Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

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शिवाजी विद्यापीठ, कोल्हापूर ४१६ ००४, महाराष्ट्र
दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४. २६०९४८७
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SU/BOS/Sci & Tech/ 182 **Date: 10/06/2026**

The Director,
School of Engineering and Technology,
Shivaji University, Kolhapur.

Subject: Regarding revised syllabus of **B. Tech.** Part - IV (Sem VII & VIII) degree **Programme (Department of Technology)** 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. Part - IV (Sem VII & VIII) degree Programme under the Faculty of Science & Technology as per National Education Policy 2020 (NEP 2020).

Sr. No.	Course Syllabus
1	Civil Engineering
2	Mechanical Engineering
3	Computer Science and Technology
4	Chemical Engineering
5	Electronics and Telecommunication Engineering
6	Food Technology

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

Vidya Nagar, Kolhapur, Maharashtra 416004

School of Engineering & Technology (Department of Technology)

As per NEP2020 guidelines

Final Year B. Tech (Electronics and Telecommunication Engineering), Detailed Curriculum 2026-27 onwards

A. Component wise distribution of credits

(Expected range of credits as per AICTE & NEP2020 guidelines is 160-176)

Sr. No.	Category Suggested	Course Code	No. of Credits	Components %
1.	Humanities and Social Sciences including Management & Environment Courses	HSMEC	04	2.27
2.	Indian Knowledge System	IKS	05	2.84
3.	Ability Enhancement Course	AEC	03	1.70
4.	Value Education Courses	VEC	02	1.14
5.	Basic Science courses	BSC	27	15.34
6.	Engineering Science Courses including workshop, drawing, basics of civil/electrical/mechanical/computer etc.	ESC	34	19.32
7.	Professional Core Courses	PCC	54	30.69
8.	Professional Elective Courses relevant to chosen specialization/branch	PEC	06	3.41
9.	Open subjects – Electives from other technical and /or emerging subjects	OEC	12	6.82
10.	Project , Seminar and Internship	PSI	15	8.52
11.	Multidisciplinary Minor	MDM	14	7.95
11.	Vocational and Skill Enhancement Courses	VSEC	Audit Courses	-
12.	Project Based Learning	PBL		
13	Mandatory Audit Courses [Some other courses Decided at the Institute level but that do not get fit in the credits]	MAC (HSMEC)*		
	Total		176	**100**

* Please note that most of the courses under HSMEC have been covered under audit courses.

B. Engineering Graduate Attributes

1. Domain specific Engineering Knowledge
2. Problem Analysis Ability
3. Acquiring Skills that enable them to Design & Develop Solutions to the Problems
4. Capacity to investigate Complex Problems
5. Familiarity of using Modern Tools
6. Understanding Engineer's role and connectivity towards Society
7. Awareness about Environment & Sustainability
8. Practicing ethics and values
9. Ability to work as an Individual & in a Team also
10. Acquiring Communication skills
11. Becoming well verse with task of Project management & Finance aspects
12. Developing Lifelong Learning attitude

C. B. Tech (Electronics & Telecommunication Engineering) Program: Vision, Mission, PEOs and POS.

Vision

To develop competent professionals in electronics and communication engineering to serve industry, academia and society.

Mission

- To provide strong foundation of basic sciences, mathematics and electronics engineering to graduates.
- To create awareness of social, cultural, technological issues and inculcate strong ethical principles among graduates.
- To develop technological professionals with leadership, management and team qualities.
- To pursue continuous improvement in knowledge and skills.

Program Educational Objectives (PEOs)

The Program Educational Objectives (PEOs) provides a clear vision for the long-term achievements of your program's graduates, guiding curriculum design and teaching practices to align with industry and societal needs. PEOs also serve as benchmarks for assessing program success and ensuring that graduates are prepared for their careers and lifelong learning.

PEO 1- Providing strong fundamentals to graduates in Mathematics, Science and Engineering to enable them to provide solutions for problems in electronics, communications and other relevant disciplines.

PEO 2- Provide sound theoretical and practical knowledge in electronics and communication engineering to enable them to contribute in growth of industry and progress of society.

PEO 3- Development of analytical and thinking abilities for research and development activities, leadership and entrepreneurship.
PEO 4- Motivate the qualities required for team work, inter-personal communications, and professional skills and to act as good human being and responsible citizenship.

Program Outcomes (POs)

Program Outcomes provide a clear roadmap for the education and development of Electronics & Telecommunication engineering students, ensuring that your program is effective, relevant, and aligned with industry standards and expectations.

1. **Domain Specific Engineering Knowledge:** Apply principles from mathematics, physics, chemistry, and engineering to solve complex Electronics & Telecommunication engineering problems.
2. **Problem Analysis Ability:** Develop skills to analyse and solve problems encountered in Electronics & Telecommunication and allied industries and consultancy services.
3. **Acquiring Skills to Design/Develop Solutions to Problems:** Design and manage Electronics & Telecommunication processes and systems while considering current and emerging industrial practices.
4. **Capacity to Investigate Complex Problems:** Identify new research areas and utilize advanced research methods to analyse data and draw conclusions, aiming for innovative solutions in Electronics & Telecommunication engineering.
5. **Modern Tool Usage:** Select and apply modern engineering and IT tools, including modelling and prediction techniques, to complex engineering tasks.
6. **The Engineer's Connectivity with Society:** Assess and address societal, health, safety, legal, and cultural issues with informed engineering judgement.
7. **Environment and Sustainability Awareness:** Understand and integrate environmental impacts and sustainability into engineering solutions.
8. **Practicing Ethics and Values:** Uphold professional ethics and responsibilities in engineering practice.
9. **Ability to Work as an Individual and in Team:** Work effectively both individually and as a part of diverse and multidisciplinary teams.
10. **Acquiring Communication Skills:** Communicate complex engineering information effectively through written reports, presentations, and interpersonal communication.
11. **Well Versed with Task of Project Management and Finance Aspects:** Apply engineering and management principles to lead and manage projects in multidisciplinary environments.
12. **Life-Long Learning Attitude:** Recognize and engage in lifelong learning to stay abreast of technological advancements in engineering.

Shivaji University, Kolhapur
School of Engineering & Technology
(Department of Technology)
Final Year B. Tech (Electronics and Telecommunication Engineering), Semester- VII

Teaching & Evaluation Scheme

S.N.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Program Core Course	PCC411	Mobile Communication	03	-	02	05	04	30:70	00:50
2.	Program Core Course	PCC412	Digital Image Processing	03	-	02	05	04	30:70	00:50
3.	Program Core Course	PCC413	Internet of Things	03	-	-	03	03	30:70	00:00
4.	Program Elective Course	PEC 411	Program Elective II	03	-	02	03	04	30:70	00:50
5.	Open Elective Course	OEC 411	Open Elective- II	03	-	-	03	03	30:70	00:00
6.	Project Based Learning	PBL 411	Major Project - I	-	-	02	02	01	-	100: 00
7.	Value Education Course	VEC411	Green Technology & Sustainability	01	-	-	01	01	-	50:00
8.	Project Seminar Internship	PSI 412	MDM based Industry Internship *	One Month Duration*				03	-	50:50
							-	**23**	**500**	**400**
			Total Hours	16	01	10	25	-		

* The MDM based industry Internship to be completed during any winter/summer vacation slots 4th Semester onwards, before 7th Semester commencement.

Shivaji University, Kolhapur
School of Engineering & Technology
(Department of Technology)
Final Year B. Tech (Electronics and Telecommunication Engineering), Semester- VIII

Teaching & Evaluation Scheme

S.N.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Project Seminar Internship	PSI 421	Industrial Internship (Follow up by department)	Entire Semester to be spent in industry				10	00:00	150:200
2.	Program Elective Course	OEC 421	Program Elective –III (online *)	03	-	-	03	03	30:70	00:00
3.	[SWAYAM (NPTEL) or any other MOOCs or online]	OEC 422	Program Elective –IV (online *)	03	-	-	03	03	30:70	00:00
4.	Project Based Learning	PBL 424	Major Project -II			02	02	01	-	50:50
5.	Indian Knowledge System	PSI 425	Program Specific IKS (online **)	02	-	-	02	02	30:70	00:00
6.	Value Education Course	VEC421	Professional Ethics (online *)	01	-	-	01	01	-	50:00
7.	Project Seminar Internship	PBL 421	MDM based Mini Project***	-	-	-	-	02	-	50:50
							-	**22**	**300**	**600**
			Total Hours (Other than Internship)	**09**	**00**	**02**	**11**	**-**	**-**	**-**

*There is an option for End Semester Examination either on respective MOOC platform or at the course teacher's end through the University System.
** Though the course is to be completed online either through course coordinator or via suitable MOOC if any, the ISE will be coordinated by the course in charge and the ESE will be through University system.
*** MDM based Mini Project to be completed during 4th Semester to 8th Semester.

List of Program Elective – II

1. Microwave Engineering
2. Satellite and Radar Engineering
3. PLC and automation

List of Open Elective – II

1. Finance Management
2. Human Resource Management

List of Program Elective – III (Online or Through MOOCs)

1. Embedded Systems Design
   https://onlinecourses.nptel.ac.in/noc26_cs54/preview
2. Electric Vehicle Technology for Academia
   https://onlinecourses.swayam2.ac.in/ntr26_ed15/preview

(Department has to choose any course mentioned in above list or may offer new course with approval from appropriate body)

List of Program Elective – IV (Online or Through MOOCs)

1. Foundation of Virtual and Augmented reality systems
   https://onlinecourses.nptel.ac.in/noc26_cs03/preview
2. Advanced Computer Networks
   https://onlinecourses.nptel.ac.in/noc26_cs60/preview

(Department has to choose any course mentioned in above list or may offer new course with approval from appropriate body)

Equivalence for semester VII

	Final Year B. TechSemester VII Pre-revised syllabus	Final Year B. Tech Semester VII Revised syllabus (NEP -2020)	Remark
1	----	Mobile Communication	Shifted from 8th semester to 7th Semester
2	Digital Image Processing	Digital Image Processing	Contents modified
3	Internet of Things (OE-I)	Internet of Things	Made compulsory subject and removed from OE-I
4	----	**Program Elective - II**	
4.1	Microwave Engineering	Microwave Engineering (PE-II)	Compulsory subject is converted to Program Elective - II
4.2	----	Satellite and Radar Engineering (PE-II)	Shifted to sem- VII from sem VIII
5	PLC and automation (PE-I)	PLC and automation (PE-II)	No change
6		**Open Elective- II**	
6.1	----	Finance Management (OE-II)	Compulsory subject converted to OE-II
6.2	----	Human Resource Management (OE-II)	Newly introduced
7	Major project (Phase-I)	Major Project - I	----
8	----	Green Technology & Sustainability	Newly added
9	----	MDM based Industry Internship *	Newly added
10	ARM & Embedded systems	----	Removed and shifted as elective 1 subject to sem 6
11	Wireless Networks (PE-I)	----	Removed from syllabus
12	RF Circuit Design (PE-I)	----	Removed from syllabus
13	Micro Electro Mechanical Systems (OE-I)	----	Removed from syllabus
14	Remote Sensing & GIS (OE-I)	----	Removed from syllabus
15	Software Defined Radio (OE-I)	----	Removed from syllabus
16	Internship-II	----	Major project (Phase-I)
17	Professional Ethics	----	Removed and shifted to sem 8

Equivalence for semester VIII

Sr. No.	Final Year B. TechSemester VIII Pre-revised syllabus	Final Year B. Tech Semester VIII Revised syllabus (NEP-2020)	Remark
1	----	Industrial Internship (Follow up by department)	Newly added
2	----	**Program Elective –III (Online or Through MOOC*) Newly added**	
2.1	----	Embedded Systems Design	Newly added
2.2	----	Electric Vehicle Technology for Academia	Newly added
3	----	**Program Elective –IV (Online or Through MOOC*)**	
3.1	----	Foundation of Virtual and Augmented reality systems	Newly added
3.2	----	Advanced Computer Networks	Newly added
4	Major Project (Phase-II)	Major Project -II	Newly added
5	----	Program Specific IKS	Newly added
6	----	Professional Ethics (Online or Through MOOC*)	Newly added
7	----	MDM based Mini Project***	Newly added
8	Digital Television & Multimedia	----	Removed from syllabus
9	Operating systems	----	Removed from syllabus
10	Optical Fiber Communication	----	Removed from syllabus
11	Program Elective-II	----	
12	Satellite & Radar Engineering	----	Shifted to Sem 7 as program elective 2
13	Speech and Audio Processing	----	Removed from syllabus
14	Wireless Sensor Networks	----	Removed from syllabus
15	Open Elective-II	----	
16	Automotive Electronics	----	Opted as a subject for Honors / Honors with Research degree course
17	Robotics	----	Removed from syllabus
18	Artificial Intelligence	----	Removed from syllabus
19	Financial Management	----	Shifted to Sem 7
20	Introduction to Indian Constitution	----	Major Project (Phase-II)

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VII				
Course Code	PCC 411				
Course Category	Program Core Course				
Course title	**Mobile Communication**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	02	05	04
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)	Analog & Digital Communication, Signals & Systems, Probability Theory				
Course Rationale	Mobile communication is the backbone of today's smartphones, IoT, 4G/5G networks and wireless data services. This course builds strong fundamentals in cellular concepts, radio propagation and wireless technologies while introducing modern mobile systems.				
Course Objectives	1. To introduce the fundamental concepts of cellular communication and frequency reuse used in mobile networks. 2. To develop understanding of radio wave propagation and large-scale path loss in wireless environments. 3. To study the effects of multipath and fading on wireless signal transmission. 4. To explain how multiple users share the wireless spectrum using modern transmission techniques. 5. To familiarize students with the evolution and architecture of cellular systems from GSM to LTE. 6. To introduce advanced mobile communication technologies and future wireless trends.				
Course Outcomes	Students are able to 1. Explain cellular structure, frequency reuse, handoff, interference and system capacity. 2. Analyse path loss, reflection, diffraction and shadowing in mobile radio channels. 3. Evaluate fading, Doppler Effect and delay spread in communication 4. Apply multiple access and OFDM techniques in mobile communication systems. 5. Describe the operation of GSM, CDMA, 3G and LTE networks. 6. Explain 5G architecture, massive MIMO, IoT and future wireless technologies.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	1	1								2	2
CO2	3	3	1	2	–	–	–	–	–	–	–	–	3	2
CO3	3	3	1	2	1	–	–	–	–	–	–	–	3	2
CO4	3	2	3	1	2	–	–	–	–	–	–	–	3	2
CO5	3	2	2	1	1	1	–	–	–	–	–	–	2	3
CO6	2	2	1	1	2	2	1	–	–	–	–	2	2	3

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Cellular Communication Fundamentals** Wireless Communication Systems, Cellular Concept, Hexagonal Cell Structure, Frequency Reuse, Channel Assignment, Handoff, Interference and System Capacity, Trunking, Cell Splitting, Sectoring and Microcells	**07**
2	**Mobile Radio Propagation** Free Space and Two-Ray Ground Reflection Models, Reflection, Diffraction, Scattering, Large-Scale Path Loss, Shadowing, Introduction to Multipath Propagation	**08**
3	**Fading & Wireless Channel** Multipath Channel, Impulse Response, Delay Spread, Doppler Effect, Coherence Bandwidth & Time, Fading	**07**
4	**Multiple Access & Wireless Transmission** FDMA, TDMA, CDMA, OFDMA, FDD & TDD, Single-Carrier Vs Multicarrier Transmission, SISO and MIMO, OFDM	**05**
5	**Cellular System Evolution** (1G To 4G) GSM Architecture and Channels, CDMA (IS-95), 3G (IMT-2000, W-CDMA), LTE Architecture, LTE Features and Spectrum	**07**
6	**5G and Emerging Wireless Technologies** 5G Architecture, Beamforming, Massive MIMO, Network Slicing, Introduction To 6G, IOT and Future Wireless Trends	**05**

General Instructions:

Based on the syllabus content students have to complete any one of the following activities:

1. Simulation based small project work

2. Case study work
3. Site visit
4. Solve technical quiz
5. Solve home assignments
6. Question paper will be based on all six units covering of theory, derivations and numericals.

Sr. No.	Reference Books
1	Wireless Communications Principals & Practice - Theodore S. Rappaport, Pearson
2	Mobile Communications - Jochen Schiller, Pearson
3	Wireless Communications & Networks - William Stallings, Pearson
4	Wireless Telecommunications Systems and Networks – Mullett, Cengage
5	Wireless Communication - Goldsmith Andrea, Cambridge University Press
6	Fundamentals of Wireless Communication - David Tse and Pramod Viswanath, Cambridge University Press
7	Wireless Digital Communications Modulation and Spread Spectrum Applications Kamilo
8	Wireless Communications, P. Muthu Chidambra Nathan, PHI
9	Wireless Communication Systems: From RF Subsystems to 4G Enabling Technologies by Ke-Lin Du and M. N. S. Swamy, Cambridge University Press
10	William C.Y.Lee, “Mobile Communications Engineering Theory & Applications”, TMH.
11	V.K.Garg, J.E.Wilkes, “Principle and Application of GSM”, Pearson Education.
12	V.K.Garg, “IS-95 CDMA & CDMA 2000”, Pearson Education

Sr. No.	Important web references
1	https://swayam.gov.in/
2	https://nptel.ac.in/
3	https://onlinecourses.nptel.ac.in/noc21_ee66/preview

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VII				
Course Code	PCC 411 L				
Course Category	Program Core Course				
Course title	**Mobile Communication Laboratory**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	-	-	02	02	01
Evaluation Scheme	**-**		**EE: 50**		**Total=50**
Pre-requisites (if any)	Analog & Digital Communication, Signals & Systems, Probability Theory				
Course Rationale	Mobile communication is the backbone of today's smartphones, IoT, 4G/5G networks and wireless data services. This course builds strong fundamentals in cellular concepts, radio propagation and wireless technologies while introducing modern mobile systems.				
Course Objectives	1. To introduce the fundamental concepts of cellular communication and frequency reuse used in mobile networks. 2. To develop understanding of radio wave propagation and large-scale path loss in wireless environments. 3. To study the effects of multipath and fading on wireless signal transmission. 4. To explain how multiple users share the wireless spectrum using modern transmission techniques. 5. To familiarize students with the evolution and architecture of cellular systems from GSM to LTE. 6. To introduce advanced mobile communication technologies and future wireless trends.				
Course Outcomes	Students are able to 1. Explain cellular structure, frequency reuse, handoff, interference system capacity. 2. Analyse path loss, reflection, diffraction and shadowing in mobile radio channels. 3. Evaluate fading, Doppler Effect and delay spread in wireless communication. 4. Apply multiple access and OFDM techniques in mobile communication systems. 5. Describe the operation of GSM, CDMA, 3G and LTE networks. 6. Explain 5G architecture, massive MIMO, IoT and future wireless technologies.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3	2	1	1	–	–	–	–	–	–	–	–	2	2
CO 2	3	3	1	2	–	–	–	–	–	–	–	–	3	2
CO 3	3	3	1	2	1	–	–	–	–	–	–	–	3	2
CO 4	3	2	3	1	2	–	–	–	–	–	–	–	3	2
CO 5	3	2	2	1	1	1	–	–	–	–	–	–	2	3
CO 6	2	2	1	1	2	2	1	–	–	–	–	2	2	3

Level of Mapping as: Low 1, Moderate 2, High 3

	Practical / Tutorial List	**Hours**
1	Study of sections of 3G mobile phone trainer.	**02**
2	Study of 3G network AT commands.	**02**
3	Study and starting 4G VoLTE Smart Phone. 4.	**02**
4	Study and analyze the Power Management Unit in 4G LTE Smart Phone.	**02**
5	Study and analyze of SIM Interface section in 4G LTE Smart Phone.	**02**
6	Study and analyze that a mobile is powered ON at the alarm Set Time (Function of RTC system) in 4G LTE Smart Phone.	**02**
7	Study and understand 4G AT Commands	**02**
8	Study of real-time operation of 5G VoLTE Smart Phone.	**02**
9	Study of Dual SIM interface section of 5G VoLTE Smartphone.	**02**
10	Study of Battery charging circuit of 5G VoLTE Smartphone.	**02**
11	Study of Power management unit 5G VoLTE Smartphone.	**02**
12	Study of Buzzer, Vibrator and Mic Speaker units of 5G VoLTE Smart phone.	**02**
13	Study of RF signals using RF Spectrum Analyzer module	**02**
14	Visit to Mobile Base station or Wireless station (Optional)	**02 _**

General Instructions: Any 8 experiments based on the subject syllabus but not limited to this list should be conducted using hardware/software/simulator/virtual lab etc.	
Sr. No.	**Reference Books**
1	Wireless Communications Principals & Practice - Theodore S. Rappaport, Pearson
2	Mobile Communications - Jochen Schiller, Pearson
3	Wireless Communications & Networks - William Stallings, Pearson
4	Wireless Telecommunications Systems and Networks – Mullett, Cengage
5	Wireless Communication - Goldsmith Andrea, Cambridge University Press
6	Fundamentals of Wireless Communication - David Tse and Pramod Viswanath, Cambridge University Press
7	Wireless Digital Communications Modulation and Spread Spectrum Applications Kamilo
8	Wireless Communications, P. Muthu Chidambra Nathan, PHI
9	Wireless Communication Systems: From RF Subsystems to 4G Enabling Technologies by Ke-Lin Du and M. N. S. Swamy, Cambridge University Press
10	William C.Y.Lee, “Mobile Communications Engineering Theory & Applications”, TMH.
11	V.K.Garg, J.E.Wilkes, “Principle and Application of GSM”, Pearson Education.
12	V.K.Garg, “IS-95 CDMA & CDMA 2000”, Pearson Education
Sr. No.	**Important web references**
1	https://swayam.gov.in/
2	https://nptel.ac.in/
3	https://onlinecourses.nptel.ac.in/noc21_ee66/preview

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VII				
Course Code	PCC412				
Course Category	Program Core Course				
Course title	**Digital Image Processing**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	--	--02	05	04
Evaluation Scheme	**ISE:30**			**ESE:70**	**Total=100**
Pre-requisites (if any)	Signals and Systems, Digital Signal Processing, Digital Communication.				
Course Rationale	Digital Image Processing deals with the analysis and processing of digitized images. Image processing has two major objectives: the first is to enhance image quality for better visual interpretation by humans, and the second is to extract meaningful information from images for machine-based analysis and decision support. This course introduces fundamental image processing techniques and algorithms used for improving visual quality and interpreting image content. The curriculum also provides an introduction to image segmentation and object representation methods, which form the basis for advanced image analysis and computer vision applications. Overall, the course builds a strong foundation for practical and research-oriented applications in image processing.				
Course Objectives	1. Explain the fundamentals of digital image formation and acquisition. 2. Introduce gray-scale and color image representation techniques and their inter-conversion. 3. Explain image enhancement techniques in spatial and frequency domains. 4. Describe morphological image processing concepts and algorithms. 5. Explain image compression methods and standards. 6. Introduce image segmentation and object representation techniques.				
Course Outcomes	Students are able to 1. Explain the basics of image formation and acquisition. 2. Elaborate gray-scale and color image representation techniques and perform their inter-conversion. 3. Apply image enhancement algorithms to digital images. 4. Apply various morphological image processing algorithms on digital images. 5. Apply image compression techniques on digital images. 6. Apply segmentation algorithms and obtain object representation using boundary and surface-based methods.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3	2	1	1	--	--	--	--	--	--	--	1		
CO 2	3	2	1	1	2	--	--	--	--	--	--	1		
CO 3	2	3	2	2	3	--	--	--	--	--	--	2		
CO 4	2	3	2	2	3	--	--	--	--	--	--	2		
CO 5	2	3	2	2	3	--	--	--	--	--	--	2		
CO 6	2	3	2	3	2	--	--	--	1	2	--	2		

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Digital Image Fundamentals** Introduction, Digital image representation, fundamental steps in digital image processing. Image sampling and quantization, two-dimensional sampling theory, reconstruction of images from samples, practical limits in sampling and reconstruction .	05
2	**Image Enhancement** Image enhancement in spatial domain: point operations, contrast stretching, clipping, thresholding, negative image, intensity level slicing, bit plane slicing. Histogram processing: histogram modelling, equalization, and specification. Spatial filtering: smoothing and sharpening techniques. Image enhancement in frequency domain.	08
3	**Colour Image Processing** Colour image representation and chromaticity diagram. RGB, HSI, CMY, and CMYK colour models. Inter-conversion among colour models. Colour image enhancement and basic color segmentation.	07
4	**Morphological Image Processing** Binary morphological operations: dilation, erosion, opening and closing, hit-or-miss transform. Morphological algorithms: region filling, boundary extraction, skeletonization, convex hull.	04
5	**Image Compression** Image compression fundamentals, compression models, elements of information theory. Lossless compression techniques: Huffman coding, arithmetic coding, LZW. Lossy	08

	compression techniques: transform-based coding using DCT and wavelets. Image compression standards: JPEG and JPEG2000.	
6	**Image Segmentation and Representation** Point, line, Edge detection, Discontinuity based and similarity-based segmentation algorithms. Representation: Boundary and shape-based representation and descriptors, Texture and Texture based Descriptors.	**07**

General Instructions:

Based on the syllabus content students have to complete any one of the following activities:

1. Simulation based small project work
2. Case study work
3. Site visit
4. Solve technical quiz
5. Solve home assignments
6. Question paper will be based on all six units covering of theory, derivations and numerical.

Sr. No.	**Reference Books**
1	Gonzalez, Rafel C. and Woods, Richard E., "Digital Image Processing", Forth Edition, Prentice Hall.
2	Pratt, William K., "Digital Image Processing", John Wiley & Sons, New York.
3	M Sonka, V Hlavac and R Boyle, Image Processing, Analysis and Machine Vision, PWS.
4	Jain, Anil K., "Fundamentals of Digital Image Processing", Prentice Hall of India, New Delhi.
Sr. No.	**Important web references**
1	https://nptel.ac.in/courses/117105079
2	https://nptel.ac.in/

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VII				
Course Code	PCC412				
Course Category	Program Core Course				
Course title	Digital Image Processing Laboratory				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	-	--	02	01	01
Evaluation Scheme	**-**			**EE: 50**	**Total=50**
Pre-requisites (if any)	Basic MATLAB				
Course Rationale	The Digital Image Processing Laboratory provides practical exposure to fundamental and advanced image processing techniques using MATLAB/PYTHON. This laboratory course bridges the gap between theoretical concepts and real-world implementation by enabling students to design, implement, and analyze image processing algorithms.				
Course Objectives	1. Introduce students to MATLAB environment for digital image processing applications. 2. Demonstrate implementation of fundamental image processing algorithms. 3. Enable students to analyze image enhancement, segmentation, and compression techniques. 4. Develop problem-solving and algorithmic thinking through hands-on experiments. 5. Encourage practical understanding of real-world image processing applications. 6. To design an Design and document image processing solutions				
Course Outcomes	Students are able to 1. Use MATLAB tools and functions for digital image processing tasks. 2. Implement image enhancement algorithms on digital images. 3. Apply morphological operations and segmentation techniques. 4. Perform image compression and reconstruction experiments. 5. Analyze and interpret results obtained from image processing algorithms. 6. Design and document image processing solutions for given problems.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	2	1	1	3	--	--	--	--	--	--	2		
CO 2	2	3	2	2	3	--	--	--	--	--	--	2		
CO 3	2	3	2	2	3	--	--	--	--	--	--	2		
CO 4	2	3	2	2	3	--	--	--	--	--	--	2		
CO 5	2	3	1	3	2	--	--	--	--	1	--	2		
CO 6	2	2	3	2	2	--	--	--	1	2	1	2		

Level of Mapping as: Low 1, Moderate 2, High 3

	Practical / Tutorial List	**Hours**
1	Image manipulation and basic operations	02
2	Gray level transformations	02
3	Histogram plotting, histogram equalization and Matching	02
4	Spatial domain filtering (smoothing and sharpening).	02
5	Frequency domain filtering using Fourier transform.	02
6	RGB separation, Image conversion and visualization (RGB, HSI, CMY, CMYK).	02
7	Color Complement	02
8	Morphological operations (erosion, dilation, opening, closing).	02
9	Applications of Morphology – Region Filling , Skeletonization etc	02
10	Edge detection techniques using different operators	02
11	Image segmentation using Thresholding methods.	02
12	Boundary detection and shape representation.	02
13	Texture feature extraction.	02

General Instructions: 0
1.Minimum 8 tutorials should be carried out based on above list or syllabus.
2.Batch wise tutorials are to be conducted. The number of students per batch should be as per the practical batches.

3.Students must be encouraged to solve engineering mathematics problems using different mathematical software's like MATLAB, Scilab etc.	
Sr. No.	**Reference Books**
1	Digital Image Processing Using MATLAB (3rd Edition) by Gonzalez, Woods & Steven L. Eddins
Sr. No.	**Important web references**
1	https://nptel.ac.in/courses/117105079

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VII				
Course Code	PCC413				
Course Category	Program Core Course				
Course title	**Internet of Things**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)	Microcontroller, Computer Networks				
Course Rationale	The Internet of Things (loT) course explores the interconnected world of smart devices, enabling students to grasp the fundamentals of IoT architecture, protocols, and applications. Through hands-on projects, students develop skills in device integration and data management. The course equips learners with a comprehensive understanding of loT's transformative potential, preparing them to navigate the evolving landscape of connected technologies and contribute to the advancement of the digital era.				
Course Objectives	1. Understand the fundamental concepts, architecture, evolution, and ecosystem of IoT, including sensing, actuation, and emerging trends. 2. Analyze and compare IoT communication networks and protocols, addressing standardization challenges and unified data issues.. 3. Gain practical knowledge of IoT hardware platforms and interfacing techniques for commonly used sensors.Explore cloud platforms and IoT data management, including storage, analytics, visualization, and interoperability 4. Identify security and privacy challenges in IoT systems and apply basic security mechanisms to mitigate threats. 5. Examine real-world IoT applications and future trends, including AI integration, edge computing, and domain-specific IoT solutions. 6.				
Course Outcomes	Students are able to 1. Explain the definition, characteristics, architecture, and components of IoT systems, and assess emerging trends and challenges 2. Differentiate between IoT communication protocols and networking technologies and select appropriate protocols for specific applications 3. Demonstrate the ability to use IoT hardware platforms and interface temperature, humidity, and light sensors with embedded devices. 4. Apply cloud-based IoT platforms for data storage, processing, analytics, and visualization using dashboards 5. Analyze IoT security threats and vulnerabilities and implement basic security measures such as encryption, authentication, and authorization 6. Design and evaluate IoT-based applications in domains such as smart homes, healthcare, industrial automation, and environmental monitoring				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	–	–	–	–	–	–	–	1	–	2	3	2
CO2	3	3	1	–	2	–	–	–	–	–	–	2	3	3
CO3	3	2	3	1	3	–	–	–	2	–	–	1	3	2
CO4	3	2	2	1	3	–	–	–	–	–	–	2	3	2
CO5	2	3	2	2	1	2	–	3	–	–	–	2	2	3
CO6	3	2	3	1	2	2	2	1	2	1	1	3	3	2

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Fundamentals of Internet of Things** Definition and Characteristics of IoT, Evolution of loT: Internet to IoT, Sensing and Actuation, Things in IoT, Elements of an IoT ecosystem, IoT Architecture, Emerging trends and challenges in IoT.	**06**
2	**IoT Communication Networks and Protocols** Overview of loT networks: LAN, PAN, WAN, IoT protocols: MQTT, HTTP, COAP, Restful API, Bluetooth Low Energy (BLE), ZigBee, RFID, LoRa WAN, BAC Net, KNX, 6LOWPAN, Comparison of loT communication technologies, Protocol Standardization for IoT, Issues with IoT Standardization: Unified Data.	**07**
3	**IoT Hardware Platforms and Sensor Interfacing** Overview of IoT hardware's: Intel Galileo Edison Board, Arduino Boards ESP8266, Raspberry Pi, interfacing sensors with IoT Hardware: Temperature, humidity and light sensors	**06**
4	**Cloud Platforms and IoT Data Analytics** Google, AWS, Microsoft Azure, Thing speak, Interoperability. IoT Data and Analytics IoT Data Lifecycle: Data collection, storage, and processing, Role of cloud computing in loT data management, Data analytics techniques for IoT applications, Tools for IoT analytics: Edge analytics, cloud-based analytics platforms, Storing loT data in the cloud (Firebase/AWS IoT Core), Basic data visualization using loT dashboards.	**07**
5	**IoT Security and Privacy** Security and Privacy Issues, IoT Security Challenges, Threats and vulnerabilities, Security protocols and best practices, Importance of data privacy in loт applications, Role of encryption, authentication, and authorization, Case Study: Analyzing real-world IoT security breaches, Implementing basic security measures in IoT systems.	**06**
6	**IoT Applications and Emerging Technologies**	**07**

	Web of Things, IoT in Industry and Automation: Industrial IoT (IloT) and smart manufacturing, Edge computing and fog computing, loT with Al and machine learning integration, Smart Home Automation System, IoT based healthcare monitoring system, Environmental monitoring using loT.	

General Instructions:
Based on the syllabus content students have to complete any one of the following activities:
1. Simulation based small project work
2. Case study work
3. Site visit
4. Solve technical quiz
5. Solve home assignments
6. Question paper will be based on all six units covering of theory, derivations and numerical.

Sr. No.	**Reference Books**
1	Nitesh Dhanjani, Abusing the Internet of Things, Shroff Publisher/O'Reilly Publisher.
2	Internet of Things, RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, John Wiley and Sons.
3	Internet of Things, Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, John Wiley & Sons.
4	Cuno Pfister, "Getting Started with the Internet of Things", Shroff Publisher/Maker Media.
5	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications.
6	Massimo Banzi, Michael Shiloh Make: Getting Started with the Arduino, Shroff Publisher/Maker Media Publishers.
Sr. No.	**Important web references**
1	Introduction To Internet Of Things - Course https://onlinecourses.nptel.ac.in/noc26_cs37/preview

Year, Program, Semester	Final Year B. Tech (Electronics & Telecommunication Engineering), Part 4, Semester VII				
Course Code	PEC 411				
Course Category	Program Elective course II				
Course title	**Microwave Engineering**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	02	03	04
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)	Electronic Circuit Design, Electromagnetic Fields				
Course Rationale	Microwave engineering deals with the generation, transmission, control and measurement of electromagnetic waves in the frequency range of 1–300 GHz. These waves are fundamental to modern communication, radar, satellite, remote sensing and wireless systems. This course provides theoretical and practical knowledge of waveguides, microwave components, tubes, solid-state devices and measurement techniques required for designing and analysing microwave systems used in advanced electronics and telecommunication applications.				
Course Objectives	1. Explain the microwave spectrum, wave characteristics and major application areas. 2. Develop the theoretical framework for electromagnetic wave propagation and mode formation in rectangular waveguides. 3. Describe the operating principles and functions of microwave passive components and ferrite devices. 4. Analyze the physical processes and performance parameters of microwave vacuum tubes. 5. Explain the operating mechanisms of microwave semiconductor devices 6. Demonstrate standard microwave measurement techniques using laboratory test setups.				
Course Outcomes	Students are able to 1. Identify and classify microwave frequency bands, explain their characteristics and relate them to communication applications. 2. Analyze field distribution, propagation modes and cut-off frequencies in rectangular waveguides. 3. Select and apply microwave passive components and ferrite devices to meet specified microwave system requirements. 4. Analyze the working and performance of microwave tubes such as klystron, TWT and magnetron. 5. Understand and analyze the various microwave solid state devices 6. Measure and interpret microwave parameters such as power, frequency, VSWR and impedance using microwave test benches.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	2	–	–	–	–	1	–	–	–	–	1	2	2
CO 2	3	3	2	–	1	–	–	–	–	–	–	1	3	2
CO 3	2	2	3	1	2	–	–	–	1	–	–	1	3	3
CO 4	2	3	2	1	–	–	–	–	–	–	–	1	3	2
CO 5	2	2	2	–	2	–	–	–	–	–	–	1	3	3
CO 6	2	2	2	3	3	–	–	1	2	1	–	1	3	3

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Introduction to Microwave** Definition, Microwave Frequency Bands, Microwave Characteristics, Microwave System, Microwave Applications. Microwave Bench: Different Blocks and their Features	04
2	**Microwave Waveguides** Types of Waveguides, Rectangular Waveguides, Wave Equations, Solutions of Wave Equations in Rectangular Coordinates, TE and TM Modes in Rectangular Waveguide, Impossibility of TEM Waves, Cut Off Frequency, Wave Impedance for TE and TM Wave, Dominant Mode and Degenerate Modes, Mode Characteristics of Phase Velocity, Group Velocity, Wavelength and Impedance Relations, Power Transmission in Rectangular Waveguide, Excitations of Modes, Illustrative Problems. Resonator.	08
3	**Waveguide Components** Introduction of S-Parameters, E and H Plane Tee, Hybrid Junctions, Hybrid Ring, Circulator, Isolator, Directional Coupler, Attenuators.	08
4	**Microwave Tubes** Limitations of Conventional Tubes at Microwave Frequencies, Types of Microwave Tubes, Two cavity Klystron, Reflex Klystron, Slow Wave Structures: Helix Traveling Wave Tube, Microwave cross field tubes: Magnetrons.	08
5	**Microwave Semiconductor Devices** Microwave Solid-State Devices: Microwave Tunnel Diode; PIN Diode, Varactor Diode. Transferred Electron Devices: Gunn-Effect Diodes, RWH Theory, Modes of Operations; Avalanche Transit Time Devices: IMPATT Diode, TRAPATT Diode.	06
6	**Microwave Measurements** Attenuation, Frequency, Low and High VSWR, Impedance Measurements.	05

General Instructions:

Based on the syllabus content students have to complete any one of the following activities:

1. Simulation based small project work
2. Case study work
3. Site visit
4. Solve technical quiz
5. Solve home assignments
6. Question paper will be based on all six units covering of theory, derivations and numericals.

Sr. No.	Reference Books
1	Samuel Y. Liao, Microwave Devices and Circuits, Pearson, 3rd Edition, 2003.
2	Pozar, David M. Microwave Engineering. John Wiley & Sons, 2011.
3	Peter A. Rizzi, Microwave Engineering Passive Circuits, PHI, 3rd Edition, 1999.
4	M.L. Sisodia, G.S.Raghuvanshi, Microwave Circuits and Passive Devices Wiley Eastern Ltd., New Age International Publishers Ltd, 1stEdition, 1995.
5	R.E. Collin, Foundations for Microwave Engineering, IEEE Press, John Wiley.
6	Srivastava, Ganesh Prasad and Vijay Laxmi Gupta. Microwave Devices and Circuit Design. PHI Learning Pvt. Ltd., 2006.
7	Sharma, K. K. Fundamentals of Microwave & Radar Engineering. S. Chand Publishing, 2011.
8	Kulkarni, Muralidhar. Microwave and Radar Engineering. Umesh Publications, New Delhi, 5th Edition.
9	Gottapu Sasi Bhushana Rao, Microwave and Radar Engineering, Dorling Kindersley (India), New Delhi, India, 2014 (Licensees of Pearson Education)
Sr. No.	**Important web references**
1	http://nptel.ac.in/courses
2	https://swayam.gov.in
3	https://nptel.ac.in/courses/108101112
4	https://onlinecourses.nptel.ac.in/noc25_ee178
5	http://www-group.slac.stanford.edu/kly/Lecture_Series/slac_klystron_lecture_series.htm

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VII				
Course Code	PEC 411 L				
Course Category	Program Elective Course				
Course title	Microwave Engineering Laboratory				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
			02	02	01
Evaluation Scheme	**-**			**EE: 50**	**Total=50**
Pre-requisites (if any)	Electronic Circuit Design, Electromagnetic Fields				
Course Rationale	Microwave engineering deals with the generation, transmission, control and measurement of electromagnetic waves in the frequency range of 1–300 GHz. These waves are fundamental to modern communication, radar, satellite, remote sensing and wireless systems. This course provides theoretical and practical knowledge of waveguides, microwave components, tubes, solid-state devices and measurement techniques required for designing and analyzing microwave systems used in advanced electronics and telecommunication applications				
Course Objectives	1. Explain the microwave spectrum, wave characteristics and major application areas. 2. Develop the theoretical framework for electromagnetic wave propagation and mode formation in rectangular waveguides. 3. Describe the operating principles and functions of microwave passive components and ferrite devices. 4. Analyze the physical processes and performance parameters of microwave vacuum tubes. 5. Explain the operating mechanisms of microwave semiconductor devices 6. Demonstrate standard microwave measurement techniques using laboratory test setups				
Course Outcomes	Students are able to 1. Identify and classify microwave frequency bands and relate them to communication applications. 2. Analyze field distribution, propagation modes and cut-off frequencies in rectangular waveguides. 3. Select and apply microwave passive components and ferrite devices to meet specified microwave system requirements. 4. Analyze the working and performance of microwave tubes such as klystron, TWT and magnetron. 5. Understand and analyze the various microwave solid state devices. 6. Measure and interpret microwave parameters such as power, frequency, VSWR and impedance using microwave test benches				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	2	–	–	–	–	1	–	–	–	–	1	2	2
CO 2	3	3	2	–	1	–	–	–	–	–	–	1	3	2
CO 3	2	2	3	1	2	–	–	–	1	–	–	1	3	3
CO 4	2	3	2	1	–	–	–	–	–	–	–	1	3	2
CO 5	2	2	2	–	2	–	–	–	–	–	–	1	3	3
CO 6	2	2	2	3	3	–	–	1	2	1	–	1	3	3

Level of Mapping as: Low 1, Moderate 2, High 3

	Practical / Tutorial List	**Hours**
1	Study of field patterns of various modes inside a rectangular waveguide using Virtual lab.	**2**
2	Study of field pattern of various modes inside a rectangular waveguide cavity using Virtual lab.	**2**
3	Measurement of Unknown frequency using direct and indirect method.	**2**
4	Measurement of wavelength by slotted line method.	**2**
5	Measurement of VSWR of unknown load.	**2**
6	Concept of generalized n-port scattering parameters, and formulation of these parameters into 2-port reflection and transmission coefficients.	**2**
7	Measurement of attenuation.	**2**
8	Measurement of impedance of unknown load.	**2**
9	Determination of VI characteristics of Gunn diode using microwave test bench.	**2**
10	Study of characteristics of E-Plane Tee and H-Plane Tee.	**2**
11	Study of characteristics of directional coupler.	**2**
12	Measurement of insertion loss of the waveguide	**2**
13	Measurement of phase constant of the waveguide	**2**

14	S- Parameter measurement of the magic tee	**2**
15	Measurement of Microwave Parameters such as Return loss, Bandwidth, Smith Chart using Vector Network Analyzer.	**2**

General Instructions:
Any 8 experiments based on the subject syllabus but not limited to this list should be conducted using hardware/software/simulator/virtual lab etc.

Sr. No.	**Reference Books**
1	Samuel Y. Liao, Microwave Devices and Circuits, Pearson, 3rd Edition, 2003.
2	Pozar, David M. Microwave Engineering. John Wiley & Sons, 2011.
3	Peter A. Rizzi, Microwave Engineering Passive Circuits, PHI, 3rd Edition, 1999.
4	M.L. Sisodia, G.S.Raghuvanshi, Microwave Circuits and Passive Devices Wiley Eastern Ltd., New Age International Publishers Ltd, 1stEdition, 1995.
5	R.E. Collin, Foundations for Microwave Engineering, IEEE Press, John Wiley.

Sr. No.	**Important web references**
1	http://nptel.ac.in/courses
2	https://swayam.gov.in
3	https://nptel.ac.in/courses/108101112
4	https://onlinecourses.nptel.ac.in/noc25_ee178
5	http://www-group.slac.stanford.edu/kly/Lecture_Series/slac_klystron_lecture_series.htm

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VIII				
Course Code	PEC 411				
Course Category	Program Elective course				
Course title	Satellite & Radar Engineering				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	3		2	03	04
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)	Annalena theory				
Course Rationale	The goal of this course is to make students familiar with how satellites and radars work and applications of these technologies.				
Course Objectives	1. . Introduce student to the fundamental concepts of satellite communication, satellite subsystems and their operation. 2. Enable the student to locate satellite and determine antenna angles for establishment of link. 3. Enable student to analyse, design satellite link and evaluate performance of satellite link. 4. Make students aware about different satellite applications 5. To study the principles of operation of various blocks of Radar systems and Radar Range equation 6. . Make students aware about different types of radars and their applications.				
Course Outcomes	Students are able to 1. Explain basic satellite system with its subsystems. 2. . Define orbital parameters and determine antenna look angles. 3. Classify types of losses and formulate power link budget for satellite. 4. Illustrate applications of satellite communication such as DBS, VSAT and GPS. 5. Determine range, power and other performance parameters required 6. Differentiate between different types of radars with their application.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	2												
CO 2	3	3	2											1
CO 3	3	3	3	2	2								2	1
CO 4	3	3	2	2									1	2
CO 5	3	3	2	2									3	2
CO 6	2	2				2	1					2		1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Introduction to Satellite Systems** Introduction, Frequency Allocations, Satellite services, Satellite Subsystem: Attitude and Control System (AOCS), Telemetry, Tracking, Command and Monitoring, Power Systems, Communication Subsystem, Satellite Antennas, Equipment Reliability and Space Qualification	**07**
2	**Orbital Mechanics and Geostationary Satellite** Introduction, Kepler's Laws, Orbital Elements, Orbit Perturbations, Inclined Orbits, Local Mean Solar Time and Sun-Synchronous Orbits, Antenna Look Angles Determinations, Limits of Visibility, Earth Eclipse of Satellite, Sun Transit Outage, Polar Orbiting Satellites.	**06**
3	**Satellite Link Design** Introduction, Atmospheric Losses, Ionospheric Effects, Rain Attenuation, Transmission Losses, Link Power Budget Equation, System Noise, Carrier to Noise Ratio for Uplink and Downlink, Combined Uplink and Downlink Carrier to Noise Ratio, Inter Modulation Noise.	**07**
4	**Satellite communication applications** Introduction to DBS system: Orbital Spacing, Power Rating and Number of Transponders, Frequencies and Polarization, Transponder Capacity; Home DBS system: Home Receiver Outdoor Unit (ODU), Home Receiver Indoor Unit (IDU), Satellite Mobile Services, VSATs, Global Positioning Satellite System (GPS), Prominent space agencies of the world, ISRO – Activities & Services, ISRO- Satellite Navigation Services.	**07**
5	**RADAR**	**06**

	Fundamentals Basic RADAR, Radar range equation, Radar Block Diagram, Radar Frequencies, Applications of radar, Detection of signals in Noise, Receiver Noise and the signal to noise ratio, Radar Cross Section of Targets, Transmitter Power, PRF, Antenna Parameters, System Losses, Display methods.	
6	**RADAR Systems** Types of Radar, CW Doppler Radar, Moving Target Indication radar, Pulsed Radar System, Frequency modulated CW Radar, Phased Array Radar: Principles, Operation, Performance, Limitations and Applications. Overview of Indian Radars.	**06**

General Instructions:

Based on the syllabus content students have to complete any one of the following activities:

1. Simulation based small project work
2. Case study work
3. Site visit
4. Solve technical quiz5. Solve home assignments
6. Question paper will be based on all six units covering of theory , derivations and numericals.

Sr. No.	**Reference Books**
1	Satellite Communications - Dennis Roddy - Mc-Graw Hill Publication
2	Introduction to Radar System - M. I. Skolnik ,Mc-Graw Hill publication
3	**4. Satellite Communications Systems Engineering: Atmospheric Effects, Satellite Link Design and System Performance - Louis J. Ippolito, Jr. -John Wiley and Sons, Ltd, Publication**
4	Satellite Communications Systems: Systems, Techniques and Technology, Michel 5. Bousquet Gerard Maral, Wiley
5	Satellite Communications, Robert M. Gagliardi, CBS Publishers
6	Principles of Radar, Toomay J.C, PHI Publications
7	**Satellite Communication Engineering** – Michael O. Kolawole
8	**Satellite Communication : Concepts and Applications** – Raja Rao (PHI)
9	**Microwave, Radar & RF Engineering** – by Prakash Kumar Chaturvedi
Sr. No.	**Important web references**
1	https://swayam.gov.in/
2	https://nptel.ac.in/

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VIII				
Course Code	PEC411L				
Course Category	Program Elective Course				
Course title	**Satellite & Radar Engineering Laboratory**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	-	0	2-	02	01
Evaluation Scheme	**IOE=50**			**IE: 50**	**Total=50**
Pre-requisites (if any)	Antenna theory				
Course Rationale	The goal of this course is to make students familiar about how satellites and radars work and applications of these technologies.				
Course Objectives	1. Introduce student to the fundamental concepts of satellite communication, satellite subsystems and their operation. 2. Enable the student to locate satellite and determine antenna angles for establishment of link. 3. Enable student to analyze, design satellite link and evaluate performance of satellite link. 4. Make students aware about different satellite applications 5. To study the principles of operation of various blocks of Radar systems and Radar Range equation. 6. Make students aware about different types of radars and their applications.				
Course Outcomes	Students are able to 1. Explain basic satellite system with its subsystems. 2. 2.Define orbital parameters and determine antenna look angles 3. 3.Classify types of losses and formulate power link budget for satellite. 4. 4.Illustrate applications of satellite communication such as DBS, VSAT and GPS. 5. Determine range, power and other performance parameters required for radar. 6. 6. Differentiate between different types of radars with their application.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	2										1		
CO 2	3	3	2									1		1
CO 3	3	3	3	2	2							1	1	2
CO 4	2		2		2	2				1		1	3	3
CO 5	3	3	3	2	2							1	2	2
CO 6	2	2	2			2				1		1	2	2

Level of Mapping as: Low 1, Moderate 2, High 3

	Practical / Tutorial List	**Hours**
1	Study of Satellite communication System	**02**
2	**Establishment of a Direct Communication Link.**	**02**
3	**Verification of Direct Communication Link.**	**02**
4	Demonstration of transmission & reception of Function Generator Waveforms through Direct Link	**02**
5	Demonstration of transmission & reception of multiple Signals simultaneously through Direct Link.	**02**
6	Establishment of an Active Satellite Link.	**02**
7	Verification of Satellite Communication Link.	**02**
8	Demonstration of transmission & reception of Function Generator Waveforms through Satellite Link.	**02**
9	Demonstration of transmission & reception of multiple Signals simultaneously through Satellite Link.	**02**
10	Study of Global Positioning System & IRNSS.	**02**
11	Study of Doppler Radar	**02**
12	Measurement of Velocity and Vibrations using RADAR	**02**
13	Study of Radar based alarm system and object detection	**02**

General Instructions:

1. Minimum 8 tutorials should be carried out based on above list or syllabus.
2. Batch wise tutorials are to be conducted. The number of students per batch should be as per the practical batches.

3.Students must be encouraged to solve engineering mathematics problems using different mathematical software's like MATLAB, Scilab etc.	
Sr. No.	**Reference Books**
1	Satellite Communications - Dennis Roddy - Mc-Graw Hill Publication
2	Introduction to Radar System - M. I. Skolnik ,Mc-Graw Hill publication
3	**Satellite Communications systems - M. Richharia - Mc Millan publication**
Sr. No.	**Important web references**
1	https://swayam.gov.in/
2	https://nptel.ac.in/

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VII				
Course Code	PEC 411				
Course Category	Program Elective Course				
Course title	**PLC and Automation**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	--	02	03	04
Evaluation Scheme	**ISE:30**			**ESE:70**	**Total=100**
Pre-requisites (if any)					
Course Rationale	This course deals with the study of PLC architecture, ladder diagram and programming.				
Course Objectives	1. Understand the evolution and need of automation 2. Study the PLC and their types 3. Study the programming concept in PLC 4. Understand the need of PLC in automation 5. Study the commissioning and maintenance of PLCs 6. Study of the SCADA				
Course Outcomes	Students will be able to: 1. Explain the need of automation for industry and society 2. Describe the PLC types and architecture 3. Write program for PLC to control the application 4. Explain the role of PLC in manufacturing automation. 5. Explain the role of PLC in process automation. 6. Discuss the installation and commissioning issues in PLCs				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8		PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	1				2	2	1				1		
CO 2	3	2			2							1	2	
CO 3	3	3	3	2	3				1			1	3	2
CO 4	3	2	3	2	3	2			1		1		3	3
CO 5	3	2	3	2	3	2	2		1		1		3	3
CO 6	2	2	1		2	2		1	1	1	2	2	2	1

Level of Mapping as: Low 1, Moderate 2, High

Unit No.	Course Content	Hours
1	**Introduction to Automation** Introduction to Automation, Evolution of Industrial Automation. Controllers, Role of PLC in automation, PLC Types, PLC programming, Standard Hierarchical Automation Systems Levels, Functional Levels & Database Organization. Automation in manufacturing and process control. Automation options with merits and demerits – PC, DCS, PLC, Fieldbus & hybrid architectures- selection criteria and comparative study	06
2	**Fundamentals of PLC** Families, Processors, operation, Programming tools, memory structure, access & programming modes. PLC Hardware- Physical components, racks, slot, Power, CPU, Discrete & Analog Input/Output modules, RTUs & HMI panels Programming Numbering systems, Ladder Logic Symbols, Instructions, Program Logic Development, testing & debugging.	06
3	**PLC programming** Programming Language Standards IEC 61131-3: IL, ST, SFC, FBD, L L Programming, Multi Rung Ladders, Sequence, Logic, transfer of control timers & counters. Process Interfacing elements- analog sensors, digital sensors, actuators, Linear & Rotary Encoders.	06
4	**PLC in manufacturing and process automation** Logic Development steps for programming, Fail safe Programming, Emergency shutdown, Safety Interlocks Case Studies- AC/ DC Motor Controls, Variable speed AC motor drives, conveyer belt, robots, CNCs, Computer integrated manufacturing. Control strategies in process automation- Auto/Manual control, Open loop, closed loop, on-off. Case Studies- Temperature control system, Level control system, Pressure & flow control, Continuous & Batch processing.	06
5	**Commissioning & Maintenance** Project Planning, installation and verification, Project & Program Documentation. PLC Fault Handling & Diagnosis, Redundant configurations, networking.	06
6	**SCADA** Plant monitoring & control based on SCADA. Functions of SCADA, PLC/SCADA Communication, Graphics & HMI, animation, database configuration, Real-Time & historical trends, wireless controls.	09

General Instructions:

Based on the syllabus content students have to complete any one of the following activities:

1. Simulation based small project work
2. Case study work
3. Site visit
4. Solve technical quiz
5. Solve home assignments
6. Question paper will be based on all six units covering of theory, derivations and numerical.

Sr. No.	Reference Books
1	Programmable Logic Controllers, John & Fredric Hackworth, Pearson
2	Programmable Logic Controllers, Webb & Reis, PHI
3	Distributed computer control for Industrial Automation, Popovic & Bhatkar
4	Introduction to Programmable Logic Controllers, Gary Dunning, Thomson
5	SCADA: Supervisory Control and Data Acquisition By: Stuart Boyer ISA
Sr. No.	**Important web references**
1	https://swayam.gov.in/
2	https://nptel.ac.in/

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VII				
Course Code	PEC 411L				
Course Category	Program Elective Course				
Course title	**PLC and Automation Laboratory**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	-	--	02	02	01
Evaluation Scheme	**-**			**EE: 50**	**Total=50**
Pre-requisites (if any)					
Course Rationale	This course deals with the study of PLC architecture, ladder diagram and programming.				
Course Objectives	1. Understand the evolution and need of automation 2. Study the PLC and their types 3. Study the programming concept in PLC 4. Understand the need of PLC in automation 5. Study the commissioning and maintenance of PLCs 6. Study of the SCADA				
Course Outcomes	Students will be able to: 1. Explain the need of automation for industry and society 2. Describe the PLC types and architecture 3. Write program for PLC to control the application 4. Explain the role of PLC in manufacturing automation. 5. Explain the role of PLC in process automation. 6. Discuss the installation and commissioning issues in PLCs				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	1				2	2	1				1		
CO 2	3	2			2							1	2	
CO 3	3	3	3	2	3				1			1	3	2
CO 4	3	2	3	2	3	2			1		1		3	3
CO 5	3	2	3	2	3	2	2		1		1		3	3
CO 6	2	2	1		2	2		1	1	1	2	2	2	1

Level of Mapping as: Low 1, Moderate 2, High 3

	Practical / Tutorial List	Hours
1	Demonstration PLC Architecture and PLC Software Installation.	**02**
2	Logic gates by using PLC.	**02**
3	Implementation of Boolean Logic and Multiplexer Using PLC	**02**
4	Delay Generation for Event Control	**02**
5	Analog signal interfacing and sensing	**02**
6	Digital signal interfacing and sensing	**02**
7	DC motor control	**02**
8	Switch interfacing and sensing	**02**
9	AC motor control	**02**
10	Pulse counter application	**02**
11	Relay interfacing and controlling	**02**
12	Stepper motor control	**02**
13	SCADA based system simulation	**02**

General Instructions:

1. A minimum of eight practical shall be conducted in accordance with the prescribed syllabus.
2. Practical sessions shall be conducted batch-wise, with the batch strength as approved by the institute.
3. Students shall be encouraged to apply engineering mathematics concepts using appropriate computational software tools such as MATLAB, Scilab, or equivalent, wherever applicable.

Sr. No.	Reference Books
1	Programmable Logic Controllers, John & Fredric Hackworth, Pearson
2	Programmable Logic Controllers, Webb & Reis, PHI
3	Distributed computer control for Industrial Automation, Popovic & Bhatkar
4	Introduction to Programmable Logic Controllers, Gary Dunning, Thomson
5	SCADA: Supervisory Control And Data Acquisition By : Stuart Boyer ISA
Sr. No.	**Important web references**
1	https://swayam.gov.in/
2	https://nptel.ac.in/

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VII				
Course Code	OEC411				
Course Category	Open Elective Course				
Course title	**Finance Management**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03			03	03
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)					
Course Rationale	In this course of students will learn basics of personal financial planning and management.				
Course Objectives	1. Develop financial literacy among engineering students to help them make informed personal and professional financial decisions. 2. Introduce the concepts of financial planning, money management, budgeting, taxation, and credit management. 3. Enable students to understand consumer purchasing decisions, housing, insurance, and risk management. 4. Provide knowledge of investment planning, including stocks, bonds, mutual funds, real estate, and other financial instruments. 5. Create awareness about retirement planning and long-term financial security. 6. Equip students with practical skills to manage financial resources effectively throughout their career and life.				
Course Outcomes	Student will be able to: 1. Understand and apply the principles of **financial literacy and financial planning**, including time value of money and opportunity cost. 2. Prepare and analyze **personal financial statements**, budgets, tax plans, and manage daily financial needs effectively. 3. Evaluate **financial services, savings plans, and consumer credit**, and assess the cost and implications of borrowing. 4. Analyze **consumer purchasing decisions**, including major purchases such as vehicles and housing, along with legal consumer protections. 5. Assess various **insurance products** (life, health, property, automobile) and apply risk management techniques for asset protection. 6. Develop an **investment plan**, evaluate investment alternatives, and understand risk-return trade-offs in stocks, bonds, mutual funds, real estate, and other assets.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	1				2		2			2	3		2
CO 2	2	2				2		2			3	3		3
CO 3	2	2				2		2			3	2		2
CO 4	1	2				3		2			2	2		2
CO 5	2	2				3		3			2	2		2
CO 6	2	3				2		2			3	3		3

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Financial Planning** What is Financial Literacy and financial planning, Need of financial planning, The Financial Planning Process, Opportunity Costs and the Time Value of Money, Financial Aspects of Career Planning: Employment Search Strategies, Financial and Legal Aspects of Employment. Money Management Strategy: Personal Financial Statements, Budgeting for Skilled Money Management, Planning Your Tax Strategy: Income Tax Fundamentals, Filing Your Federal Income Tax Return, Tax Planning Strategies.	**07**
2	**Financial Management** Financial Services for Financial Planning: Managing Daily Money Needs, Types of Financial Services, Savings Plans, Evaluating Savings Plans, Payment Methods. Introduction to Consumer Credit: Measuring Your Credit Capacity, Applying for Credit, Complaining about Consumer Credit, The Cost of Credit.	**06**
3	**Purchasing Decisions** Consumer Purchasing Strategies, Financial Implications of Consumer Decisions, Major Consumer Purchases: case study-vehical, Legal Options for Consumers. The Housing Decision: Housing Alternatives, The Home-Buying Process, The Finances of Home Buying, Selling Your Home.	**07**
4	**Insuring the assets and Resources** Insurance and Risk Management: An Introduction, Property and Liability Insurance, Home and Property Insurance, Home Insurance Cost Factors, Automobile Insurance Coverage and cost. Health insurance: Health Care Costs, Health Insurance and Financial Planning, Private Sources of Health Insurance and Health Care, Government Health Care Programs, Life Insurance: Determining Your Life Insurance Needs, Important Provisions in a Life Insurance Contract, Buying Life Insurance, Life Insurance Proceeds.	**07**
5	**Investing Your Financial Resources**	**06**

	Preparing for an Investment Plan, Factors Affecting the Choice of Investments, Factors That Reduce Investment Risk, Investing in Stocks: Evaluating a Stock Issue, Numerical Measures That Influence Investment Decisions, Buying and Selling Stocks. Investing in Bonds and Mutual funds: Types of Bonds, Government Bonds and Debt Securities, factors Deciding to Buy or Sell Bonds, Classifications of Mutual Funds, deciding factors to Buy or Sell Mutual Funds. Investing in Real Estate, Advantages and disadvantage of Real Estate Investments, Investing in Precious Metals, Gems, and Collectibles.	
6	Controlling financial future Why Retirement Planning, Retirement Living Expenses, conducting a Financial Analysis, Planning Your Retirement Income, Living on Your Retirement Income.	**06**

General Instructions:

Based on the syllabus content students have to complete any one of the following activities:

1. Simulation based small project work
2. Case study work
3. Site visit
4. Solve technical quiz
5. Solve home assignments
6. Question paper will be based on all six units covering of theory , derivations and numericals.

Sr. No.	**Reference Books**
1	Jack R. Kapoor, Les R. Dlabay, Robert j. Hughes, Melissa m. Hart, “Personal Finance”, The McGraw-Hill Education Publication.
2	Madura , Casey, Roberts , “Personal Financial Literacy”, Pearson Educatio
Sr. No.	**Important web references**
1	https://swayam.gov.in/
2	https://nptel.ac.in/

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VII				
Course Code	OEC411				
Course Category	Open Elective Program				
Course title	**Human Resource Management**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	3			3	3
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)					
Course Rationale	Human Resource Management is a core management subject that focuses on the effective utilization of human resources in organizations. The course provides students with a comprehensive understanding of HR concepts, principles, and practices such as manpower planning, recruitment, training, compensation, industrial relations, and employee welfare. It helps learners develop managerial skills, ethical values, and a people-oriented approach essential for achieving organizational effectiveness and sustainable growth in a competitive business environment.				
Course Objectives	1. To develop managerial and leadership skills for business environments. 2. To provide knowledge of modern business and management practices. 3. To enhance analytical and decision-making abilities. 4. To promote ethical behavior and social responsibility. 5. To prepare students for employment, entrepreneurship, and higher studies. 6. To improve communication, teamwork, and interpersonal skills.				
Course Outcomes	Students are able to 1. Explain the fundamental concepts, functions, and systems approach of HRM. 2. Demonstrate understanding of manpower planning, job analysis, and job evaluation. 3. Analyze recruitment, selection, induction, and placement procedures. 4. Apply training, performance appraisal, and compensation techniques. 5. Examine industrial relations and labor dispute management. 6. Formulate solutions for grievance handling, discipline, and employee participation.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	2	1	1			2	1	1	1	1	1	1	1
CO 2	3	3	2	1			2	1	1	1	1	1	1	1
CO 3	2	3	2	2			2	2	1	1	1	2	1	1
CO 4	2	3	3	2			2	2	1	1	1	2	1	1
CO 5	2	3	1	2			2	2	1	1	1	2	1	1
CO 6	1	3	2	3			3	2	1	1	2	3	1	1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	Human Resource Management – Definition, Concept, Objectives, Characteristics, Functions – Systems approach to personnel Management – Organisational structures.	07
2	HR Planning & Staffing Man Power Planning, Job analysis, Job description, Job specification, Job Evaluation, Recruitment and selection Process.	06
3	**Recruiting HR:** Nature, Purpose, Factors and Process, Evaluation and Control, Effective recruiting internal and external sources, Selection, Selection process, Employee induction and Placement: Requisites & Problems.	
4	**Employee Management** Training of employees, supervisors and Executives – Promotions – Demotions, Transfer, Absenteeism, Turnover, Employee Remuneration: Wages and Salary Administration – Rewards and Incentives, Benefits and Employee Services – Performance appraisal	07
5	**Industrial Harmony** Definition – Significance Causes for poor industrial Relations Suggestions to Improve Industrial Relations – Labour disputes and Industrial Relations in India.	07
6	Workers' Participation & IR Workers Participation in Management, Collective Bargaining and Industrial relations – Employee Grievance Procedures & Industrial Disciplinary System.	06
General Instructions:		

Based on the syllabus content students have to complete any one of the following activities: 1. Simulation based small project work 2. Case study work 3. Site visit 4. Solve technical quiz 5. Solve home assignments 6. Question paper will be based on all six units covering of theory , derivations and numericals.	
Sr. No.	**Reference Books**
1	Personnel Management : EDWIN & FLIPPO
2	Personnel Management : C.B.MAMORIA
3	Industrial Relations in India : CHARLES MYERS
4	Labour Problem in India : MAHINDRA
Sr. No.	**Important web references**
1	https://swayam.gov.in/
2	https://nptel.ac.in/

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VII				
Course Code	PSI 411				
Course Category	Project based learning				
Course title	**Major Project-I**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	-	-	02	02	01
Evaluation Scheme	**-**			**IE: 100**	**Total=100**
Pre-requisites (if any)	Knowledge of electronics circuit design, Microcontrollers, Digital Electronics, VLSI Design courses is desirable				
Course Rationale	This course deals with identifying, classifying and formulating the problem and finding technological solution to correct the problem. The students are encouraged to find the technological solution on societal, environmental related problems.				
Course Objectives	1.Understand basic stages in electronic system design 2.Surveying the problem and finding technological solution. 3.Designing electronics systems. 4.Learning and using circuit simulation and development tools 5.Working in team to accomplish task 6.Project management and life-long learning				
Course Outcomes	Students are able to 1. . Identify social, environmental, market needs and solutions. 2. . Explain design and development stages in electronics engineering projects 3. . Apply engineering knowledge for solving real world problems. 4. Manage project and finance. 5. Provide technological solutions on recent problems and lifelong learning. 6. Work in team, follow ethical practices, and prepare documentation and presentation.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	2	3	2	2	3	3	0	0	0	0	0	2	1
CO 2	3	3	3	2	3	1	0	0	1	0	0	0	3	1
CO 3	3	3	3	2	3	2	0	0	2	0	0	2	3	2
CO 4	1	0	0	0	1	0	0	0	1	0	3	0	2	3
CO 5	3	3	3	2	3	2	0	0	0	0	0	3	2	2
CO 6	1	1	1	1	0	1	0	3	3	3	2	0	1	1

Level of Mapping as: Low 1, Moderate 2, High 3

	Course Curriculum	Hours
	The project work is to be carried out in two semesters of final year B. Tech. (E & TC), semester VII & VIII. Each major project group will consist of maximum 3 students. In semester – VII, group will select a project with the approval of the guide and submit the synopsis of project in the month of August. The group is expected to complete detailed system design, layout etc. and at least 80% project work should be completed in semester – VII, as a part of term work. In addition, all students of project group will deliver the seminar on the proposed project only. Team of faculty members and guide will assess the term work. **If a group of students selects a project under sponsored category from industry, it is essential that they should take prior written permission & approval at the beginning of semester-VII from Head of Institution through Head of Department & Concerned Guide.**	**26**

General Instructions:
Students have to submit the synopsis up to 30th August. They have to submit monthly progress reports. Work in laboratory under supervision of guide. At the time of semester end assessment demonstrate the project. They have to bring model, convey technical details using PPT.

Sr. No.	Reference Books
1	Articles from reputed journals, magazines, websites, real world problems, case studies, Survey reports
2	Institute's Laboratory Course Manual and equipment-wise Standard Operating Procedure to follow.

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VII				
Course Code	VEC411				
Course Category	Value Education Course				
Course title	**Green Technology & Sustainability**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	01	--	--	01	01
Evaluation Scheme	**ISE:50**			**ESE:00**	**Total=50**
Pre-requisites (if any)					
Course Rationale	This course introduces students of all engineering disciplines to the concepts and practices of sustainable development, emphasizing environmentally responsible engineering design and operation. It aims to develop awareness, critical understanding, and innovation for applying **green technologies** that minimize resource consumption, reduce pollution, and promote circular economy approaches. The course empowers engineers to integrate sustainability principles in diverse fields such as manufacturing, infrastructure, computing, food systems, and communication technologies.				
Course Objectives	1. Understand the core principles of sustainability. 2. Explain green technology and eco-innovation concepts. 3. Assess environmental impacts of engineering systems. 4. Identify renewable and resource-efficient alternatives. 5. Integrate sustainable practices in design and operation. 6. Promote responsible and ethical engineering decisions.				
Course Outcomes	students will be able to: 1. Explain sustainability and green engineering principles. 2. Identify major environmental and resource issues. 3. Apply life-cycle and impact assessment tools. 4. Evaluate cleaner and renewable technologies. 5. Design eco-efficient and sustainable solutions. 6. Communicate sustainability ideas effectively.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	2	1				2	3	2		1				1
CO 2	2	2		1		2	3							1
CO 3	1	3	2	2	2		3							2
CO 4	1	2	3	2	2	1	3	1		1				2
CO 5	1	2	3	1	2	2	3	2	1	2				3
CO 6			11		1		2	2	2	3				2

2Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Sustainability Fundamentals** Definition and dimensions of sustainability (environmental, social, economic), Sustainable Development Goals (SDGs) and their engineering relevance Principles of green engineering and sustainable innovation	02
2	**Environmental Challenges & Resource Management** Energy, water, and material resource depletion, Waste generation and its impact across industries	02
3	**Green Technologies & Eco-Innovation** Concepts and case studies in clean and green technologies, Sustainable materials, cleaner manufacturing, digital sustainability (IoT, AI for energy management), Smart cities, green buildings, and sustainable mobility .	03
4	**Life Cycle Thinking & Environmental Assessment** Basics of Life Cycle Assessment (LCA), Carbon and water foot printing, Environmental performance indicators and sustainability metrics	03
5	**Renewable Energy and Sustainable Systems** Solar, wind, hydro, bioenergy, and hydrogen systems, Energy conservation and efficiency improvement, Integration of renewable technologies into engineering design	03
6	**Circular Economy & Sustainable Future**	02

	Waste-to-wealth concepts, product stewardship, recycling loops, Ethical, economic, and policy aspects of sustainability, Case studies and communication of sustainability projects	

General Instructions:

Based on the syllabus content students have to complete any one of the following activities:

1. Simulation based small project work
2. Case study work
3. Site visit
4. Solve technical quiz
5. Solve home assignments
6. Question paper will be based on all six units covering of theory, derivations and numerical.

Sr. No.	Reference Books
1	Allen, D.T., & Shonnard, D.R. (2001). Green Engineering: Environmentally Conscious Design of Chemical Processes. Prentice Hall, New Jersey.
2	Anastas, P.T., & Zimmerman, J.B. (2018). The Twelve Principles of Green Chemistry and Engineering. Oxford University Press, Oxford.
3	Graedel, T.E., & Allenby, B.R. (2010). Industrial Ecology and Sustainable Engineering. Pearson Education, New Jersey
4	Jain, Anil K., "Fundamentals of Digital Image Processing", Prentice Hall of India, New Delhi.
5.	**Azapagic, A., Perdan, S., & Clift, R. (2004). Sustainable Development in Practice: Case Studies for Engineers and Scientists. John Wiley & Sons, Chichester.**

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VII				
Course Code	PSI 412				
Course Category	Project Seminar Internship				
Course title	MDM based Industry Internship				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	--	--	--	One Month	03
Evaluation Scheme	**ISE:50**			**ESE:50**	**Total=100**
Pre-requisites (if any)	---				
Course Rationale	The Industry Internship is designed to bridge the gap between academic learning and real-world industrial practice. It provides students with practical exposure to professional environments, enabling them to understand industry expectations, work culture, and technological trends. Through this course, students receive continuous guidance from both industry and academic mentors, ensuring outcome-oriented learning. The course enhances technical competence, soft skills, and professional ethics of the student.				
Course Objectives	1. To provide an exposure to industrial working environments and professional practices. 2. To enable students to apply theoretical engineering knowledge to practical problems. 3. To develop technical, communication, and teamwork skills. 4. To enhance problem-solving ability and innovative thinking. 5. To prepare students for industry readiness and career development.				
Course Outcomes	Students are able to: 1. Demonstrate practical application of engineering concepts. 2. Use professional tools and technologies. 3. Communicate technical work effectively. 4. Work in multidisciplinary teams. 5. Follow industrial ethics and safety standards. 6. Prepare technical reports and presentations.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3	1	1	--	--	--	--	--	--	1	--	--
CO2	3	1	3	1	3	--	--	--	--	--	--	1	--	--
CO3	--	--	--	--	--	--	--	--	1	3	--	1	--	--
CO4	--	--	--	--	--	--	--	--	3	1	--	1	--	--
Co5	--	--	--	--	--	--	--	3	1	1	1	1	--	--
CO6	--	--	1	--	--	--	--	--	1	3	--	1	--	--

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content
The internship focuses on understanding organizational structure, professional ethics, safety practices, and industry workflows. Students undergo domain-specific technical training using modern tools and technologies relevant to their discipline. They identify practical problems and develop engineering solutions under industry and faculty mentorship. Emphasis is given to teamwork, communication, and professional responsibility. Student should seek to enhance problem-solving, analytical, and documentation skills. Final evaluation is based on mentor feedback, report quality, and presentation performance. The internship prepares students for industry readiness and lifelong learning. Guidelines: • Internship is mandatory for all B.Tech students and must be completed after 4th semester and before 7th semester without hampering the academics. • Internship shall be carried out during approved summer or winter vacation periods only. • Minimum duration of internship is 4 weeks (120 hours). • Internship must be relevant to the student's branch of study. • Each student shall be guided by an Industry Mentor and a Faculty Mentor. • Student must register internship with the department before joining the organization. • Weekly progress should be reported to the faculty mentor. • Student shall maintain an internship logbook duly signed by the industry mentor. • Internship certificate from organization is mandatory for evaluation. • Final evaluation shall include report submission and presentation/viva. • Minimum 80% attendance is required for successful completion. • Internship during academic semester is not permitted without prior approval. • Internship completion is compulsory for degree eligibility.

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VIII				
Course Code	PSI 421				
Course Category	Project Seminar Internship				
Course title	Industrial Internship				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	--	--	--	**One Semester**	10
Evaluation Scheme	**IE:150**			**EE:200**	**Total=350**
Pre-requisites (if any)	---				
Course Rationale	The Industrial Internship aims to provide students with real-time industrial exposure, practical application of engineering knowledge, professional skill development, and understanding of industry practices in Electronics and Telecommunication domains.				
Course Objectives	1. Provide students with real industrial exposure and professional work experience. 2. Enable application of theoretical engineering knowledge to practical industry problems. 3. Develop technical competence using modern engineering tools and technologies. 4. Enhance professional skills such as communication, teamwork, and ethics. 5. Prepare students for industry readiness and career development. 6. To prepare 1.				
Course Outcomes	Students are able to 1. Apply concepts of Electronics and Telecommunication Domain to solve real-world industrial problems. 2. Use modern tools, software, and technologies relevant to Electronics and Telecommunication domain preferred by industry. 3. Demonstrate professional work ethics, safety awareness, and responsibility during Internship. 4. Work effectively as an individual and as a member of multidisciplinary teams. 5. Communicate effectively with peers and organizational superiors. 6. Demonstrate industry readiness and enhance employability.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	3	2	2	2	--	--	--	--	--	--	2		
CO 2	2	2	2	2	3	--	--	--	--	--	--	2		
CO 3	--	--	--	--	--	1	--	3	--	--	--	2		
CO 4	--	--	1	--	--	--	--	--	3	1	--	2		
CO 5	--	--	--	--	--	--	--	--	1	3	--	2		
CO 6	2	2	1	1	2	--	--	--	2	2	1	3		

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content

The Industrial Internship is a full-semester industry-oriented training program conducted in reputed industries, R&D organizations, startups, or government sectors related to Electronics and Telecommunication Engineering. Students work under the guidance of industry and faculty mentors on real engineering problems involving electronics, communication systems, embedded systems, networking, signal processing, VLSI, IoT, or allied areas. The internship emphasizes practical implementation, system understanding, professional ethics, teamwork, and documentation. Students are required to maintain a daily logbook, prepare periodic progress reports, and submit a final technical internship report. The course enhances employability, professional confidence, and industry readiness.

Guidelines, Rules and Regulations

All the B.Tech E&TC students are required to complete an Industrial Internship during the eighth semester of the program. The internship is intended to provide extensive industrial exposure and practical learning experience.

The internship shall be carried out for one full semester in an approved industry, R&D organization, startup, government organization, or reputed IT/technology organization relevant to the student's program. The internship organization must be recommended by the department and approved by the institute prior to commencement.

Students must submit an official offer letter or confirmation letter from the organization to the department before joining the internship. Each student shall be assigned a faculty mentor from the respective program, who will monitor progress and provide academic guidance throughout the internship period.

Students are required to strictly follow the rules, regulations, safety policies, confidentiality agreements, and professional ethics of the internship organization. Any misconduct may lead to cancellation of the internship and disciplinary action as per institute norms.

Change of internship organization is not permitted without prior written approval from the Head of the Department and the institute authorities. At the end of the internship, students must submit a detailed internship report in the prescribed format along with an Internship Completion Certificate issued by the organization.

Failure to complete the internship satisfactorily or failure to submit the required documents within the stipulated time shall result in non-award of credits for the course.

Course Assessment

At the end of the internship, the student shall deliver a presentation before a departmental evaluation committee. The assessment shall be based on the internship report, presentation, technical competence, problem-solving ability, professional attitude, and overall performance during the internship. Internal Evaluation (IE) and End Examination (EE) marks shall be awarded, and grades shall be assigned in accordance with the institute's academic regulations

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VIII				
Course Code	PEC 421				
Course Category	Program Elective Course				
Course title	**Embedded Systems Design**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	--	--	03	03
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)	Digital Electronics, Programming Techniques				
Course Rationale	This course introduces students to the fundamentals of embedded systems, including ASICs, ASIPs, microcontrollers, FPGAs, and real-time operating systems. Students will learn to design, model, optimize, and verify embedded systems, gaining practical skills in hardware-software co-design and low-power implementation. It prepares students for careers in electronics, communication, IoT, and advanced embedded system development.				
Course Objectives	1. Understand embedded systems and application-specific processors, and the basics of single-purpose processor design and optimization. 2. Introduce FPGA architecture, synthesis, and Verilog HDL for digital design. 3. Understand microcontroller architecture and principles of power-aware embedded system design. 4. Introduce real-time operating systems and real-time scheduling algorithms. 5. Understand embedded system modelling, design synthesis, and hardware–software partitioning using practical case studies. 6. design optimization methods and verification techniques for embedded systems.				
Course Outcomes	Students will be able to: 1. Explain embedded systems and application-specific processor concepts. 2. Understand FPGA fundamentals and develop basic digital designs using Verilog HDL. 3. Explain microcontrollers and apply basic power-aware design techniques in embedded systems. 4. Explain RTOS concepts and analyse basic real-time scheduling algorithms. 5. Apply modelling, design synthesis, and hardware–software partitioning in embedded system development. 6. Perform design optimization and verify embedded system designs.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	2										2	3	1
CO 2	3	2	3		3							2	2	3
CO 3	3	2	2		2		2					2	3	2
CO 4	2	3	2	2								2	2	2
CO 5	2	3	3	2	3				2			2	2	3
CO 6	2	3	3	3	3							3	2	3

Level of Mapping as: Low 1, Moderate 2, High-3

Unit No.	Course Content	Hours
1	**Introduction to Embedded Systems and Application-Specific Processors** Introduction to Embedded System, ASICs and ASIPs, Designing Single Purpose Processors and Optimization	07
2	**Introduction to FPGAs and Verilog HDL** Introduction to FPGAs and Synthesis, Verilog Hardware Description Language (Verilog HDL)	06
3	**Microcontrollers and Power-Aware Embedded Design** Microcontrollers and Power Aware Embedded System Design	05
4	**Real-Time Operating Systems and Scheduling** Real Time Operating System, Real Time Scheduling Algorithms	06
5	**Embedded System Modelling and Design Methodology** Modelling and Specification, Design Synthesis, Digital Camera Design and Hardware Software Partitioning	08
6	**Optimization and Verification Techniques** Design Optimization, Simulation and Verification	07

General Instructions:

Based on the syllabus content students have to complete any one of the following activities:

1. Simulation based small project work
2. Case study work
3. Site visit

4. Solve technical quiz 5. Solve home assignments 6. Question paper will be based on all six units covering of theory, derivations and numerical.	
Sr. No.	**Reference Books**
1	A Unified Hardware/Software Introduction by Frank Vahid & Tony Givargis
2	Embedded Systems: Architecture, Programming and Design by Raj Kamal
3	An Embedded Software Primer by David E. Simon
Sr. No.	**Important web references**
1	https://www.nptelprep.in/courses/108105057/videos
2	https://swayam.gov.in/
3	https://nptel.ac.in/
4	https://onlinecourses.nptel.ac.in/noc26_cs54/preview.

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VIII				
Course Code	PEC 421				
Course Category	Program Elective Course				
Course title	**Electric Vehicle Technology for Academia**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	--	--	03	03
Evaluation Scheme	**ISE:30**			**ESE:70**	**Total=100**
Pre-requisites (if any)	Digital Electronics, Programming Techniques				
Course Rationale	This course introduces the fundamentals and advanced concepts of electric vehicle technology, including powertrains, electric drives, energy storage, and control systems. It prepares students to address sustainability challenges and meet industry demands in electric mobility through engineering analysis and design.				
Course Objectives	1. Introduce the history, evolution, architecture, and key components of electric vehicles and different EV types. 2. Understand embedded control systems in EVs and the role of power electronics converters in energy conversion and management. 3. Study different electric motors, their controllers, regenerative braking, and integration with EV systems. 4. Provide knowledge of battery technologies, management systems, and charging methods for electric vehicles. 5. Develop understanding of EV modelling, design principles, performance calculations, and safety standards. 6. Study advanced driver assistance systems (ADAS) and autonomous vehicle technologies including sensors, navigation, and control systems.				
Course Outcomes	Students will be able to: 1. Describe EV history, types, powertrain architecture, and key components. 2. Explain VCU, embedded controllers, automotive applications, and analyze power electronic converters. 3. Select suitable motors (Induction, BLDC, PMSM, SRM), understand controllers, regenerative braking, and integration. 4. Compare battery types, analyse Li-ion packs, evaluate energy density and lifetime, and explain BMS and EV charging. 5. Model vehicle dynamics, battery, motors, and power electronics; design EV components; calculate performance and apply safety standards. 6. Describe ADAS functions, autonomous vehicle components, path planning, obstacle avoidance, and integrate sensing and control.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	2					2						2	
CO 2	3	3	2		3								3	2
CO 3	3	3	2		3								3	2
CO 4	3	3	2	2			2						3	2
CO 5	3	3	3	2	3		2					2	3	3
CO 6	3	3	2	2	3							2	3	3

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Electric Vehicle Components and Architecture** History of electric vehicles; automobile powertrain; architecture of electric vehicles; types of electric vehicles; breakdown of key components in EV.	05
2	**Embedded Controllers and Power Electronics for EV** Embedded controllers for EV; vehicle control unit (VCU); controllers used in EV; automotive embedded applications; power semiconductor devices; rectifiers; DC–DC converters; inverters; bidirectional chargers; hybrid-bridge-based dual active bridge (DAB) converter—working principle, performance, voltage-mode control; dual-transformer-based DAB converter; three-level bidirectional DC–DC converter; applications.	08
3	**Electrical Motors and Drives for EV** Induction motors; permanent magnet brushless DC motor; switched reluctance motor; permanent magnet synchronous motor and their controllers; regenerative braking; integration with vehicle systems.	06
4	**Battery Technology, BMS, and EV Charging** Battery technology: batteries and types of batteries, lithium-ion battery, battery packs, energy density and range, battery degradation and lifetime, emerging battery technologies; battery management system (BMS): functions, state of charge (SoC), depth of discharge (DoD), state of health (SoH), temperature management, cell balancing, active and passive balancing, charging control, sensors, user interface and communication; electric vehicle charging: on-board and off-board chargers, Level 1 and Level 2 charging, DC fast charging, charging connectors, range and efficiency.	08

5	**Modelling, Design, and Safety of Electric Vehicles** EV modelling and simulation: vehicle dynamics, battery, motor and power electronics, thermal management, system-level integration; EV design: motor and power pack sizing, gearbox and gear ratio, torque–speed characteristics, vehicle motion equations, tractive effort, acceleration, rated speed, gradability, brake performance, electronic control system, range calculation; EV standards and safety: vehicle and electrical safety standards, cell testing and certification, thermal management, crash and fire safety, government incentives and policies .	**07**
6	**ADAS and Autonomous Vehicles** Advanced driver assistance systems—adaptive cruise control, lane departure warning (LDW) and lane keep assist (LKA), automatic emergency braking, blind spot detection (BSD) and rear cross traffic alert, traffic sign recognition, driver monitoring systems, gesture control and voice recognition; autonomous vehicles—drive-by-wire, LiDAR, camera, computing unit, navigation system, path planning, path following, vector map building, obstacle avoidance, traffic lights recognition, open CAN interface.	**05**

General Instructions:

Based on the syllabus content students have to complete any one of the following activities:

1. Simulation based small project work
2. Case study work
3. Site visit
4. Solve technical quiz
5. Solve home assignments
6. Question paper will be based on all six units covering of theory, derivations and numerical.

Sr. No.	**Reference Books**
1	Modern Electric Vehicle Technology – C.C. Chan & K.T. Chau
2	Electric and Hybrid Vehicles: Design Fundamentals – Iqbal Hussein
3	Electric Vehicle Technology Explained – James Larminie & John Lowry
4	Electric Vehicle Battery Systems – Sandeep Dhameja
5	Motor Drives: Modelling, Analysis & Control – R. Krishnan
6	Power Converters for Electric Vehicles – L. Ashok Kumar & S. Albert Alexander
Sr. No.	**Important web references**
1	https://swayam.gov.in/
2	https://onlinecourses.swayam2.ac.in/ntr26_ed15/preview
3	https://onlinecourses.swayam2.ac.in/
4	https://nptel.ac.in/

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VIII				
Course Code	PEC 422				
Course Category	Program Elective Course				
Course title	Advanced Computer Networks				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03			03	03
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)					
Course Rationale	This course introduces advanced networking concepts such as high-performance routing, SDN, NFV, programmable networks, and data center networking, preparing students to understand and work with modern and future network architectures.				
Course Objectives	1. To understand the principles of high-performance switching and routing in modern networks. 2. To study packet classification, Quality of Service, and traffic management techniques. 3. To introduce network softwarization concepts including SDN and NFV. 4. To explore programmable networks, data center networking, and virtualization technologies. 5. To understand content-centric and information-centric networking architectures. 6. To provide hands-on exposure using network emulation and simulation tools.				
Course Outcomes	Students are able to 1. . Explain high-performance switching, routing, and IP lookup mechanisms. 2. . Analyze packet classification methods and QoS techniques for traffic management. 3. Describe SDN and NFV architectures and their role in modern networks. 4. . Implement basic SDN, NFV, and programmable network concepts using tools like Mininet 5. Explain data center networking architectures and container networking concepts. 6. Understand content distribution, ICN/NDN architectures, and related security mechanisms.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	2	1										3	
CO 2	3	3	2	1									3	
CO 3	3	2	2										2	
CO 4	2	2	3		1								2	3
CO 5	1	2	2		3								3	1
CO 6	2	1	1										2	

Level of Mapping as: Low 1, Moderate 2, High-3

Unit No.	Course Content	Hours
1	**High-Performance Switching & Routing** Switching vs Routing: Throughput, latency, packet loss, IP Lookup: Longest Prefix Match, routing tables, Algorithms: Trie, Patricia Trie, Hashing, Optimization: Table compression, caching, hardware (CAM/TCAM), Applications: High-speed routers, data centres, SDN	07
2	**Packet Classification & QoS** Packet Classification: Need, methods, DiffServ: Traffic priority, QoS: Delay, jitter, loss Traffic Control: Shaping, policing	06
3	**Network Softwarization & SDN** Network Softwarization: Introduction, SDN: Concept, architecture SDN Interfaces: Northbound & Southbound, Mininet: SDN emulation, basic lab exercises	07
4	**NFV & Programmable Networks** NFV: Concepts, architecture, Programmable Networks: Overview, P4: Introduction, SmartNICs & P4 Switches: Basics, Lab: Mininet with BMV2	07
5	**Data Centre Networking (DCN)** DCN: Introduction, DCN Architecture: Overview, Topologies: Fat-tree, Leaf–Spine, Container Networking: CNI basics	06
6	**Content-Centric & Information-Centric Networking** Content Distribution: Internet models, ICN: Architecture overview, Content Naming: Naming schemes, Routing & Caching: Data delivery, NDN Security: Basics	06

General Instructions:

Based on the syllabus content students have to complete any one of the following activities:

1. Simulation based small project work
2. Case study work
3. Site visit
4. Solve technical quiz
5. Solve home assignments
6. Question paper will be based on all six units covering of theory , derivations and numerical.

Sr. No.	Reference Books
1	High Performance Switches and Routers, H. Jonathan Chao, Bin Liu, 2007, John Wiley & Sons, Inc. ISBN-10: 0-470-05367-
2	. Information-Centric Networks: A New Paradigm for the Internet (Focus Series in Networks and Telecommunications), Gabriel M. de Brito, Pedro B. Velloso, Igor M. Moraes, Wiley-ISTE; 1st edition, 2013, ISBN
3	. Information-Centric Networking (ICN): Content Centric Networking (CCNx) and Named Data Networking (NDN) Terminology, B. Wissingh, C. Wood, A. Afanasyev, L. Zhang, D. Oran and C. Tschudin, RFC 8793, June 2020
4	Software-Defined Networks: A Systems Approach, Peterson, Cascone, O'Connor, Vachuska, and Davie, Online Free Reference Book available at https://sdn.systemsapproach.org/index.html
5	Cloud Networking: Understanding Cloud-based Data Centre Networks, Gary Lee (Author), Morgan Kaufmann (Publisher), 2014,ISBN-139780128007280
Sr. No.	**Important web references**
1	https://swayam.gov.in/
2	https://nptel.ac.in/
3	https://onlinecourses.nptel.ac.in/noc26_cs60/preview

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VIII				
Course Code	PEC 422				
Course Category	Program Elective Course				
Course title	Foundation of Virtual and Augmented reality systems				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	3			03	03
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)	Computer Graphics & 3D Modeling				
Course Rationale	This course provides a foundation in **Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR)** systems, focusing on both theoretical concepts and practical applications. It introduces students to XR hardware and software, human factors, system design, implementation, and optimization techniques. Through case studies, students gain hands-on understanding of the **Interactive System Development Life Cycle (ISDLC)**, user experience design, and resource management. The course equips students with the knowledge and skills required to design, implement, and optimize immersive XR applications across diverse domains such as gaming, education, healthcare, and industry.				
Course Objectives	1. Understand the fundamentals, categories, and applications of VR, AR, and MR. 2. Explore XR hardware components, software platforms, and tracking technologies. 3. Analyze human factors and multisensory perception for immersive XR experiences. 4. Apply the Interactive System Development Life Cycle (ISDLC) for designing XR systems using case studies. 5. Implement XR applications, integrate systems, and optimize user experience. 6. Evaluate system resources and apply computer graphics and optimization techniques for XR system efficiency.				
Course Outcomes	Students are able to 1. Explain the fundamentals, applications, and challenges of VR, AR, and MR. 2. Identify XR hardware components, tracking systems, and software platforms. 3. Analyze human factors and sensory perception for immersive XR experiences. 4. Apply the ISDLC to design XR systems using case studies. 5. Implement XR applications and optimize user experience. 6. Evaluate resources and apply optimization and computer graphics techniques for XR systems				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO 1	3	2										1	2	3
CO 2	2	3	3		3								2	3
CO 3	2	3	2		3								3	2
CO 4	2	3	3	2	3								3	2
CO 5	2	2	3	3	3				2				3	2
CO 6	2	3	2	3	2		2					3	3	2

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Introduction to Virtual and Augmented Reality Systems** Introduction to Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR). Application domains and system categories of VR and AR. Basic definitions and key terminology. Historical evolution of VR and AR technologies. Issues and challenges in VR/AR systems. Concept, causes, and mitigation of cybersickness.	**07**
2	**XR Hardware and Software** VR and AR hardware components. Head-mounted displays, sensors, and input/output devices. Fundamentals of tracking systems and techniques. VR software architecture and development platforms. AR software frameworks and toolkits.	**06**
3	**Human Factors in XR Experience** XR as interactive systems. Human factors influencing user experience in XR. Visual perception and display technologies. Auditory perception and immersive audio. Role of haptics and other sensory modalities in achieving full immersion.	**07**
4	**Building an XR System – Case Study Approach** Overview of XR system development using the Interactive System Development Life Cycle (ISDLC). Case Study 1: Requirement gathering and analysis Case Study 2: System design and architecture Case Study 3: Planning for implementation of XR applications	**07**
5	**System Implementation and Optimization – Case Study Approach** Implementation and optimization of XR systems using insights from Case Studies : Case Study 1: System coding, integration, and initial testing of XR application.	**06**

	Case Study 2: Implementation of XR interaction modules and debugging. Case Study 3: Optimization of user experience, including navigation time, navigation paths, immersive interaction, and overall efficiency	
6	**System and Resource Optimization** Techniques for optimizing XR systems and resources. Introduction to computer graphics for XR applications. Understanding resource requirements and applying resource optimization methods. Future directions in XR system design.	**06**

General Instructions:

Based on the syllabus content students have to complete any one of the following activities:

1. Simulation based small project work
2. Case study work
3. Site visit
4. Solve technical quiz
5. Solve home assignments
6. Question paper will be based on all six units covering of theory , derivations and numericals.

Sr. No.	**Reference Books**
1	Bhattacharya, S. (2019). Human-Computer Interaction: User-Centric Computing for Design, McGraw-Hill India..
2	Bhattacharya, S. (2015). Computer Graphics. Oxford University Press
3	Gerald, J. (2015). The VR Book: Human-Cantered Design for Virtual Reality. ACM and & Morgan & Claypool Publishers
4	LaValle, S. M. (2023). Virtual Reality. Cambridge University Press
5	Several topic specific research articles, which will be mentioned at the end of each lecture.
Sr. No.	**Important web references**
1	https://swayam.gov.in/
2	https://nptel.ac.in/
3	https://onlinecourses.nptel.ac.in/noc26_cs03/preview

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VIII				
Course Code	PSI 424				
Course Category	Project Based Learning				
Course title	**Major Project-II**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	-	-	02	02	01
Evaluation Scheme	**EE-50**			**IE: 50**	**Total=100**
Pre-requisites (if any)	Knowledge of electronics circuit design, Microcontrollers, Digital Electronics, VLSI Design courses is desirable				
Course Rationale	This course deals with identifying, classifying and formulating the problem and finding technological solution to correct the problem. The students are encouraged to find the technological solution on societal, environmental related problems.				
Course Objectives	1.Understand basic stages in electronic system design 2.Surveying the problem and finding technological solution. 3.Designing electronics systems. 4.Learning and using circuit simulation and development tools 5.Working in team to accomplish task 6.Project management and life-long learning				
Course Outcomes	Students are able to 1.Identify social, environmental, market needs and solutions. 2.Explain design and development stages in electronics engineering projects 3.Apply engineering knowledge for solving real world problems. 4.Manage project and finance. 5.Provide technological solutions on recent problems and lifelong learning. 6.Work in team, follow ethical practices, and prepare documentation and presentation.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	2	3	2	2	3	3	0	0	0	0	0	2	1
CO 2	3	3	3	2	3	1	0	0	1	0	0	0	3	1
CO 3	3	3	3	2	3	2	0	0	2	0	0	2	3	2
CO 4	1	0	0	0	1	0	0	0	1	0	3	0	2	2
CO 5	3	3	3	2	3	2	0	0	0	0	0	3	2	2
CO 6	1	1	1	1	0	1	0	3	3	3	2	0	1	1

Level of Mapping as: Low 1, Moderate 2, High 3

	Course Curriculum	Hours
	The project selected and approved in semester VII has to be continued in semester VIII. Students have to complete the project in all aspects and submit the written project report of the same. External examiner from Industry or faculty member from out of the University has to be called for project assessment.	**26**

General Instructions:

Students have to submit monthly progress reports. Work in laboratory under supervision of guide. At the time of semester end assessment demonstrate the project. They have to bring model, convey technical details using PPT. Students have to face viva voce. At the end students have to submit the hard copy of project report to department.

Sr. No.	Reference Books
1	Articles from reputed journals, magazines, websites, real world problems, case studies, Survey reports
2	Institute's Laboratory Course Manual and equipment-wise Standard Operating Procedure to follow.

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VIII					
Course Code	PSI 425					
Course Category	Indian Knowledge System					
Course title	**Program Specific IKS**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	2	**-**	**-**	**02**		**02**
Evaluation Scheme	**ISE**		**ESE**	**IE**	**EE**	**Total**
	30		**70**	**-**	**-**	**100**
Pre-requisites (if any)	Knowledge of Indian culture					
Course Objectives	**The Course is aimed to-** 1. Introduce fundamentals of Ancient Indian Educations to understand the pattern and purpose of studying Vedas, Vedangas, upangas, upveda, purana & Itihasa 2. To help students to trace, identify and develop the ancient knowledge systems. 3. To help to understand the apparently rational, verifiable and universal solution from ancient Indian knowledge system for the holistic development of physical, mental and spiritual wellbeing 4. To build in the learners a deep-rooted pride in Indian knowledge, committed to universal human right, well-being and sustainable development.					
Course Outcomes	Students will be able to: 1. Explain the structure of Indian Knowledge Systems (IKS) including Vedas, Vedāṅgas, Upavedas, Puranas and Itihāsas. 2. Identify major Indian philosophical traditions and compare Vedic and Non-Vedic schools of thought. 3. Demonstrate understanding of contributions of IKS to mathematics, astronomy, science and technology. 4. Apply concepts such as number systems, measurement systems, and computational ideas from Sanskrit grammar in modern contexts. 5. Analyze Indian approaches to health, wellness, psychology, governance and ethics for holistic well-being and sustainable living. 6. Develop appreciation and pride in Indian heritage with sensitivity to universal human values and rights					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	2	1				1	2			2		1		
CO 2	2	2				1	2			2		1		
CO 3	2	2	1	2	1		2			2		1		
CO 4	2	2	2	2	2					2		1		
CO 5		1				3	3	2	1	2	2	2		
CO6						3	3	2	1	2	2	2		

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Introduction to IKS** Caturdaśa Vidyāsthānam, 64 Kalas, Shilpa Śāstra, Four Vedas, Vedāṅga, Indian Philosophical Systems, Vedic Schools of Philosophy (Sāṃkhya and Yoga, Nyaya and Vaiśeṣika, Pūrva-Mīmāṃsā and Vedānta), Non-Vedic schools of Philosophical Systems (Cārvāka, Buddhist, Jain), Puranas (Maha-puranas, Upa-Puranas and Sthala-Puranas), Itihasa (Ramayana, Mahabharata), Niti Sastras, Subhasitas	5
2	**Foundation concept for Science & Technology** Linguistics & Phonetics in Sanskrit (panini's), Computational concepts in Astadhyayi Importance of Verbs, Role of Sanskrit in Natural Language Processing, Number System and Units of Measurement, concept of zero and its importance, Large numbers & their representation, Place Value of Numerals, Decimal System, Measurements for time, distance and weight, Unique approaches to represent numbers (Bhūta Saṃkhya System, Kaṭapayādi System), Pingala and the Binary system, Knowledge Pyramid, Prameya – A Vaiśeṣikan approach to physical reality, constituents of the physical reality, Pramāṇa, Saṃśaya	5
3	**Indian Mathematics & Astronomy in IKS Indian Mathematics** Great Mathematicians and their contributions, Arithmetic Operations, Geometry (Sulba Sutras, Aryabhatiya-bhasya), value of π, Trigonometry, Algebra, Chandah Sastra of Pingala, Indian Astronomy, celestial coordinate system, Elements of the Indian Calendar Aryabhatiya and the Siddhantic Tradition Pancanga – The Indian Calendar System Astronomical Instruments (Yantras) Jantar Mantar or Raja Jai Singh Sawal.	6
4	**Indian Science & Technology in IKS** Indian S & T Heritage ,sixty-four art forms and occupational skills (64 Kalas) Metals and Metalworking technology (Copper, Gold, Zinc, Mercury, Lead and Silver), Iron & Steel, Dyes and Painting Technology), Town & Planning Architecture in India, Temple Architecture, Vastu Sastra,	6

5	**Humanities & Social Sciences in IKS** Health, Wellness & Psychology, Ayurveda Sleep and Food, Role of water in wellbeing Yoga way of life Indian approach to Psychology, the Triguṇa System Body-Mind-Intellect- Consciousness Complex. Governance, Public Administration & Management reference to ramayana, Artha Sastra, Kauṭilyan Stat	**6**

Text/Reference Books	
i)	Textbook on IKS by Prof. B Mahadevan, IIM Bengaluru.
ii)	Bhartiya Knowledge Systems by M.C. Bora, Khanna Publishing House.
iii)	Kapur K and Singh A. K (Eds) 2005). Indian Knowledge Systems, Vol. 1. Indian Institute of Advanced Study, Shimla. Tatvabodh of sankaracharya, Central chinmay mission trust, Bombay, 1995.
iv)	Dr. Girish Nath Jha, Dr. Umesh Kumar Singh and Diwakar Mishra, Science 7 and Technology in Ancient Indian Texts, DK Print World limited,

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VIII				
Course Code	VEC421				
Course Category	Valeue Education Course				
Course title	**Professional Ethics**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	1			11	1
Evaluation Scheme	**ISE:**			**ESE:**	**Total=100**
Pre-requisites (if any)					
Course Rationale	This course aims to develop ethical awareness and professional responsibility among engineering graduates. In a world of rapid technological change and complex socio-environmental challenges, engineers must balance technical excellence with moral integrity, social accountability, and human values. The course sensitizes students to ethical frameworks, professional codes of conduct, workplace dilemmas, and decision-making processes to help them act responsibly as global engineers and leaders				
Course Objectives	1. Understand the nature and scope of ethics. 2. Recognize ethical issues in engineering practice. 3. Apply ethical theories to real-world dilemmas. 4. Examine professional responsibilities and codes. 5. Develop moral reasoning and decision skills. 6. Demonstrate ethical leadership and communication.				
Course Outcomes	Students will be able to 1. Explain fundamental concepts of ethics. 2. Students will be able to Identify ethical challenges in engineering practice. 3. Students will be able to Apply moral reasoning to resolve dilemmas. 4. Students will be able to Interpret professional codes and responsibilities. 5. Students will be able to Evaluate ethical dimensions in real situations. 6. Students will be able to Communicate ethical decisions effectively				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	1				2	2	3	0	1		1	1	
CO 2	2	2		1		3	2	3	0			1	2	
CO 3	1	3	1	2	1	2	2	3	0	1		2	1	1
CO 4	1	2	2	2		2	2	3	0	1		2	2	
CO 5		2	3		1	2	2	3	1	2	2	3	1	
CO 6			1		1		2	2	3	3	1	2		1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Introduction to Ethics and Human Values** Definition, scope, and importance of ethics, Relationship between values, morals, and ethics, Human values and their role in engineering	02
2	**Professionalism and Engineering Ethics (2 Hours)** Characteristics of a profession, Responsibilities of engineers toward society, employers, and peers Role of professional bodies (e.g., IEEE, ASME, IEI)	02
3	**Ethical Theories and Decision-Making Models (3 Hours)** Utilitarianism, duty ethics, virtue ethics, Ethical decision-making frameworks, Case studies in engineering contexts	03
4	**Workplace Ethics and Professional Conduct (3 Hours)** Conflict of interest, confidentiality, intellectual property rights, Ethics in research and publication Harassment, discrimination, and whistleblowing	03
5	**Ethics in Emerging Technologies** Ethical issues in AI, automation, biotechnology, and data security, Environmental ethics and sustainable responsibility, Globalisation and cultural diversity in ethics	03
6	**Ethical Leadership and Communication (2 Hours)** Traits of ethical leaders, Team ethics and collaborative responsibility, Case presentations and role-play exercises	02

General Instructions:

Based on the syllabus content students have to complete any one of the following activities:

1. Simulation based small project work
2. Case study work
3. Site visit
4. Solve technical quiz
5. Solve home assignments
6. Question paper will be based on all six units covering of theory , derivations and numericals.

Sr. No.	Reference Books
1	Charles E. Harris Jr., Michael S. Pritchard, Michael J. Rabins (2018). Engineering Ethics: Concepts and Cases. Cengage Learning, Boston.
2	Govindarajan, M., Natarajan, S., & Senthil Kumar, V.S. (2004). Engineering Ethics. Prentice Hall of India, New Delhi
3	Fleddermann, C.B. (2011). Engineering Ethics. Pearson Education, New Jersey.
4	Martin, M.W., & Schinzinger, R. (2009). Introduction to Engineering Ethics. McGraw-Hill, New York.
5	R. Subramanian (2015). Professional Ethics. Oxford University Press, New Delhi

Sr. No.	Important web references
1	https://swayam.gov.in/
2	https://nptel.ac.in/

Year, Program, Semester	Final Year B.Tech (Electronics & Telecommunication Engineering), Part 4, Semester VIII				
Course Code	PBL 421				
Course Category	Project Based Learning				
Course title	MDM based Mini Project				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	-	-	-	--	02
Evaluation Scheme	**EE:50**		**IE: 50**		**Total=100**
Pre-requisites (if any)	Knowledge of selected multi-disciplinary course , Internship / Industrial training in same domain, electronics circuit design, Microcontrollers, Digital Electronics, VLSI Design courses is desirable				
Course Rationale	This course deals with domain of multi-disciplinary course selected by student.				
Course Objectives	1.Understand basic stages in electronic system design 2.Surveying the problem and finding technological solution. 3.Designing electronics systems. 4.Learning and using circuit simulation and development tools 5.Working in team to accomplish task 6.Project management and life-long learning				
Course Outcomes	Students are able to 1.Identify social, environmental, market needs and solutions. 2.Explain design and development stages in electronics engineering projects 3.Apply engineering knowledge for solving real world problems. 4.Manage project and finance. 5.Provide technological solutions on recent problems and lifelong learning. 6.Work in team, follow ethical practices, and prepare documentation and presentation.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	2	2	3	2	2	3	3	0	0	0	0	0	2	1
CO 2	3	3	3	2	3	1	0	0	1	0	0	0	3	1
CO 3	3	3	3	2	3	2	0	0	2	0	0	2	3	2
CO 4	1	0	0	0	1	0	0	0	1	0	3	0	2	3
CO 5	3	3	3	2	3	2	0	0	0	0	0	3	2	2
CO 6	1	1	1	1	0	1	0	3	3	3	2	0	1	1

Level of Mapping as: Low 1, Moderate 2, High 3

	Practical / Tutorial List	Hours
1	Students have to complete the mini project in the selected domain of multi-disciplinary course. In a group maximum 3 students are allowed. Students have to submit the spiral copy of mini project report in the format given by department.	

General Instructions:

Maximum 3 students are allowed in a group. They can start the project work from semester IV in the domain of selected MDM course but they have to complete , demonstrate and submit the project in semester 8. Internal and external evaluation will be done at the end of semester 8. They have to bring model, convey technical details. Students have to face viva voce. At the end students have to submit the soft and hard spiral copy of project report to department.

Sr. No.	Reference Books
1	Articles from reputed journals, magazines, websites, real world problems, case studies, Survey reports
2	Institute's Laboratory Course Manual and equipment-wise Standard Operating Procedure to follow.