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शिवाजी विद्यापीठ, कोल्हापूर ४१६ ००४, महाराष्ट्र
दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४. २६०९४८७
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Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SU/BOS/Sci & Tech/ 183 **Date: 10/06/2026**

The Principal / Director,
All Concerned Affiliated Colleges / Institutions,
Shivaji University, Kolhapur.

Subject: Regarding revised syllabus of **B. Tech.** degree **Programme (Affiliated Colleges)** under the Faculty of Science and Technology as per NEP 2020.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, Nature of Question paper and equivalence of B. Tech. degree programme under the Faculty of Science & Technology as per National Education Policy 2020 (NEP 2020).

Sr. No.	B. Tech Course Syllabus	
1	Civil Engineering	Part-III
2	Mechanical Engineering	Part-III
3	Mechanical and Mechatronic Engineering (Additive Manufacturing)	Part-III
4	Electrical Engineering	Part-III
5	Electrical and Computer Engineering	Part-III
6	Electronics and Telecommunication Engineering	Part-III
7	Electronics & Computer Science Engineering	Part-III
8	Computer Science and Engineering	Part-III
9	Computer Science and Engineering (Artificial Intelligence & Machine Learning) (AIML)	Part-III
10	Computer Science and Engineering (Data Science) (DS)	Part-III
11	Computer Science and Engineering (Artificial Intelligence & Data Science) (AIDS)	Part-III
12	Electronics and communication Engineering (Bio-Medical Engineering)	Part-II

This Syllabus, nature of question and equivalence shall be implemented from the academic year **2026-27** onwards. A soft copy containing the syllabus is attached herewith and it is available on university website **www.unishivaji.ac.in>Syllabus>Syllabus as per NEP-2020.**

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October/ November 2026 & March / April 2027. These chances are available for repeater students, if any

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dy. Registrar

Copy to: for Information and necessary action

1	The I/c Dean, Faculty of Science & Technology	7	Appointment A & B Section
2	Director, Board of Examinations & Evaluation	8	Affiliation (T.1) (T.2) Section
3	The Chairperson, Respective Board of Studies	9	P.G.Admission Section,
4	Other Exam 4 Section,	10	P.G Seminar Section
5	Eligibility Section,	11	Computer Centre/ IT Cell
6	Internal Quality Assurance Cell (IQAC)		

Shivaji University

Kolhapur

Revised Syllabus

T. Y. B. Tech.

Electronics and Telecommunication Engineering

To be implemented from

Academic Year 2026-27

SHIVAJI UNIVERSITY, KOLHAPUR

NAME OF FACULTY: SCIENCE AND TECHNOLOGY

PROGRAMME NAME AND CODE: ELECTRONICS AND TELECOMMUNICATION ENGINEERING

PART: THREE

Preamble

The Third Year B. Tech. Mechanical Engineering Curriculum of Shivaji University is designed to equip students with strong theoretical knowledge, practical skills, and emerging technological competencies required in modern industries and research environments. The syllabus emphasizes the integration of core Mechanical Engineering principles with advanced technologies such as Artificial Intelligence (AI), Machine Learning (ML), Computational Fluid Dynamics (CFD), Additive Manufacturing, and Smart maintenance systems to meet the demands of Industry 4.0.

The curriculum provides a balanced blend of design, manufacturing, thermal sciences, fluid mechanics, quality engineering, maintenance engineering, and system analysis. Courses such as Design of Machine Elements, Fluid Mechanics and Machinery, Metrology and Quality Control, Mechanical System Design, and Industrial Fluid Power strengthen the students' analytical and problem-solving abilities while developing a solid engineering foundation. The laboratory courses and project work encourage experiential learning, hands-on practice, innovation, teamwork, and industry-oriented skill development.

Special emphasis has been given to multidisciplinary learning and emerging domains through programme electives and minor courses including Computational Fluid Dynamics, Failure Analysis, Additive Manufacturing, Total Productive Maintenance, and Heat Power Engineering. These subjects prepare students to address real-world engineering challenges related to sustainability, automation, product reliability, smart manufacturing, energy efficiency, and predictive maintenance.

The inclusion of AI and ML applications across various subjects reflects the evolving needs of modern engineering industries. Students are introduced to data-driven approaches, intelligent monitoring systems, optimization techniques, and predictive analysis tools that enhance engineering decision-making and operational efficiency.

The curriculum also focuses on Outcome-Based Education (OBE), promoting critical thinking, creativity, communication skills, ethical values, and lifelong learning. Through laboratory work, industrial visits, assignments, mini-projects, students gain exposure to industrial practices and develop professional competencies required for higher studies, entrepreneurship, research, and employment in diverse sectors.

Overall, this syllabus aims to develop competent, innovative, and socially responsible mechanical engineers capable of contributing effectively to technological advancement, industrial growth, and sustainable development at national and global levels.

Program Learning Outcomes (PLOs) / Program Outcomes (POs)

- **PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- **PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- **PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- **PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis and interpretation of data to provide valid conclusions. (WK8).
- **PO5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- **PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
- **PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national and international laws. (WK9)
- **PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- **PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- **PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- **PO11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Educational Objectives (PEOs)

1. **Professional Competence and Career Growth**
   Graduates will apply fundamental knowledge of mechanical engineering to solve real-world engineering problems and establish successful careers through professional employment, higher education, research, or entrepreneurship in core and allied fields.

2. **Lifelong Learning and Technological Adaptability**
   Graduates will engage in continuous learning and adapt to emerging technologies such as automation, artificial intelligence, and advanced manufacturing to meet evolving industrial and societal needs.

3. **Ethics, Leadership, and Social Responsibility**
   Graduates will demonstrate ethical practices, environmental awareness, leadership qualities, teamwork, and effective communication skills while contributing to sustainable development in multidisciplinary environments.

Eligibility for Admission-

Eligibility for F.Y. B.Tech.

(First Year - Engineering or Technology (4 years duration))

(1) Maharashtra State Candidature Candidate.-

The candidate,-

(i) should be a citizen of India;

(ii) (ii) should have Passed 10+2 examination or its equivalent examination with Physics and Mathematics as compulsory subjects along with Chemistry or Biotechnology or Biology or Technical Vocational subject or Computer Science or Information Technology or Informatics Practices or Agriculture or Engineering Graphics or Business Studies or Electronics or Entrepreneurship and obtained at least forty five per cent marks (at least forty per cent marks, in case of Reserved categories, Economically Weaker Section and Persons with Disability candidates belonging to the Maharashtra State only) in the above subjects taken together and The Candidate should have appeared in all the subjects in PCM MHT-CET 2026 and obtained non zero score in PCM MHT-CET 2026 conducted by the Competent Authority; (There candidates are eligible to apply for all 29 major disciplines declared by AICTE)

Or

(iii) Should have passed 10+2 examination or its equivalent examination with Physics and Chemistry as compulsory subjects along with the Mathematics or Biotechnology or Biology or Technical Vocational subject or Computer Science or Information Technology or Informatics Practices or Agriculture or Engineering Graphics or Business Studies or Electronics or Entrepreneurship as one of the subject and obtained at least forty five per cent marks (at least forty per cent marks, in case of Reserved categories, Economically Weaker Section and Persons with Disability candidates belonging to the Maharashtra State only) in the above subjects taken together and the candidate should have appeared in all the subjects in MHT-CET 2025 and obtained non zero score in Physics, Chemistry and Biology (PCB) MHT-CET 2025 conducted by the Competent Authority is eligible for admission to any of the following Courses under major disciplines declared by concerned Appropriate Authority or All India Council for Technical Education (AICTE), namely:- (a)Agriculture Engineering; (b)Biotechnology; (c)Food Engineering; (d)Leather Technology; (e)Packaging Technology; (f) Pharmaceutical Engineering; (g)Printing Engineering; (h)Fashion Technology; or (i) Textile Chemistry;

Or

(iv) Should have passed minimum three years Diploma in Engineering and Technology and obtained at least forty five per cent marks (at least forty per cent marks, in case of Reserved categories, Economically Weaker Section and Persons with Disability candidates belonging to the Maharashtra State only) ;

Or

(v) Passed three years Diploma of Vocation (D. Voc.) stream in the same or allied sector;

Eligibility for Direct Second Year B.Tech.

(Direct Second Year (Lateral Entry)- Engineering /Technology (3 Years duration)

The candidate,-
should be a citizen of India;
should have passed minimum three years or two years (Lateral Entry) Diploma Course in Engineering and Technology with at least forty five per cent. marks (at least forty per cent. marks in case of Candidates of Reserved categories, Economically Weaker Section and Persons with Disability category belonging to Maharashtra State) in any branch of Engineering and Technology from an All India Council for Technical Education (AICTE) or Central Government or State Government approved Institution or its equivalent;

Or

should have passed B.Sc. Degree from a University Grants Commission (UGC) or Association of Indian Universities recognized University with at least forty five per cent. marks (at least forty per cent. marks in case of candidates of Reserved categories, Economically Weaker Section and Persons with Disability category belonging to Maharashtra State) and passed HSC or its equivalent examination with Mathematics as a subject;

Or

should have passed three years D. Voc. Stream in the same or allied sector;
and Any other eligibility criteria and requirement declared from time to time by the appropriate authority as defined under the Act.

STANDARD OF PASSING AND DETERMINATION OF SGPA/CGPA, GRADING AND DECLARATION OF RESULTS

Passing criteria:

1. Passing with 40% marks is mandatory in ESE theory. The duration of ESE theory examination will be 02:30 Hrs. For Engineering Graphics subject of F. Y. B. Tech, it will be of 03:00 Hrs. Combined passing marks (MSE+ISE/CA+ESE) for theory course are 40%.
2. MSE will be based on 50% syllabus from beginning (First Three Units).
3. No compulsory passing for MSE.
4. Compulsory passing percentage for ISE/CA of theory and practical is 40%.
5. Compulsory passing percentage for ESE practical / oral examination 40%.
6. Student should clear all first year passing heads before admits to third year and clear all second year passing heads before admits to fourth year.
7. Aggregate of a particular year (both the semesters) shall considered as a separate head of passing for the result of that concerned year and 45 % aggregate score is mandatory. The student not fulfilling this criterion can improve the score of 45% aggregate through appearing in re-examination for maximum of three theory courses.
8. If student fails to improve the score of 45% aggregate through appearing in re-examination then he/she can improve the score of 45% aggregate by re-appearing in subsequent concern odd semesters (3, 5, 7) or concern even semesters (4, 6, 8) ESE of theory course examination in next academic year.

The Semester Grade Point Average (SGPA) shall be calculated for each semester and Cumulative Grade Point Average (CGPA) shall be calculated at the end of all semesters.
The standard of passing shall be in accordance with the following table:

Marks Obtained	Numerical Grade (Grade Point)		CGPA	Letter Grade
Absent	0 (zero)		-	-
0 – 39	0 (zero)		0.0 – 4.99	F (Fail)
40 – 49	5		5.00 – 5.49	C
50 – 59	6		5.50 – 6.49	B
60 – 69	7		6.50 – 7.49	B+
70 – 79	8		7.50 – 8.49	A
80 – 89	9		8.50 – 9.49	A+
90 – 100	10		9.50 – 10.0	O (Outstanding)

Note :

The award of the final Grade for the degree of B. Tech. shall be calculated based on CGPA.

Calculation of SGPA and CGPA:

1. Semester Grade Point Average **(SGPA)**

$$\textbf{SGPA} = \frac{\sum(\text{Course credits} \times \text{Grade points obtained}) \text{ of a Semester}}{\sum(\text{Course credits}) \text{ of respective Semester}}$$

2. Cumulative Grade Point Average **(CGPA)**

$$\textbf{CGPA} = \frac{\sum(\text{Total credits of a Semester} \times \text{SGPA of respective Semester}) \text{ of all Semesters}}{\sum(\text{Total course credits}) \text{ of all Semesters}}$$

1. Marks obtained > = 0.5 shall be rounded off to next higher digit.
2. The SGPA & CGPA shall be rounded off to 2 decimal points.
3. CGPA will be calculated cumulatively from Sem. I to Sem. VIII for regular students and from Sem. III to Sem. VIII for lateral entry students.

Note: An equivalent certificate of CGPA to percentage of marks will be provided to student on candidate's demand after remitting prescribed fees by Shivaji University.

Awards of Grades for Re-Examination:

1. There will be Re-examination for all failure ESE theory/practical courses in a year after even semester immediately the result declaration of ESE and before the commencement of next academic year.
2. A student will apply for re-examination before the last date of such application and will appear for re-examination.
3. In such cases In Semester Examination performance of a student will not be wiped out.
4. The weightage similar to ESE will be given to re-examination.
5. A student who is eligible for re-examination but remains absent for re-examination will be given grade 'Absent'.
6. If the student fails in an odd semesters (1, 3, 5, 7) and/or even semesters (2, 4, 6, 8) in ESE of theory/practical credit course in an academic year shall be allowed to appear for re-examination.
7. There will be ESE examination of theory and practical courses of semester 1, 3, 5 and 7 at the end of odd semester, there will be ESE examination of theory and practical courses of semester 2, 4, 6 and 8 at the end of even semester and there will be re-examination for all ESE theory and practical courses from semester 1 to semester 8 after one month of

declaration of result of even semester.

8. If the student fails to clear the ESE of theory/practical course even in re-examination conducted after even semesters (2, 4, 6, 8) in a year, he/she shall have to re-appear in subsequent concern odd semesters (3, 5, 7) or concern even semesters (4, 6, 8) ESE of theory/practical credit course examination in next academic year for the failed ESE of theory/practical credit course examination of concern odd semester or concern even semester that she/he has failed in previous academic year.
9. The candidate can apply for revaluation of photocopy of re-examination for ESE of theory/practical course conducted after even semesters (2, 4, 6, 8).
10. A student will be awarded a grade given in Table of **R. R. B. Tech. 9** depending upon the cumulative marks obtained by him/her in Re-examination.

Shivaji University, Kolhapur

T. Y. B. Tech. (NEP 2.0 Pattern)

Question Paper Pattern

ESE-End Semester Examination

25% marks based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.

- **Instructions for Paper Setter**

Que.1: MCQ's based on All Units (Carries 12 Marks).

Que.2: Solve any Two [based on Unit 1, 2, 3] (6*2 = 12 Marks).

a)
b)
c)

Que.3: Solve any Two [based on Unit 4, 5, 6] (6*2 = 12 Marks).

a)
b)
c)

Que.4: Solve any Two [based on Unit 4, 5, 6] (6*2 = 12 Marks).

a)
b)
c)

Que.5: Solve any Two [based on Unit 4, 5, 6] (6*2 = 12 Marks).

a)
b)
c)

Second Year Exit: Teaching Methodology, Assessment and Evaluation

[I] As per R. R. B. Tech. 12.2 Rule: Award of Degree

If a student passes all the courses of first year, second year and earns the requisite number of credits, the student will become entitled to Undergraduate Diploma (Two years or four semesters) in the programme of his/her major subject. If he/she wants to exit, can exit the programme with UG Diploma certificate. However, for the award of two years UG Diploma Certificate in Major with 88 credits, an additional 8 credits from Exit Courses are required to earn.

[II] Second Year Exit Course:

Methodology 1:

1. The students should complete two online certification courses (NPTEL) related to their programme, each of 3 credits. In addition to this, they will also need to complete 2 credits worth of two Virtual Lab work related to online certification courses. These additional 8 credits earn by students shall be based upon skill based vocational courses or internship/Apprenticeship.

2. The NPTEL courses are likely to be available online and can be completed at the student's own pace. The content will be specific to the student's field of study or programme. The skill based vocational courses shall be analogous to the Baskets/Areas provided by the concerned BoS.

3. The student must complete two virtual lab work that adds 2 credits to simulate practical or experimental learning experiences in a controlled virtual environment.

4. **Examination scheme:** The marks gained from the two NPTEL Courses (3 credits each) are converted to a total of 100 marks. The report for the two Virtual Lab work of 2 credits will be

evaluated for 25 marks. The report should include a detailed write-up and analysis of the virtual lab experiments conducted, encompassing the methodology, results, and conclusions.

5. There may be uncertainty in availability of the NPTEL courses offered by concerned BoS as there is continuous updatation of the NPTEL courses. The students can choose equivalent NPTEL course of the required duration with prior permission from the concerned institute. The concerned institute should communicate to Concerned BoS for their permission. For NPTEL course registration, the students are required to visit to website https://swayam.gov.in and create their account. Log in the account and join the required course and follow the instructions to compete the course. Similarly, for Virual Lab, the students are required to visit to website https://www.vlab.co.in and create their account. Log in the account and join the required lab and follow the instructions to compete the course (need to perform all listed experiments under that Lab). To fulfill the requirement of 06 credits, students can go for two courses each of 12 weeks.

Methodology 2:

1. The students should complete two online certification courses (NPTEL) related to their programme, each carrying 2 credits. In addition to this, they will also need to complete 4 credits worth of two physical internship/Apprenticeship (each of 40 hrs) work from relevant industry. These additional 8 credits earned by the students shall be based upon skill based vocational courses or internship/Apprenticeship.

2. The NPTEL courses are likely to be available online and can be completed at the student's own pace. The content will be specific to the student's field of study/programme. The skill-based vocational courses shall be analogous with the list provided by the concerned BoS.

3. The student should complete two physical internship/Apprenticeship (each of 40 hrs) work from relevant industrial practices that adds 4 credits to simulate practical or experimental learning experiences in a controlled virtual environment.

4. **Examination scheme:** The marks gained from the two NPTEL Courses (2 credits each) are converted to a total of 100 marks. The report for the performed two physical internship/Apprenticeship (each of 40 hrs) work from relevant industrial practices of 4 credits will be evaluated for 25 marks. The report should include a detailed write-up and analysis of two

physical internship/Apprenticeship (each of 40 hrs) work along with certificate of internship/Apprenticeship from relevant industrial practices conducted, encompassing the methodology, results, and conclusions.

5. There may be uncertainty in availability of the NPTEL courses offered by concerned BoS as there is continuous updatation of the NPTEL courses. The students can choose equivalent NPTEL course of the required duration with prior permission from the concerned institute. The concerned institute should communicate to Concerned BoS for their permission. For NPTEL course registration, the students are required to visit to website https://swayam.gov.in and create their account. Log in the account and join the required course and follow the instructions to compete the course.

Guidelines for Open Elective Courses: Teaching Methodology, Assessment and Evaluation

Open Elective (OE) courses other than faculty of Science and Technology through Massive Open Online Courses (MOOCs) allowing students to engage with a broad spectrum of ideas and knowledge areas. The OE courses are likely to be available online and can be completed at the student's own pace within a set timeframe. For OE course, students are required to visit to the website https://swayam.gov.in for registration and create an account. Afterward, students should Login the account and join the course assigned by the course coordinator and follow the instructions to compete the course through self-learning mode. Additionally, the respective institution should download the relevant study materials to ensure students have access to them as needed. Minimum 25 students can register for one OE course in the concerned institute. There will be one course coordinator for one OE course. Students need to cover OE Courses of 08 credits. These 08 credits over semesters III to V. OE courses are chosen from faculty other than Faculty of Science and Technology. It is offered in Second and Third year as per Semester wise credit distribution table. Students need to take up the courses of 08 credits over semesters III to V.

1. **For Semester-III,** OE theory course of 3 credits consists of Mid Semester Examination (MSE) of 30 Marks, In Semester Evaluation/Continuous Assessment (ISE/CA) of 10 Marks and End Semester Examination (ESE) of 60 Marks.
2. **For Semester-III,** OE practical lab course of 1 credit consists of In Semester Evaluation/Continuous Assessment (ISE/CA) of 25 Marks and End Semester Examination-Practical Oral Examination (ESE-POE) of 25 Marks. Course Coordinator assigned by Institute should complete the selected course practical through expert of that course. The lab exercises and demonstrations prepared by concern expert must be aligned with the specific OE course that the students have chosen.
3. **For Semester-IV,** OE theory course of 2 credits consists of Mid

Semester Examination (MSE) of 30 Marks, In Semester Evaluation/Continuous Assessment (ISE/CA) of 10 Marks and End Semester Examination (ESE) of 60 Marks.

4. **For Semester-V,** OE theory course of 2 credits consists of Mid Semester Examination (MSE) of 30 Marks, In Semester Evaluation/Continuous Assessment (ISE/CA) of 10 Marks and End Semester Examination (ESE) of 60 Marks.
5. The Mid Semester Examination (MSE) of 30 Marks based on selected OE Course will be conducted by Concerned Departmental Course Coordinator. The course expert of concerned faculty should set question paper of MSE and evaluate the same.
6. Online submitted assignments by students using SWAYAM platform for concerned OE course will be used for In Semester Evaluation/Continuous Assessment (ISE/CA) of 10 Marks by Concerned Departmental Course Coordinator appointed for particular course by Principal of the Institute. Assignments may be of varied in nature for OE course.
7. The ESE of OE courses will be conducted by the University. The setting of question papers for both MSE and ESE, as well as the evaluation of the concerned OE course, should be carried out by the course expert from the Board of Studies (BoS) of the respective faculty in accordance with the provisions under Panel of Paper Setters, Examiners, and Moderators – Clauses 41(f) and 48(3)(a).
8. MSE will be based on 50% syllabus from beginning (First 50% Weeks).
9. ESE paper setting weightage will be 25% on syllabus covered for MSE (First 50% Weeks) and 75% on remaining syllabus (Last 50% Weeks). The number of optional questions marks in a theory paper shall be 25 to 30 percent of the maximum marks.

Note: One OE course may be floated by the institute for 60 intake.

Open Electives Courses Offered to the students under Faculty of Science and Technology

In line with New Education Policy 2020

(Effective from Academic year 2025-26)

Open Electives

The students need to cover Open Elective Courses (OE) of 08 credits. These 08 credits over semesters III to V.

Semester wise credit distribution table for OE is given below

Sr. No.	Semester	Open Elective	Teaching scheme			Credits
			L	T	P	
01	III	OE-01	3	-	-	3
	III	OE-01 Lab	-	-	2	1
	IV	OE-02	2	-	-	2
02	V	OE-03	2	-	-	2
	Total		**7**	**-**	**2**	**8**

Semester wise baskets of OE from faculty other than Faculty of Science and Technology, Viz. Faculty of Commerce and Management, Faculty of Humanities and Faculty of Interdisciplinary Studies is given below

List of Open Elective Courses might be taken by students under Faculty of Science and Technology

Semester – III

Note: Choose any one course from the below basket of other than faculty in such way that the course with same name should not comes under or taught by major programme or the MDM.

Sr. No.	Name of the Course	Category	Duration (Weeks)	Credit Points	Institute Offering Course	Name of Professor/ Resource person	Link
01	Principles of Economics	Economics	12	03	IIT Madras	Prof. Sabuj Kumar Mandal	https://onlinecourses.nptel.ac.in/noc25_ec15/preview
02	German - I	Humanities and Social Science	12	03	IIT Madras	Prof. Milind Brahme	https://onlinecourses.nptel.ac.in/noc25_hs121/preview
03	Science, Technology and Society	Humanities and Social Science	12	03	IIT Guwahati	Prof. Sambit Mallick	https://onlinecourses.nptel.ac.in/noc25_hs189/preview
04	Environment and Development	Humanities and Social Science	12	03	IIT Guwahati	Prof. Ngamjahao Kipgen	https://onlinecourses.nptel.ac.in/noc25_hs195/preview
05	Logistics & Supply Chain Management	Humanities and Social Science	12	03	IIT Kharagpur	Prof. Vikas Thakur	https://onlinecourses.nptel.ac.in/noc25_hs205/preview
06	Introduction to Film Studies	Humanities and Social Sciences English studies	12	03	IIT Madras	Prof. Aysha Viswamohan	https://onlinecourses.nptel.ac.in/noc25_hs138/preview
07	Entrepreneurship	Management	12	03	IIT Madras	Prof. C Bhaktavatsala Rao	https://onlinecourses.nptel.ac.in/noc25_mg81/preview
08	Managerial Skills for Interpersonal Dynamics	Management	12	03	IIT Roorkee	Prof. Santosh Rangnekar	https://onlinecourses.nptel.ac.in/noc25_mg91/preview
09	Automation in Production Systems and Management	Management	12	03	IIT Kharagpur	Prof. Pradip Kumar Ray	https://onlinecourses.nptel.ac.in/noc25_mg135/preview
10	Numerical Methods for Engineers	Multidisciplinary	12	03	IIT Madras	Prof. Niket Kaisare	https://onlinecourses.nptel.ac.in/noc25_ge59/preview

Semester – IV

Note: Choose any one course from the below basket of other than faculty in such way that the course with same name should not comes under or taught by major programme or the MDM.

Sr. No.	Name of Course	Category	Duration (Weeks)	Credit Points	Institute Offering Course	Name of Professor/ Resource person	Link
01	Indian Business History	Humanities And Social Sciences	08	02	IIT Guwahati	Prof. Vipul Dutta	https://onlinecourses.nptel.ac.in/noc25_hs32/preview
02	Probability and Stochastic for Finance	Economic Sciences	08	02	IIT Kanpur	Prof. Joydeep Dutta	https://onlinecourses.nptel.ac.in/noc25_ma58/preview
03	Enhancing Soft Skills and Personality	Humanities and Social Sciences	08	02	IIT Kanpur	Prof. T. Ravichandran	https://onlinecourses.nptel.ac.in/noc25_hs87/preview
04	Mastering Speaking and Presentations: A case Based Approach	Humanities and Social Sciences	08	02	IIT Kharagpur	Prof. Seema Singh	https://onlinecourses.nptel.ac.in/noc25_hs96/preview
05	The Science of Happiness and Wellbeing	Humanities and Social Sciences	08	02	IIT Kharagpur	Prof. Priyadarshi Patnaik Prof. Manas K Mandal	https://onlinecourses.nptel.ac.in/noc25_hs103/preview
06	Philosophical Foundations Of Social Research	Humanities And Social Sciences	08	02	IIT Guwahati	Prof. Sambit Mallick	https://onlinecourses.nptel.ac.in/noc25_hs63/preview
07	Emotional Intelligence	Humanities and Social Science	08	02	IIT Kharagpur	Prof. Rabindra Kumar Pradhan	https://onlinecourses.nptel.ac.in/noc25_hs16/preview
08	Employment Communication: A Lab based course	Humanities and Social Science	08	02	IIT Kharagpur	Prof. Seema Singh	https://onlinecourses.nptel.ac.in/noc25_hs17/preview
09	Soft Skill Development	Humanities and Social Science	08	02	IIT Kharagpur	Prof. Priyadarshi Patnaik Prof. V. N. Giri Prof. D. Suar	https://onlinecourses.nptel.ac.in/noc25_hs72/preview
10	Social Behavior and the Brain: An Introduction to Social Neuroscience	Humanities and Social Science, Psychology, Neuroscience, Cognitive Science	08	02	IIT Kanpur	Prof. Ark Verma	https://onlinecourses.nptel.ac.in/noc25_hs101/preview
11	Economic Growth And Development	Humanities and Social Sciences	08	02	IIT Guwahati	Prof. Rajshree Bedamatta	https://onlinecourses.nptel.ac.in/noc25_hs11/preview

12	Effective Writing	Humanities and Social Sciences	08	02	IIT Roorkee	Prof. Binod Mishra	https://onlinecourses.nptel.ac.in/noc25_hs14/preview
13	Centre-State Relations in India	Law	08	02	IIT Kharagpur	Prof. Uday Shankar	https://onlinecourses.nptel.ac.in/noc25_lw04/preview
14	Foundation Course in Managerial Economics	Management	08	02	IIT Kharagpur	Prof. Barnali Nag	https://onlinecourses.nptel.ac.in/noc25_mg25/preview
15	International Marketing	Management	08	02	IIT Kharagpur	Prof. Biswarup Ghosh	https://onlinecourses.nptel.ac.in/noc25_mg32/preview
16	Introduction to System Dynamics Modeling	Management	08	02	IIT Bombay	Prof. Jayendran Venkateswaran	https://onlinecourses.nptel.ac.in/noc25_mg37/preview
17	Management of New Products and Services	Management	08	02	IIT Kharagpur	Prof. KBL Srivastava	https://onlinecourses.nptel.ac.in/noc25_mg44/preview
18	Business Forecasting	Management	08	02	IIT Bombay	Prof. Pankaj Dutta	https://onlinecourses.nptel.ac.in/noc25_mg66/preview
19	Yoga and Positive Psychology for Managing Career and Life	Management	08	02	IIT Bombay	Prof. Ashish Pandey	https://onlinecourses.nptel.ac.in/noc25_mg75/preview
20	Roadmap for patent creation	Multidisciplinary	08	02	IIT Kharagpur	Prof. Gouri Gargate	https://onlinecourses.nptel.ac.in/noc25_ge30/preview

Semester – V

Note: Choose any one course from the below basket of other than faculty in such way that the course with same name should not comes under or taught by major programme or the MDM.

Sr. No.	Name of Course	Category	Duration (Weeks)	Credit Points	Institute Offering Course	Name of Professor/ Resource person	Link
01	Enhancing Study Skills	Multidisciplinary	08	02	Indira Gandhi National Open University, New Delhi	Dr. P. Lakshmi; Dr. G. Mythili	https://onlinecourses.swayam2.ac.in/nou25_ge69/preview
02	Community Engagement and Social Responsibility	Multidisciplinary	10	02	Dayalbagh Educational Institute, Agra, Uttar Pradesh	Prof. Akshay Kumar Satsangi	https://onlinecourses.swayam2.ac.in/ugc25_ge10/preview
03	Economic Environment and Business Strategy	Economics	8	02	IIT Kanpur	Prof. Sukumar Vellakkal	https://onlinecourses.nptel.ac.in/noc25_ec16/preview
04	Corporate Social Responsibility	Management	8	02	IIT Kharagpur	Prof. Aradhna Malik	https://onlinecourses.nptel.ac.in/noc25_mg139/preview
05	Soft Skill Development	Humanities and Social Science	8	02	IIT Kharagpur	Prof. Priyadarshi Patnaik, Prof. V. N. Giri, Prof. D. Suar	https://onlinecourses.nptel.ac.in/noc25_hs142/preview
06	Developing Soft Skills and Personality	Humanities and Social Science	8	02	IIT Kanpur	Prof. T Ravichandran	https://onlinecourses.nptel.ac.in/noc25_hs174/preview
07	Introduction to Advanced Cognitive Processes	Humanities and Social Science	8	02	IIT Kanpur	Prof. Ark Verma	https://onlinecourses.nptel.ac.in/noc25_hs177/preview
08	Entrepreneurship and IP Strategy	Humanities and Social Science	8	02	IIT Kharagpur	Prof. Gouri Gargate	https://onlinecourses.nptel.ac.in/noc25_hs213/preview
09	Artificial Intelligence, Law and Justice	Law	8	02	NALSAR University of Law	Prof. Krishna Ravi Srinivas	https://onlinecourses.nptel.ac.in/noc25_lw12/preview
10	Innovation, Business Models and Entrepreneurship	Management	8	02	IIT Roorkee	Prof. Rajat Agrawal Prof. Vinay Sharma	https://onlinecourses.nptel.ac.in/noc25_mg95/preview
11	Organization Development and Change in 21st Century	Management	8	02	IIT Bombay	Prof. Ashish Pandey	https://onlinecourses.nptel.ac.in/noc25_mg103/preview

Guidelines for Multidisciplinary Minor (MDM) Programmes

As per the directives of the Government of Maharashtra, engineering colleges are encouraged to update their curricula in alignment with the guidelines of the National Education Policy (NEP) 2020. As part of this transformative initiative, the 'Minor Programme' has been introduced to promote multidisciplinary learning at the undergraduate level. These programmes are structured to provide students with interdisciplinary knowledge, enhancing their core academic disciplines and preparing them to meet the evolving demands of the global job market.

Minor programmes across various disciplines have been introduced to provide students with the opportunity to explore fields beyond their core B. Tech curriculum. These programmes enable students from specific branches to broaden their knowledge and skill sets. For example, a student pursuing Mechanical Engineering can opt for a Minor in Computer Science and Engineering, thereby acquiring interdisciplinary expertise that enhances both academic depth and professional flexibility. However, students enrolled in the Computer Science and Engineering (CSE) programme are restricted from choosing MDM's in Artificial Intelligence and Data Science, CSE (Data Science), and CSE (Artificial Intelligence and Machine Learning) in order to prevent overlap between the core curriculum of CSE and the content of these minors, ensuring that students gain diverse and non-redundant knowledge through their minor specializations. **(Refer Table: MDM Courses)**

Common guidelines to students:

1. The Multidisciplinary Minor (MDM) must be compulsorily chosen from engineering discipline different from the student's Major engineering programme. Students should take MDM from the list of MDM Offered by Other Departments/Branches/ programmes only. Ex: A Student of Mechanical Engineering should take MDM from other departments/branches/Programmes except MDM offered by Mechanical Engineering Dept. **(Refer Table: MDM Courses)**
2. The entry point for any compulsory MDM programme is the 3rd semester. The required credits for MDM courses must be acquired from the 3rd semester of second year to the final year of UG Programme.
3. A student is required to continue with the selected Minor programme consistently throughout all six semesters.
4. No changes to the selected Minor programme will be permitted under any circumstances.
5. A student may choose only one Minor programme (track), from the list of MDM courses offered by the institute.
6. The allotment of the MDM course will be based on the marks obtained by the student in the first year for Sem-I and Sem-II combinely.
7. The compulsory MDM programme will admit a maximum of 75 students into its minor course, with selection strictly based on first-year academic merit. Preference order for allocating MDM minor will follow the hierarchy: Candidates with no backlogs first, then those with one backlog, followed by those with two backlogs, and so on.
8. All students must complete the Google form provided by the Institute, indicating their preferences to MDM programme within the specified deadline. Students should ensure that they enter their accurate first year marks in the form along with the attachment of marksheets of Sem-I and Sem-II to avoid any discrepancies.

(Refer Table: MDM Courses)

List of S. Y. B. Tech. and T.Y.B.Tech MDM Courses Offered by the Various Programmes under the Faculty of Science and Technology at Shivaji University, Kolhapur

Sr. No.	Name of the Programme (Major) Offering MDM	Name of the corresponding Minor Programme to be offered	Semester	Name of the MDM Course offered by the Major Programme	Teaching scheme			Credits
					L	T	P	
01	Mechanical Engineering	1. Computer Science and Engineering 2. Electronics and Computer Science 3. Computer Science and Engineering (AIML) 4. Civil Engineering 5. Electronics and Telecommunication Engineering 6. Computer Science and Engineering (Data Science) 7. Electrical Engineering 8. Artificial Intelligence & Data Science 9. Electrical and Computer Engineering	III	MDM 01: Thermodynamics	2	-	-	2
			IV	MDM 02: Theory of Machines	2	-	-	2
			V	MDM 03: Heat Power Engineering	3	-	2	4
			VI	MDM 04: Machine Design	2	-	-	2
02	Computer Science and Engineering	1. Mechanical Engineering 2. Civil Engineering 3. Electronics and Telecommunication Engineering 4. Electrical Engineering 5. Mechanical and Mechatronics Engineering (Additive Manufacturing)	III	MDM 01: Data Structures using C	2	-	-	2
			IV	MDM 02: Object Oriented Programming	2	-	-	2
			V	MDM 03: Java Programming	3	-	2	4
			VI	MDM 04: Database Engineering	2	-	-	2

03	Electronics and Computer Science	1. Mechanical Engineering 2. Civil Engineering 3. Electrical Engineering 4. Mechanical and Mechatronics Engineering (Additive Manufacturing)	III	MDM 01: Logic Design	2	-	-	2
			IV	MDM 02: Electronics Measurements	2	-	-	2
			V	MDM 3 : Microprocessor and Microcontroller	3	-	2	4
			VI	MDM 4 : Introduction to IOT	2	-	-	2
04	Computer Science and Engineering (AIML)	1. Mechanical Engineering 2. Civil Engineering 3. Electronics and Telecommunication Engineering 4. Electrical Engineering 5. Mechanical and Mechatronics Engineering (Additive Manufacturing)	III	MDM 01: Object Oriented Programming	2	-	-	2
			IV	MDM 02: Introduction to AI	2	-	-	2
			V	MDM 03: Database Management	3	-	2	4
			VI	MDM 04: Internet of Things	2	-	-	2
05	Civil Engineering	1. Mechanical Engineering 2. Computer Science and Engineering 3. Electronics and Computer Science 4. Computer Science and Engineering (AIML) 5. Electronics and Telecommunication Engineering 6. Computer Science and Engineering (Data Science) 7. Electrical Engineering 8. Artificial Intelligence & Data Science 9. Electrical and Computer Engineering 10. Mechanical and Mechatronics Engineering (Additive Manufacturing)	III	MDM 01: Building Construction	2	-	-	2
			IV	MDM 02: Waste Management	2	-	-	2
			V	MDM 3 : Infrastructure Engineering	3	-	2	4
			VI	MDM 4: Concrete Technology	2	-	-	2

06	Electronics and Telecommunication Engineering	1. Mechanical Engineering 2. Computer Science and Engineering 3. Computer Science and Engineering (AIML) 4. Civil Engineering 5. Computer Science and Engineering (Data Science) 6. Electrical Engineering 7. Artificial Intelligence & Data Science 8. Electrical and Computer Engineering 9. Mechanical and Mechatronics Engineering (Additive Manufacturing)	III	MDM 01: Electronics System	2	-	-	2
			IV	MDM 02: Electronics Measurements	2	-	-	2
			V	MDM-3: Communication Engineering	3	-	2	4
			VI	MDM-4:Mobile Technology	2	-	-	2
07	Computer Science and Engineering (Data Science)	1. Mechanical Engineering 2. Civil Engineering 3. Electronics and Telecommunication Engineering 4. Electrical Engineering 5. Mechanical and Mechatronics Engineering (Additive Manufacturing)	III	MDM 01: C Programming	2	-	-	2
			IV	MDM 02: Python Programming	2	-	-	2
			V	MDM 03:Programming using Java	3	-	2	4
			VI	MDM 4:Database concepts and Design	2	-	-	2
08	Electrical Engineering	1. Mechanical Engineering 2. Computer Science and Engineering 3. Electronics and Computer Science 4. Computer Science and Engineering (AIML) 5. Civil Engineering 6. Electronics and Telecommunication Engineering 7. Computer Science and Engineering (Data Science) 8. Artificial Intelligence & Data Science 9. Mechanical and Mechatronics Engineering (Additive Manufacturing)	III	MDM 01: Introduction to Electrical and Electronics Circuits	2	-	-	2
			IV	MDM 02: Electrical Power System	2	-	-	2
			V	MDM 03:Electrical Machines	3	-	2	4
			VI	MDM 04:Power Electronics and Embedded System	2	-	-	2

09	Artificial Intelligence & Data Science	1. Mechanical Engineering 2. Civil Engineering 3. Electronics and Telecommunication Engineering 4. Electrical Engineering 5. Mechanical and Mechatronics Engineering (Additive Manufacturing)	III	MDM 01: Fundamentals of AI	2	-	-	2
			IV	MDM 02: Python for Data Science	2	-	-	2
			V	MDM 03: Machine Learning	3	-	2	4
			VI	MDM 04: Deep Learning	2	-	-	2
10	Electrical and Computer Engineering	1. Mechanical Engineering 2. Civil Engineering 3. Electronics and Telecommunication Engineering 4. Mechanical and Mechatronics Engineering (Additive Manufacturing)	III	MDM 01: Renewable Energy Sources	2	-	-	2
			IV	MDM 02: Python Programming	2	-	-	2
			V	MDM 03: Operating System	3	-	2	4
			VI	MDM 04: Electrical Design Estimation And Costing	2	-	-	2
11	Mechanical and Mechatronics Engineering (Additive Manufacturing)	1. Computer Science and Engineering 2. Electronics and Computer Science 3. Computer Science and Engineering (AIML) 4. Civil Engineering 5. Electronics and Telecommunication Engineering 6. Computer Science and Engineering (Data Science) 7. Electrical Engineering 8. Artificial Intelligence & Data Science 9. Electrical and Computer Engineering	III	MDM 01: Computer Aided Design (CAD)	2	-	-	2
			IV	MDM 02: Product Design & Development	2	-	-	2
			V	MDM 03: Fundamentals of Design for Product Manufacturing (FDPM)	3	-	2	4
			VI	MDM 04:Ergonomics & Human Factors	2	-	-	2

Third Year Exit: Teaching Methodology, Assessment and Evaluation

[I] As per R. R. B. Tech. 12.3 Rule: Award of Degree

If a student passes all the courses of first year, second year and third year and earns the requisite number of credits, the student will become entitled to three years Bachelor's Degree in Vocational in the faculty of his/her major subject. If he/she wants to exit, can exit the programme with three years Bachelor's Degree in Vocational. However, for the award of three years Bachelor's Degree in Vocational in the faculty of his/her major subject with 132 credits, an additional 8 credits from Exit Courses are required to earn.

[II] Third Year Exit Course:

Methodology 1:

1. The students should complete two online certification courses (NPTEL) related to their programme, each of 3 credits. In addition to this, they will also need to complete 2 credits worth of two Virtual Lab work related to online certification courses. These additional 8 credits earn by students shall be based upon skill based vocational courses or internship/Apprenticeship.
2. The NPTEL courses are likely to be available online and can be completed at the student's own pace. The content will be specific to the student's field of study or programme. The skill based vocational courses shall be analogous to the Baskets/Areas provided by the concerned BoS.
3. The student must complete two virtual lab work that adds 2 credits to simulate practical or experimental learning experiences in a controlled virtual environment.
4. **Examination scheme:** The marks gained from the two NPTEL Courses (3 credits each) are converted to a total of 100 marks. The

report for the two Virtual Lab work of 2 credits will be evaluated for 25 marks. The report should include a detailed write-up and analysis of the virtual lab experiments conducted, encompassing the methodology, results, and conclusions.

5. There may be uncertainty in availability of the NPTEL courses offered by concerned BoS as there is continuous updatation of the NPTEL courses. The students can choose equivalent NPTEL course of the required duration with prior permission from the concerned institute. The concerned institute should communicate to Concerned BoS for their permission. For NPTEL course registration, the students are required to visit to website https://swayam.gov.in and create their account. Log in the account and join the required course and follow the instructions to compete the course. Similarly, for Virual Lab, the students are required to visit to website https://www.vlab.co.in and create their account. Log in the account and join the required lab and follow the instructions to compete the course (need to perform all listed experiments under that Lab). To fulfill the requirement of 06 credits, students can go for two courses each of 12 weeks.

Methodology 2:

1. The students should complete two online certification courses (NPTEL) related to their programme, each carrying 2 credits. In addition to this, they will also need to complete 4 credits worth of two physical internship/Apprenticeship (each of 40 hrs) work from relevant industry. These additional 8 credits earned by the students shall be based upon skill based.
   vocational courses or internship/Apprenticeship.
2. The NPTEL courses are likely to be available online and can be completed at the student's own pace. The content will be specific to the student's field of study/programme. The skill-based vocational courses shall be analogous with the list provided by the concerned

BoS.

3. The student should complete two physical internship/Apprenticeship (each of 40 hrs) work from relevant industrial practices that adds 4 credits to simulate practical or experimental learning experiences in a controlled virtual environment.
4. **Examination scheme:** The marks gained from the two NPTEL Courses (2 credits each) are converted to a total of 100 marks. The report for the performed two physical internship/Apprenticeship (each of 40 hrs) work from relevant industrial practices of 4 credits will be evaluated for 25 marks. The report should include a detailed write-up and analysis of two physical internship/Apprenticeship (each of 40 hrs) work along with certificate of internship/Apprenticeship from relevant industrial practices conducted, encompassing the methodology, results, and conclusions.
5. There may be uncertainty in availability of the NPTEL courses offered by concerned BoS as there is continuous updatation of the NPTEL courses. The students can choose equivalent NPTEL course of the required duration with prior permission from the concerned institute. The concerned institute should communicate to Concerned BoS for their permission. For NPTEL course registration, the students are required to visit to website https://swayam.gov.in and create their account. Log in the account and join the required course and follow the instructions to compete the course.

Exit Course for Electronics and Telecommunication Engineering After Second Year

Exit option: Award of UG Diploma in Major with 88 credits and an additional 8 credits from Following Exit Courses				
Sr. No	**Course Code**	**Course Title**	**Mode**	**Credits**
1	ETC-EC-0203	Electronics Servicing and Maintenance	Online/offline certification Course or project of total 8 credits	8
		OR		
2	ETC-EC-0204	Fundamental Programming Language		8

S.Y. Exit Course

To earn 8 credits, the student must complete two NPTEL courses and two virtual labs related to Electronics Servicing and Maintenance or Fundamental Programming Language

1. Electronics Servicing and Maintenance (8)

Electronics Servicing & Maintenance	Recommended NPTEL Course **(3)**	Equivalent Virtual Lab **(1)**
Basic electronic components and measurements	Basic Electronics and Lab (IIT Madras)	Basic Electronics Virtual Laboratory
Electronic devices, analog circuits and troubleshooting	Introduction to Electronics (IIT Kanpur)	Analog Electronics Lab
Analog circuit testing and servicing	Analog Circuits	Analog Electronics Circuits Virtual Lab
Digital IC testing and maintenance	Digital Electronic Circuits	Digital Electronics Lab
PCB design, assembly and hardware prototyping	Electronic Systems Design: Hands-on Circuits and PCB Design with CAD Software (IIT Delhi)	Electronic Circuits Virtual Lab / Analog & Digital Electronics Lab

2. Fundamental Programming Language

Fundamental Programming Language	Recommended NPTEL Course **(3)**	Equivalent Virtual Lab **(1)**
Programming fundamentals using C	Programming, Data Structures and Algorithms using C (IIT Madras)	Programming Lab (C)
Problem solving and programming	Introduction to Problem Solving and Programming	Virtual Programming Lab
Programming using Python	Programming, Data Structures and Algorithms using Python	Python Programming Lab
Basic programming concepts	Basic Programming Constructs	C Programming Virtual Lab
Data structures and algorithms	Data Structures and Algorithms	Data Structures Virtual Lab

Emerging (Specialization) Minor (18 Credits) in Electronics and Telecommunication Engineering

to be implemented from Academic Year 2026-27

(As per GR NEP-2022(67/23) / Tanshi -2, Dated 04th July 2023)

Emerging Course with a Maximum of 18- 20 Credits					
Sr. No.	**Semester**	**Course Code**	**Course Title**	**Mode**	**Credits**
1	III	ETC-EMR-0211	Introduction to consumer electronics	Online/offline certification Course of total 18 credits	3
2	IV	ETC-EMR-0221	5G Technology		3
3	V	ETC-EMR-0311	6G Technology		3
4	VI	ETC-EMR-0321	Radio Engineering		3
5	VII	ETC-EMR-0411	Embedded Linux		3
6	VIII	ETC-EMR-0421	Quantum Computing		3

Shivaji University, Kolhapur

S.Y (Sem- III) B.Tech. Electronics & Telecommunication Engineering

Course Category	**Emerging Minor**

Introduction to Consumer Electronics

Teaching Scheme			**Examination Scheme**	
Lectures	--		MSE	30 Marks
Tutorials	--		ISE/CA	10 Marks
Total Credits	3		ESE	60 Marks
			Total Marks	100 Marks

Prerequisites: Basic Electronics Engineering

Course Objectives:

1	Understand the fundamentals of consumer electronics
2	Explain the principles and operation of various types of audio systems
3	Understand television, display, and multimedia technologies.
4	Study the operation of consumer electronic appliances.
5	Understand office automation equipment and their applications.
6	Explore modern smart consumer electronics, IoT devices, and wireless technologies.

Course Outcomes: At the end of this course, student will be able to

CO1	Explain the fundamentals of consumer electronic devices and systems.
CO2	Describe the operation of audio systems and sound equipment.
CO3	Illustrate the working of television, display, and multimedia systems.
CO4	Explain the operation and applications of consumer electronic appliances.
CO5	Describe the working principles of office automation equipment.
CO6	Analyze smart consumer electronic devices, IoT technologies, and security aspects.

	Course Contents	COs	Hours
Unit 1	**Fundamentals of Consumer Electronics** Introduction to Consumer Electronics ,Evolution of Consumer Electronic Products ,Basic Electronic Components used in Consumer Devices ,Power Supplies (Linear and SMPS) , Basic Sensors and Actuators in Consumer Electronics , Safety Standards, Energy Rating and EMI/EMC ,Introduction to IoT-enabled Consumer Appliances	CO1	**(06)**
Unit 2	**Audio Systems** Basic characteristics of sound signal : Intensity and loudness, pitch, frequency response, fidelity, sensitivity and selectivity, Audio Amplifiers: Mono, stereo, block diagram of Hi- Fi amplifier and its working, use of bass, treble tone controls, Microphone: Working principle and Types condenser, crystal, dynamic moving coil, Speakers: Working principle and types- electrostatic, dynamic, Public Address System (PA system) and Home theatre : Block diagram and working principle	CO2	**(06)**
Unit 3	**Television and Display Technologies** Closed circuit television (CCTV): functional block diagram, working Principle, Liquid crystal display (LCD) television: Principle, Block diagram and working ,Block diagram and working principle: Light emitting diode(LED) TV, Organic light emitting diode(OLED) TV,	CO3	**(06)**

	Direct to Home (DTH) television : Block diagram and working principle , Smart interactive TV : Features and applications		
Unit 4	**Consumer Electronic Appliances** Photocopier: Block diagram and working principle , Microwave Oven: Block diagram, single chip controllers, types, safety instructions, electrical specifications, Washing Machine: Block diagram, electrical specifications, types and features of (Automatic, Semiautomatic) washing machine ,Digital Camera and Camcorder: Working principle, picture processing, picture storage, electrical specification , Scanner: Working principle, Specifications, types of scanners, interface cables, ports and connectors , Bar code reader: Working principle , applications	CO4	**(06)**
Unit 5	**Office Automation Appliances** Laser Printer: Working principle, features, specifications, functional block diagram, control unit and troubleshooting procedure , Smart Interactive Board: Working principle, features and specifications ,LED Projector: Working principle, features, specifications, functional block diagram, control unit and troubleshooting procedure ,Biometric Attendance system: Hardware and software components , working principle , Video conferencing system: Components and working principle	CO5	**(06)**
Unit 6	**Modern Consumer Electronics and Smart Devices** Smartphones and Tablets ,Smart Watches and Wearable Devices ,Smart Home Automation ,Wi-Fi, Bluetooth, ZigBee and NFC ,Voice Assistants , IoT-based Consumer Products , Security and Privacy in Smart Devices	CO6	**(06)**
Text Books			
01	Bali S.P.- Consumer Electronics Pearson Education India, New Delhi,2007;ISBN:9788131717592		
02	Bali R and Bali S.P.- Audio video systems: principle practices and troubleshooting Khanna Book Publishing Co.(P) Ltd.,New Delhi,2014;ISBN:9780070067172		
03	K. R. Botkar- Consumer Electronics, Vidhyarthi Griha Prakashan, Pune		
Reference Books			
01	R. R. Gulati- Modern Consumer Electronics- New Age International (P) Ltd.		
02	B. R. Gupta -Consumer Electronics S. K. Kataria & Sons		

Shivaji University, Kolhapur

Second Year (Sem- IV) B.Tech. Electronics and Telecommunication Engineering

Course Category	**Emerging Minor**

5G Technology

Teaching Scheme			**Examination Scheme**	
Lectures	--	3 Hrs./Week	MSE	30 Marks
Tutorials	--		ISE/CA	10 Marks
Total Credits	3		ESE	60 Marks
			Total Marks	100 Marks

Prerequisites: Basic knowledge of Digital Communication. ,Fundamentals of Wireless Communication,Computer Networks and Mobile Communication.

Course Objectives:

1	To understand the evolution of mobile communication technologies leading to 5G.
2	To study the architecture and enabling technologies of 5G networks.
3	To understand radio access technologies, spectrum, and massive MIMO.
4	To explore network virtualization, SDN, and Network Slicing.
5	To study applications of 5G in IoT, Industry 4.0, Smart Cities, and Healthcare.
6	To understand security challenges and future trends in 5G communication.

Course Outcomes: At the end of this course, student will be able to

CO1	Explain the evolution and key features of 5G communication systems.
CO2	Describe the architecture and components of 5G networks.
CO3	Analyze enabling technologies such as Massive MIMO, Beamforming, and mmWave communication.
CO4	Explain the concepts of SDN, NFV, and Network Slicing in 5G.
CO5	Identify various applications and use cases of 5G technology.
CO6	Discuss security challenges and future developments in next-generation wireless networks.

	Course Contents	COs	Hours
Unit 1	**Introduction to Mobile Communication Evolution** Evolution from 1G to 5G, Limitations of previous generations, Requirements of 5G, Key features of 5G, ITU IMT-2020 requirements, Performance metrics.	CO1	06
Unit 2	**5G Network Architecture** 5G Core Network, Next Generation Radio Access Network (NG-RAN), Service-Based Architecture (SBA), Control Plane and User Plane Separation (CUPS), Deployment models (NSA & SA).	CO2	06
Unit 3	**5G Radio Technologies** New Radio (NR), OFDM Numerology, Massive MIMO, Beamforming, Millimeter Wave Communication, Small Cells, Spectrum Allocation.	CO3	06
Unit 4	**Network Virtualization and Slicing** Software Defined Networking (SDN), Network Function Virtualization (NFV), Edge Computing, Mobile Edge Computing (MEC), Network Slicing concepts and applications.	CO4	06

Unit 5	**Applications of 5G** Internet of Things (IoT), Smart Cities, Industry 4.0, Autonomous Vehicles, Healthcare, Smart Agriculture, AR/VR, Smart Manufacturing.	CO5	06
Unit 6	**Security and Future Trends** 5G Security Architecture, Authentication and Privacy, Cybersecurity Challenges, AI in 5G Networks, Towards 6G Communication, Future Research Directions.	CO6	06
	Text Books		
01	**Afif Osseiran, Jose F. Monserrat and Patrick Marsch**, *5G Mobile and Wireless Communications Technology*, Cambridge University Press.		
02	**Jonathan Rodriguez**, *Fundamentals of 5G Mobile Networks*, Wiley.		
03	**Sassan Ahmadi**, *5G NR: Architecture, Technology, Implementation and Operation of 3GPP New Radio Standards*, Academic Press.		
04	**Larry Peterson and Oğuz Sunay**, *5G Mobile Networks: A Systems Approach*, Open Networking Foundation.		
	Reference Books		
01	**Erik Dahlman, Stefan Parkvall and Johan Skold**, *5G NR: The Next Generation Wireless Access Technology*, Academic Press.		
02	**Haralabos Sarimveis and Symeon Chatzinotas**, *5G and Beyond Wireless Systems*, Springer.		
03	**William Stallings**, *Wireless Communications and Networks*, Pearson.		
04	**Theodore S. Rappaport**, *Wireless Communications: Principles and Practice*, Pearson.		
05	**Andreas F. Molisch**, *Wireless Communications*, Wiley.		

Shivaji University, Kolhapur

Second Year (Sem- V) B.Tech. Electronics and Telecommunication Engineering

Course Category	**Emerging Minor**

6G Technology

Teaching Scheme			**Examination Scheme**	
Lectures	--	3 Hrs./Week	MSE	30 Marks
Tutorials	--		ISE/CA	10 Marks
Total Credits	3		ESE	60 Marks
			Total Marks	100 Marks

Prerequisites: Fundamentals of Digital Communication. ,Basics of Wireless and Mobile Communication. ,Basic knowledge of Computer Networks and Internet of Things (IoT).

Course Objectives:

1	To understand the evolution of wireless communication from 5G to 6G.
2	To study the architecture, vision, and enabling technologies of 6G networks.
3	To understand advanced communication technologies such as THz communication, AI-native networks, and Intelligent Reflecting Surfaces.
4	To explore integrated communication, sensing, computing, and network intelligence in 6G.
5	To study emerging applications enabled by 6G technology.
6	To understand security, sustainability, and future research directions in 6G communication.

Course Outcomes: At the end of this course, student will be able to

CO1	Explain the evolution, vision, and key performance indicators of 6G communication systems.
CO2	Describe the architecture and enabling technologies of 6G networks.
CO3	Analyze advanced communication technologies including THz communication, AI-native networking, and Intelligent Reflecting Surfaces.
CO4	Explain integrated communication, sensing, edge intelligence, and digital twin technologies in 6G.
CO5	Identify potential applications of 6G in smart industries, healthcare, transportation, and immersive communication.
CO6	Discuss security, sustainability, standardization, and future research challenges of 6G.

	Course Contents	**COs**	**Hours**
Unit 1	**Introduction to 6G Communication** Evolution from 1G to 6G, Limitations of 5G, Vision and Requirements of 6G, ITU IMT-2030 Framework, Key Performance Indicators (KPIs), Design Goals and Challenges of 6G.	CO1	06
Unit 2	**6G Network Architecture** 6G Architecture Overview, AI-Native Network Architecture, Integrated Space-Air-Ground-Sea Networks (SAGSIN), Cloud-Native Core, Edge Intelligence, Open RAN (O-RAN), Network Softwarization.	CO2	06

Unit 3	**Enabling Technologies for 6G** Terahertz (THz) Communication, Visible Light Communication (VLC), Intelligent Reflecting Surfaces (IRS), Massive MIMO Evolution, Cell-Free Massive MIMO, Ultra-Massive MIMO, Reconfigurable Intelligent Surfaces (RIS).	CO3	06
Unit 4	**AI, Sensing and Intelligent Networking** Artificial Intelligence and Machine Learning in 6G, Integrated Communication and Sensing (ISAC), Digital Twins, Semantic Communication, Edge AI, Federated Learning, Network Automation.	CO4	06
Unit 5	**Applications of 6G** Extended Reality (XR), Metaverse, Holographic Communication, Autonomous Transportation, Industry 5.0, Smart Healthcare, Smart Agriculture, Internet of Everything (IoE), Smart Cities, UAV Communication.	CO5	06
Unit 6	**Security, Sustainability and Future Trends** 6G Security Architecture, Quantum Communication and Quantum Key Distribution (QKD), Privacy Preservation, Green Communication, Energy-Efficient Networks, Standardization Activities, Future Research Challenges and Roadmap Beyond 6G.	CO6	06
Text Books			
01	**Khaled M. Rabie**, *6G Wireless Communications and Mobile Networking*, Wiley.		
02	**Wanshi Chen, Feng Lyu and Xuemin (Sherman) Shen**, *6G Mobile Wireless Networks*, Springer.		
03	**Kai-Kit Wong, Chau Yuen and Mohamed-Slim Alouini (Editors)**, *6G Wireless Systems: Vision, Requirements, Challenges, Insights and Opportunities*, IEEE/Wiley.		
04	**Amit Kumar, Mohsen Guizani and Adnan Al-Anbuky (Editors)**, *Toward 6G Communication Networks: Vision, Enabling Technologies and Applications*, CRC Press.		
Reference Books			
01	**Yang Yang, Mischa Dohler and Hamid Gharavi (Editors)**, *6G Mobile Wireless Networks*, Springer.		
02	**Michele Zorzi, H. Vincent Poor, Andrea Zanella and others (Editors)**, *Towards 6G Networks: Use Cases and Technologies*, Wiley.		
03	**Theodore S. Rappaport et al.**, *Wireless Communications and Applications Above 100 GHz*, Pearson.		
04	**Erik Dahlman, Stefan Parkvall and Johan Skold**, *5G NR: The Next Generation Wireless Access Technology*, Academic Press.		
05	**William Stallings**, *Wireless Communications and Networks*, Pearson.		

Shivaji University, Kolhapur

Second Year (Sem- VI) B.Tech. Mechanical Engineering

Course Category	**Emerging Minor**

Radio Engineering

Teaching Scheme			**Examination Scheme**	
Lectures	--		MSE	30 Marks
Tutorials	--		ISE/CA	10 Marks
Total Credits	3		ESE	60 Marks
			Total Marks	100 Marks

Prerequisites: Electronic Devices and Circuits, Analog Communication, Network Theory, Electromagnetic Fields, Signals and Systems.

Course Objectives:

1	To introduce the basic principles and concepts of radio engineering.
2	To understand radio wave propagation and different radio communication systems.
3	To study the operation of radio transmitters, receivers, and antennas.
4	To familiarize students with modulation techniques used in radio communication.
5	To develop an understanding of modern radio communication technologies and applications.
6	To create awareness of current trends and future developments in radio engineering.

Course Outcomes: At the end of this course, student will be able to

CO1	Explain the fundamentals of radio engineering and radio communication systems.
CO2	Describe the principles of radio wave propagation, antennas, and transmission lines.
CO3	Explain the working of radio transmitters and receivers.
CO4	Analyze different modulation techniques used in radio communication.
CO5	Identify the components and operation of modern radio communication systems.
CO6	Describe the applications and future trends in radio engineering.

	Course Contents	COs	Hours
Unit 1	**Fundamentals of Radio Engineering** Introduction to radio engineering, History and evolution of radio communication, Electromagnetic spectrum, Radio frequency bands, Radio communication system block diagram, Radio wave generation, Applications of radio engineering.	CO1	**(06)**
Unit 2	**Radio Wave Propagation** Propagation of radio waves, Ground wave propagation, Sky wave propagation, Space wave propagation, Ionosphere and its characteristics, Factors affecting propagation, Propagation losses, Radio horizon.	CO2	**(08)**
Unit 3	**Radio Transmitters and Receivers** Basic transmitter architecture, AM and FM transmitters, Radio frequency amplifiers, Receiver architecture, Superheterodyne receiver, Frequency conversion, Intermediate frequency amplifier, Automatic Gain Control (AGC), Receiver performance parameters	CO3	**(06)**

Unit 4	**Antennas and Transmission Lines** Introduction to antennas, Antenna parameters, Dipole antenna, Monopole antenna, Yagi-Uda antenna, Parabolic reflector antenna, Transmission lines, Standing Wave Ratio (SWR), Impedance matching, Applications of antennas.	CO4	**(06)**
Unit 5	**Radio Communication Systems** AM and FM broadcasting systems, Two-way radio communication, Marine and aeronautical radio communication, Satellite radio communication, Digital radio, Software Defined Radio (SDR), Mobile radio systems.	CO5	**(06)**
Unit 6	**Modern Trends in Radio Engineering** Wireless communication technologies, Internet of Things (IoT) communication, Cognitive radio, RFID systems, Spectrum management, Radio regulations and standards, Future trends and emerging applications	CO6	**(06)**

	Text Books
01	Simon Haykin - *Communication Systems* - Wiley.
02	Wayne Tomasi - *Electronic Communication Systems* - Pearson.
03	Dennis Roddy - *Electronic Communications* - McGraw-Hill.
04	John D. Kraus and Ronald J. Marhefka - *Antennas for All Applications* - McGraw-Hill.
	Reference Books
01	Theodore S. Rappaport - *Wireless Communications: Principles and Practice* - Pearson.
02	B. P. Lathi - *Modern Digital and Analog Communication Systems* - Oxford University Press.
03	John G. Proakis and Masoud Salehi - *Fundamentals of Communication Systems* - Pearson.
04	George Kennedy and Bernard Davis - *Electronic Communication Systems* - McGraw-Hill.
05	John D. Ryder - *Networks, Lines and Fields* - Prentice Hall.

Shivaji University, Kolhapur				
Second Year (Sem- VII) B.Tech. Electronics and Telecommunication Engineering				
Course Category	**Emerging Minor**			
Embedded Linux				
Teaching Scheme			**Examination Scheme**	
Lectures	--		MSE	30 Marks
Tutorials	--		ISE/CA	10 Marks
Total Credits	3		ESE	60 Marks
			Total Marks	100 Marks

Prerequisites: C Programming, Microprocessors & Microcontrollers, Operating Systems, Embedded Systems

Course Objectives:

1	Understand the architecture, components, and boot process of Embedded Linux operating systems.
2	Apply Linux commands, shell scripting, and system programming concepts for embedded application development.
3	Configure and customize the Linux kernel, bootloader, and root file system for embedded platforms.
4	Design and develop basic Linux device drivers for embedded peripherals and hardware interfaces.
5	Develop network-enabled Embedded Linux applications using inter-process communication (IPC), multithreading, and socket programming.
6	Build and deploy Embedded Linux-based solutions for IoT, industrial automation, robotics, and communication systems.

Course Outcomes: At the end of this course, student will be able to

CO1	Explain the architecture, file system, boot process, and essential features of Embedded Linux.
CO2	Develop Linux-based applications using shell scripting, system calls, process management, and file handling.
CO3	Configure, compile, and customize the Linux kernel, bootloader, and embedded root file system for ARM-based platforms.
CO4	Develop and test basic Linux kernel modules and character device drivers for embedded hardware interfaces.
CO5	Implement inter-process communication, multithreading, networking, and serial communication in Embedded Linux applications.
CO6	Design and implement complete Embedded Linux-based systems for real-world applications such as IoT, smart agriculture, industrial control, and communication systems.

	Course Contents	COs	Hours
Unit 1	**Introduction to Embedded Linux** Introduction to Embedded Systems, Linux Operating System Overview, Desktop Linux vs Embedded Linux, Linux Architecture, Linux Kernel Components, Linux File System Hierarchy, Linux Boot Process, Basic Linux Commands and Shell Environment	CO1	**(06)**
Unit 2	**Linux Programming Fundamentals** Linux System Calls, File Handling in Linux, Process Management, Process Creation using fork() and exec(), Signal Handling, Shell Scripting, Introduction to Makefiles,	CO2	**(08)**

Unit 3	**Embedded Linux System Development** Cross Compilation, Cross Compiler Toolchain, BusyBox, Root File System, Bootloader (U-Boot) Fundamentals, Linux Kernel Configuration, Kernel Compilation Process, Device Tree Basics	CO3	**(06)**
Unit 4	**Linux Device Driver Development** Introduction to Linux Device Drivers, Kernel Modules, Module Programming, Character Device Drivers, Device Files, GPIO Driver Programming, Introduction to Interrupt Handling	CO4	**(06)**
Unit 5	**Inter-Process Communication and Networking** Pipes, Message Queues, Shared Memory Semaphores, POSIX Threads, Socket Programming TCP/IP Basics, Serial Communication in Linux	CO5	**(06)**
Unit 6	**Embedded Linux Applications and Case Studies (6 Hours)** Embedded GUI Overview, Embedded Linux for IoT, Embedded Linux Security Basics, Power Management, Embedded Multimedia Applications, Raspberry Pi as Embedded Linux Platform, BeagleBone Black Overview, Industrial and Automotive Applications, Case Studies in Smart Agriculture, Robotics, and Communication Systems	CO6	**(06)**
Text Books			
1	Karim Yaghmour, *Building Embedded Linux Systems*, O'Reilly.		
2	Christopher Hallinan, *Embedded Linux Primer*, Pearson.		
3	Craig Hollabaugh, *Embedded Linux: Hardware, Software and Interfacing*, Addison-Wesley.		
4			
Reference Books			
1	Jonathan Corbet, Alessandro Rubini, Greg Kroah-Hartman, *Linux Device Drivers*, O'Reilly.		
2	Robert Love, *Linux Kernel Development*, Addison-Wesley.		
3	W. Richard Stevens, *Advanced Programming in the UNIX Environment*, Pearson.		
4	P. Raghavan, *Embedded Linux System Design and Development*, CRC Press.		

Shivaji University, Kolhapur

Final Year (Sem- VIII) B.Tech. Electronics & Telecommunication Engineering

Course Category	**Emerging Minor**

Quantum Computing

Teaching Scheme			**Examination Scheme**	
Lectures	--		MSE	30 Marks
Tutorials	--		ISE/CA	10 Marks
Total Credits	3		ESE	60 Marks
			Total Marks	100 Marks

Prerequisites: Engineering Mathematics, Digital Electronics, Programming Fundamentals, Basic Engineering Physics.

Course Objectives:

1	To introduce the basic concepts and principles of quantum computing.
2	To understand qubits, quantum states, and basic quantum gates.
3	To learn the construction and working of simple quantum circuits.
4	To familiarize students with basic quantum algorithms and their applications.
5	To provide hands-on exposure to quantum computing using simulation tools such as Qiskit.
6	To create awareness about the potential applications and future scope of quantum computing.

Course Outcomes: At the end of this course, student will be able to

CO1	Explain the basic concepts and principles of quantum computing.
CO2	Describe qubits, quantum states, superposition, entanglement, and basic quantum gates.
CO3	Develop simple quantum circuits using quantum gates.
CO4	Demonstrate basic quantum algorithms using quantum computing simulators.
CO5	Use basic quantum computing tools such as Qiskit to implement simple quantum programs.
CO6	Identify the applications and future scope of quantum computing in engineering and technology.

	Course Contents	COs	Hours
Unit 1	**Introduction to Quantum Computing** Definition and history of quantum computing, Need for quantum computing, Classical computing vs quantum computing, Basic concepts of quantum mechanics, Qubits and quantum states, Superposition and measurement, Bloch sphere representation, Applications and future scope of quantum computing.	CO1	**(06)**
Unit 2	**Quantum Gates and Quantum Circuits** Quantum bits (Qubits), Single-qubit quantum gates (Pauli-X, Pauli-Y, Pauli-Z, Hadamard, Phase gates), Multi-qubit gates (CNOT, SWAP), Quantum circuit model, Circuit representation and notation, Design and analysis of simple quantum circuits.	CO2	**(08)**
Unit 3	**Quantum Algorithms** Introduction to quantum algorithms, Deutsch's Algorithm, Deutsch-Jozsa Algorithm (basic concept), Grover's Search Algorithm (basic concept), Shor's Factoring Algorithm (overview), Comparison of classical and quantum algorithms, Applications of quantum algorithms.	CO3	**(06)**

Unit 4	**Quantum Programming and Simulation** Introduction to quantum programming, Quantum computing platforms, IBM Quantum Experience, Basics of Qiskit, Creating simple quantum circuits using Qiskit, Running quantum circuits on simulators, Interpretation of simulation results.	CO4	**(06)**
Unit 5	**Applications of Quantum Computing** Quantum cryptography, Quantum Key Distribution (QKD), Quantum communication, Applications in optimization, Artificial Intelligence and Machine Learning, Drug discovery, Financial modeling, Healthcare, Scientific research and engineering applications.	CO5	**(06)**
Unit 6	**Challenges and Future Trends in Quantum Computing** Challenges in quantum computing, Quantum noise and decoherence (basic concepts), Quantum error correction (overview), Quantum hardware technologies, Current industrial developments, Future trends in quantum computing, Career opportunities and emerging research areas.	CO6	**(06)**

	Text Books
01	Chris Bernhardt - Quantum Computing for Everyone - MIT Press.
02	Robert S. Sutor - Dancing with Qubits: How Quantum Computing Works and How It Can Change the World - Packt Publishing.
03	Jack D. Hidary - Quantum Computing: An Applied Approach - Springer.
04	Michael A. Nielsen and Isaac L. Chuang - Quantum Computation and Quantum Information - Cambridge University Press.
	Reference Books
01	Scott Aaronson - Quantum Computing Since Democritus - Cambridge University Press.
02	Eleanor G. Rieffel and Wolfgang H. Polak - Quantum Computing: A Gentle Introduction - MIT Press.
03	N. David Mermin - Quantum Computer Science: An Introduction - Cambridge University Press.
04	Noson S. Yanofsky and Mirco A. Mannucci - Quantum Computing for Computer Scientists - Cambridge University Press.
05	Maria Schuld and Francesco Petruccione - Supervised Learning with Quantum Computers - Springer.

Design Thinking Course: Teaching Methodology, Assessment, and Evaluation

- The Non Credit Course under Design Thinking Category is offered to the students in Fifth or Sixth Semester through Massive Open Online Courses (MOOCs), and students may select a course from the following list or relevant course available on the respective online platform at that time. The course should have duration of not less than 4 weeks and not more than 6 weeks with minimum of 20 lectures and maximum of 30 lectures.
- The course is learned in online mode and can be completed by the student at their own pace within the prescribed duration.
- For enrollment, students are required to visit the SWAYAM or Coursera platform, register, and create their individual accounts.
- After successful registration, students must log in to their accounts, enroll in the course, and follow all instructions provided to complete the course.
- A Departmental Course Coordinator shall be appointed for the respective course.
- Students must submit all weekly assignments available on the respective platform, or those assigned by the Course Coordinator with prior approval from the respective Course Coordinator for assessment and evaluation.
- The Institute shall issue a Course Completion Certificate to students only after fulfilment of the following requirement:

    - Successful Completion and submission of 100% of the weekly assignments.

- Students are expected to adhere to all course guidelines and complete the course within the stipulated timeframe specified on the respective platform or by the Course Coordinator.

Online Platform- Swayam

1] Course Title- Design Thinking

Instructor- Dr. Rajeshwari Patil, Dr. Manisha Shukla, Dr. Deepali Raheja, Dr. Mansi Kapoor
Sri Balaji University Pune

Course Information

Welcome to the captivating world of Design Thinking! This online course is designed to introduce you to the essential principles and techniques of Design Thinking—a powerful approach to problem-solving and innovation that has gained widespread recognition across various sectors in today's contemporary era.

In this course, you will discover that Design Thinking is much more than mere thinking. It is a mindset—an innovative and human-centric approach to identifying problems, designing effective solutions, and delivering outcomes that address unmet human needs.

Are you ready to unlock your creative potential and become a visionary leader in the business world? Join us on an exhilarating journey as we dive deep into the transformative power of design thinking through our immersive MOOC course on "Design Thinking."

Prepare to embark on a dynamic adventure where you will explore cutting-edge methodologies, challenge conventional thinking, and develop the essential skills to drive innovation. By participating in this course, you will be equipped with actionable strategies to tackle complex problems, discover untapped opportunities, and create value in today's ever-evolving business landscape.

Get ready to unleash your imagination, collaborate with like-minded individuals, and revolutionize your approach to problem-solving. Enroll now and embrace the boundless possibilities that await you!

This course adopts the Learner-Centric Model approach developed by IIT Bombay while planning, designing, and conducting this MOOC.

Learning Objectives-

This course will help you gain a strong foundation in design thinking principles and equip you with the necessary skills to apply this methodology in your future endeavors. Also, this course will help you to develop a problem-solving mindset and the ability to approach challenges from a human-centered perspective.

Course outline-

Week 0: Welcome to the course
Week 1: Foundation of Design Thinking
Week 2: Empathy-Foundation and Tools of Empathy
Week 3: Define-Foundation and Tools
Week 4: Ideate-Foundation and Tools
Week 5: Prototype & Foundation and Tools
Week 6: Learn From Practitioner

Syllabus-

Week/ Module	Topics
Week 0	• Demo Video • Welcome to the course • Course Schedule ● Grading Policy ● Exam Details ● FAQ
Week 1	**Foundation of Design Thinking** • Introduction to Design Thinking • Significance of Design Thinking • Key Tenets of Design Thinking • Design Thinking Process- 4 Critical Questions • Design Thinking Process • Wicked Problems • How Design Thinking is Different from Traditional Thinking • The Knowledge Funnel • Cognitive Bias: What Design Thinkers Should Avoid
Week 2	**Empathy-Foundation and Tools of Empathy** • Foundation of Empathy • Purpose of empathy • Observation as a tool of empathy • Methods of Observation • Empathetic Interview • Stakeholder maps • Jobs to be done • Empathy Maps
Week 3	**Define- Foundation and tools** • Rules of Defining • Importance of Defining • Customer Journey Map • Customer experience • Persona
Week 4	**Ideate-Foundation and Tools** • Introduction to Ideation • Double Diamond • Brainstorming • Rules for Brainstorming • Mind Mapping • Worst Possible Idea
Week 5	**Prototype -Foundation and Tools** • Concept of Prototyping • Paper prototype • Story Board prototype • Scenario prototype • Low fidelity and high fidelity Test Foundation and Tools • Introduction to Test
Week 6	**Learn from Practitioner** • Interview 1 Mr Rohit Dubepatil – Director ORAH Nutrichem.Pvt.Ltd • Interview 2 Dr Bala Ramadurai • Interview 3Mr Abhijeet Kumar- Founder StepBeta • Interview 4 Ms Savita Rajiv

Online Platform- Coursera
Course Title- Design Thinking and Innovation
Instructor: B K Chakravarthy – IIT Bombay

Syllabus-

Module 1-Innovation by Design:
Introducing the fundamental concepts of design thinking and the 7 Concerns for Innovation. This module will establish the foundation for understanding how design can solve complex problems by focusing on user needs and iterative innovation. Understand the principles of design thinking. Familiarize yourself with the 7 Concerns for Innovation. Recognize the importance of collaboration in the innovation process.
Module 2- The resolve to solve a problem:
Every design project is initiated by a _need', which becomes _The Cause' of the entire journey that follows. This need may be a commercial requirement, a social necessity or a specific niggling problem with an existing product. The recognition of such a need is a key trigger for the project and it can be identified by any of the stakeholders connected to the product – a product manufacturer or marketer, a user or a product designer.
Module 3- Understanding the problem space:
To study and understand an existing product or similar products in the market, it is critical that the environment in which the product is used, which designers like to call 'The Context' is understood comprehensively. This means that a designer must study the users and their perspectives on the product. Often, this involves several rounds of interaction and observation.
Module 4- Arriving at a Design insight:
At this stage, the designer analyses all the information gathered and methodically lists out their observations and perceptions of any notable issues in the use of the product. Such analysis results in the thorough, all-round 'Comprehension' of the product as it functions within the context of its use. The design insights thus arrived at give rise to creative ideas, and form the basis of the intervention that follows.
Module 5- Creating a product brief:
The Check is an essential step in understanding what requirements the product should ultimately meet and what problems the design intervention should address. The check, which is often a document in the form of a product brief, is created from the design insights and must be approved by the client. The product brief is an important point of reference throughout the journey as concepts and prototypes are created and evaluated.
Module 6- Generating ideas and concepts:
At this stage called 'The Conception ', the designer arrives at multiple ideas to come up with solutions for the problems listed using the product brief. At this crucial stage, ideas are proposed and grouped into clusters. This makes possible the consideration of multiple concepts. Finally, the team zeros in on one all-encompassing concept that best addresses all aspects of the product.
Module 7- Building Mockups and prototypes:
The final concept is further refined with reference to criteria like materials available or desirable, and the conditions in which the product is to be manufactured. At this penultimate stage, the designer creates several style options according to the user profile and selects one that best addresses all the aesthetic concerns. The chosen product design is showcased by 'Crafting' small-scale mock-up models, CAD models, or working prototypes. A final version of the product that meets all conditions in the product brief is then taken up for mass production

SCHEME OF INSTRUCTION & SYLLABI

Name of Programme: Electronics and Telecommunication Engineering

Scheme of Instructions: Third Year B. Tech. in Electronics and Telecommunication Engineering

Semester – V

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME			
									MSE	ISE/CA	ESE	TOTAL
1	PCC	ETC0251	Antenna & Microwave Engineering	3	--	--	3	3	30	10	60	100
2	PCC	ETC0252	Digital design using VLSI	3	--	--	3	3	30	10	60	100
3	PCC	ETC0253	Signal & System	3	--	--	3	3	30	10	60	100
4	PEC	ETC0254	PEC-1	3	--	--	3	3	30	10	60	100
5	MDM	ETC0255	Multi-disciplinary Minor–03	3	--	--	3	3	30	10	60	100
6	OE	ETC0256	Open Elective-03	2	--	--	2	2	30	10	60	100
7	PCC	ETC0257	Antenna & Microwave Engineering Lab	--	--	2	2	1	-	25	25	50
8	PCC	ETC0258	Digital design using VLSI Lab	--	--	2	2	1	-	25	25	50
9	PEC	ETC0259	PEC-1 Lab	--	--	2	2	1	-	25	--	25
10	MDM	ETC02510	Multi-disciplinary Minor–03 Lab	--	--	2	2	1	-	50	--	50
11	EL	ETC02511	Capstone Project-I	--	--	2	2	1	-	25	--	25
			Total	**17**	**--**	**10**	**27**	**22**	**180**	**210**	**410**	**800**

L-Lecture T-Tutorial P-Practical

MSE-Mid Semester Examination ISE/CA-In Semester Evaluation/Continuous Assessment

ESE-End Semester Examination (For Laboratory End Semester performance)

Course Category	Basic Science Courses (BSC)	Engineering Science Courses (ESC)	Programme Core Course (PCC)	Programme Elective Course (PEC)	Open Elective other than Particular Program (OE/MDM)	Vocational and Skill Enhancement Course (VSEC)	Humanities Social Science and Management (HSSM)	Experiential Learning (EL)	Co-curricular And Extracurricular Activities (CCA)
Last Sem. Cumulative Sum	**16**	**18**	**25**	**-**	**10**	**05**	**12**	**--**	**02**
Semester Credits	**-**	**-**	**11**	**04**	**06**	**-**	**-**	**01**	**-**
Cumulative Sum	**16**	**18**	**36**	**04**	**16**	**05**	**12**	**01**	**02**

PROGRESSIVE TOTAL CREDITS: 88 + 22 = 110

SCHEME OF INSTRUCTION & SYLLABI

Name of Programme: Electronics and Telecommunication Engineering

Scheme of Instructions: Third Year B. Tech. in Electronics and Telecommunication Engineering

Semester – VI

Sr. No.	CourseCategory	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME			
									MSE	ISE/CA	ESE	TOTAL
1	PCC	ETC0261	Microprocessor and Microcontroller	3	--	--	3	3	30	10	60	100
2	PCC	ETC0262	Optical Communication	3	1	--	4	4	30	10	60	100
3	PCC	ETC0263	Digital Signal Processing	3	--	--	3	3	30	10	60	100
4	PEC	ETC0264	PEC-II	3	--	--	3	3	30	10	60	100
5	PEC	ETC0265	PEC-III	3	--	--	3	3	30	10	60	100
6	MDM	ETC0266	Multi-disciplinary Minor–04	2	--	--	2	2	30	10	60	100
7	PCC	ETC0267	Microprocessor and Microcontroller Lab	--	--	2	2	1	-	50	25	75
8	PCC	ETC0268	Digital Signal Processing Lab	--	--	2	2	1	-	50	25	75
9	EL	ETC0269	Capstone Project-II	--	--	4	4	2	-	50	--	50
			Total	**17**	**1**	**8**	**26**	**22**	**180**	**210**	**410**	**800**

L-Lecture T-Tutorial P-Practical

MSE-Mid Semester Examination ISE/CA-In Semester Evaluation/Continuous Assessment

ESE-End Semester Examination (For Laboratory End Semester performance)

Course Category	Basic Science Courses (BSC)	Engineering Science Courses (ESC)	Programme Core Course (PCC)	Programme Elective Course (PEC)	Open Elective other than particular (OE/MDM)	Vocational and Skill Enhancement Course (VSEC)	Humanities Social Science and Management (HSSM)	Experiential Learning (EL)	Co-curricular And Extracurricular Activities (CCA)
Last Sem. Cumulative Sum	**16**	**18**	**36**	**04**	**16**	**05**	**12**	**01**	**02**
Semester Credits	**-**	**-**	**12**	**06**	**02**	**--**	**-**	**02**	**-**
Cumulative Sum	**16**	**18**	**48**	**10**	**18**	**05**	**12**	**03**	**02**

PROGRESSIVE TOTAL CREDITS : 110 + 22 = 132

Following Degrees will begin with effect from Academic Year 2026-27.

A) Bachelor's Engg./Tech. Honors Degree in chosen Major Engg./Tech. Discipline with Multidisciplinary Minor (194 credits)

B) Bachelor's Engg./Tech. Honors with Research Degree in chosen Major Engg./Tech. Discipline with Multidisciplinary Minor (194 credits)

C) Bachelor's Engg./Tech. Degree in chosen Major Engg./Tech. Discipline with Double Minor (Multidisciplinary and specialization Minor (194 credits)

List of Electives: Verticals

Specialization	Industrial Automation	IoT/Embedded System	AIML/CSE/IT	Communication
Elective-I	PLC Programming	Embedded Linux	Data Science using Python	Massive MIMO
Elective-II	Wiring Harness an Panel Design	IoT Architecture with Raspberry Pi	Artificial Intelligence	Multi-media Communication
Elective-III	Sensors and Actuators	IoT Communication Protocol	Machine Learning	Advanced Network Security
Elective-IV	SCADA & DCS	System on Chip	Deep Learning	Satellite Communication
Elective-V	Mechatronics	CAD for VLSI	Cloud Computing	Wireless Sensor Networks
Elective-VI	Robotics	Advance Processors and Design	Cyber security	Audio and Video Communication

List of Open Electives

Open Elective-I	Introduction to IoT
Open Elective-II	Control System Engineering
Open Elective-III	Introduction to MEMS
Open Elective-IV	Information Theory and Coding Techniques

List of MDM

Multi-disciplinary Minor-03	Communication Engineering
Multi-disciplinary Minor-04	Mobile Technology

Instructions regarding Examinations:

1. Compulsory passing with 40% marks is mandatory in ESE examinations and combined passing marks (MSE+ISE/CA+ESE) for theory course is 40%
2. Mid sem. examination will be based on 50% syllabus from beginning (First Three Units).
3. No compulsory passing for **MSE.**
4. ESE paper setting weightage will be, **25% on syllabus covered for MSE (First Three Units) and 75% on remaining syllabus (Last Three Units).**
5. Passing percentage for ESE practical examination 40%.

SHIVAJI UNIVERSITY, KOLHAPUR
ELECTRONICS AND TELECOMMUNICATION ENGINEERING

1. Antenna & Microwave Engineering

Course Details:

Class	T. Y. B-Tech. Sem-V
Course Code & Course Title	PCC-ETC0251: Antenna & Microwave Engineering
Prerequisites:	Fundamentals of Electromagnetics Engineering
Teaching scheme: Lecture / Practical	03/02
Credits	03 + 01 = 04
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: 20 Hrs. /Week	25 (ESE) + 25 (ISE/CA)

Course Objectives: The course aims to:	
1	Learn and understand antenna fundamentals and parameters
2	Learn and understand HF, VHF and UHF antennas
3	Learn and understand Microwave antennas
4	Understand the basic concept of microwave engineering, and apply EM wave theory to understand the nature of microwave signal.
5	Understand the theoretical and experimental design and analysis of microwave tube devices and circuits
6	Study Microwave semiconductor devices & applications

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Evaluate antenna parameters
2	Select antennas for communication applications

3	Select antennas for Microwave Applications.
4	Analyze the microwave waveguides and passive circuit components.
5	Identify and differentiate the state of art in microwave tubes and their uses in real life
6	Differentiate solid-state devices used in microwave based on their characteristics and operations

Course Contents		
Unit 01	**Antenna Basics** Introduction, Radiation Mechanism, Antenna Parameters-Radiation Patterns, Main Lobe and Side Lobes, Beam widths, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain, Impedance, Antenna Apertures, Aperture Efficiency, Effective Height, Reflection Coefficient, VSWR (Numerical Expected).	**06 Hrs.**
Unit 02	**HF, VHF & UHF ANTENNAS:** Traveling wave radiators–basic concepts, Long wire antennas, V-antennas, Rhombic Antennas and Design Relations, Small Loop antennas-, Helical Antennas, Yagi-Uda Arrays, Log periodic antennas.	**06 Hrs.**
Unit 03	**MICROWAVE ANTENNAS:** Reflector Antennas, Flat Sheet and Corner Reflectors, Parabolic Reflectors, with all types of feeding methods, Slot antennas, Micro-strip antennas, Horn antennas, Lens Antenna	**06 Hrs.**
Unit 04	**WAVE GUIDES AND MICROWAVE COMPONENTS** Rectangular wave guides: TE and TM mode wave, power transmission in wave guide, power losses in wave guide, excitation of modes in wave guide. Microwave cavities, microwave hybrid circuits, directional coupler, Circulators and Isolators, microwave attenuators. (Numerical Expected).	**06 Hrs.**
Unit 05	**MICROWAVE TUBES** Microwave linear beam Tubes: Klystrons, Reentrant Cavities, Velocity-Modulation Process, Bunching Process in Klystrons, reflex klystron, slow wave structures, principle of operation of Helix Traveling-Wave Tubes (TWTs). Microwave CROSSED-FIELD TUBES: Magnetron Oscillators, Cylindrical Magnetron, Forward and backward wave crossed field amplifier(CFA).	**06 Hrs.**
Unit 06	**MICROWAVE SOLID STATE DEVICES** Microwave bipolar transistor, microwave FETs, Microwave tunnel diodes, Gunn Effect diodes, RWH Theory, LSA diodes, InP diodes, IMPATT diodes, PIN diodes, MESFETs and HEMT.	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	Antenna Theory: Analysis and Design, Constantine A. Balanis, John Wiley & Sons, 3rd/4th Edition
2	Antennas and Wave Propagation, A. R. Harish & M. Sachidananda, Oxford University Press
3	Microwave Engineering. David M. Pozar, John Wiley & Sons, 3rd/4th Edition
4	Microwave, Radar & RF Engineering, Prakash Kumar Chaturvedi, Springer, 2018

Reference Books:

Sr. No.	Name of Author and Publication Details
1	Antennas, John D. Kraus, Ronald J. Marhefka, Ahmad S. Khan, McGraw-Hill Education
2	Handbook of Microwave and Radar Engineering, Anatoly Belous, Springer, 2021
3	Smart Antennas, EMI and Microwave Antennas, S. Kannadhasan et al., River Publishers, 2023

List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments/Tutorials based on the curriculum.

List of Experiment for ISE/CA/MSE:

- Minimum 10 Experiments based on the curriculum.

Sr. No.	Title of Experiment
1.	Measurement of radiation pattern of a dipole antenna
2.	Determination of antenna gain and beamwidth
3.	Study of Yagi-Uda antenna characteristics
4.	VSWR and reflection coefficient measurement
5.	Impedance measurement of an antenna
6.	Study of horn antenna characteristics
7.	Radiation pattern of microstrip antenna
8.	Measurement of attenuation and power in rectangular waveguide
9.	Determination of guide wavelength and cutoff frequency
10.	Study of directional coupler characteristics
11	Measurement of isolation and insertion loss of circulator and isolator
12	Study of reflex klystron characteristics
13	Study of Gunn diode characteristics
14	Study of IMPATT diode characteristics

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.

	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).
ESE (Practical) 25 Marks	Practical Oral Examination based on the List of Experiment for ISE/CA/MSE.

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2. Digital design using VLSI

Course Details:

Class	T. Y. B-Tech. Sem-V
Course Code & Course Title	PCC- ETC0252: Digital design using VLSI
Prerequisites:	Digital electronics
Teaching scheme: Lecture / Practical	03/02
Credits	03+01 = 04
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: 02 Hrs. /Week	25 (ESE) + 25 (ISE/CA)

Course Objectives: The course aims to:	
1	To understand the fundamentals of digital design, Karnaugh map simplification and fundamentals of Verilog.
2	To analyze, design, and implement combinational logic circuits and code them efficiently using Verilog.
3	To study sequential logic and implement using Verilog.
4	To design and implement various counters and shift registers and implement using Verilog.
5	To understand FSM concepts and implement using Verilog.
6	To be able to understand architecture and functionality of on-chip and peripheral communication protocols.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Students will be able to minimize logic functions using K-maps and will be able to understand basics of Verilog

2	Students will be able to design and implement combinational logic circuits
3	Students will be able to analyze and design implement sequential circuits using Verilog HDL.
4	Students will be able to design and implement various counters and shift registers
5	Students will be able to model Moore and Mealy FSMs and implement FSMs using Verilog HDL.
6	Students will be able to explain the architecture and functionality of standard on-chip and peripheral communication protocols

Course Contents		
Unit 01	**Introduction to digital design and VERILOG** K-map (Karnaugh map) 2,3 & 4 K map with Don't care terms, Level of abstraction. Introduction to HDL and need for Verilog, Design abstraction levels: Behavioral, Dataflow, Structural, Lexical elements: identifiers, keywords, operators, numbers, Data types, modelling styles in Verilog, statements in Verilog.	**06 Hrs.**
Unit 02	**Combinational logic:** Adder, Subtractor, Code converters (binary to gray & gray to binary, BCD to Excess 3 and vice versa, BCD to 7 segment display), Multiplexer and Demultiplexer, Encoder, Priority encoder, Decoder, Comparator, ALU. VERILOG coding for combinational circuits.	**06 Hrs.**
Unit 03	**Sequential Circuits:** 1-Bit Memory Cell, Latches (SR, JK, D and T), Clocked latches (SR, JK, D and T), flips flop (SR, JK, T and D). Use of preset and clear, Excitation Table for flip flops, VERILOG coding for Sequential circuit	**06 Hrs.**
Unit 04	**Counter and shift register:** Counter – ripple counters, synchronous counters, Up/down counters, Ring counters, Johnson Counter, MOD-N counter, Shift register VERILOG coding for Counters	**06 Hrs.**
Unit 05	**FSM:** FSM, Moore/Mealy machines, state diagram, state table, state assignment and state reduction, Sequence detector. VERILOG coding for FSM	**06 Hrs.**
Unit 06	**VLSI communication protocols** On-Chip Protocols: - block diagram of AMBA (AXI, AHB, APB) Peripheral Protocols: - block diagram of I2C, SPI, UART, PCIe, USB	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	A. Anand Kumar, "Fundamentals of digital circuits", 4th edition, PHI publication, 2016
2	Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education
3	Stephen Brown and ZvonkoVranesic, "Fundamentals of Digital Logic with VHDL design", Tata Mc-graw Hill

4	"AMBA-AHB Architecture in VLSI Design: Applications of AMBA-AHB in VLSI RTL Coding" by Anusha Suryavanshi

Reference Books:

Sr. No.	Name of Author and Publication Details
1	Wakerly, "Digital Design Principles and Application", Pearson Education
2	M. Morris Mano, "Digital Design", 3rd Edition, Pearson Education
3	Roth John, "Principals of Digital System Design using VHDL", Cengage Learning.
4	R. P. Jain, "Modern digital electronics", 3rd edition, 12th reprint TATA Tata McGraw Hill Publication, 2007
5	Donald E. Thomas & Philip R. Moorby, "The Verilog Hardware Description Language", McGraw-Hill
6	

List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments/Tutorials based on the curriculum.

List of Experiment for ISE/CA/MSE:

- Minimum 10 Experiments based on the curriculum.

Sr. No.	Title of Experiment
1	Implementation of universal gates in Verilog.
2	Design and simulate half adder and full adder using Verilog.
3	Design and simulate Multiplexer and Demultiplexer using Verilog.
4	Design and simulate Comparator adder using Verilog.
5	Design and simulate 3to8 decoder using Verilog.
6	Design and simulate flip-flops using Verilog.
7	Design and simulate 4-bit up-down counter using Verilog.
8	Design and simulate Shift register using Verilog.
9	Design and simulate Sequence detector using Verilog.
10	Mini project based on above syllabus.

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.

ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).
ESE (Practical) 25 Marks	Practical Oral Examination based on the List of Experiment for ISE/CA/MSE.

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3. Signal & System

Course Details:

Class	T. Y. B-Tech. Sem-V
Course Code & Course Title	**PCC ETC0253: Signal & System**
Prerequisites:	Mathematics for Electronics Engineering
Teaching scheme: Lecture / Practical	03/--
Credits	03
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: -- Hrs. /Week	--

Course Objectives: The course aims to:	
1	To introduce the fundamental concept of signals, their classifications and basic operations.
2	To develop an understanding of system representation and classification.
3	To analyze CT and DT systems in the time domain using impulse response, convolution sum, and convolution integral techniques.
4	To provide conceptual and mathematical understanding of the Fourier Transform for the analysis of signals in the frequency domain and its properties.
5	To understand z-transform and its region of convergence for analysis of discrete-time signals and systems, including inverse Z-transform techniques.
6	To understand system realization techniques using difference equations and implement discrete-time systems using various realization structures.

Course Outcomes:

Upon successful completion of this course, the student will be able to:	
1	Mathematically represent and classify the continuous-time and discrete-time signals and perform basic operations on signals.
2	Classify CT and DT systems based on their properties
3	Apply convolution techniques to determine the response of continuous-time and discrete-time systems.
4	Analyze signals in the frequency domain using Fourier Transform
5	Compute z-transform and inverse z-transform of discrete-time signals.
6	Realize discrete-time systems using various realization structures.

Course Contents		
Unit 01	**Introduction to Signals** Signal, Classifications of Signals: Continuous time signals & discrete time, analog & digital, even &odd signals, periodic &non-periodic, deterministic &non-deterministic, energy & power, Basic CT & DT signals: unit impulse, unit step, unit ramp, complex exponential & sinusoidal, Basic operations on signals - Folding, time shifting, time scaling, amplitude scaling, addition, subtraction, multiplication.	**06 Hrs.**
Unit 02	**Introduction to Systems** A System Representation, Classification of Systems: Continuous time & discrete Systems, Static and dynamic systems, Causal and non-causal systems, Linear and nonlinear systems, Time invariant and time variant systems, Stable and unstable systems, Invertibility and Inverse Systems.	**06 Hrs.**
Unit 03	**Time domain Analysis of DT and CT systems (LTI Systems)** Representation of DT Signals, Impulse Response and Convolution Sum, Properties of Convolution Sum, Matrix Convolution Method, Representation of CT Signals, Convolution Integral, Graphical representation of convolution, Properties of Convolution, Integral.	**06 Hrs.**
Unit 04	**Fourier Transform** Fourier Transform, Fourier Transform of CT and DT signals, Properties of Fourier Transform, Fourier transform using properties, Limitations of Fourier Transform.	**06 Hrs.**
Unit 05	**z transform:** Introduction of z-transform, ROC, properties of ROC, Unilateral z-transform, properties of z-transform, Inverse z-transform: long division method, PFE method, residue method.	**06 Hrs.**
Unit 06	**System Realization** Discrete time system representation by difference equation, transfer function in z-domain, Realization of discrete time systems by Direct Form I, Direct Form II, Parallel Form and Cascade Form.	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details

1	P. Ramesh Babu, R. Anandanatarajan, " Signals and Systems " 4th Edition, SCITECH publication
2	S. Palani, " Signals and Systems", Ane Books Pvt. Ltd
3	A. Anand Kumar, "Signals and Systems", PHI publication

Reference Books:

Sr. No.	Name of Author and Publication Details
1	Alan Oppenheim, Alan S. Willsky , "Signals and Systems ", 2nd Edition , PHI Publication.
2	Simon Haykin, Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley Publication
3	Michael J. Roberts, "Fundamentals of signals & systems", Tata McGraw Hill Publication Publication, 2007.

List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments based on the curriculum.

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).

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4. PEC-I: PLC Programming

Course Details:

Class	T. Y. B-Tech. Sem-V
Course Code & Course Title	PLC Programming
Prerequisites:	Basic knowledge of electrical circuits, digital electronics, and industrial control concepts.
Teaching scheme: Lecture / Practical	03/02
Credits	03 + 01=04
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: 02 Hrs. /Week	25 (ISE/CA)

Course Objectives: The course aims to:	
1	Introduce the fundamentals of Programmable Logic Controllers (PLC).
2	Provide understanding of PLC hardware architecture and components.
3	Develop skills in PLC programming using standard programming languages.
4	Enable students to design and implement industrial automation solutions.
5	Familiarize students with PLC-based control of industrial processes.
6	Prepare students for automation and control engineering applications.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Explain PLC architecture, components, and working principles.
2	Develop PLC programs using ladder logic and other IEC standards.
3	Interface PLCs with sensors, actuators, and industrial devices.
4	Implement timers, counters, and sequencing operations.
5	Analyze and troubleshoot PLC-based automation systems.
6	Apply PLC programming concepts to real-time industrial control problems.

Course Contents		
Unit 01	**Introduction to PLC and Automation** Overview of industrial automation, Need and evolution of PLCs Comparison of PLC with hardwired logic, PLC applications in industry PLC standards and manufacturers	**06 Hrs.**
Unit 02	**PLC Hardware and Architecture** PLC block diagram, CPU, memory, power supply, Input/output modules (digital and analog), Addressing and wiring concepts, PLC scan cycle	**06 Hrs.**
Unit 03	**PLC Programming Basics** Introduction to IEC 61131-3 standards, Ladder logic programming Basic instructions: contacts and coils, Timers and counters, Simple ladder programs	**06 Hrs.**
Unit 04	**Advanced PLC Programming** Arithmetic and logical instructions, Comparison and data handling instructions, Sequencing and interlocking, Program control instructions Introduction to function block diagrams (FBD)	**06 Hrs.**
Unit 05	**PLC Communication and HMI** PLC communication protocols, PLC networking basics Introduction to SCADA and HMI, PLC–HMI interfacing Industrial case studies	**06 Hrs.**
Unit 06	**Industrial Applications and Troubleshooting** PLC-based motor control applications, Conveyor and batch process control, Troubleshooting techniques, PLC maintenance and safety practices, Recent trends in industrial automation	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	Frank D. Petruzella, Programmable Logic Controllers, McGraw-Hill.
2	W. Bolton, Programmable Logic Controllers, Newnes.

Reference Books:

Sr. No.	Name of Author and Publication Details
1	Hugh Jack, Automating Manufacturing Systems with PLCs, Pearson.
2	John W. Webb, Programmable Logic Controllers: Principles and Applications, Pearson.
3	Siemens PLC Documentation and Manuals.

List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments/Tutorials based on the curriculum.

List of Experiment for ISE/CA/MSE:

- Minimum 10 Experiments based on the curriculum.

Sr. No.	Title of Experiment
1.	Study of Familiarization with PLC hardware
2.	Study of Basic ladder logic programming
3.	Study of Digital I/O interfacing
4.	Study of Timer-based control
5.	Study of Counter-based applications
6.	Study of Arithmetic operations in PLC
7.	Study of Motor control using PLC
8.	Study of Sequencing application
9.	Study of PLC–HMI interfacing
10.	Mini project / case study

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).
ESE (Practical)	Practical Oral Examination based on the List of Experiment for ISE/CA/MSE.

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4. PEC-I: Embedded Linux

Course Details:

Class	T. Y. B-Tech. Sem-V
Course Code & Course Title	Embedded Linux
Prerequisites:	Basic knowledge of embedded systems, C programming, and microprocessor fundamentals.
Teaching scheme: Lecture / Practical	03/02
Credits	03 + 01= 04
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: 02 Hrs. /Week	25 (ISE/CA)

Course Objectives: The course aims to:	
1	Introduce fundamentals of Embedded Linux and its role in embedded systems.
2	Provide understanding of Linux architecture and kernel concepts.
3	Enable students to develop and deploy applications on embedded Linux platforms.
4	Familiarize students with system programming and device driver basics.
5	Develop skills for configuring, building, and booting embedded Linux systems.
6	Prepare students for industrial applications involving embedded and IoT systems.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Understand Embedded Linux architecture and system components.
2	Configure and build a Linux kernel for embedded platforms.
3	Develop Linux-based embedded applications using system calls.
4	Explain booting process and file system management.
5	Understand basics of device drivers and hardware interfacing.
6	Apply Embedded Linux concepts to real-world embedded and IoT applications

Course Contents		
Unit 01	**Introduction to Embedded Linux (06 Hours)** Overview of embedded systems and operating systems Need for Embedded Linux Advantages and limitations of Embedded Linux Embedded Linux architecture Comparison with RTOS	**06 Hrs.**
Unit 02	**Linux System Architecture (06 Hours)** Linux kernel architecture User space and kernel space Linux file system structure Process management and scheduling Memory management concepts	**06 Hrs.**
Unit 03	**Embedded Linux Development Environment (06 Hours)** Cross-compilation concepts Toolchains and build systems Introduction to BusyBox Root file system creation Introduction to Yocto and Buildroot (overview)	**06 Hrs.**
Unit 04	**Booting and File Systems (06 Hours)** Bootloader concepts (U-Boot overview) Linux booting sequence Flash file systems (JFFS2, YAFFS, EXT) Mounting and managing file systems	**06 Hrs.**
Unit 05	**Linux System Programming (06 Hours)** System calls and kernel interface Process creation and management Inter-process communication (pipes, signals, shared memory) Thread programming basics File I/O operations	**06 Hrs.**
Unit 06	**Device Drivers and Embedded Applications (06 Hours)** Introduction to Linux device drivers Character device drivers (conceptual) GPIO and peripheral interfacing Embedded Linux applications in IoT Case studies and industry applications	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	Karim Yaghmour, Embedded Linux Systems, O'Reilly Media.
2	Frank Vasquez and Chris Simmonds, Embedded Linux Primer, Pearson.
3	Christopher Hallinan, Embedded Linux Primer, Pearson
4	

Reference Books:

Sr. No.	Name of Author and Publication Details
1	Robert Love, Linux Kernel Development, Pearson.
2	Daniel P. Bovet and Marco Cesati, Understanding the Linux Kernel, O'Reilly Media.
3	Steve Bird, Linux Kernel Programming, Packt.
4	Linux Foundation Training Material.

List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments/Tutorials based on the curriculum.

List of Experiment for ISE/CA/MSE:

- Minimum 10 Experiments based on the curriculum.

Sr. No.	Title of Experiment
1.	Study of Linux command-line practice
2.	Study of Cross-compiling simple applications
3.	Study of Kernel configuration exercise
4.	Study of Root file system creation
5.	Study of Bootloader study
6.	Study of Process and thread programming
7.	Study of IPC mechanisms
8.	Study of File I/O programming
9.	Study of Device driver demonstration
10.	Mini project / case study

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).
ESE (Practical)	Practical Oral Examination based on the List of Experiments for ISE/CA/MSE.

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4. PEC-I: Data Science using Python

Course Details:

Class	T. Y. B-Tech. Sem-V
Course Code & Course Title	ETC0254: Data Science Using Python
Prerequisites:	statistics and probability along with fundamentals of programming
Teaching scheme: Lecture / Practical	03/02
Credits	03 +01 =04
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: 02 Hrs. /Week	25 (ISE/CA)

Course Objectives:

The course aims to:

1	Introduce fundamental concepts of data science and its applications in engineering domains.
2	Develop proficiency in Python programming for data analysis and manipulation.
3	Enable students to apply statistical techniques for exploratory data analysis.
4	Familiarize students with data visualization techniques using Python libraries.
5	Provide understanding of basic machine learning algorithms for data-driven decision making.
6	Encourage practical problem-solving using real-world datasets.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1	Understand the data science lifecycle and its relevance in engineering applications.
2	Use Python programming constructs and libraries for data handling.
3	Perform exploratory data analysis using statistical and visualization techniques.
4	Apply data preprocessing and feature engineering methods.

5	Implement basic machine learning models using Python.
6	Analyze results and interpret insights from data-driven models.

Course Contents		
Unit 01	**Introduction to Data Science and Python Basics** Introduction to Data Science: scope, applications, and challenges Data science lifecycle Introduction to Python: features and environment setup Python syntax, variables, data types Control structures and functions	**06 Hrs.**
Unit 02	**Python Libraries for Data Science** NumPy: arrays, operations, and numerical computing Pandas: Series, DataFrames, data loading and manipulation Data cleaning and handling missing values Data transformation and aggregation	**06 Hrs.**
Unit 03	**Exploratory Data Analysis (EDA)** Descriptive statistics and summary measures Data visualization concepts Matplotlib and Seaborn for visualization Correlation analysis and insights from data	**06 Hrs.**
Unit 04	**Data Preprocessing and Feature Engineering** Data normalization and standardization Encoding categorical data Feature selection and feature extraction Train-test split and cross-validation concepts	**06 Hrs.**
Unit 05	**Introduction to Machine Learning** Overview of machine learning and types Supervised vs unsupervised learning Linear regression and logistic regression Performance evaluation metrics	**06 Hrs.**
Unit 06	**Classification and Clustering Techniques** Decision trees and k-nearest neighbors Introduction to clustering: k-means algorithm Model evaluation and interpretation Case studies using real-world datasets	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	Joel Grus, *Data Science from Scratch*, O'Reilly Media.
2	Wes McKinney, *Python for Data Analysis*, O'Reilly Media.
3	Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn*, O'Reilly Media.
4	

Reference Books:

Sr.No.	Name of Author and Publication Details
1	Jake VanderPlas, *Python Data Science Handbook*, O'Reilly Media.
2	Ethem Alpaydin, *Introduction to Machine Learning*, MIT Press.
3	Mark Lutz, *Learning Python*, O'Reilly Media.
4	Andreas Müller and Sarah Guido, *Introduction to Machine Learning with Python*, O'Reilly Media.

List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments/Tutorials based on the curriculum.

List of Experiment for ISE/CA/MSE:

- Minimum 10 Experiments based on the curriculum.

Sr. No.	Title of Experiment
1.	Study of Python programming fundamentals
2.	Study of NumPy operations
3.	Study of Data handling using Pandas
4.	Study of Data cleaning techniques
5.	Study of Visualization techniques
6.	Study of Regression model implementation
7.	Study of Classification model implementation
8.	Study of Clustering using k-means
9.	Study of Model evaluation
10.	Case study-based experiment

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).
ESE (Practical)	Practical Oral Examination based on the List of Experiments for ISE/CA/MSE.

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4. PEC-I: Massive MIMO

Course Details:

Class	T. Y. B-Tech. Sem-V
Course Code & Course Title	PEC-ETC0254:Massive MIMO
Prerequisites:	Digital Communication, Antenna & Wave Propagation, Linear Algebra
Teaching scheme: Lecture / Practical	03/02
Credits	03 + 01=04
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: 02 Hrs. /Week	25 (ISE/CA)

Course Objectives: The course aims to:	
1	Introduce the fundamental concepts of MIMO and its evolution to Massive MIMO.
2	Understand the propagation channels and modeling for Massive MIMO systems.
3	Analyze the performance limits and capacity of Massive MIMO.
4	Study pilot contamination and its impact on system performance.
5	Explore various beamforming and precoding techniques.
6	Discuss the implementation challenges and future trends in 5G/6G.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Differentiate between conventional MIMO and Massive MIMO technologies.
2	Characterize and model Massive MIMO propagation channels.
3	Calculate the spectral and energy efficiency of Massive MIMO systems.
4	Evaluate the effects of pilot contamination and mitigation strategies.
5	Design precoding and detection algorithms for large-scale antenna arrays.
6	Identify hardware impairments and deployment challenges in Massive MIMO.

Course Contents		
Unit 01	**Introduction to Massive MIMO:** Evolution from Point-to-Point MIMO to Multi-user MIMO and Massive MIMO. Benefits: Spectral efficiency, energy efficiency, and reliability. TDD vs. FDD operation.	**06 Hrs.**
Unit 02	**Channel Modeling:** Statistical channel models, Correlated Rayleigh fading, Line-of-sight (LoS) vs. Non-line-of-sight (NLoS) models. Channel hardening and favorable propagation.	**06 Hrs.**
Unit 03	**Pilot Contamination:** Uplink pilot transmission, Channel estimation techniques (LS and MMSE). The pilot contamination problem, its sources, and its impact on asymptotic performance.	**06 Hrs.**
Unit 04	**Spectral and Energy Efficiency:**Achievable rate analysis, spectral efficiency in the uplink and downlink. Power control strategies and energy efficiency trade-offs.	**06 Hrs.**
Unit 05	**Precoding and Detection:**Linear precoding: Maximum Ratio (MR), Zero-Forcing (ZF), and Minimum Mean Square Error (MMSE). Linear detection methods in the uplink.	**06 Hrs.**
Unit 06	**Implementation and Future Trends:** Hardware impairments (phase noise, amplifier non-linearity). Low-resolution ADCs, hybrid beamforming, and the role of Massive MIMO in 6G and beyond	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	Thomas L. Marzetta, Erik G. Larsson, Yang Hong, and Hien Quoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press
2	Emil Björnson, Jakob Hoydis, and Luca Sanguinetti, "Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency", Foundations and Trends in Signal Processing.
3	David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press.

Reference Books:

Sr. No.	Name of Author and Publication Details
1	Andreas F. Molisch, Wireless Communications, Wiley-IEEE Press
2	S. R. Saunders and A. Aragón-Zavala, Antennas and Propagation for Wireless Communication Systems, Wiley
3	E. G. Larsson et al., “Pilot Contamination in Massive MIMO Systems,” IEEE

	Transactions on Communications.

List of Assignments for ISE/CA:

- Minimum 06 Assignments based on the curriculum.

List of Experiment for ISE/CA/MSE:

- Experiments based on MATLAB

Sr. No.	Title of Experiment
1	Visualization of Antenna Array Patterns
2	Capacity Comparison: SISO vs. MIMO vs. Massive MIMO
3	Rayleigh Fading Channel Realization
4	Simulation of Channel Hardening Effect
5	Analysis of Favorable Propagation
6	LS and MMSE Channel Estimation Performance
7	Modeling Pilot Contamination in Multi-cell Systems
8	Linear Precoding: Maximum Ratio (MR) vs. Zero-Forcing (ZF)
9	Spectral Efficiency (SE) vs. Energy Efficiency (EE) Trade-off
10	Impact of Low-Resolution ADCs on Signal Constellation

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).
ESE (Practical)	Practical Oral Examination based on the List of Experiments for ISE/CA/MSE.

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5. Multi-disciplinary Minor–03: Communication Engineering

Course Details:

Class	T. Y. B-Tech. Sem-V
Course Code & Course Title	Multi-disciplinary Minor–03: Communication Engineering
Prerequisites:	Basics of baseband communication
Teaching scheme: Lecture / Practical	03/02
Credits	03+01=04
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: 02 Hrs. /Week	50 (ISE/CA)

Course Objectives: The course aims to:	
1	To study amplitude modulation techniques and analyze their mathematical representation, spectrum, bandwidth, power relations, and efficiency.
2	To understand angle modulation techniques such as frequency modulation and phase modulation, including their generation and detection methods.
3	To explain pulse modulation techniques and digital representation of analog signals, including PCM and Delta Modulation.
4	To analyze the sources and effects of noise in communication systems and evaluate noise performance of AM, FM, and pulse modulation systems.
5	To introduce line coding and digital modulation techniques.
6	To study digital modulation techniques such as ASK, FSK, and PSK and compare their performance.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Analyze amplitude techniques with respect to mathematical representation, spectrum, bandwidth, power, and efficiency.
2	Analyze angle modulation techniques with respect to mathematical representation, spectrum, bandwidth, power, and efficiency.
3	Understand and compare pulse modulation techniques including PAM, PWM, PPM, PCM, and Delta Modulation.
4	Analyze the effect of noise on analog and digital communication systems and evaluate noise performance of AM and FM receivers.

5	Apply line coding techniques for efficient digital data transmission.
6	Explain the principles, generation, detection, and comparison of digital modulation techniques such as ASK, FSK, and PSK.

Course Contents		
Unit 01	**Amplitude Modulation** introduction to communication systems and need for modulation, AM techniques: DSB-LC, DSB-SC, SSB, VSB, Mathematical representation, spectrum, and bandwidth, Generation and detection of AM, Power relations and efficiency	**07 Hrs.**
Unit 02	**Angle Modulation** Introduction to angle modulation, Frequency Modulation (FM) and Phase Modulation (PM), Mathematical representation of FM and PM Frequency spectrum and bandwidth; Carson's rule, Generation of FM: direct and indirect (Armstrong method), FM detection: slope detector, Foster–Seeley discriminator, ratio detector, Comparison of FM and PM	**06 Hrs.**
Unit 03	**Pulse Modulation** Introduction to pulse modulation, Sampling theorem, Pulse modulation techniques: PAM, PWM, PPM, Pulse Code Modulation (PCM): quantization, encoding, decoding, Delta Modulation (DM), Advantages and limitations of pulse modulation systems	**06 Hrs.**
Unit 04	**Noise Analysis** Introduction to noise and its sources, Types of noise: internal and external, Signal-to-Noise Ratio (SNR), Noise performance of AM and FM receivers Effect of noise in pulse modulation systems, Noise reduction techniques	**06 Hrs.**
Unit 05	**Line Coding** Line codes: Unipolar, Bipolar, NRZ, RZ, RZ-AMI, Manchester	**04 Hrs.**
Unit 06	**Digital Communication** Introduction to digital communication systems, Digital modulation techniques: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Generation and detection of ASK, FSK, and PSK, Comparison of ASK,FSK,PSK	**07 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	Simon Haykin, Communication Systems, Wiley India.
2	B. P. Lathi, Modern Digital and Analog Communication Systems, Oxford University Press.
3	Taub & Schilling, Principles of Communication Systems, McGraw-Hill.
4	R. P. Singh & S. D. Sapre, Communication Systems – Analog and Digital, Tata McGraw-Hill.

Reference Books:

Sr. No.	Name of Author and Publication Details
1	Wayne Tomasi, Electronic Communications Systems, Pearson Education.
2	Dennis Roddy and John Coolen, Electronic Communications, Pearson Education.
3	Kennedy and Davis, Electronic Communication Systems, McGraw-Hill.

List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments/Tutorials based on the curriculum.

List of Experiment for ISE/CA/MSE:

- Minimum 08 Experiments based on the curriculum.

Sr. No.	Title of Experiment
1	Perform and test amplitude modulation and demodulation.
2	Perform and test of frequency modulation and demodulation.
3	Perform and test of PAM/PWM/PPM system
4	Perform and test Sampling and Reconstruction
5	Practical implementation Pulse Code Modulation/Delta Modulation
6	Practical implementation Data Formats
7	Perform and test of ASK/FSK/PSK modulation technique
8	Study of any Digital Modulation (ASK,FSK,PSK) Technique using MATLAB/SCILAB
9	Study of any Analog Modulation (AM,FM,PM) Technique using MATLAB/SCILAB

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).
ESE (Practical)	Practical Oral Examination based on the List of Experiment for ISE/CA/MSE.

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11. Capstone Project-I

Course Details:

Class	T. Y. B-Tech. Sem-V
Course Code & Course Title	Project -ETC02510: Capstone Project-I
Prerequisites:	Basics of Electronics
Teaching scheme: Lecture / Practical	–/02
Credits	01
Evaluation Scheme (ISE /CA) / MSE / ESE	25/--/--

Teaching Scheme	Examination Scheme
Lectures: – Hrs. /week	–
Practical: 02 Hrs. /Week	25 (ISE/CA)

Course Objectives: The course aims to:	
1	Conceptualize knowledge with emphasis on team work, effective communication, critical thinking and problem solving skills.
2	Adapt to a rapidly changing environment by having learned and applied new skills and new technologies.
3	Acquainted with the process of applying basic computer applications and provide solutions to the problems in various application domains.
4	To gain the insight of technical writing

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Identify the real life problem from societal need point of view
2	Apply software project management skills during project work
3	Analyze and synthesize the identified problem from technological perspective (may combine with first) Make use of modern tools (simulation, CAD, AI/ML-based design).

4	Build small groups to work effectively in team on medium scale computing projects.
5	Design and evaluate solutions for complex problems.
6	Develop communication skills for presentation of project related activities and project report writing

General guidelines for Capstone Project-I work

- Capstone Project must be assigned to a group of 2 to 3 students under the guidance of an identified faculty mentor.
- The Capstone Project - problems must be related to the programmer
- The individual students have different aptitudes and strengths. Capstone Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work they would like to execute.
- Capstone Project titles are to be finalized in co-ordination/consultation with the Faculty mentor.
- Students should submit an implementation plan in the form of a PERT/CPM chart. This will cover weekly activity of Capstone Project execution diary.
- Problem definition and specification development in the form of synopsis.
- Design of circuit with calculation & should include a) Analog part b) digital part c) Power supply d) Test strategy if firmware is required produce flow chart.
- Simulation of design using tools like OrCAD, Matlab, etc.
- Design of enclosure & PCB.
- Fabrication & assembly of PCB & enclosure.
- Testing & calibration.
- Measurement of specifications.
- Students shall Submit One Hard copy and one Soft copy each of Capstone Project Report and soft-copy of the project code or the working model.
- Students must maintain a Capstone Project execution diary having the progress steps and details. The concerned faculty should check the diary on a weekly basis and accordingly interact with students based on the progress shown and keep proper record with feedback if any.
- Allow interdisciplinary projects (IoT, AI, biomedical, renewable energy).
- Encourage industry-sponsored or community-based projects for real-world relevance.

NOTE: 1. Students can add/remove/edit chapter names as per the discussion with their guide

Following is the suggestive format for preparing the Project report.

a. The PROJECT report shall be computer typed (English- British) and printed on A4 size paper.

b. Text Font -Times New Roman (TNR), Size-12 point

c. Subsection heading TNR- 12 point bold normal

d. Section heading TNR- 12 capital bold

e. Chapter Name/ Topic Name – TNR- 14 Capital

f. All text should be justified. (Settings in the Paragraph)

g. The report must be typed on one side only with double space with a margin 3.5 cm on the left, 2.5 cm on the top, and 1.25 cm on the right and at bottom.

On completion of the project work, every student will submit a project report which should contain the following:

1. Cover Page
2. Title page
3. Certificate by the Guide
4. Acknowledgment (The candidate may thank all those who helped in the execution of the project.)
5. Abstract (It should be in one page and include the purpose of the study; the methodology used.)
6. Table of Contents (as per general guidelines): Detailed description of the project (This should be split in various chapters/sections with each chapter/section describing a project activity in totality).
    - Chapter–1 Introduction (background of the Industry or User based Problem/Task)
    - Chapter–2 Literature Survey (to finalize and define the Problem Statement)
    - Chapter–3 Scope of the project
    - Chapter–4 Methodology/Approach, if any
    - Chapter-5 Details of designs, working and processes
    - Chapter-6 Results and Applications
    - Chapter-7 Add Future Scope & Limitations
7. Conclusion
8. References (The listing of references should be typed 2 spaces below the heading "REFERENCES" in alphabetical order in single spacing left – justified. It should be numbered consecutively (in square [] brackets, throughout the text and should be collected together in the reference list at the end of the report. The references should be numbered in the order they are used in the text. The name of the author/authors should be immediately followed by the year and other details).

Following is the suggestive format for preparing the Project Execution Diary

PROJECT EXECUTION DIARY

Day and Date-

Project Title: ----------

1. **Work done:**
2. **People Visited:**
3. **Project Notes Prepared:**

Name & Signature Students

1. ---------- 2. ---------- 3. ----------

Suggestions from the guide/people visited:-

Name & Signature Guide

Examination Scheme and Guidelines:

Rubrics for Assessment of the Team		
Sr. No	**Criteria**	**Marks**
ESE (Practical) 50 Marks	Project Selection & Problem definition	05
	Literature survey and data collection/ Gathering	05
	Design / concept of project/ Working - Execution of Project	10
	Stage wise progress as per Action plan/milestone	05
	Quality Report Writing	05
Rubrics for Individual Assessment		
ISE/CA 25 Marks	Contribution as a team member	05
	Depth of Knowledge	10
	Presentation	05
	Attendance	05

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1. Microprocessor and Microcontroller

Course Details:

Class	T. Y. B-Tech. Sem-VI
Course Code & Course Title	PCC-ETC0261: Microprocessor and Microcontroller
Prerequisites:	Digital Electronics and VLSI
Teaching scheme: Lecture / Practical	03/02
Credits	03+01=04
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: 02 Hrs. /Week	25 (ESE) + 50 (ISE/CA)

Course Objectives: The course aims to:	
1	To provide fundamental knowledge of the 8085 microprocessor, its architecture, pin configuration and assembly language programming.
2	To understand the fundamentals of the MCS-51 family
3	To introduce addressing modes, instruction set, assembly language programming
4	To study on-chip hardware resources of the 8051
5	To introduce Embedded C programming concepts.
6	To understand Peripheral interfacing with Embedded C programming.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Students will be able to understand the architecture of the 8085 microprocessor and develop simple assembly language programs
2	Students will be able to understand the basics of 8051 microcontroller.
3	Students will be able to develop and analyze assembly language programs using various addressing modes and instructions of the 8051.
4	Students will be able understand on chip resources of 8051

5	Students will be able to understand basic Embedded C programming concepts
6	Students will be able to interface peripheral devices with 8051 and write Embedded C programs

Course Contents		
Unit 01	**Introduction to 8085 Microprocessor** Functional Pin out, CPU Architecture, Register Organization, De-multiplexing of Address/Data bus, Addressing Modes, Instruction set and programming.	**06 Hrs.**
Unit 02	**Introduction to MCS51 (8051)** Introduction to MCS51Family, Functional Pin out diagram, Architecture, Register Organization, Memory Organization, Input/Output Ports ,Reset Circuit, Oscillator Circuit	**06 Hrs.**
Unit 03	**8051 Programming in Assembly Language** Addressing modes, Instruction set, Assembler directives, Data manipulation, Branch related programming, Simple I/O Port Programs	**06 Hrs.**
Unit 04	**Hardware overview** Timers/Counters (Configuration, Structure, Related S.F.R), Interrupts (Configuration, Structure, Related S.F.R), Serial Communication (Mode-1), (Configuration, Structure, Related S.F.R).	**06 Hrs.**
Unit 05	**8051 Programming in Embedded C:** Data Types and Variables in 8051 Embedded C, I/O Port Programming, Logic and Bitwise Operations ,Delay generation (without Timer), Delay Generation (Using Timer) , Counter programming , Serial Port Programming (Using Embedded C)	**06 Hrs.**
Unit 06	**Peripheral Interfacing and programming (Embedded C)** Interfacing simple switch and LED , Interfacing LCD, ADC , DAC, & stepper motor .	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	"Microprocessor Architecture, Programming, and Applications with the 8085" by Ramesh S. Gaonkar
2	”The 8051 microcontroller and embedded systems using assembly and c”,--By M A Mazidi and J G Mazidi, R D McKinlay-Pearson Education
3	”The 8051 Microcontroller “-By I Scott Mackenzie and R C W Phan,4th edition ,Pearson education
4	Design with PIC microcontroller By J B Peatman, Pearson education.
5	“The 8051Microcontroller-Archictecture, programming & applications”-K. J. Ayala

Reference Books:

Sr. No.	Name of Author and Publication Details
1	"Microprocessors and Interfacing" by Douglas V. Hall
2	Intel Handbook on 8 Bit and 16-bit embedded controllers PIC microchip Midrange MCU

	family reference manual.
3	“microcontrollers theory and Applications”-By Ajay Deshmukh-TATA McGraw Hill

List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments/Tutorials based on the curriculum.

List of Experiment for ISE/CA/MSE:

- Minimum 10 Experiments based on the curriculum.

Sr. No.	Title of Experiment
1	Arithmetic & Logical operations using 8051
2	Memory related operation using 8051.
3	Ascending/ Descending order sorting using 8051
4	Generate Square wave form with 50% Duty cycle (Without Timer)
5	Simple programs blinking LED, switch control (Port Handling)
6	Use of Timer operation with 8051 microcontroller
7	Use of counter operation with 8051 microcontroller
8	Interface ADC with 8051 microcontroller
9	Interface DAC with 8051 microcontroller
10	Serial communication with 8051 microcontroller (sending and receiving data)
11	Interface LCD with 8051 microcontroller
12	Interface Stepper motor with 8051 microcontroller
13	Interfacing peripherals with 8051 microcontroller (7-Segment, Switches)
14	Interfacing peripherals with 8051 microcontroller (sensors)

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ’s compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ’s based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).
ESE (Practical) 25 Marks	Practical Oral Examination based on the List of Experiment for ISE/CA/MSE.

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2. Optical Communication

Course Details:

Class	T. Y. B-Tech. Sem-VI
Course Code & Course Title	Optical Communication
Prerequisites:	Physics, Optoelectronics
Teaching scheme: Lecture / Tutorial	03/01
Credits	04
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Tutorial: 01 Hrs. /Week	01

Course Objectives: The course aims to:	
1	Introduce the fundamentals and motivation behind optical fiber communication systems.
2	Explain the physical nature of light and basic optical laws governing fiber transmission.
3	Provide understanding of optical fiber structures, waveguiding mechanisms, and modes of propagation.
4	Analyze transmission characteristics of optical fibers including losses, dispersion, and nonlinear effects.
5	Explain the operating principles of optical sources and optical receivers.
6	Familiarize students with advanced optical communication systems and modern networking technologies.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Explain the evolution, components, and operation of optical fiber communication systems.
2	Analyze optical fiber structures, modes, and waveguiding principles for signal

	transmission.
3	Evaluate transmission impairments such as attenuation, dispersion, polarization, and nonlinear effects.
4	Describe the working principles and performance characteristics of optical sources and detectors.
5	Analyze receiver performance considering noise, response time, and system limitations.
6	Understand and apply concepts of advanced optical systems such as WDM, EDFA, SONET/SDH, and optical CDMA.

Course Contents		
Unit 01	**Overview of Optical Fiber Communication** Motivation for light wave communication, Basic Network Information Rates, The evolution of Optic System, Elements of Optical Fiber Transmission Link, optical spectral band, The nature of Light, Basic Optical Laws and Definitions, Single Mode Fibers, Graded Index fiber structures.	**06 Hrs.**
Unit 02	**Optical Fibers: Structures and Wave guiding** Optical Fiber Modes and Configurations, Mode theory for waveguides, Fiber Materials, Fiber Optic cables.	**06 Hrs.**
Unit 03	**Transmission characteristics of optical fibers.** Attenuation, material absorption losses, Scattering losses, bending losses, dispersion, polarization, nonlinear effects.	**06 Hrs.**
Unit 04	**Optical Sources** Semiconductor Physics, Light-Emitting Diodes (LEDs), LED structures SLED, ELED, Quantum efficiency and LED Power. Laser Diodes, Laser diode structures and radiation patterns, Light Source Linearity.	**06 Hrs.**
Unit 05	**Optical Receiver** Physical Principal of Photodiodes, Photo detector Noise, Detectors Response Time, Structure for InGaAsAPDs, Temperature effect of Avalanche Gain, Comparison of Photo detectors , Fundamental Receiver Operation, Digital Receiver Performance	**06 Hrs.**
Unit 06	**Advances in Optical Fiber System** Operational Principles of WDM, Passive Components, Tunable Sources, Tunable Filters, optical switching, SONET/SDH, Performance of WDM+EDFA Systems, optical CDMA	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	Gerd Keiser, “Optical Fiber Communication”, 5th Edition, Tata Mcgraw Hill Publication.
2	
3	
4	

Reference Books:

Sr. No.	Name of Author and Publication Details
1	Senior, “Optical Communication”, 3rd Edition, Pearson Education.
2	Agarwal, “Optical Fiber Communication”, 3rd edition, Wiley India.
3	Ramaswamy, “Optical Networks” , Elsevier India
4	R. P. Khare, “Fiber optics and optoelectronics”, Oxford University Press
5	Anuradha, “Optical fiber and laser principles and applications”, New Age Publications.
6	Dr .R .K .Singh “Fiber optic communication systems”, Willey India.

List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments/Tutorials based on the curriculum.

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ’s compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ’s based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).

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3. Digital Signal Processing

Course Details:

Class	T. Y. B-Tech. Sem-VI
Course Code & Course Title	Digital Signal Processing
Prerequisites:	Signals and Systems
Teaching scheme: Lecture / Practical	03/02
Credits	04
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: 02 Hrs. /Week	25 (ESE) + 50 (ISE/CA)

Course Objectives: The course aims to:	
1	To understand the Discrete Fourier Transform and Fast Fourier Transform
2	To study design techniques of digital FIR filters using various methods
3	To study various design techniques of digital IIR filters.
4	To understand the key architectural features of the DSP Processor
5	To understand the basic concept of Multi-rate digital signal processing
6	To understand the basic concept of the Wavelet transform

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Apply FFT algorithms to calculate the DFT and IDFT. Use fast Convolution methods for filtering of long-duration sequences.
2	Construct Finite Impulse Response (FIR) Filters Using Various Methods.
3	Construct Infinite Impulse Response (IIR) Filters Using Various Methods.
4	Assess FIR and IIR Filter Realisation Strategies and Analyse the Impact of Finite Word Length on DSP Processor Implementation
5	Analyze the need, techniques and applications of Multirate Digital Signal Processing.
6	Analyze the need and applications of Wavelet Transform.

Course Contents		
Unit 01	**Discrete Fourier Transform, FFT Algorithms and Fast Convolution** Discrete Fourier Transform (DFT), Inverse Discrete Fourier Transform (IDFT): Direct method, DFT using Twiddle factor, Properties, Discrete Fourier Transform & FFT Algorithms Computational Complexity of DFT, Fast Fourier transform algorithms – Radix -2 DIT and DIF for DFT and IDFT computations, Circular convolution, Fast Convolution: Overlap-Add and Overlap-save algorithm.	**06 Hrs.**
Unit 02	**FIR Filter Design** Characteristic of FIR filter, properties of FIR filter, type of FIR filter, Fourier series method, frequency sampling & windowing method (Rectangular Window, Triangular window, Hamming Window and Hanning window). Direct form FIR filter realization.	**06 Hrs.**
Unit 03	**IIR Filter Design** Analog filters approximations, mapping of S-plane to Z-plane, Design of IIR using Impulse Invariance Method, Bilinear Transformation method, Frequency Transformation, Filter design methods: Butterworth filters, Chebyshev filters and its conversion to digital filter.	**06 Hrs.**
Unit 04	**DSP processors**: Introduction to DSP processors: TMS320C67XX, Architecture, Functional Units, pipelining, Registers, Addressing modes.	**06 Hrs.**
Unit 05	**Multirate digital signal processing:** Need for multirate digital signal processing, decimation by factor D, two-stage decimator, interpolation by factor I, two-stage interpolator, sampling rate conversion by rational factor I/D, applications of multirate signal processing	**06 Hrs.**
Unit 06	**Wavelet Transform:** Fourier Transform and its limitations, short-time Fourier transform, continuous wavelet Transform, Discretization of the continuous wavelet Transform, Multiresolution Approximations; mother wavelet and Scaling functions, Haar wavelets and Daubechies wavelets, Applications of wavelet transform	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	John G Prokis, Manolakis, "Digital Signal Processing Principles, Algorithms and Application", Pearson Education publication
2	Salivahanam, A Vallavaraj, C. Guanapriya, "Digital Signal Processing", Tata McGraw Hill Publication.
3	A. Anand Kumar, " Digital Signal Processing", PHI Publications

Reference Books:

Sr. No.	Name of Author and Publication Details
1	P. Ramesh Babu, "Digital Signal Processing" , SciTech Publication
2	Sanjeet Mitra, " Digital Signal Processing", Tata McGraw Hill Publication.
3	Alan Oppenheim, Schafer, "Digital Signal Processing ", PHI Publication

List of Experiment for ISE/CA/MSE:

- Minimum 10 Experiments based on the curriculum.

Sr. No.	Title of Experiment
1	Generation of DT signals a) Study of Unit impulse sequence b) Study of Unit step sequence c) Study of Exponential sequence d) Study of Sinusoidal sequence
2	Discrete Fourier Transform (DFT) using standard formula and FFT algorithms
3	Performance of Inverse Discrete Fourier Transform Using Standard formula and IFFT algorithm.
4	Computation of circular convolution
5	Computation of DFT using FFT algorithms
6	Study of Filtering of Long Data Sequences using the Overlap–Add method
7	Study of Filtering of Long Data Sequences using the Overlap – Save method
8	Design of FIR filter using frequency sampling method
9	Design of FIR filter using windowing method
10	Design of IIR filter using impulse invariance method
11	Design of IIR filter using bilinear transformation method
12	Study and Implementation of Interpolation
13	Study and Implementation of Decimation
14	Study and Implementation of I/D factor
15	Study and Implementation of Haar Wavelet Transform
16	Computation of DCT
17	Computation of DWT
18	To implement FIR & IIR filter using the TMS320C67XX processor

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).
ESE (Practical) 25 Marks	Practical Oral Examination based on the List of Experiment for ISE/CA/MSE.

SHIVAJI UNIVERSITY, KOLHAPUR
ELECTRONICS AND TELECOMMUNICATION ENGINEERING
4. PEC-II: Wiring Harness an Panel Design

Course Details:

Class	T. Y. B-Tech. Sem-VI
Course Code & Course Title	Wiring Harness an Panel Design
Prerequisites:	Basic knowledge of electrical circuits, electrical symbols, and fundamentals of industrial wiring.
Teaching scheme: Lecture / Practical	03/--
Credits	03
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: -- Hrs. /Week	--

Course Objectives: The course aims to:	
1	Introduce fundamentals of wiring harness and control panel design used in industrial systems.
2	Develop understanding of electrical schematics, wiring standards, and documentation.
3	Familiarize students with components used in wiring harnesses and electrical panels.
4	Enable students to design wiring layouts considering safety, reliability, and standards.
5	Provide exposure to panel assembly practices and testing procedures.
6	Prepare students for industry-oriented roles in electrical and electronics design.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Understand wiring harness and panel design concepts and applications.
2	Read and develop electrical schematics and wiring diagrams.
3	Select appropriate components for wiring harnesses and panels.

4	Design wiring layouts following industrial standards and safety norms.
5	Explain panel assembly, testing, and troubleshooting methods.
6	Apply wiring harness and panel design principles to real-world industrial systems.

Course Contents		
Unit 01	**Introduction to Wiring Harness and Panel Design** Overview of wiring harness and panel systems, Applications in automotive, industrial, and control systems, Types of wiring harnesses, Basics of panel design, Industrial standards and safety practices	**06 Hrs.**
Unit 02	**Electrical Drawings and Documentation** Electrical symbols and standards, Schematic diagrams, Wiring diagrams and layout drawings, Bill of Materials (BOM), Cable and wire identification methods	**06 Hrs.**
Unit 03	**Components Used in Harness and Panels** Wires and cables (types and selection), Connectors, terminals, and lugs Relays, contactors, MCBs, fuses,Switches, indicators, and sensors Cable ducts and accessories	**06 Hrs.**
Unit 04	**Wiring Harness Design Techniques** Harness routing and bundling, Crimping, soldering, and insulation techniques, Harness protection and shielding, Labeling and color coding Quality checks and testing of harnesses	**06 Hrs.**
Unit 05	**Electrical Panel Design** Control panel types and layouts, Panel wiring practices, Grounding and earthing, Heat dissipation and enclosure selection, Compliance with IEC and IS standards	**06 Hrs.**
Unit 06	**Assembly, Testing, and Industrial Practices** Panel assembly procedure, Continuity and insulation testing, Fault finding and troubleshooting, Documentation and revision control, Case studies and industry applications	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	Robert J. Althouse, Industrial Wiring, Cengage Learning.
2	Ray C. Mullin, Electrical Wiring Commercial, Delmar.
3	
4	

Reference Books:

Sr. No.	Name of Author and Publication Details
1	IEC Standards for Electrical Panels and Wiring.
2	IS Standards for Electrical Installations.

3	Manufacturer catalogs and application notes (Schneider, Siemens, ABB).
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List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments/Tutorials based on the curriculum.

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).

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4. PEC-II: IoT Architecture with Raspberry Pi

Course Details:

Class	T. Y. B-Tech. Sem-VI
Course Code & Course Title	IoT Architecture with Raspberry Pi
Prerequisites:	Basic knowledge of embedded systems, Python programming, and fundamentals of computer networks.
Teaching scheme: Lecture / Practical	03/--
Credits	03
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: -- Hrs. /Week	--

Course Objectives: The course aims to:	
1	Introduce the fundamentals and architecture of Internet of Things (IoT).
2	Provide understanding of IoT hardware platforms with emphasis on Raspberry Pi.
3	Enable students to interface sensors and actuators with Raspberry Pi.
4	Explain IoT communication protocols and networking concepts.
5	Develop skills for designing and deploying IoT applications.
6	Prepare students for real-world IoT and smart system applications.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Explain IoT concepts, architecture, and enabling technologies.
2	Understand Raspberry Pi hardware architecture and operating system.
3	Interface sensors and actuators using Raspberry Pi.
4	Apply IoT communication protocols for data transmission.
5	Develop basic IoT applications using Raspberry Pi
6	Design simple IoT-based solutions for real-world problems.

Course Contents		
Unit 01	**Introduction to IoT** Definition and characteristics of IoT, IoT architecture: perception, transport, processing, and application layers, IoT enabling technologies Applications of IoT in smart cities, healthcare, agriculture, and industry Challenges and security issues in IoT	**06 Hrs.**
Unit 02	**Raspberry Pi Hardware and Software Architecture** Overview of Raspberry Pi models, Raspberry Pi hardware architecture GPIO pins and interfaces, Operating systems for Raspberry Pi, Installation and configuration of Raspberry Pi OS	**06 Hrs.**
Unit 03	**Programming Raspberry Pi** Introduction to Python programming for IoT, GPIO programming using Python, Interfacing LEDs, switches, and sensors, Interfacing actuators (relays, motors), Basic troubleshooting techniques	**06 Hrs.**
Unit 04	**IoT Communication and Networking** IoT communication models, Protocols: HTTP, MQTT, CoAP (overview) Wireless technologies: Wi-Fi, Bluetooth, Zigbee (overview) Data acquisition and transmission, Cloud connectivity basics	**06 Hrs.**
Unit 05	**IoT Platforms and Cloud Integration** Introduction to IoT cloud platforms, Data storage and visualization Web dashboards and mobile applications, Security considerations in IoT systems, Case studies of IoT deployments	**06 Hrs.**
Unit 06	**IoT System Design and Applications** IoT system design methodology, End-to-end IoT application development Smart home and industrial IoT applications, Testing and deployment of IoT systems, Mini project / case study	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	Arshdeep Bahga and Vijay Madisetti, Internet of Things: A Hands-On Approach, VPT.
2	Perry Lea, Internet of Things for Architects, Packt.
3	
4	

Reference Books:

Sr. No.	Name of Author and Publication Details
1	Adrian McEwen and Hakim Cassimally, Designing the Internet of Things, Wiley.
2	Jon Bennett, Practical Raspberry Pi, Apress.
3	Raspberry Pi Foundation Documentation.
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List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments/Tutorials based on the curriculum.

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).

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4. PEC-II: Artificial Intelligence

Course Details:

Class	T. Y. B-Tech. Sem-VI
Course Code & Course Title	Artificial Intelligence
Prerequisites:	Basic Mathematics, Probability, Programming Fundamentals
Teaching scheme: Lecture / Practical	03/--
Credits	03
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: -- Hrs. /Week	--

Course Objectives: The course aims to:	
1	Provide in-depth understanding of Artificial Intelligence concepts relevant to E&TC engineering.
2	Introduce AI algorithms used in signal processing and communication systems.
3	Develop knowledge of neural networks and deep learning fundamentals.
4	Familiarize students with AI-based solutions for real-world E&TC problems.
5	Enable students to analyze and design intelligent communication systems.
6	Understand ethical and practical considerations of AI deployment.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Explain advanced AI concepts and architectures used in engineering.
2	Apply AI techniques to signal, image and communication problems.
3	Analyze neural network and deep learning models.
4	Design AI-based solutions for E&TC applications.
5	Evaluate performance of intelligent systems.
6	Assess ethical, social and technological impacts of AI.

Course Contents		
Unit 01	**Overview of Artificial Intelligence:** Review of AI fundamentals, intelligent agents, AI paradigms, AI vs ML vs DL, role of AI in Electronics and Telecommunication Engineering, limitations and challenges of AI, real-world case studies.	**06 Hrs.**
Unit 02	**AI-Based Search and Optimization Techniques:** Problem formulation, state space representation, uninformed search techniques (BFS, DFS, UCS), informed search techniques (heuristic search, A*), local search methods, genetic algorithms, particle swarm optimization, ant colony optimization, optimization problems in communication networks and signal processing.	**06 Hrs.**
Unit 03	**Knowledge Representation and Intelligent Decision Making:**Knowledge representation schemes, propositional and first-order logic, inference mechanisms, rule-based systems, fuzzy logic concepts, fuzzy inference systems, decision-making under uncertainty, applications in control systems, communication and automation.	**06 Hrs.**
Unit 04	**Neural Networks and Deep Learning:** Biological neuron model, artificial neuron and activation functions, learning paradigms, single-layer and multilayer perceptron, backpropagation algorithm, deep learning basics, convolutional neural networks, overview of recurrent neural networks, applications in signal, speech, image and video processing.	**06 Hrs.**
Unit 05	**AI in Communication and Signal Processing:** AI-based modulation and signal classification, channel estimation and equalization, noise reduction techniques, speech recognition, image and video analytics, intelligent wireless communication systems, adaptive and cognitive radio networks.	**06 Hrs.**
Unit 06	**Emerging AI Technologies and Ethics:**AI for Internet of Things, edge and embedded AI, autonomous and intelligent systems, AI security and privacy issues, ethical and social implications of AI, standardization and regulations, future trends of AI in electronics, communication, automation and smart systems.	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education.
2	Elaine Rich and Kevin Knight, Artificial Intelligence, Tata McGraw-Hill.
3	S. N. Sivanandam and S. N. Deepa, Introduction to Artificial Intelligence, Wiley India.

Reference Books:

Sr. No.	Name of Author and Publication Details
1	George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson.
2	Tom Mitchell, Machine Learning, McGraw-Hill.

3	Nils J. Nilsson, Principles of Artificial Intelligence, Morgan Kaufmann.

List of Assignments for ISE/CA:

- Minimum 06 Assignments based on the curriculum.

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).

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4. PEC-II: Multi-media Communication

Course Details:

Class	T. Y. B-Tech. Sem-VI
Course Code & Course Title	Multi-media Communication
Prerequisites:	Basic knowledge of digital communication, signal processing, and computer networks
Teaching scheme: Lecture / Practical	03/--
Credits	03
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: -- Hrs. /Week	--

Course Objectives: The course aims to:	
1	Introduce fundamental concepts of multimedia communication systems.
2	Explain representation, compression, and transmission of multimedia data.
3	Provide understanding of audio, image, and video processing techniques.
4	Familiarize students with multimedia standards and protocols.
5	Develop ability to analyze multimedia quality and performance.
6	Prepare students for applications involving multimedia networking and services.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Explain components and characteristics of multimedia communication systems.
2	Understand audio, image, and video representation techniques
3	Apply multimedia compression and coding standards.
4	Analyze multimedia transmission over networks.
5	Evaluate multimedia quality and performance metrics.
6	Apply multimedia communication concepts to real-world applications.

Course Contents		
Unit 01	**Introduction to Multimedia Communication** Introduction to multimedia and its applications, Multimedia components: text, audio, image, video, animation, Multimedia communication system architecture, Multimedia data characteristics, Challenges in multimedia communication	**06 Hrs.**
Unit 02	**Audio Representation and Coding** Fundamentals of audio signals, Audio perception and sampling, Pulse Code Modulation (PCM), Audio compression techniques, Audio coding standards (MP3, AAC – overview)	**06 Hrs.**
Unit 03	**Image Representation and Compression** Digital image fundamentals, Image sampling and quantization, Image compression techniques, JPEG image compression standard, Introduction to image quality measures	**06 Hrs.**
Unit 04	**Video Representation and Compression** Video signal fundamentals, Frame types and motion estimation, Video compression principles, Video coding standards (MPEG, H.264 – overview), Video quality metrics	**06 Hrs.**
Unit 05	**Multimedia Networking and Protocols** Multimedia traffic characteristics, Real-time transport requirements, Multimedia communication protocols (RTP, RTSP), Streaming and conferencing systems, QoS issues in multimedia networks	**06 Hrs.**
Unit 06	**Multimedia Applications and Emerging Trends** Multimedia over IP networks, Video-on-demand systems, Multimedia conferencing applications, Virtual reality and augmented reality, Future trends in multimedia communication	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	Fred Halsall, Multimedia Communications: Applications, Networks, Protocols and Standards, Pearson.
2	Ranjan Parekh, Principles of Multimedia, McGraw-Hill.

Reference Books:

Sr. No.	Name of Author and Publication Details
1	K. R. Rao, Zoran S. Bojkovic, *Multimedia Communication Systems*, Prentice Hall.
2	Ze-Nian Li, *Video Compression and Standards*, Springer.
3	William Stallings, *Data and Computer Communications*, Pearson.

List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments/Tutorials based on the curriculum.

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).

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5. PEC-III: Sensors and Actuators

Course Details:

Class	T. Y. B-Tech. Sem-VI
Course Code & Course Title	PEC-ETC0264: Industrial Automation: Sensors and Actuators
Prerequisites:	Fundamentals of Industrial Automation
Teaching scheme: Lecture / Practical	04/02
Credits	03
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: -- Hrs. /Week	--

Course Objectives: The course aims to:	
1	Understand the role of sensors and actuators in industrial automation
2	Select appropriate industrial sensors for real applications
3	Interface sensors and actuators with PLC / controllers
4	Apply concepts in manufacturing, process industries, robotics
5	Develop troubleshooting and selection skills
6	Available Industrial Actuator and Sensor in real applications

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	CO1 Explain the fundamentals of industrial automation systems
2	CO2 Describe the working principles of various industrial sensors
3	CO3 Select appropriate sensors for industrial applications
4	CO4 Explain different types of electrical and fluid power actuators
5	CO5 Interface sensors and actuators with industrial controllers
6	CO6 Analyze and troubleshoot sensor and actuator related faults in automation systems

Course Contents		
Unit 01	**Introduction to Industrial Automation** Overview of industrial automation, evolution of automation systems, types of automation such as fixed, programmable and flexible automation, basic automation architecture, role of sensors and actuators in automation loop, open loop and closed loop control systems, introduction to industrial standards and safety concepts.	**06 Hrs.**
Unit 02	**Sensor Fundamentals and Characteristics** Definition of sensor and transducer, classification of sensors, static and dynamic characteristics of sensors, accuracy, precision, sensitivity, linearity, hysteresis, repeatability, error analysis, calibration methods.	**06 Hrs.**
Unit 03	**Industrial Sensors** Proximity sensors including inductive, capacitive, photoelectric and ultrasonic sensors, position and displacement sensors such as potentiometer, introduction to smart sensors and digital sensors used in industry.	**06 Hrs.**
Unit 04	**Actuators in Industrial Automation** Electrical actuators including DC motors, AC motors, stepper motors and servo motors, pneumatic actuators, hydraulic actuators, solenoid valves and control valves.	**06 Hrs.**
Unit 05	**Sensor and Actuator Interfacing** Interfacing concepts, analog and digital signals, voltage and current standards such as 0–10V and 4–20 mA, signal conditioning circuits, relays, contactors and solid-state relays, introduction to PLC input and output modules, safety interlocks.	**06 Hrs.**
Unit 06	**Industrial Applications and Case Studies** Automation of conveyor systems, bottle filling and packaging system, temperature control in industrial furnaces, tank level control system, , Digital twins / simulation tools, Smart factories, Predictive maintenance platforms	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	Sensors and Transducers, D. Patranabis, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2015.
2	Industrial Automation from Scratch: A Hands-On Guide to Using Sensors, Actuators, PLCs, HMIs, and SCADA to Automate Industrial Processes, Olushola Akande, 1st Edition, Packt Publishing, 2023.
3	Industrial Instrumentation, K. Krishnaswamy, Tata McGraw-Hill Education, 2010. (commonly recommended for sensor and process measurement topics)
4	Mechatronics: Principles, Concepts and Applications, N. Chandra, Cengage Learning, 2018. (covers sensors, actuators and integration with control systems)

Reference Books:

Sr. No.	Name of Author and Publication Details
1	Handbook of Modern Sensors: Physics, Designs, and Applications, Jacob Fraden, 4th Edition, Springer, 2010.
2	Programmable Logic Controllers and Industrial Automation: An Introduction, Madhuchhanda Mitra & Samarjit Sen Gupta, 2nd Edition, Cengage Learning, 2014.
3	Industrial Automation and Robotics, A. K. Gupta & S. K. Arora, 1st Edition, CRC Press, 2015.
4	The Mechatronics Handbook, Robert H. Bishop (Ed.), CRC Press, 2002.
5	Industrial Control Systems: Design, Implementation and Maintenance, J. Davies, Elsevier, 2018. (covers automation system design and control theory)
6	Industrial Sensors and Instrumentation: Principles and Applications, Clarence W. de Silva, 2nd Edition, CRC Press, 2018. (focuses on sensor technologies and industrial applications)

List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments/Tutorials based on the curriculum.

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).

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5. PEC-III: IoT Communication Protocol

Course Details:

Class	T. Y. B-Tech. Sem-VI
Course Code & Course Title	PCE-ETC0265: IoT Communication Protocol
Prerequisites:	Computer Network
Teaching scheme: Lecture / Practical	03/--
Credits	03
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: -- Hrs. /Week	--

Course Objectives: The course aims to:	
1	To introduce the basic concepts of Internet of Things (IoT) covering all fundamental aspects of IoT.
2	To understand IoT architecture, design methodology, and system building blocks.
3	To analyze IoT protocol stack across different layers**,** including PHY/MAC, network layer protocols used in constrained environments.
4	To develop understanding of transport and application layer protocols for IoT.
5	To study short range & long-range communication technologies for IoT.
6	To introduce students to diverse IoT applications in consumer products, agriculture, media, energy, environmental monitoring, and healthcare.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Explain IoT concepts, characteristics, and real-world applications.
2	Describe IoT architecture, components, and design principles.
3	Apply knowledge of IoT networking protocols for constrained networks
4	Demonstrate understanding of transport and application layer protocols for IoT data communication.

5	Compare and select suitable IoT communication technologies based on range, data rate, power consumption, and application requirements.
6	Explain and analyze real-world IoT applications and identify suitable IoT solutions for different domain-specific case studies.

Course Contents		
Unit 01	**Fundamentals of IoT** Definition and introduction of IoT, IoT Technology trends and future opportunities, IoT evolution and business perspectives, Embedded systems Relationships, Challenges of IoT, Characteristics of IoT, Sensors and Actuators in IoT enabling Industrial Automation, IoT M2M, Software Define Networking, Importance of IoT system management	**06 Hrs.**
Unit 02	**IoT Architecture Overview** IoT functional Blocks, IoT Communication Model, IoT enabling technologies, IoT Life Cycle, Physical Design of IoT, IoT Conceptual Framework, IoT Architectural View, IoT Levels, IoT protocol stack, Technology Behind IoT, Role of communication protocols in IoT	**06 Hrs.**
Unit 03	**IoT Data Link Layer & Network Layer Protocols** PHY/MAC Layer: IEEE 802.11 and IEEE 802.15.4 standards for IoT-Features, Characteristics, Comparison, Wireless HART- Architecture Component, DASH7- Protocol Architecture, ARP and RARP - Need, Concept, Difference. Network Layer: Overview of IP addressing in IoT, 6LoWPAN-introduction, protocol stack and its mapping with OSI model ,Neighbour Discovery Protocol (ND)-working principle, ICMP-Message types, Introduction to routing protocols-RPL, CORPL,CARP.	**06 Hrs.**
Unit 04	**IoT Transport & Application Layer Protocols** Transport Layer :TCP v/s UDP, MPTC-Introduction, Option Header Format in Standard TCP Header, DCCP-Introduction, packet types use, SCTP-features, packet format,TLS-Introduction. Application Layer: HTTP and RESTful services in IoT applications, CoAP-features and working, XMPP-network components, AMQP-overview, MQTT-protocol architecture , message flow, QoS levels.	**06 Hrs.**
Unit 05	**IoT Communication Technologies** Short-range IoT communication: Introduction to Bluetooth, Bluetooth Low Energy (BLE)- architecture, Features and applications in IoT, Zigbee-protocol architecture ,working principle, network types (Star, Tree, Mesh) , Z-Wave- protocol overview and characteristics, NFC- Operating principle, communication modes, RFID -Components, Types of RFID tags, Working principle. Long-range IoT communication: LoRa introduction ,LoRaWAN- architecture , Working of LoRaWAN protocol ,NB-IoT- features and applications, Sigfox-communication technology overview.	**06 Hrs.**
Unit 06	**IoT Applications & Case Studies** IoT Consumer Applications, IoT application in Agriculture, IoT application in media, marketing, advertising, IoT energy application, IoT environment monitoring, IoT application in healthcare.	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	Internet of Things (A Hands-on-Approach) , Vijay Madisetti , Arshdeep Bahga
2	Dr. Vijendra Pratap Singh, Mr. Neeraj Kumar.., "IoT Communication Protocols", ISBN: 978 81-961690-9-1,Deccan International Academic Publishers,2023.
3	Internet of Things Architectures, Protocols and Standards, Simone Cirani, © 2019 JohnWiley & Sons Ltd
4	Fundamentals of IoT Communication Technologies – Rolando Herrero
5	Internet of Things: Architectures, Protocols, and Applications – Dilip Kumar & K R. Venugopal
6	TCP/IP Protocol Suite 4th ed. – B. Forouzan (McGraw-Hill, 2010)

Reference Books:

Sr. No.	Name of Author and Publication Details
1	Internet Of Things: Architecture and Design Principles by Raj Kamal, McGraw Hill Education (India) Private Limited
2	IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, and Jerome Henry, 2017.
3	The internet Of things: Key applications and Protocols by Olivier Hersent, David Boswarthick, Omar Elloumi Wiley Publication.

List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments/Tutorials based on the curriculum.

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).

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5. PEC-III: Machine Learning

Course Details:

Class	T. Y. B-Tech. Sem-VI
Course Code & Course Title	ETC0265: Machine Learning
Prerequisites:	Basic linear algebra, and Python-based data handling concepts
Teaching scheme: Lecture / Practical	03/--
Credits	03
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures : 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: -- 3Hrs. /Week	--

Course Objectives: The course aims to:	
1	Introduce fundamental concepts and applications of machine learning.
2	Provide mathematical and statistical foundations required for machine learning.
3	Enable students to understand and implement supervised and unsupervised learning algorithms.
4	Develop skills to preprocess data and evaluate machine learning models.
5	Familiarize students with optimization techniques used in learning algorithms.
6	Apply machine learning techniques to real-world engineering problems.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Explain key concepts, types, and applications of machine learning.

2	Perform data preprocessing and feature engineering.
3	Implement supervised learning algorithms for regression and classification.
4	Apply unsupervised learning techniques for clustering and dimensionality reduction.
5	Evaluate and optimize machine learning models.
6	Solve real-world problems using appropriate machine learning techniques.

Course Contents		
Unit 01	**Introduction to Machine Learning** Introduction to artificial intelligence and machine learning Types of machine learning: supervised, unsupervised, semi-supervised, reinforcement,Applications of machine learning in engineering Machine learning pipeline.Challenges and limitations of machine learning	**06 Hrs.**
Unit 02	**Data Preprocessing and Feature Engineering** Data types and data collection,Data cleaning and handling missing values Data normalization and standardization,Feature extraction and feature selection,Dimensionality reduction: PCA (conceptual)	**06 Hrs.**
Unit 03	**Supervised Learning – Regression** Linear regression and multiple linear regression,Cost functions and gradient descent,Polynomial regression,Model evaluation: MAE, MSE, RMSE, R^2,Overfitting and underfitting	**06 Hrs.**
Unit 04	**Supervised Learning – Classification** Logistic regression.k-Nearest Neighbors (k-NN),Decision trees Performance metrics: confusion matrix, accuracy, precision, recall, F1-score	**06 Hrs.**
Unit 05	**Unsupervised Learning** Introduction to clustering,k-means clustering algorithm,Hierarchical clustering (conceptual),Association rule mining (Apriori – overview) Applications of unsupervised learning	**06 Hrs.**
Unit 06	**Advanced Topics and Model Optimization** Support Vector Machines (SVM).Ensemble learning: bagging, boosting, random forest,Cross-validation techniques,Hyperparameter tuning Ethical issues and future trends in machine learning	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	Tom M. Mitchell, *Machine Learning*, McGraw-Hill.
2	Ethem Alpaydin, *Introduction to Machine Learning*, MIT Press.
3	Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn*, O'Reilly Media.

Reference Books:

Sr. No.	Name of Author and Publication Details
1	Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer.
2	Ian Goodfellow et al., *Deep Learning*, MIT Press.
3	Andreas Müller and Sarah Guido, *Introduction to Machine Learning with Python*, O'Reilly Media.
4	Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press.

List of Assignments for ISE/CA:

- Minimum 06 Assignments based on the curriculum.

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ's compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ's based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).

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5. PEC-III: Advanced Network Security

Course Details:

Class	T. Y. B-Tech. Sem-VI
Course Code & Course Title	PEC-ETC0265: Advanced Network Security
Prerequisites:	Modular Arithmetic, Number theory, Computer network
Teaching scheme: Lecture / Practical	03/--
Credits	03
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: -- Hrs. /Week	--

Course Objectives: The course aims to:	
1	Explain and analyze security challenges in computing systems, including access control models, authentication, and authorization mechanisms.
2	Identify and assess malware, social engineering attacks, and network-based authentication and identity management techniques.
3	Describe and evaluate physical security measures and hardware security mechanisms used to protect computing resources.
4	Analyze common web application and wireless network security attacks, identify vulnerabilities in Internet browsers, and propose appropriate security solutions.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Explain the need for security in data communication through computers and networks and describe various possible security attacks.
2	Apply various encryption mechanisms for secure transmission of data and implement appropriate key management techniques required for encryption.

3	Analyze authentication requirements and evaluate various authentication mechanisms based on security, efficiency, and resistance to attacks.
4	Explain network security concepts and describe different web security mechanisms.

Course Contents		
Unit 01	**Introduction to Network Security** The introduction to network security, need for security in data communication, security attacks, both passive and active, security services and mechanisms, network security model, CIA triad (Confidentiality, Integrity, and Availability), introduction of cryptography and authentication.	**06 Hrs.**
Unit 02	**Symmetric Ciphers** Substitution &Transposition Techniques, Block Cipher, DES, Triple DES, RC4, AES, Applications of AES in cloud security and wireless.	**06 Hrs.**
Unit 03	**Public Key Cryptography** Need and principles of public key cryptosystems, RSA algorithm, Key distribution and management, Diffie-Hellman key exchange, Digital Signatures. Applications in blockchain-based systems.	**06 Hrs.**
Unit 04	**Authentication Techniques** Authentication requirements, Message Authentication Codes, Hashes, MD5 & SHA, User Authentication: Password, Certificate based & Biometric Authentication, Kerberos.	**06 Hrs.**
Unit 05	**Network and Security Mechanisms** Firewalls, IP Security, Electronic Mail Security, Intrusion Detection, Web Security, SSL, TLS. Intrusion Prevention Systems (IPS), Web Application Firewalls (WAFs)	**06 Hrs.**
Unit 06	**Network Security Tools** Network security Monitoring Tools, Encryption Tools, Web Vulnerability Scanning Tools, Packet Sniffers and Password Auditing Tools, Network Defense Wireless Tools, Network Intrusion & Detection Tools. Case study using selected tools like Wireshark, Nmap etc.	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	William Stallings, “Cryptography and network security principles and practices”, Pearson, 6th Edition, ISBN : 978-93-325-1877-3
2	Atul Kahate, “Cryptography and Network Security”, Mc Graw Hill Publication, ISBN : 978-0-07-064823-4
3	Forouzan, “Cryptography and Network Security (SIE)”, Mc Graw Hill, ISBN, 007070208X, 9780070702080

Reference Books:

Sr. No.	Name of Author and Publication Details
1	Wenbo Mao "Modern Cryptography, Theory & Practice", Pearson Education

2	Hoffstein, Pipher, Silvermman "An Introduction to Mathematical Cryptography", Springer.
3	J. Daemen, V. Rijmen "The Design of Rijndael", Springer.
4	A. Joux "Algorithmic Cryptanalysis", CRC Press.
5	C. Boyd, A. Mathuria "Protocols for Authentication and Key Establishment",Springer.
6	Matt Bishop "Computer Security", Pearson Education
7	Christof Paar, Jan Pelzl “Understanding Cryptography”, Springer-Verlag BerlinHeidelberg.

List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments/Tutorials based on the curriculum.

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ’s compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ’s based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).

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6. Multi-disciplinary Minor–04: Mobile Technology

Course Details:

Class	T. Y. B-Tech. Sem-VI
Course Code & Course Title	Multi-disciplinary Minor–04: Mobile Technology
Prerequisites:	
Teaching scheme: Lecture / Practical	03/--
Credits	03
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. /week	Theory : 60 (ESE) + 30 (MSE) +10 (ISE/CA)
Practical: -- Hrs. /Week	--

Course Objectives: The course aims to:	
1	Realize importance of cellular concepts and its propagation mechanism
2	Nurture students with knowledge of traffic engineering in cellular networks.
3	Understand the importance of services and Channels in GSM.
4	Understand architecture of GSM, 4G and 5G.

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Apply multiple access techniques to mobile communication.
2	Explore the architecture of GSM.
3	Apply and make use of GSM Services.
4	Differentiate thoroughly the routing protocols and generations of mobile technologies

Course Contents		
Unit 01	**Introduction to Mobile Communication & Multiple Access Technique** Mobile and Personal Communication, mobile and wireless devices, Specialized packet and mobile radio networks, circuit switched data services on cellular networks, packet switched data services on cellular networks, Multiple Access Technique- FDMA, TDMA, SDMA, and CDMA.	**06 Hrs.**
Unit 02	**Cellular Concept** Introduction to cellular telephone system: Expansion of mobile system capacity through frequency reuse, Cell geometry, Selection of cluster size, Cell splitting and sectoring, Coverage and capacity in cellular system and Handoff strategies. Propagation Mechanism: Free space and two ray propagation model, Basic propagation mechanism. Hata outdoor propagation model. Small Scale Fading and Multipath: Types of Small-scale fading, Small scale multipath propagation, Impulse response model of multipath channel and Small-scale multipath measurements.	**06 Hrs.**
Unit 03	**Introduction to GSM** Introduction, Architecture of GSM, characteristics of GSM standards, services, Radio transmission parameters in GSM System.	**06 Hrs.**
Unit 04	**GSM Services and Channels** Traffic and Logical Channels in GSM, GSM time hierarchy, Description of call setup procedure, Handover mechanism in GSM, Security in GSM. Data transmission in GSM: Data Services, SMS, HSCSD, GPRS, EDGE.	**06 Hrs.**
Unit 05	**Routing Protocols** Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm.	**06 Hrs.**
Unit 06	**Evolution of Mobile Technologies** Evolution of Mobile Generation and its comparison (GSM & CDMA) LTE basics, LTE frame structure, LTE Design parameters with Standardization and Architecture of LTE. Overview of 5 G Networks, Comparison of 4G and 5G technology, Opportunities and requirements in 5G network, Open Wireless Architecture of 5G network.	**06 Hrs.**

Text Books:

Sr. No.	Name of Author and Publication Details
1	Jachen Schiller, “Mobile Communications”, Pearson Education.
2	Theodore Rappaport, “Wireless Communications Principles and Practice‖”, Pearson Education.
3	Savo Glisic, “Advanced Wireless Networks”, Wily India.
4	

Reference Books:

Sr. No.	Name of Author and Publication Details
1	William Stallings , “Wireless Communication & Networks”, Pearson Education
2	Manvi , “Wireless and Mobile Network”, Wiley India
3	Sudip Misra, Sumit Goswami, “Network Routing: Fundamentals, Applications, and Emerging Technologies”, Wiley India

List of Assignments/Tutorials for ISE/CA:

- Minimum 06 Assignments/Tutorials based on the curriculum.

Examination Scheme and Guidelines:

ISE/CA 10 Marks	ISE/CA-In Semester Evaluation/Continuous Assessment.
MSE 30 Marks	Examination of 30 marks based on Units 1, 2, and 3 should be conducted, and marks should be communicated to the university. ● One question of 06 Marks based on MCQ’s compulsory.
ESE (Theory) 60 Marks	ESE-End Semester Examination **25% marks** based on questions of Units 1, 2, and 3, and **75% marks** based on questions of Units 4, 5, and 6.
	● **Instructions for Paper Setter**
	Que.1: MCQ’s based on All Units (Carries 12 Marks).
	Que.2: based on Unit 1, 2, 3 (Carries 12 Marks).
	Que.3: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.4: based on Unit 4, 5, 6 (Carries 12 Marks).
	Que.5: based on Unit 4, 5, 6 (Carries 12 Marks).

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9. Capstone Project-II

Course Details:

Class	T. Y. B-Tech. Sem-VI
Course Code & Course Title	Capstone Project-II
Prerequisites:	
Teaching scheme: Lecture / Practical	- - /02
Credits	01
Evaluation Scheme (ISE /CA) / MSE / ESE	10/30/60

Teaching Scheme	Examination Scheme
Lectures: - - Hrs. /week	–
Practical: 02 Hrs. /Week	50 (ISE/CA)

Course Objectives: The course aims to:	
1	Conceptualize knowledge with emphasis on team work, effective communication, critical thinking and problem solving skills.
2	Adapt to a rapidly changing environment by having learned and applied new skills and new technologies.
3	Acquainted with the process of applying basic computer applications and provide solutions to the problems in various application domains.
4	To gain the insight of technical writing

Course Outcomes: Upon successful completion of this course, the student will be able to:	
1	Identify the real life problem from societal need point of view
2	Apply software project management skills during project work
3	Analyze and synthesize the identified problem from technological perspective (may combine with first)

	Make use of modern tools (simulation, CAD, AI/ML-based design).
4	Build small groups to work effectively in team on medium scale computing projects.
5	Design and evaluate solutions for complex problems.
6	Develop communication skills for presentation of project related activities and project report writing

General guidelines for Capstone Project-II work

- Capstone Project must be assigned to a group of 2 to 3 students under the guidance of identified faculty mentor.
- The Capstone Project - problems must be related to the programmer
- The individual students have different aptitudes and strengths. Capstone Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work they would like to execute.
- Capstone Project titles are to be finalized in co-ordination/consultation with the Faculty mentor.
- Students should submit an implementation plan in the form of a PERT/CPM chart. This will cover weekly activity of Capstone Project execution diary.
- Problem definition and specification development in the form of synopsis.
- Design of circuit with calculation & should include a) Analog part b) digital part c) Power supply d) Test strategy if firmware is required produce flow chart.
- Simulation of design using tools like OrCAD, Matlab, etc.
- Design of enclosure & PCB.
- Fabrication & assembly of PCB & enclosure.
- Testing & calibration.
- Measurement of specifications.
- Students shall Submit One Hard copy and one Soft copy each of Capstone Project Report and soft-copy of the project code or the working model.
- Students must maintain a Capstone Project execution diary having the progress steps and details. The concerned faculty should check the diary on a weekly basis and accordingly interact with students based on the progress shown and keep proper record with feedback if any.
- Allow interdisciplinary projects (IoT, AI, biomedical, renewable energy).
- Encourage industry-sponsored or community-based projects for real-world relevance.

NOTE: 1. Students can add/remove/edit chapter names as per the discussion with their guide

Following is the suggestive format for preparing the Project report.

a. The PROJECT report shall be computer typed (English- British) and printed on A4 size paper.

b. Text Font -Times New Roman (TNR), Size-12 point

c. Subsection heading TNR- 12 point bold normal

d. Section heading TNR- 12 capital bold

e. Chapter Name/ Topic Name – TNR- 14 Capital

f. All text should be justified. (Settings in the Paragraph)

g. The report must be typed on one side only with double space with a margin 3.5 cm on the left, 2.5 cm on the top, and 1.25 cm on the right and at bottom.

On completion of the project work, every student will submit a project report which should contain the following:

1. Cover Page
2. Title page
3. Certificate by the Guide
4. Acknowledgment (The candidate may thank all those who helped in the execution of the project.)
5. Abstract (It should be in one page and include the purpose of the study; the methodology used.)
6. Table of Contents (as per general guidelines): Detailed description of the project (This should be split in various chapters/sections with each chapter/section describing a project activity in totality).
    - Chapter–1 Introduction (background of the Industry or User based Problem/Task)
    - Chapter–2 Literature Survey (to finalize and define the Problem Statement)
    - Chapter–3 Scope of the project
    - Chapter–4 Methodology/Approach, if any
    - Chapter-5 Details of designs, working and processes
    - Chapter-6 Results and Applications
    - Chapter-7 Add Future Scope & Limitations
7. Conclusion
8. References (The listing of references should be typed 2 spaces below the heading "REFERENCES" in alphabetical order in single spacing left – justified. It should be numbered consecutively (in square [] brackets, throughout the text and should be collected together in the reference list at the end of the report. The references should be numbered in the order they are used in the text. The name of the author/authors should be immediately followed by the year and other details).

Following is the suggestive format for preparing the Project Execution Diary

PROJECT EXECUTION DIARY

Day and Date-

Project Title: ----------

1. **Work done:**
2. **People Visited:**
3. **Project Notes Prepared:**

Name & Signature Students

1. ---------- 2. ---------- 3. ----------

Suggestions from the guide/people visited:-

Name & Signature Guide

Examination Scheme and Guidelines:

Rubrics for Assessment of the team		
Sr. No	**Criteria**	**Marks**
ESE (Practical) 50 Marks	Project Selection & Problem definition	05
	Literature survey and data collection/ Gathering	05
	Design / concept of project/ Working - Execution of Project	10
	Stage wise progress as per Action plan/milestone	05
	Quality Report Writing	05
Rubrics for Individual Assessment		
ISE/CA 25 Marks	Contribution as a team member	05
	Depth of Knowledge	10
	Presentation	05
	Attendance	05

Exit Course for Electronics and Telecommunication Engineering After Third Year

Exit option: Award of B. Vocational in Major with 132 credits and an additional 8 credits from following Exit Courses				
Sr. No	**Course Code**	**Course Title**	**Mode**	**Credits**
1	ETC-EC-0205	Basics of Networking	Online/offline certification Course or project of total 8 credits	8
OR				
2	ETC-EC-0206	Basics of Electronics Sensors		8

T.Y. Exit Course

To earn 8 credits, the student must complete two NPTEL courses and two virtual labs related to Basics of Networking or Basics of Electronics Sensors

1. Basics of Networking (8)

Basics of Networking	**Recommended NPTEL Course**	**Equivalent Virtual Lab**
Computer network fundamentals	Computer Networks (IIT Indore)	Computer Networking Virtual Lab
Introduction to networking	Demystifying Networking (IIT Bombay)	Virtual Networking Lab
TCP/IP, routing, switching	Computer Networks and Internet Protocol (IIT Kharagpur)	Computer Networks Virtual Lab
OSI model, LAN, WAN, Internet	Computer Networks (IIT Madras)	Network Simulation Lab
Data communication and protocols	Communication Networks (IIT Kharagpur)	Data Communication & Networking Lab

2. Basics of Electronics Sensors (8)

Basics of Electronics Sensors	**Recommended NPTEL Course**	**Equivalent Virtual Lab**
Sensor fundamentals, transducers, signal conditioning	Sensors and Actuators (IISc Bangalore)	Sensors Virtual Lab
Sensors and instrumentation	Mechatronics (IIT Roorkee)	Industrial Instrumentation Virtual Lab
Sensors for automation and process control	Industrial Automation and Control (IIT Kharagpur)	Process Instrumentation Virtual Lab
IoT sensor interfacing and applications	Introduction to Internet of Things	IoT Virtual Lab