |
| IoT communication models (Device-to-Device, Device-to-Cloud, Device-to-Gateway, Back-End Data Sharing), MQTT, HTTP/REST, CoAP, BLE, Wi-Fi, Protocol comparison for use-cases | | |
| **Unit No 4:** | **Web & Cloud Integration** | **[7 Hours]** |
| RESTful APIs for IoT, Cloud platforms and dashboards, Data collection and visualization, Middleware and platform services, Introduction to Web of Things (WoT) concept | | |
| **Unit No 5:** | **IoT Applications, Security & Case Studies** | **[6Hours]** |
| Security, privacy, and governance basics, Power management and efficiency, Industrial IoT applications, Smart city, healthcare, agriculture applications, Case studies from real IoT deployments | | |

**Text Books**

| | |
|---|---|
| 1. | Get Started With ESP8266 Programming NodeMCU Using Arduino, Up skill Learning. |
| 2. | Internet of Things with Raspberry Pi 3, ManeeshRao,pack |
| 3. | Internet of Things with ESP8266, Marco Schwartz |
| 4. | Internet of Things with Arduino Cookbook, Marco Schwartz |

**Reference Books**

| | |
|---|---|
| 1. | Internet of Things: A Hands-On Approach- Arsheep Bahga,Vijay Madisetti |
| 2. | Raspberry Pi Cookbook for Python Programmers by Tim Cox |
| 3. | Learning Internet of Things, Peter Waher |

# Third Year (Semester –VI)
# Product Development

| | | | | |
|---|---|---|---|---|
| **26AF1928VS609** | **Product Development** | **VSEC** | **0L- 0T - 4P** | **2 Credits** |

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Practical: 04hrs./week | Continuous Assessment : 60 Marks<br>End Semester Exam: 40 Marks<br>Total : 100 Marks |

### Guidelines for Product Development

The students shall study in group of 4 or 5 members members (or individual) on some special topic beyond the scope of the syllabus under the subjects of Electronics & Telecommunication, Electronics Engineering, Computer Engineering, Artificial Intelligence, Data Science, Electronics and Computer Science Engineering or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher.

In this subject head, it is expected that the student should complete the following tasks.

1. Identify problem statement / idea which is solving one problem preferably local problem may be in their University / College / nearby vicinity.

2. Do the literature survey,

3. Design the solutions

4. Implement solution using latest technology like Drone, IoT, Robotics and Automation, Communication System Design etc.

5. Write 20-25 pages report (use of latex is more suitable).

6. Present / demonstrate the solution in front of faculty member
The students shall prepare his report and execution of projects for other students of his class in the presence of his guide and examiner. The student is permitted to use audio-visual aids or any other such teaching aids.