B. Tech in Electronics and Telecommunication Engineering with Multidisciplinary Minor

Rajarambapu Institute of Technology, Rajaramnagar

(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)

Curriculum Structure and Evaluation Scheme

To be implemented for 2022-26 Batch

Department of Electronics and Telecommunication Engineering

Rev: EC Course Structure/RIT/02/2022-26

Class: S. Y. B. Tech **Semester:** III

Course Code	Course	Teaching Scheme				Evaluation Scheme				
							Theory (Marks)		Practical (Marks)	
		L	T	P	Credits	Scheme	Max	Min. % for passing	Max.	Min.% for passing
EC259	Analog Circuits	3	-	-	3	ISE	20	40	----	----
						UT1	15		----	----
						UT2	15		----	---
						ESE	50	40	----	----
EC2014	Digital Design	3	-	-	3	ISE	20	40	----	----
						UT1	15		----	----
						UT2	15		----	----
						ESE	50	40	----	----
EC2034	Analog Communication	3	-	-	3	ISE	20	40	----	----
						UT1	15		----	----
						UT2	15		----	----
						ESE	50	40	----	----
EC2054	Network Theory	3	-	-	3	ISE	20	40	----	----
						UT1	15		----	----
						UT2	15		----	----
						ESE	50	40	----	----
	Multidisciplinary Minor-I	3	-	-	3	ISE	20	40	----	----
						UT1	15		----	----
						UT2	15		----	----
						ESE	50	40	----	----
SH2174	Environmental Science	1	-	2	2	ISE	50	40	--	---
						ESE	50	40	---	---
EC2074	Analog Communication Lab	-	-	2	1	ISE	----	----	100	50
EC2094	Digital Design lab			2	1	ISE	----	----	50	50
						ESE	----	----	50	50
EC261	Analog Circuits & PCB Design Lab	-	-	2	1	ISE	----	----	50	50
						ESE	----	----	50	50
EC2114	Technical Aptitude-I	-	-	2	1	ESE	----	----	100	50
	Professional Skills Development and Foreign Languages	-	-	2	1	ISE	----	----	100	50
	TOTAL	**16**	**-**	**12**	**22**					
	TOTAL CONTACT HOURS	**28**								

ISE = In Semester Evaluation, UT-I = Unit Test-I, UT-II = Unit Test-II, ESE = End Semester Examination

Total Contact Hours/week : 28

Total Credits : 22

Technical Aptitude-I courses: Analog circuits, Digital Design, Analog Communication and Network theory.

Note: ISE of the Environment Science course will be the project on application of technology in Environmental concerns. If student fails in ISE (i.e. project), he/she will not be eligible for ESE of the course. In time table alloy one hour for theory and two hours for Environmental Science-project (batch wise).

Professional Skills Development and Foreign Languages:

Sr. No.	Subject Name		Course Code
1.	Professional Skills Development and Foreign Languages	Professional Leadership Skills	SH2634
2.		Interpersonal Skills	SH2614
3.		Innovation Tools and Methods for Entrepreneurs	SH2694
4.		Personal Effectiveness and Body Language	SH2594
5.		German Language – III	SH2734
6.		Japanese Language – III	SH2714

Note:

1. A student has to complete any two courses out of six choices offered under Choice Based Professional Skills Development Programme. A course in each semester will be allocated without any repetition.
2. Foreign Language course selected in F. Y. B. Tech Sem-I will remain the same with next levels in Sem-III & IV. (No new entries in S. Y. B. Tech Sem-III)

Class: S. Y. B. Tech **Semester:** IV

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (Marks)			Practical (Marks)	
							Max	Min.% for passing		Max	Min. % for passing
EC260	Mathematics for ECE	2	-	-	2	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
EC2024	Digital Communication	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
EC2044	Microcontroller	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			--	---
						UT2	15			---	---
						ESE	50	40		---	---
EC2064	Linear Integrated Circuits	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Multidisciplinary Minor-II	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Modern Indian Language	2	-	-	2	ISE	100	50	---	---	---
EC2084	Digital Communication Lab	-	-	2	1	ISE	---	----	---	50	50
						ESE	---	----	--	50	50
EC2104	Microcontroller Lab	-	-	2	1	ISE	---	----	---	50	50
						ESE	---	----	--	50	50
EC2124	Linear Integrated Circuits Lab	-	-	2	1	ISE	---	----		50	50
						ESE	---	---		50	50
EC2144	Programming with C++ Lab	-	-	2	1	ISE	---	---		100	50
EC2164	Technical Aptitude-II	-	-	2	1	ESE	---	---		100	50
	Professional Skills Development and Foreign Languages	-	-	2	1	ISE	-	-		100	50
	Total	**16**	**-**	**12**	**22**						
	Total Contact Hours	**28**									

ISE = In Semester Evaluation, UT-I = Unit Test-I, UT-II = Unit Test-II, ESE = End Semester Examination

Total Contact Hours/week : 28

Total Credits : 22

Technical Aptitude-II courses: Mathematics for ECE, Digital Communication, Microcontroller, Linear Integrated Circuits.

Note: Students are required to undergo industrial / field training of minimum two weeks in the vacation of Semester-IV and its evaluation will be carried out in the Semester-V.

Professional Skills Development and Foreign Languages:

Sr. No.	Course Name		Course Code
1	Professional Skills Development and Foreign Languages	Professional Leadership Skills	SH2634
2		Interpersonal Skills	SH2614
3		Innovation Tools and Methods for Entrepreneurs	SH2694
4		Personal Effectiveness and Body Language	SH2594
5		German Language – IV	SH2644
6		Japanese Language – IV	SH2624

Modern Indian Language:

Sr. No.	Course Name		Course Code
1	Modern Indian Language	मराठी भाषिक कौशल्यविकास	SH202
2		हिंदी कथा साहित्य एवं प्रयोजमूलक हिंदी	SH204

Note:

1. A student has to complete any two courses out of six choices offered under Choice Based Professional Skills Development Programme. A Course in each semester will be allocated without any repetition.
2. Foreign Language course selected in F. Y. B. Tech Sem-I will remain the same with next levels in Sem-III & IV. (No new entries in S. Y. B. Tech Sem-III)

Class: T. Y. B. Tech **Semester:** V

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (Marks) Max	Theory (Marks) Min. % for Passing		Practical (Marks) Max	Practical (Marks) Min. % for passing
EC3014	Signal Processing	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
EC3034	Electromagnetic Waves and Antenna Theory	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Programme Elective-I	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Open Elective-I	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Multidisciplinary Minor-III	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Multidisciplinary Minor-IV	2	-	-	2	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
SH3034	Scholastic Aptitude I	2	-	-	2	ISE	20	40	40	---	----
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
EC3174	Signal Processing Lab	-	-	2	1	ISE	---	---	--	100	50
EC3194	Electromagnetic Waves and Antenna Theory Lab	-	-	2	1	ISE	---	---	---	50	50
						ESE	---			50	50
EC3214	Technical Aptitude-III	-	-	2	1	ESE	---	---	----	100	50
EC3234	Summer Internship	-	-	-	2	ISE	---	---	---	100	50
	Total	**19**	**-**	**6**	**24**						
	Total Contact Hours	**25**									

ISE = In Semester Evaluation, UT-I = Unit Test-I, UT-II = Unit Test-II, ESE = End Semester Examination

Total Contact Hours/week : 25

Total Credits : 24

Technical Aptitude-III courses: Signal Processing, Electromagnetic Waves and Antenna Theory.

Program Elective-I

Sr.No	Course Code	Domain	Course
1.	EC3054	Communication	Information Theory and Coding
2.	EC3074		Wireless Communication
3.	EC3094	VLSI and Signal Processing	RTL Simulation and Synthesis
4.	EC3114		Digital Image Processing
5.	EC3134	Embedded Systems and Automation	Real-Time Operating System
6.	EC3154		Computer Architecture and Organization

Open Elective-I

Open Elective-I			
Sr. No	Course Code	Course Name	Offered By Department
1	OE345	Soft Computing	Computer Science & Information Technology
2	OE361	Object Oriented Modeling and Design	Computer Science & Information Technology
3	OE343	Data Science	Computer Science & Engineering (Artificial Intelligence and Machine Learning)
4	OE347	New Product Design & Development	Mechanical Engineering
5	OE349	Non-Conventional Energy Sources	Mechanical Engineering
6	OE351	Hydrogen & Fuel Cell Technology	Mechanical Engineering
7	OE3044	Renewable Energy Sources	Automobile Engineering
8	OE353	Factory Automation	Mechatronics Engineering
9	OE355	Cyber Physical Systems	Mechatronics Engineering
10	OE3104	Network Administration	Computer Science & Engineering
11	OE3064	Environmental Impact Assessment	Civil Engineering
12	OE350	Operations Research	Civil Engineering
13	OE341	Energy Auditing and Management	Electrical Engineering
14	OE357	Internet of Things	Electronics & Telecommunication Engineering
15	OE359	Drone Technology	Electronics & Telecommunication Engineering

Class: T. Y. B. Tech **Semester:** VI

Course Code	Course	Teaching Scheme				Evaluation Scheme					
							Theory (Marks)			Practical (Marks)	
		L	T	P	Credits	Scheme	Max	Min. % for passing		Max	Min. % for passing
EC3024	CMOS Digital VLSI Design	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
EC3044	Power Electronics	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
EC3064	Research Methodology	2	-	-	2	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Program Elective-II	2	-	-	2	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Open Elective-II	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Multidisciplinary Minor-V	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
SH3044	Scholastic Aptitude II	2	-	-	2	ISE	20	40	40	---	----
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
EC3104	CMOS Digital VLSI Design Lab	-	-	2	1	ISE	---	---	---	50	50
						ESE	---	---	--	50	50
EC3124	Power Electronics Lab	-	-	2	1	ISE	--	---	---	100	50
	Program Elective-II Lab	-	-	2	1	ISE	--	---	---	100	50
EC3164	Python Programming Lab	-	-	2	1	ISE	---	---		100	50
EC3184	Technical Aptitude IV	-	-	2	1	ESE	---	----		100	50
EC3204	Capstone Project Phase- I	-	-	2	1	ISE	---	---		100	50
	Total	**18**	**-**	**12**	**24**						
	Total Contact Hours	**30**									

ISE = In Semester Evaluation, UT-I = Unit Test-I, UT-II = Unit Test-II, ESE = End Semester Examination

Total Contact Hours/week : 30

Total Credits : 24

Technical Aptitude-IV courses: CMOS Digital VLSI Design and Power Electronics.

Program Elective-II

Sr.No	Course Code	Domain	Course
1.	EC364	Communication	Advanced Mobile Communication
2.	EC3084		Microwave Engineering
3.	EC366	VLSI and Signal Processing	Computer-Aided Design for VLSI
4.	EC368		Speech Processing
5.	EC370	Embedded Systems and Automation	Embedded Processors
6.	EC372		Data Structure and Algorithms

Program Elective-II Laboratory

Sr. No	Course Code	Domain	Course
1.	EC374	Communication	Advanced Mobile Communication Lab
2.	EC3144		Microwave Engineering Lab
3.	EC376	VLSI and Signal Processing	Computer-Aided Design for VLSI Lab
4.	EC378		Speech Processing Lab
5.	EC380	Embedded Systems and Automation	Embedded Processors Lab
6.	EC382		Data Structure and Algorithms Lab

Open Elective-II

Open Elective-II			
Sr. No	Course Code	Course Name	Offered By Department
1	OE3401	Cyber security	Computer Science & Information Technology
2	OE360	Distributed Systems	Computer Science & Information Technology
3	OE342	Data Mining	Computer Science & Engineering (Artificial Intelligence and Machine Learning)
4	OE3024	Reliability Engineering	Automobile Engineering
5	OE344	Supply Chain Analytics	Mechatronics Engineering
6	OE346	Mobile Robotics	Mechatronics Engineering
7	OE348	Information Technology Foundation Program	Computer Science & Engineering
8	OE3381	Disaster Management	Civil Engineering
9	OE3084	Materials Management	Civil Engineering
10	OE358	Plumbing (Water and Sanitation)	Civil Engineering

Open Elective-II			
Sr. No	Course Code	Course Name	Offered By Department
11	OE3182	Industrial Drives	Electrical Engineering
12	OE352	Image Processing	Electronics & Telecommunication Engineering
13	OE354	Fuzzy logic and Neural Network	Electronics & Telecommunication Engineering
14	OE3284	Supply Chain Management	Mechanical Engineering
15	OE3324	Entrepreneurship Development	Mechanical Engineering
16	OE356	Project Management	Mechanical Engineering

Class: Final Year B. Tech **Semester:** VII

Course Code	Course	Teaching Scheme				Evaluation Scheme					
							Theory (Marks)			Practical (Marks)	
		L	T	P	Credits	Scheme	Max.	Min. % for passing		Max.	Min. % for passing
EC4014	Internet of Things	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
EC4034	Computer Communication Network	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
EC461	RTOS and Embedded Linux	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Program Elective-III	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Program Elective-IV	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
EC475	RTOS and Embedded Linux Lab	-	-	2	1	ISE	--	---	---	50	50
						ESE	--	---	---	50	50
	Program Elective-III Lab	-	-	2	1	ISE	--	---	---	50	50
						ESE	--	---	---	50	50
EC4294	Capstone Project-II	-	-	6	3	ISE	--	---		50	50
						ESE	--	---		50	50
	TOTAL	**15**	**-**	**10**	**20**						
	TOTAL CONTACT HOURS	**25**									

ISE = In Semester Evaluation, UT-I = Unit Test-I, UT-II = Unit Test-II, ESE = End Semester Examination

Total Contact Hours/week: 25

Total Credits : 20

Program Elective-III

Sr.No	Course Code	Domain	Course
1.	EC4054	Communication	Microwave Engineering
2.	EC4074		Wireless Sensor Network
3.	EC4094	VLSI and Signal Processing	System Verilog
4.	EC463		Biomedical Signal Processing
5.	EC4114	Embedded Systems and Automation	Industry Automation
6.	EC4134		Soft Computing

Program Elective-IV

Sr.No	Course Code	Domain	Course
1.	EC4154	Communication	Satellite Communication
2.	EC465		Radar and Optical Fiber Communication
3.	EC467	VLSI and Signal Processing	VLSI Testing
4.	EC469		Pattern Recognition
5.	EC471	Embedded Systems and Automation	Instrumentation for Robotics and Automation
6.	EC4174		AI and ML

Program Elective-III Laboratory

Sr.No	Course Code	Domain	Course
1.	EC4194	Communication	Microwave Engineering Lab
2.	EC4214		Wireless Sensor Network Lab
3.	EC4234	VLSI and Signal Processing	System Verilog Lab
4.	EC473		Biomedical Signal Processing Lab
5.	EC4254	Embedded Systems and Automation	Industry Automation Lab
6.	EC4274		Soft Computing Lab

Choice based Internship Model
Model I: Industry Internship (II)

Class: Final Year B. Tech **Semester:** VIII

Course Code	Course	Teaching Scheme				Evaluation Scheme					
							Theory (Marks)			Practical (Marks)	
		L	T	P	Credits	Scheme	Max.	Min. % for passing		Max.	Min. % for passing
OE4382	Finance for Engineers (Online Course)	2	-	-	2	ISE	25	40	40	---	---
						ESE	75	40		---	---
OE4362	Engineering Management & Economics (Online Course)	2	-	-	2	ISE	25	40	40	---	---
						ESE	75	40		---	---
IP4024	Industry Internship & Project	-	-	-	12	ISE	---	----		50	50
						ESE	---	---		50	50
	TOTAL	-	-	-	**16**						

ISE = In Semester Evaluation, ESE = End Semester Examination

Total Contact Hours/week : --
Total Credits : 16

Note:
1] Weekly Contact hours are not mentioned as student is expected to be in industry regularly for 20 weeks. However, student needs to report to Institute mentors as and when required.
2] For online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments within specified time.
Weightage: 25% weightage for unit wise assignments + 75% weightage for final exam. Final exam will be held at college campus.

Model II: Research Internship (RI)

Class: Final Year B. Tech **Semester:** VIII

Course Code	Course	Teaching Scheme				Evaluation Scheme					
							Theory (Marks%)			Practical (Marks%)	
		L	T	P	Credits	Scheme	Max.	Min. % for passing		Max.	Min. % for passing
OE4382	Finance for Engineers (Online Course)	2	-	-	2	ISE	25	40	40	---	---
						ESE	75	40		---	---
OE4362	Engineering Management & Economics (Online Course)	2	-	-	2	ISE	25	40	40	---	---
						ESE	75	40		---	---
RE4044	Research Internship	-	-	-	12	ISE	---	----		50	50
						ESE	---	---		50	50
	TOTAL	-	-	-	**16**						

ISE = In Semester Evaluation, UT-I = Unit Test-I, UT-II = Unit Test – II, ESE = End Semester Examination

Total Contact Hours/week: ---

Total Credits : 16

Note:
1] Weekly Contact hours are not mentioned as student is expected to be in outside research organization regularly for 20 weeks. However, student needs to report to Institute mentors as and when required.
2] For online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments within specified time.
3] Students who opt for a research internship need to undergo a minimum of one month of research internship in outside research organizations or laboratories.

Weightage: 25% weightage for unit wise assignments + 75% weightage for final exam. Final exam will be held at college campus.

Model III: Entrepreneurial Internship (EI)

Class: Final Year B. Tech **Semester:** VIII

Course Code	Course	Teaching Scheme			Credits	Evaluation Scheme					
						Scheme	Theory (Marks)			Practical (Marks)	
		L	T	P			Max	Min. % for passing		Max	Min. % for passing
ED4104	Project Management (Online Course)	2	-	-	2	ISE	25	40	40	-	-
						ESE	75	40		-	-
ED4044	Commercial Aspects of the Project (Online Course)	2	-	-	2	ISE	25	40	40	-	-
						ESE	75	40		-	-
ED4064	Entrepreneurship Development Program (EDP)	-	-	-	1	ISE				100	50
ED4084	Entrepreneurial Internship	-	-	-	11	ISE				50	50
						ESE				50	
		-	-	-	16						

ISE = In Semester Evaluation, UT-I = Unit Test-I, UT-II = Unit Test – II, ESE = End Semester Examination

Total Contact Hours/week: -

Total Credits : 16

Students who opt for an entrepreneurial internship need to undergo a one-month internship at an outside reputed organization or firm.

Note:

1] Weekly Contact hours are not mentioned as student is expected to be in outside research organization regularly for 20 weeks. However, student needs to report to Institute mentors as and when required.

2] For online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments within specified time.

Weightage: 25% weightage for unit wise assignments + 75% weightage for final exam. Final exam will be held at college campus.

3] A one week Entrepreneurship Development Program (EDP) will be conducted after completion of 7th semester and before start of 8th semester.

4] Students who opt for an entrepreneurial internship need to undergo a one-month internship at an outside reputed organization or firm

Multidisciplinary Minor

Note:

- Student should choose any one specialization given by the department and complete all the five courses under the specialization to earn 170 Credits.
- Following are the baskets of multidisciplinary minor courses

Multidisciplinary Minor Baskets					
MDM BasketName	**Sr. No.**	**Course Code**	**Course Name**	**Semester**	**Offered by Department**
Automobile Engineering	1	ATMD201	Automobile Systems	III	Automotive Technology
	2	ATMD202	I. C. Engines	IV	
	3	ATMD301	Automotive Safety & Ergonomics	V	
	4	ATMD303	Automotive Engineering Lab.	V	
	5	ATMD302	Electric Vehicles	VI	
Construction Engineering	1	CEMD201	Building Construction and Planning	III	Civil Engineering
	2	CEMD202	Building Estimation and Valuation	IV	
	3	CEMD301	Infrastructure Engineering	V	
	4	CEMD303	Smart Cities and Sustainable Development	V	
	5	CEMD302	Environmental Engineering	VI	
Software Programming	1	CSMD201	Introduction to Data Structures	III	Computer Science& Engineering
	2	CSMD202	Problem solving using JAVA	IV	
	3	CSMD301	Fundamentals of Database Systems	V	
	4	CSMD303	Object-oriented Programming in Python	V	
	5	CSMD302	Artificial Intelligence	VI	
	1	EEMD201	Electrical Power Generation	III	

Electrical Power System	2	EEMD202	Power System	IV	Electrical Engineering
	3	EEMD301	Electrical Machines	V	
	4	EEMD303	Electrical Technology Lab	V	
	5	EEMD302	Smart Grid	VI	
Electronics System Design	1	ECMD201	Electronics Devices and Applications	III	Electronics & Telecommunication Engineering
	2	ECMD202	Electronics Communication Systems	IV	
	3	ECMD301	Advanced Communication Systems	V	
	4	ECMD303	Electronic Product Design	V	
	5	ECMD302	Industrial Electronics	VI	
Software Development	1	CIMD201	Data Structures	III	Computer Science& Information Technology
	2	CIMD202	Computer Algorithms	IV	
	3	CIMD301	Introduction to DBMS	V	
	4	CIMD303	OOP using Java	V	
	5	CIMD302	Software Engineering	VI	
Elements of Mechanical Engineering	1	MEMD201	Materials and Applications	III	Mechanical Engineering
	2	MEMD202	Design and Drawing of Machine Components	IV	
	3	MEMD301	Manufacturing and Assembly Process	V	
	4	MEMD303	Refrigeration and Air Conditioning	V	
	5	MEMD302	Power Plant Engineering	VI	
Mechatronics Engineering	1	MCMD201	Fundamentals of Mechatronics	III	Mechatronics Engineering
	2	MCMD202	Industrial Fluid Power	IV	
	3	MCMD301	Sensor and Instrumentation	V	
	4	MCMD303	Industrial Automation	V	

	5	MCMD302	Industrial Robotics	VI	
Artificial Intelligence	1	AIMD201	Object Oriented Programming	III	Computer Science& Engineering (AI-ML)
	2	AIMD202	Data Structures and Algorithms	IV	
	3	AIMD301	Machine Learning	V	
	4	AIMD303	Business Intelligence	V	
	5	AIMD302	Principles of AI	VI	

B. Tech in Electronics and Telecommunication Engineering with Double Minor (Multidisciplinary and Specialization Minor)

B.Tech. in Electronics and Telecommunication Engineering with Double Minor degree

1. It is required to complete SIX courses (each of 3 credits) from ONLINE platform to earn a total of 18 credits under Double Minor (DM) certification.
2. Students must complete and earn the credits for all six courses starting from Second Year's First semester (3rd semester) to the Final Year's Second Semester (8th semester).
3. Basket of the DM courses and respective semesters is mentioned in the following table.

Sr. No.	Course	Code
1	DM-I	ECDM5XXX
2	DM-II	ECDM5XXX
3	DM-III	ECDM6XXX
4	DM-IV	ECDM6XXX
5	DM-V	ECDM7XXX
6	DM-VI	ECDM8XXX

4. To select a course platform, first preference must be given to NPTEL.
5. Other than NPTEL, courses from COURSERA and UDEMY platforms are allowed to register only in the following cases,
    a. If the timeline of NPTEL course is not in line with timeline of academic calendar.
    b. The suitable succeeding course in line with previous course is not available on NPTEL.
    c. If any other unavoidable circumstances occurs.
6. Platform and course selection must be as per recommendation of BOS of the department.
7. Student will get the credits of respective DM course in following conditions,
    a. In case of course selected from NPTEL platform, student have to complete the timely assignments, PASS the exam and secure the certificate.
    b. In case of course selected from COURSERA or UDEMY, student have to secure the certificate and appear for VIVA(oral) exam.
8. While selecting online course, following points must be taken care of,
    a. Selected course must be of basic or fundamental level.
    b. Contents of the course should not be covered in any of the course offered in regular curriculum or not listed in any elective (open or program elective) or in Multidisciplinary Minor (MDM)

Duration of each online course must be of EIGHT weeks for NPTEL and 30+ hours for UDEMY, COURSERA courses.

B. Tech in Electronics and Telecommunication Engineering with Honor and Multidisciplinary Minor

B.Tech. in Electronics and Telecommunication Engineering with Honor and Multidisciplinary Minor degree

1. It is required to complete SIX courses (each of 3 credits) from ONLINE platform to earn total of 18 credits under Honor certification.
2. Student must complete and earn the credits for all the six courses starting from Second Year First semester (3rd semester) to Final Year Second Semester (8th semester).
3. Basket of the Honor courses and respective semester is mentioned in the following table.

Sr. No.	Course	Code
1	Honor - I	ECH5XXX
2	Honor - II	ECH5XXX
3	Honor - III	ECH6XXX
4	Honor - IV	ECH6XXX
5	Honor - V	ECH7XXX
6	Honor - VI	ECH8XXX

4. To select course platform, first preference must be given to NPTEL.
5. Other than NPTEL, courses from COURSERA and UDEMY platforms are allowed to register only in following cases,
    a. If timeline of NPTEL course is not in line with timeline of academic calendar.
    b. The suitable succeeding course in line with previous course is not available on NPTEL.
    c. If any other unavoidable circumstances occurs.
6. Platform and course selection must be as per recommendation of BOS.
7. Student will get the credits of respective Honor course in following conditions,
    a. In case of course selected from NPTEL platform, student have to complete the timely assignments, PASS the exam and secure the certificate.
    b. In case of course selected from COURSERA or UDEMY, student have to secure the certificate and appear for VIVA(oral) exam.
8. While selecting online course, following points must be taken care of,
    a. Selected course must be of advanced level and not basic or fundamental level.
    b. Contents of the course should not be covered in any of the course offered in regular curriculum or not listed in any elective (open or program elective)
    c. Duration of each online course must be of EIGHT weeks for NPTEL and 30+ hours for COURSERA, UDEMY courses.

B. Tech in Electronics and Telecommunication Engineering-Honors with Research and Multidisciplinary Minor

Honors with Research and Multidisciplinary Minor

The student will work on Research Project or Dissertation for 18 Credits in the Fourth Year in respective discipline. The distribution of 18 Credits for Research project in Sem-VII and Sem-VIII is given below. To get B.Tech in Electronics and Telecommunication Engineering-Honors with Research and Multidisciplinary Minor degree Student need to earn total 188 Credits which consist 170 credits of regular Multidisciplinary Minor courses and 18 credits of Research courses.

Class: Final Year B. Tech **Semester:** VII

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
							Max.	Min. for passing		Max.	Min. for passing
REH401	Intellectual Property Rights	-	-	-	2	ISE	50	40	40	---	---
						ESE	50	40		---	---
REH403	Research project (Synopsis) phase - I	-	-	-	2	ISE	--	--	--	50	50
						ESE	--	--		50	50
REH405	Research Specific core course - I (Online NPTEL course)	-	-	-	3	ISE	50	40	40	--	--
						ESE	50	40		--	--
	TOTAL	-	-	-	7						

ISE: In Semester Evaluation, UT-I: Unit Test-I, UT-II: Unit Test-II, ESE: End Semester Exam

Note: For Evaluation of Online NPTEL course ISE Marks will be marks obtained by students in the assignments given by NPTEL, students who will secure NPTEL certification will be only eligible for ESE of the same course which will be conducted at institute

Class: Final Year B. Tech **Semester:** VIII

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (Marks %)			Practical (Marks %)	
							Max.	Min. for passing		Max.	Min. for passing
REH402	Research project phase - II	-	-	-	11	ISE	--	--	--	50	50
						ESE	--	--		50	
	TOTAL	-	-	-	11						

ISE: In Semester Evaluation, UT-I: Unit Test-I, UT-II: Unit Test-II, ESE: End Semester Exam

K. E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Final Year B. Tech Syllabus
To be implemented for 2022-26 Batch
Department of Electronics and Telecommunication Engineering

Class: **Final Year B. Tech**	Semester - **VII**
Course Code: **EC4014**	Course Name: **Internet of Things**

L	T	P	Credits
3	-	--	3

Course Description:
The Internet of Things (IoT) 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 IoT's transformative potential, preparing them to navigate the evolving landscape of connected technologies and contribute to the advancement of the digital era.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Describe the fundamentals of the Internet of Things (IoT) and its architecture.
2. Analyze IoT protocols, communication technologies, and hardware platforms.
3. Develop skills in IoT programming, security, and data analytics.
4. Design IoT applications and systems for real-world problems.

Prerequisite: Basic knowledge of Embedded Systems, Sensors, fundamentals of Embedded C and Python programming

Course Content

Unit No.	Description	Hrs
1.	**Introduction to IoT** Definition and Characteristics of IoT, Evolution of IoT: 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 Protocols** Overview of IoT networks: LAN, PAN, WAN, IoT protocols: MQTT, CoAP, Bluetooth Low Energy (BLE), ZigBee, RFID, LoRa WAN, BAC Net, KNX, 6LoWPAN, Comparison of IoT communication technologies, Protocol Standardization for IoT, Issues with IoT Standardization: Unified Data.	06
3.	**IoT Hardware Platforms and Characteristics** Overview of IoT hardware's: Arduino, ESP32, Raspberry Pi, interfacing sensors with IoT Hardware: Temperature, humidity, motion, and light sensors,	06

	Introduction to Cloud Platforms: AWS, Microsoft Azure, Thing speak, IoTivity, Interoperability.	
4.	**IoT Data and Analytics** IoT Data Lifecycle: Data collection, storage, and processing, Role of cloud computing in IoT data management, Data analytics techniques for IoT applications, Tools for IoT analytics: Edge analytics, cloud-based analytics platforms, Storing IoT data in the cloud (Firebase/AWS IoT Core), Basic data visualization using IoT dashboards.	**06**
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 IoT applications, Role of encryption, authentication, and authorization, Case Study: Analyzing real-world IoT security breaches, Implementing basic security measures in IoT systems.	**06**
6.	**Applications and Future Trends** Web of Things, IoT in Industry and Automation: Industrial IoT (IIoT) and smart manufacturing, Edge computing and fog computing, IoT with AI and machine learning integration, Smart Home Automation System, IoT based healthcare monitoring system, Environmental monitoring using IoT.	**06**

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press.
2. Kamal, R., Internet of Things – Architecture and Design Principles, 1st Edition, Mcgraw Hill.
3. Simone Cirani, Internet of Things- Architectures, Protocols and Standards, WILEY.

Reference Books:

1. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, Wiley.
2. Xiaolin Lu, IoT Edge Computing: An Introduction to Internet of Things with Edge Computing, Springer.
3. Alessandro Bassi, Enabling Things to Talk- Designing IoT solutions with the IoT Architectural Reference Model, Springer.

Class: - **Final Year B. Tech**	Semester - **VII**
Course Code: **EC4034**	Course Name: **Computer Communication Network**

L	T	P	Credits
3	-	-	3

Course Description: This course introduces the fundamental concepts of computer communication networks, including network architectures, protocols, and technologies. It covers topics such as network topologies, OSI and TCP/IP models, data link and medium access control protocols, IP addressing, routing algorithms, and transport layer mechanisms. The course also explores application-layer protocols, network security principles, and emerging technologies. Emphasis is placed on integrating networking concepts with electronics and communication systems for real-world applications.

Course Learning Outcomes:

After completion of this course, students will be able to:

1. Explain networking concepts and fundamental principles.
2. Develop algorithms for error correction and congestion control.
3. Analyze network performance using various optimization algorithms.
4. Illustrate network security measures and protocols.

Prerequisite: Basic knowledge of computer networking

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Introduction To Computer Networks** Network topologies and types, Reference models: OSI and TCP/IP, addressing types: Physical, Logical, Port, Application-level, Network Devices: Connectors, Hubs, Switches, Routers, and Bridges, Data transmission techniques and switching: Circuit, Packet, and Message switching.	06
2.	**Data Link Layer** Design issues in data link layer, Error detection and correction techniques (Parity, CRC, Hamming Code), Data link protocols: Stop-and-Wait, Sliding Window Protocols, High-Level Data Link Control (HDLC).	06
3.	**Medium Access Sub Layer** Channel allocation problems, Multiple access protocols: ALOHA, CSMA/CD, CSMA/CA, Networking standards: IEEE 802.1Q (VLAN), IEEE 802.3 (Ethernet), IEEE 802.11 (Wi-Fi), IEEE 802.16 (WiMAX).	06

4.	**Network Layer** Design issues in the network layer, IPv4 addressing and network address hierarchy, IPv6 addressing (address space and features), IP protocol: Header formats for IPv4 and IPv6, Address Resolution Protocol (ARP), Reverse ARP (RARP), Internet Control Message Protocol (ICMP) and Internet Group Management Protocol (IGMP), Routing algorithms: Shortest Path, Distance Vector, and Link State Routing.	**06**
5.	**Transport And Application Layer** Overview of TCP/IP and the Internet, Transport layer protocols: TCP and UDP, Congestion control and prevention policies, Algorithms: Leaky Bucket and Token Bucket, Application layer protocols: Domain Name System (DNS), Electronic Mail (SMTP, POP3, IMAP), World Wide Web (HTTP/HTTPS).	**06**
6.	**Network Security** Basics of cryptography: Substitution and Transposition Ciphers, Symmetric key and public key algorithms (e.g., AES, RSA), Email security and digital signatures, Entity authentication and key management, Security mechanisms for Wi-Fi networks, Malicious software: Viruses, Worms, Trojans, and Ransomware.	**06**

Text Books:

1. Andrew S. Tannenbaum, Computer Networks, Pearson Education
2. Behrouz A. Foruzan, Data communication and Networking, Tata McGraw-Hill,

Reference Books:

1. Bernard Menezes, Network Security & Cryptography, Cengage Learning
2. Garcia Leon and Widjaja, Communication Networks, Tata Mcgraw-Hill,

Class: **Final Year B. Tech**	Semester: **VII**
Course Code: **EC461**	Course Name: **RTOS & Embedded Linux**

L	T	P	Credits
3	-	-	3

Course Description:
This course introduces the fundamentals and advanced concepts of Real-Time Operating Systems (RTOS) and Embedded Linux in the context of modern embedded systems. Students will learn about multitasking, real-time scheduling, inter-process communication, and device drivers. The course also covers the structure and usage of Embedded Linux, kernel architecture, cross-compilation, bootloaders, and file systems. RTOS (like FreeRTOS) and Embedded Linux platforms (like Raspberry Pi or BeagleBone) will enable students to develop and deploy real-time and Linux-based embedded applications.

Course Learning Outcomes:
After completion of this course, students will be able to:

1. Explain the architecture, design, and functioning of RTOS and Embedded Linux.
2. Develop embedded applications using RTOS APIs.
3. Build and configure embedded Linux systems, including kernel compilation and root file system design.
4. Integrate device drivers and bootloaders in embedded Linux environments.
5. Deploy real-time embedded applications on hardware platforms.

Prerequisite: Basic knowledge of microcontrollers, embedded systems, and Linux programming.

Course Content

Unit No.	Description	Hrs
1.	**Introduction** General purpose OS and RTOS, Real-time systems: hard vs soft real-time, RTOS architecture and components, Task creation, states, and management, Scheduling algorithms	06
2.	**Inter-task communication & Synchronization** Inter-task communication: queues, semaphores, message mailboxes, Mutual exclusion and deadlock, Time management and software timers, Event flags and synchronization, Deadlock, Priority Inversion	06
3.	**RTOS Kernel Services** Memory management: memory allocation, fragmentation, Timer, clock interrupt handling, System calls, Exception & interrupt handling, I/O management	06

4.	**Embedded Linux Architecture** Embedded Linux vs Desktop Linux, Linux Distributions, Facilities in Embedded Linux Boards used in Industry/Market, Care to take in handling the Linux boards, Development Setup for Embedded Linux, OS installation, Case studies of Embedded Linux Based Systems, Linux kernel architecture, Boot process and bootloaders (GRUB, U-Boot), File systems (initramfs, rootfs, ext3/ext4)	**06**
5.	**Linux commands, Shell Scripting and File Systems** CLI and Linux Shells, Linux Commands, Linux concepts, Shell Script, Linux commands for file and process management, Linux Programming, Multi-file C Programming Using make utility, Makefile, GNU debugger, Linux File System and Permissions	**06**
6.	**Device Drivers and Real-Time Linux** Introduction to Linux device drivers, Character and block drivers, User Space and Kernel Space, Loadable kernel modules (LKM), Real-time Linux (PREEMPT-RT patch, Xenomai), Performance considerations	**06**

References –

Text Books:

1. Raj Kamal, "Embedded Systems: Architecture, Programming and Design", McGraw Hill Education
2. Qing Li, Caroline Yao, "Real-Time Concepts for Embedded Systems", Elsevier / CMP Books
3. Jean J. Labrosse, "MicroC/OS-II: The Real-Time Kernel", CRC Press

Reference Books:

1. Christopher Hallinan, "Embedded Linux Primer: A Practical Real-World Approach", Pearson / Prentice Hall
2. Karim Yaghmour, "Building Embedded Linux Systems", O'Reilly Media
3. Derek Molloy, "Exploring BeagleBone: Tools and Techniques for Building with Embedded Linux", Wiley

Class: **Final Year B. Tech**	Semester- **VII**
Course Code: **EC4054**	Course Name: **Microwave Engineering**

L	T	P	Credits
3	-	-	3

Course Description:
This is the elective course at the seventh semester of B.Tech. The Course broadly focuses on fundamentals of transmission lines, analysis of RF and microwave transmission lines. It makes students understand concepts of microwave devices and different applications. Also, the design principles of Microwave systems and applications are included in it.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Explain different Microwave components and devices.
2. Discuss microwave measurement techniques and applications.
3. Analyze RF and Microwave networks.
4. Design microwave systems for different practical applications.

Prerequisite: Basic Knowledge of Electromagnetics field theory and Mathematics

Course Content

Unit No.	Description	Hrs
1.	**Microwaves and Transmission Lines.** Microwave Frequency bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC. Coaxial line, Strip lines, Microstrip lines and coupled lines: Impedance matching network using lumped and distributed parameters.	06
2.	**S-parameters and Waveguides** Scattering Parameters, properties of S parameters, signal flow graph, s-parameters of the two-port network, ABCD Parameters, Rectangular waveguide, Circular waveguide.	06
3.	**Passive Microwave Devices** Microwave passive components: E-Plane T, H-plane T, Directional Coupler, Isolator, Power Divider, Magic Tee, Attenuator.	06
4.	**Active Microwave Devices** Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, TWT, Magnetron.	06
5.	**Microwave Design Principles**	06

	Impedance transformation, Impedance Matching, Microwave Filter Design using Insertion Loss method.	
6.	**Microwave Systems** Radar, Terrestrial and Satellite Communication, Radio aids to Navigation, RFID, and GPS. Modern Trends in Microwaves Engineering- Effect of Microwaves on human body, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Monolithic Microwave ICs, RF MEMS for microwave components, Microwave Imaging.	**06**

Text Books:

1. R.E. Collins, Microwave Circuits, McGraw Hill
2. David M Pozar, Microwave Engineering, John Wiely and Sons
3. Liao, Samuel Y. Microwave devices and circuits. Pearson Education India.

Reference Books:

1. S Vasuki, D. Margaret, Microwave Engineering, Tata Mcgraw Hill.
2. Sanjay Kumar, Sourabh Shukla. Concepts and Applications of Microwave Engineering, Prentice Hall India Learning Private Limited
3. K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech house

Class: - **Final Year B. Tech**	Semester - **VII**
Course Code: **EC4074**	Course Name: **Wireless Sensor Network**

L	T	P	Credits
3	-	-	3

Course Description:
This course introduces students to the foundational concepts and applications of Wireless Sensor Networks (WSNs). It covers the architecture, networking protocols, and infrastructure of WSNs, along with their platforms and tools. Students will explore the challenges and opportunities in deploying WSNs for various applications, such as healthcare, agriculture, industry, and smart cities. Emphasis is placed on key design principles, optimization techniques, and emerging trends, preparing students for future research and development in this rapidly evolving field.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Analyze the unique constraints, challenges, and enabling technologies in WSNs.
2. Design and evaluate network architectures and protocols for efficient data communication.
3. Apply networking concepts, including MAC protocols, routing strategies, and energy management.
4. Investigate emerging trends and future advancements in WSNs, including AI and IoT integration.

Prerequisite: Fundamentals of Communication Systems, Networking Fundamentals, Programming Skills in C/C++ or Python, etc.

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Introduction to Wireless Sensor Networks** Introduction to Wireless Sensor Networks and their Importance, Single Node Architecture: Key Components and Functions, Overview of Sensors, Actuators, and Transceivers, Network Characteristics: Scalability, Energy Efficiency, and Reliability, Challenges in Wireless Sensor Networks: Deployment, Coverage, and Cost, Unique Constraints: Power Limitations and Environmental Factors, Enabling Technologies, Wireless Communication, and MEMS, Types of Wireless Sensor Networks: Static, Mobile, and Hybrid Networks.	06

2.	**Wireless Sensor Network Architectures** Network Architecture: Components and Layered Models, Design Principles for Efficient Sensor Network Deployment, Scenarios for Sensor Networks: Urban, Rural, and Industrial Applications, Physical Layer and Transceiver Design Considerations: Modulation and Power Control, Optimization Goals: Energy, Latency, and Throughput Trade-offs, Performance Metrics: Packet Delivery Ratio, Energy Consumption, and Delay, Gateway Concepts: Role and Integration in Sensor Networks, Operating Systems.	06
3.	**Networking in Wireless Sensor Networks** MAC Protocols: SMAC, B-MAC, and Low Power MAC Designs, Low Duty Cycle Protocols: Energy Management and Wakeup Concepts, IEEE 802.15.4 Standard: Features and Role in WSNs, ZigBee Protocol: Overview and Use Cases in WSNs, Mediation Device Protocols: Enhancing Interoperability, Wakeup Radio Concepts: Reducing Idle Listening in Nodes, Addressing and Name Management: Unique Identification in WSNs, Assignment of MAC Addresses: Dynamic vs. Static Approaches, Routing Protocols: Energy-Efficient and Geographic-Based Techniques.	06
4.	**Network Infrastructure** Topology Control: Strategies for Efficient Network Coverage, Clustering Techniques: Advantages and Implementation, Role of Coordinators in Cluster-Based WSNs, Time Synchronization Protocols for Synchronized Communication, Localization and Positioning Techniques: GPS-Based and Anchor-Free Methods, Sensor Tasking: Dynamic Scheduling of Sensor Activities, Control Mechanisms in Wireless Sensor Networks, Fault Tolerance in Network Infrastructure.	06
5.	**Sensor Platforms and Tools** Sensor Node Hardware: Detailed Overview of Berkeley Motes, Programming Challenges in Resource-Constrained Environments, Node-Level Software Platforms: Tools and Frameworks, Node Simulators, State-Centric Programming: Concepts, Data Acquisition and Storage in Sensor Networks, Energy Harvesting and Power Management in Sensor Nodes, Security Challenges and Solutions in Sensor Platforms.	06
6.	**Applications and Case Studies** Healthcare Applications: Patient Monitoring and Diagnostics, Agricultural Applications: Precision Farming and Irrigation Management, Industrial Applications: Asset Tracking and Predictive Maintenance, Environmental Monitoring: Pollution Control and Wildlife Tracking, Smart Cities: Traffic Monitoring and Energy Management, Case Studies: Real-World Deployment of WSNs in Different Sectors, Emerging Trends: AI and Machine Learning in	06

	WSNs, Future Scope: Integration with 5G and IoT Ecosystems, Challenges and Opportunities in Large-Scale WSN Deployments.	

Text Books:

1. Holger Karl, Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, Wiley.
2. Feng Zhao, Leonidas Guibas, Wireless Sensor Networks: An Information Processing Approach, Morgan Kaufmann.
3. Kazem Sohraby, Daniel Minoli, Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, Wiley.

Reference Books:

1. Carlos De Morais Cordeiro, Dharma P. Agrawal, Ad Hoc and Sensor Networks: Theory and Applications, World Scientific.
2. Yang Xiao, Muhammad Ilyas, Wireless Sensor Networks: From Theory to Applications, CRC Press.
3. Sunggu Lee, Young-Ho Kim, Wireless Sensor Networks: A Systems Perspective, CRC Press.
4. D. P. Agrawal, Q. A. Zeng, Introduction to Wireless and Mobile Systems, Brooks/Cole.
5. Lajos Hanzo, Marco A. Khalighi, Thomas Keller, Wireless Multimedia Communications: Techniques, Standards, and Applications, Wiley.

Class: - **Final Year B. Tech.**	**Semester-VII**
Course Code: **EC4094**	Course Name: **System Verilog**

L	T	P	Credits
3	-	--	3

Course Description:

In the semiconductor and electronic design industry, System Verilog is a combined hardware description language and hardware verification language based on extensions to Verilog. System Verilog started with the donation of the Superlog language to Accellera in 2002. In 2005, System Verilog was adopted as IEEE Standard 1800-2005. In 2009, the standard was merged with the base Verilog (IEEE 1364-2005) standard, creating IEEE Standard 1800-2009. The current version is IEEE standard 1800-2012.

The feature-set of System Verilog can be divided into two distinct roles:

1. System Verilog for RTL design is an extension of Verilog-2005; all features of that language are available in System Verilog.
2. System Verilog for verification uses extensive object-oriented programming techniques and is more closely related to Java than Verilog.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Describe various concepts of verification methodologies, using system verilog.
2. Write a system verilog code for any digital function/module.
3. Analyze the system verilog codes.
4. Design digital modules and verify using system Verilog.

Prerequisite: Basic knowledge of Digital Design and HDL.

Course Content		
Unit No.	**Description**	**Hrs**
1.	**Basics of Verification** Basics of verification, Difference between ASIC verification and ASIC testing, The Verification process, Standard Verification Methodologies, Basic Test bench functionality, directed testing, Methodology basics, Constrained random stimulus, Functional coverage, Code Coverage, System Verilog Testbench Flow, how it's different from Verilog Test bench? simulation environment phases, maximum code reviews, test bench performance. System Verilog literal values and Built in Data Types	**06**
2.	**System verilog operators, Loops, Jumps, Functions** New operators: Enhanced for loops, The foreach array looping construct, new jump statements, guidelines, Enhanced block names statement labels, Enhanced case statements, enhanced if else decisions, Verilog general purpose always procedural block, system verilog specialized procedural block, Enhancement to task and Functions -Pass by value, pass by name, Pass by reference	**06**
3.	**System Verilog Packed and Unpacked Arrays, Structure, Unions** Structures: Unions, Unpacked arrays, packed arrays, passing arrays through ports and two task and functions, arrays in structure and unions, Examples of using arrays, The foreach array looping construct, array queuing system functions, $bits size of system functions, dynamic arrays, associative arrays, sparse arrays and strings, basics of OOP, application of OOP's concepts for verification	**06**
4.	**Coverage, Interfaces and Program Blocks** Basics of threads, semaphore, mailboxes, queues, Interfaces: Separating the Test bench and Design, The Interface Construct, Virtual Interface, Stimulus Timing, Clocking Block, Mod port, Interface Driving and Sampling, Program block: Program Block Considerations, Connecting It Altogether, Top Level Scope, Program module interaction, Coverage: Gathering Cover Data, Coverage Types, Functional coverage strategies, cover group, triggering a cover group.	**06**
5.	**Randomization and System Verilog Assertions** Randomization in System Verilog, Constraint details, Random Number Generators, Randomization Problems	**06**

	SV Assertions: Assertion definition, assertion benefits, system Verilog assertion types, immediate assertions, concurrent assertions, cover properties, implications, edge testing functions, sequences, Clock definitions, Assertion severity tasks, assertion and coverage example of an FSM design. Modeling of FSM. Few examples on assertion writing	
6.	**Introduction to UVM** Introduction, History, Definitions, Generator, Sequencer, Scoreboard, Driver, Agent, Checker, Environment, UVM macros, UVM Phases, Case studies, UVM Topology.	**06**

Text Books:

1.Christian B Spear, System Verilog for Verification: A guide to learning the Testbench language features, III, Springer publications.
2. Vijaya Raghavan, System Verilog Assertions, Springer publications.

Reference Books:

1. Stuart Southerland, System Verilog for Design, II, Springer publications.

Class: - **Final Year B. Tech**	Semester - **VII**
Course Code: **EC463**	Course Name: **Biomedical Signal Processing**

L	T	P	Credits
3	-	-	3

Course Description:
This course focuses on understanding the sources, types, and characteristics of noise and artifacts in biomedical signals. Students will learn to design time-domain and frequency-domain filters for noise removal and apply various methods to analyze signal characteristics. Additionally, the course encourages exploration of alternative techniques for biomedical signal analysis in both time and frequency domains.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Describe the origin, characteristics, and types of various biomedical signals.
2. Illustrate the principles of biomedical signal acquisition and preprocessing.
3. Analyze ECG, EEG and EMG signals to identify characteristic feature points and interpret their significance.
4. Evaluate various case study approaches in processing biomedical signals.

Prerequisite: Fundamental of Signals and Systems, Digital Signal Processing

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Introduction to Biomedical Signals** Action Potential and Its Generation, Origin and Waveform Characteristics of Basic Biomedical Signals Like: Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Phonocardiogram (PCG), Electroneurogram (ENG), Event-Related Potentials (ERPS), Electrogastrogram (EGG), Objectives of Biomedical, Signal Analysis, Difficulties in Biomedical Signal Analysis.	06
2.	**Biomedical Signals Sensing and Conditioning** Electrode-electrolyte interface, polarization, electrode skin interface and motion artefact, biomaterial used for electrode, Types of electrodes (body surface,	06

	internal, array of electrodes, microelectrodes), Practical aspects of using electrodes, Acquisition of bio-signals (signal conditioning) and Signal conversion (ADC's DAC's) Processing.	
3.	**Transform Techniques** Biomedical signal processing by Fourier analysis, Biomedical signal processing by wavelet (time frequency) analysis, Analysis (Computation of signal parameters that are diagnostically significant), Classification of signals and noise, Spectral analysis of deterministic, stationary random signals and non-stationary signals.	**06**
4.	**Removal of Noise and Artifacts from Biomedical Signal** Random and Structured Noise, Physiological Interference, Stationary and Nonstationary Processes, Noises and Artifacts Present in ECG, Time and Frequency Domain Filtering	**06**
5.	**EEG Signal Processing and Event Detection in Biomedical Signals** EEG Signal and Its Characteristics, EEG Analysis, Linear Prediction Theory, Autoregressive Method, Sleep EEG, Application of Adaptive Filter for Noise Cancellation in ECG and EEG Signals; Detection of P, Q, R, S and T Waves in ECG, EEG Rhythms.	**06**
6.	**Analysis of Nonstationary Signals** Heart Sounds and Murmurs, Characterization of Nonstationary Signals and Dynamic Systems, Short-Time Fourier Transform, Considerations in Short-Time Analysis and Adaptive Segmentation.	**06**

Text Books:

1. D C Reddy, Biomedical Signal Processing, McGraw Hill.
2. R. M. Rangayyan Biomedical Signal analysis: A Case study approach, John Wiley & Sons.

Reference Books:

1. W. J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall.
2. Eugene N Bruce, Biomedical Signal Processing and Signal Modeling, John Wiley & Sons.

Class: - Final Year B. Tech	Semester - VII
Course Code: **EC4114**	Course Name: **Industry Automation**

L	T	P	Credits
3	-	--	3

Course Description:
This course provides a comprehensive introduction to the fundamentals of industrial automation, covering sensors, actuators, and controllers. It emphasizes key technologies such as PLC programming, SCADA systems, and DCS, along with their communication protocols and industrial applications. The course also introduces advanced topics, including Industrial IoT (IIoT), robotics, digital twins, and artificial intelligence, highlighting their role in modern manufacturing and process automation.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Explain the principles and components of industrial automation systems.
2. Apply fundamental techniques and tools to solve basic industrial automation problems.
3. Analyze industrial automation systems to identify and address operational challenges.
4. Design automation solutions to meet industrial requirements using modern technologies.

Prerequisite: Basic knowledge of electrical and electronics components, devices and measurements.

Course Content

Unit No.	Description	Hrs
1.	**Fundamentals of Industrial Automation** Introduction to industrial automation: definition, need, and benefits, review of power electronics devices SCR, DIAC, TRIAC, power MOSFET and IGBT, types of power electronic circuits, protection circuits, control circuits, review of process controllers-ON/OFF, P, PI and PID.	06
2.	**Industrial Sensors and Actuators** Contactors, control relays, classification of sensors: Proximity, temperature, pressure, and flow sensors. Actuators: DC motors, stepper motors, and solenoids, Signal conditioning, role of sensors and actuators in automated systems.	
3.	**Programmable Logic Controllers** PLC hardware components- I/O modules and specifications, memory types, program scan, seal-in circuits, interlocking circuits, PLC programming-	06

	developing PLC wiring diagrams and ladder logic programs for simple applications.	
4.	**Programmable Timers and Counters** Timer instructions, on-delay and off-delay timers, retentive timers, cascading timers, counter instructions, up and down counters, combining counter and timer, timer/counter applications. Program control instructions, function block programming.	**06**
5.	**Industrial Communication Systems** Data communication, Device Net, Control Net, Ethernet, Modbus, Field Bus, Profibus, Industrial IoT (IIoT): Concepts and applications.	**06**
6.	**SCADA and DCS Systems** SCADA: Architecture and components, Functions and applications of SCADA in monitoring and control, Introduction to Distributed Control Systems (DCS): Architecture and advantages, Comparison of PLC, SCADA, and DCS systems, Emerging Trends in Industrial Automation-role of robotics, Artificial Intelligence (AI) and Machine Learning (ML) and digital twins in automation.	**06**

Text Books:

1. Frank Petruzella, Programmable Logic Controllers, McGraw Hill Publication
2. A. K. Gupta, S. K. Arora, Industrial Automation and Robotics, Laxmi Publications
3. John W. Webb, Ronald A. Reis, Programmable Logic Controllers: Principles and Applications, Pearson Education.
4. Jon Stenerson, Industrial Automation and Process Control, Pearson.

Reference Books:

1. S.K. Singh, "Industrial Instrumentation and Control", McGraw Hill Publication
2. C.D. Johnson," Process Control Instrumentation Technology", Prentice Hall India Publication
3. Webb and Reis, "Programmable Logic Controllers: Principles and Applications", Prentice Hall India Publication
4. M. H. Rashid, "Power Electronics Circuits Devices and Applications", Prentice Hall India Publication

Class: - **Final Year B. Tech**	Semester - **VII**
Course Code: **EC4134**	Course Name: **Soft Computing**

L	T	P	Credits
3	-	-	3

Course Description:
This course offers a comprehensive introduction to Soft Computing methodologies, focusing on Fuzzy Logic and Neural Networks. It emphasizes a strong foundation in theoretical concepts, enabling students to understand and apply computational approaches to address complex engineering challenges. Students will explore fuzzy systems, neural network architectures, and their diverse real-world applications across various domains.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Describe the foundational concepts of soft computing techniques, including fuzzy logic and neural networks.
2. Differentiate fuzzy logic from traditional logic systems to assess its effectiveness in addressing uncertainty in engineering scenarios.
3. Analyze neural network architectures and their theoretical applications in classification, regression, and control systems.
4. Evaluate the theoretical integration of fuzzy logic and neural networks in adaptive systems for engineering problem-solving.

Prerequisite: Knowledge of Probability & Statistics.

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Fuzzy Sets, Relations and Fuzzy Control** Classical Sets, Classical Set Operations, Properties of Classical Sets, Fuzzy Sets, Fuzzy Membership Functions, Fuzzy Set Operations, Properties of Fuzzy Sets, Real world Problems based on Fuzzy sets.	06
2.	**Fundamentals of Neural Networks** Introduction, Basic Structure of a Neuron, Model of Biological Neurons, Elements of Neural Networks, Weighting Factors, Threshold Activation Function, Linear Separable Patterns, Single Layer Perceptron, Multi-Layer Perceptron.	06
3.	**Fuzzy Relations**	06

	Fuzzy Relations, Alpha-Cut Fuzzy Sets, Classical Relations vs. Fuzzy Relations, Extension Principle, Real world Problems based on Fuzzy Relations.	
4.	**Neural Network Architecture** NN Classifications, Feedforward and feedback networks, Supervised and Unsupervised Learning Networks, Back Propagation Algorithm, Delta Training Rule, Radial Basis Function Network (RBFN), Kohonen Self Organization Network, Hopfield Network.	**06**
5.	**Fuzzy Control System** Fuzzy Knowledge base control system, Neuro Fuzzy system, Adaptive Neuro Fuzzy System, Fuzzy control Design, Analysis of Fuzzy Control Systems.	**06**
6.	**Applications of Soft Computing** Adaptive Neuro-Fuzzy Inference Systems, Applications of Adaptive Neuro-Fuzzy Inference Systems, Applications of Neural Networks in Medicine and Biological Sciences, Application of Neural Network in Design of Digital Filters, Application of Computer Networking Using Neural Network, Autonomous Underwater Vehicle Control Using Fuzzy Logic, Application of Fuzzy Logic for Control of Heating, Chilling and Air Conditioning Systems.	**06**

Text Books:

1. Ali Zilouchian, Mo Jamshidi, Intelligent control systems using soft computing methodologies, CRC Press LLC.
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications,Wiley.
3. Dimiter Driankov, An Introduction to Fuzzy Control, Springer-Verlag Berlin Heidelberg, Wiley.

Reference Books:

1. S.N. Shivanandam, Principle of soft computing, Wiley.
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, euro-Fuzzy and Soft Computing, Prentice-Hall of India.
3. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice Hall.
4. James A. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson publication.

Class: - **Final Year B. Tech**	Semester - **VII**
Course Code: **EC4154**	Course Name: **Satellite Communication**

L	T	P	Credits
3	-	-	3

Course Description:
Satellite communication is offered as the program elective course for final year students of Electronics and Telecommunication Engineering. It unfolds history of satellite communication, orbital mechanics, satellite hardware and subsystems. Design of uplink and downlink along with worst case condition design has been included in the curriculum. Further this course describes VSAT, LEO, NGSO and various applications of satellites along with current developments, advances and explorations.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Discuss the components and subsystems of satellite.
2. Calculate various parameters of satellite communication by applying the knowledge of engineering fundamentals.
3. Design link budget for a satellite that meet specified need of communication and application.
4. Compile different applications of satellite systems by conducting surveys.
5. Demonstrate individually or in team, the life-long learning in technological change, effective communication by using variety of media to convey a message in document/poster/presentation.

Prerequisite: Basic knowledge of Engineering Physics and Telecommunication

Course Contents		
Unit no.	**Description**	**Hrs.**
1.	**Orbital Mechanics** History and overview of Satellite Communication, Kepler's Law of Motion, Types of Orbit, Orbital Mechanics, Look angle determination, Orbital perturbations, Launchers and Launch Vehicles, Orbital effects in communication system performance. Case Study: Study GEO Stationary Satellite Launching Activity (Refer ISRO website) eg. PSLV-C50 launching for CMS-01 Satellite	06
2.	**Satellite Hardware** Satellite subsystems, Mechanical structure, Attitude and control systems, Telemetry, Tracking, Command and Monitoring, Power systems, Communication	06

	subsystems, Thermal subsystem, Satellite antennas, Propulsion subsystems, Equipment reliability and space qualification. Conventional Vs High Throughput Satellites.	
3.	**Satellite Link Design** EM Spectrum for Satellite Communication, Basic transmission Theory, System Noise Temperature and G/T Ratio, Design of Downlinks, Satellite Systems using Small Earth Stations, Uplink Design, Design of Specified C/N: Combining C/N and C/I values in Satellite Links, System Design Examples.	**06**
4.	**VSAT, LEO and NGSO** Introduction, Overview of VSAT Systems, Network Architecture, VSAT Earth Station Engineering, LEO and NGSO: Orbit considerations, Coverage and frequency Consideration, Delay and Throughput considerations	**06**
5.	**Satellite Applications** Communication satellites, Digital DBS TV, Satellite communication on the Move Technology: Marine, Aerospace, Remote Sensing satellites: Forest, Ocean, Agriculture, Disaster Management, Navigation satellites, GPS,	**06**
6.	**Applications, Advances and Explorations** Weather satellites: Climate and Environment, Military satellites, Scientific satellites, Satellite Technology Advances: Electric Propulsion and Launch Platforms, Satellite Debris threat & management, Launches by ISRO: Mars orbiter mission, Chandrayan, Aditya mission	**06**

Text Books:

1. Timothy Pratt, Charles Bostian and Jeremy Allnutt, Satellite Communications, John Wiley and Sons.
2. Daniel Minoli, Innovations in Satellite Communication Technology, Wiley Publications.

Reference Books:

1. Dennis Roddy, Satellite Communications, III, McGraw Hill.
2. Anil K Maini, Varsha Agrawal, Satellite Technology Principles and applications, Wiley Publications.

Class: - **Final Year B. Tech**	Semester - **VII**
Course Code: **EC465**	Course Name: **Radar and Optical Communication**

L	T	P	Credits
3	-	-	3

Course Description:
This course provides in depth understanding of the fundamental concepts and applications of radar. It provides introduction to radar signal detection. It provides basic knowledge of fiber optics devices its characteristics and fundamental operations

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Analyze Operational characteristics of Radar system.
2. Elaborate fundamentals and applications of various application of Radar.
3. Analyze Operational characteristics of optical fiber system.
4. Design applications of various optical sources.

Prerequisite: Fundamental of electronics and physics and mathematical knowledge.

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Operational characteristic of radar** Radar Frequencies, Pulsed Operation, Pulse Repetition Frequency, Radar Range Equation.	06
2.	**Radar Systems** Principles and Block diagram of Pulse Radar, CW Radar, FM-CW Radar, MTI Radar, Noncoherent MTI Radar, Doppler Radar Detection of Radar Signals: Matched Filter Receiver, Correlation Detection, Likelihood function, Detector Characteristics. statistical estimation of parameter maximum likelihood Estimation.	06
3.	**Radar Applications** Direction Finder, Instrument landing system, radar Beacons, Bistatic Radar.	06
4.	**Optical Fiber Waveguides**	06

	Transmission Characteristics of Optical Fibers: Attenuation. Material Absorption losses in Silica Glass Fibers, Intrinsic absorption. Linear Scattering Losses: Rayleigh/Mie scattering.	
5.	**Non-Linear Scattering Losses** Stimulated Brillouin Scattering, Simulated Raman Scattering, Fiber bend loss, core and cladding losses Dispersion: Intramodal Dispersion: Material and Waveguide Dispersion. Intermodal Dispersion: Multimode step index, Multimode Graded Index, Overall Fiber Dispersion.	**06**
6.	**Optical Sources** LED Structures and LASER Diodes: Principles, Absorption, Quantum Efficiency. PIN Photo diode, Avalanche Photo Diode optical receiver circuit. Fundamental of optical receiver operation. Link power budget, Rise time, Line coding.	**06**

Text Books:

1. Merrill I Skolnick, Introduction to radar systems, TATA Mc Graw-Hill
2. Gerd Keiser, optical fiber and communications, Mc Graw-Hill

Reference Books:

1. Fiber – optic communication system, Govind P. Agrawal, WSE, Willey
2. Simon Kingsley and Shaun Quegan, Understanding Radar system

Class: - **Final Year B. Tech**	Semester - **VII**		**L**	**T**	**P**	**Credits**
Course Code: **EC467**	Course Name: **VLSI Testing**		**3**	**-**	**-**	**3**

Course Description:
This course explores the fundamental principles and methodologies of VLSI testing to ensure circuit functionality and reliability. It covers fault modeling, test generation techniques, and advanced testing methods like Built-In Self-Test (BIST) and Design for Testability (DFT). Students will learn to analyze and improve test efficiency using test vector compression and response compaction techniques.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Illustrate fundamental concepts of testing and its importance in circuit functionality.
2. Implement algorithms for Automatic Test Pattern Generation (ATPG) and generate test vectors.
3. Apply DFT techniques viz. scan based testing, BIST and boundary scan for improving Testability.
4. Evaluate the effectiveness of test vector compression and test response compaction techniques to reduce test time and memory storage.

Prerequisite: Digital Electronics, VLSI Design.

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Introduction to Logic Testing** VLSI design flow, Importance of Testing, Testing during the VLSI lifecycle, Challenges in VLSI Testing, Levels of Abstractions, Functional vs. Structural approach to Testing, Complexity of the Testing problem, Test Economics, Faults, Fault Coverage, Yield and Defects, Review of VLSI Test Technology.	**06**
2.	**Fault Modeling and Simulation** Levels of Fault Models, Fault Equivalence, Fault Dominance, Fault Collapsing, Check Point Theorem, Single Stuck and Multiple Stuck Fault Models, Fault Simulation: Serial, Parallel, Deductive, Concurrent.	**06**

3.	**Test Generation** Random Test Generation, Combinational circuit Test Generations, D Algorithm, FAN algorithm, PODEM algorithm, Bridging Fault ATPG, Untestable Faults, IDDQ Testing, Testing of Sequential Circuits, Emerging Testing Paradigms.	**06**
4.	**Design for Testability** Testability, Controllability and Observability, Adhoc and Structured approaches, Testability Analysis, Scan Cell Designs, Scan Architectures, Scan Design Rules, Scan Design Flow, Boundary Scan.	**06**
5.	**Logic Built-In Self-Test** BIST Design Rules, Test Pattern Generation: Exhaustive Testing, Pseudo-Random Testing, Pseudo-Exhaustive Testing, Delay Fault Testing, Output Response Analysis, Logic BIST Architectures.	**06**
6.	**Test Compression and Compaction** Test Stimulus Compression: Code-Based Schemes, Linear-Decompression Based Schemes, Test Response Compaction, Logic Diagnosis.	**06**

Text Books:

1. Parag K. Lala, An Introduction to Logic Circuit Testing, Morgan & Claypool Publishers.
2. C. W. Wu and L. T. Wang, VLSI Test Principles and Architectures: Design for Testability, Morgan Kaufmann Publishers In.
3. M. L. Bushnell, V. D. Agarwal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Springer.

Reference Books:

1. D. Friedman, Melvin A. Breuer, and Miron Abramovici, Digital Systems Testing and Testable Design, IEEE Publications U.S.
2. Hideo Fujiwara, Logic Testing and Design for Testability, MIT Press.

Class: **Final Year B. Tech**	Semester - **VII**
Course Code: **EC469**	Course Name: **Pattern Recognition**

L	T	P	Credits
3	-	-	3

Course Description:
This course provides an in-depth introduction to the fundamental principles and techniques of Pattern Recognition, focusing on the design, analysis, and implementation of systems that recognize patterns and make intelligent decisions based on data. It includes statistical pattern recognition, machine learning algorithms, feature extraction and selection, classification techniques, clustering methods, and dimensionality reduction. By the end of the course, students will be equipped with the skills to design and implement pattern recognition systems and evaluate their performance effectively.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Explain key concepts and techniques in pattern recognition.
2. Develop and implement classification and clustering algorithms.
3. Analyse and pre-process data for optimal pattern recognition performance.
4. Apply pattern recognition techniques to real-world problems.
5. Evaluate and compare the performance of recognition systems.

Prerequisite: Basic knowledge of linear algebra, probability & statistics, basic programming skills

Course Content

Unit No.	Description	Hrs
1.	**Introduction** Overview of Pattern Recognition, Types of Learning: Supervised, Unsupervised, Reinforcement Learning, Probability Theory, Decision Theory, Probability Distributions, Gaussian Distribution.	06
2.	**Linear Models for Regression and Classification** Linear Basis Function Models, Bayesian Linear Regression, Discriminant Functions, Probabilistic generative and discriminative models, Bayesian Logistic Regression.	06

3.	**Neural Networks** Feedforward Neural Networks, Network training, Error Backpropagation, Activation Functions, Regularization and Overfitting, Bayesian Neural Network.	06
4.	**Kernel Methods** Constructing Kernels, Gaussian Process for regression, Gaussian Process for classification, Laplace Transformation, Support Vector Machine, Relevance Vector Machine.	06
5.	**Graphical Models** Bayesian Networks, Linear Gaussian Model, Markov Random Fields, Inference in Graphical Models, Hidden Markov Models.	06
6.	**Mixture Models and EM Algorithm** K-means Clustering, Gaussian Mixture Models (GMM), Expectation-Maximization (EM) Algorithm, Latent Variable Models, Sampling methods.	06

Text Books:

1. Pattern Recognition and Machine Learning" by Christopher M. Bishop, Springer
2. Introduction to Pattern Recognition" by M. Narasimha Murty and V. Susheela Devi

Reference Books:

1. Pattern Classification" by Richard O. Duda, Peter E. Hart, and David G. Stork
2. Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy

Class: **Final Year B. Tech**	Semester - **VII**
Course Code: **EC471**	Course Name: **Instrumentation for Robotics and Automation**

L	T	P	Credits
3	-	-	3

Course Description:
Robotics is an interdisciplinary branch of electronic engineering and mechanical engineering. Robotics involves design, construction, operation, and use of robots. The goal of robotics is to design machines that can help and assist humans. Robotics and automation technology especially with the advent of Industry 4.0. This course provides an overview of robot mechanisms and intelligent control. This course enriches with knowledge related to design, construction, operation, and applications of robots as well as the techniques of industrial automation. It also focuses on robotic controllers and FMS. The working principles of various sensors used in robots will be explained in detail.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Acquire knowledge on different types of Power Sources (actuators) and Sensors,
2. Classification of Manipulators, Actuators and Grippers.
3. Develop Interfacing of robot controller
4. Clear the concepts of flexible manufacturing system (FMS)

Prerequisite: Basic knowledge of Electronics and Control System.

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Basic Concepts & Power Sources** Fundamentals: Robot Components, an overview of Robotics power sources, Types of robot power sources, comparison of different robot power sources, Components of Industrial robotics-precession of movement-resolution, accuracy & Repeatability-Dynamic characteristics- speed of motion, load carrying capacity & speed of response.	**06**
2.	**Smart Sensors & Grippers** Smart sensors, MEMS based sensors, Robotic vision sensor, Light sensors, Grippers: Mechanical Gripper-Grasping force, mechanisms for actuation, Magnetic gripper vacuum cup gripper-considerations in gripper selection & design.	**06**

3.	**Robotics Drives Systems** Introduction, Functions of drive systems, Hydraulic actuators- Linear Hydraulic actuators and Rotary Hydraulic actuators. Pneumatic Actuators- Linear Pneumatic actuators and Rotary Pneumatic actuators. Electric Actuators-D.C. Motor, Reversible A.C. Motors, Brushless D.C. Motors, D.C. Servomotors, A.C. Servomotors, Stepper Motors	06
4.	**Robotic Controllers and Accessories** Microprocessors and Microcontrollers based robotic controllers, Sensors & Actuators, Gripper's interfacing with robotic controller, Introduction to PLCs, Basic Structure of a PLC, Principles of Operation, PLC Programming Languages, Ladder diagram, Latching and internal relays, Timers and Counters, Selection of a PLCs, Application of PLCs.	06
5.	**Flexible Manufacturing Systems (FMS)** Introduction to Flexible Manufacturing Systems, Challenges of traditional manufacturing in a dynamic market, FMS architecture: workstations, material handling systems, Computer control systems: supervisory control, part programming, and data management, Principles and applications of GT, Production planning concepts: capacity planning, material requirements planning (MRP), and Just-in-Time (JIT) in FMS.	06
6.	**Applications of Robots** Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, and robot for under water applications. material handling, Robotics and Automation for Industry 4.0, Autonomous mobile robot (AMR)	06

References-

Text Books:

1. Fundamentals of Robotics by D.K. Pratihar, Narosa Publishing House, New-Delhi
2. D. Patranabis, Sensors and Transducers, PHI, 2nd Edition
3. Industrial Automation and Robotics, A. K. Gupta and S. K. Arora, University Science Press
4. P. N. Rao, Manufacturing Technology, Vol- II, McGraw Hill Education (India) Private Limited

Reference Books:

1. Robotics and Industrial Automation, R. K. Rajput, S. Chand, New Delhi
2."Industrial Robotics, Technology programming and Applications", McGraw Hill

Class: **Final Year B. Tech**	Semester - **VII**
Course Code: **EC4174**	Course Name: **AI and ML**

L	T	P	Credits
3	-	-	3

Course Description:
This course provides an in-depth exploration of Artificial Intelligence (AI) concepts, methodologies, and applications. It covers the foundational principles of AI, problem-solving strategies, knowledge representation, and reasoning. The course also introduces machine learning, neural networks, and deep learning techniques, focusing on ethical considerations and societal impacts of AI. Students will gain a comprehensive understanding of AI's role in shaping the future and its potential risks and benefits

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Understand and explain the foundational principles of artificial intelligence and machine learning.
2. Demonstrate and apply problem-solving and reasoning techniques using search algorithms and knowledge representation methods.
3. Apply machine learning techniques to develop solutions for real-world problems.
4. Analyze the working of neural networks and their applications in artificial intelligence.
5. Evaluate AI technologies' ethical and societal implications and propose recommendations for their future potential.

Prerequisite: Knowledge of linear algebra, probability, and statistics. Familiarity with data structures and algorithms.

Course Content		
Unit no.	**Description**	**Hrs.**
1.	**Introduction to Artificial Intelligence** Definition of AI and scope, Foundations of AI, History of AI and its evolution, Risks and Benefits of AI, Intelligent Agents: Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.	**06**
2.	**Problem Solving and Search Strategies**	**06**

	Problem-Solving Agents: Example Problems, Search Algorithms, Uninformed search strategies, Informed search strategies, and Heuristic Functions. Search in complex Environments: Local Search and Optimization Problems, Search in Partially Observable Environments, Online Search Agents and Unknown Environments.	
3.	**Knowledge Representation and Reasoning** Propositional and first-order logic, Inference mechanisms and resolution, Categories and Objects, Reasoning Systems for Categories, Acting under Uncertainty, Basic Probability Notation, Bayes' Rule and Its Use, and Naive Bayes Models. Probabilistic Reasoning.	**06**
4.	**Fundamentals of Machine Learning** Forms of Learning, Supervised Learning, Learning Decision Trees, Model Selection and Optimization, The Theory of Learning, Linear Regression and Classification, Nonparametric Models, Ensemble Learning, Developing Machine Learning Systems.	**06**
5.	**Neural Networks and Deep Learning** Simple Feedforward Networks, Computation Graphs for Deep Learning, Convolutional Networks, Learning Algorithms, Generalization, Recurrent Neural Networks, Unsupervised Learning and Transfer Learning, Reinforcement Learning.	**06**
6.	**Ethical, Societal, and Future Implications of AI** The Limits of AI, Can Machines Think? The Ethics of AI. Societal impacts of AI: employment, privacy, and security, The Future of AI: AI Components, AI Architectures. Applications and case studies of Artificial Intelligence and Machine Learning.	**06**

Text Books:

1. Artificial Intelligence: A Modern Approach, by Stuart Russell and Peter Norvig, 4th Edition, Pearson Education.
2. Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press.

Reference Books:

1. Pattern Recognition and Machine Learning by Christopher M. Bishop, Springer.
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron, O'Reilly Media.
3. Neural Networks and Deep Learning by Michael Nielsen (online e-book).

Class: Final Year B. Tech	Semester - VII
Course Code: **EC475**	Course Name: **RTOS and Embedded Linux Lab**

L	T	P	Credits
-	-	2	1

Course Description:
This laboratory course introduces students to the practical aspects of Real-Time Operating Systems (RTOS) and Embedded Linux, two key platforms in modern embedded system design. Students will gain hands-on experience in developing multitasking applications using RTOS APIs, managing inter-task communication, and handling interrupts and synchronization. The course also explores the embedded Linux environment, covering shell scripting, file system management, kernel module programming, and device driver development. Through the use of industry-relevant platforms such as FreeRTOS, Raspberry Pi, and BeagleBone, students will learn how to build, configure, and deploy embedded software in real-time and Linux-based systems. The course aims to bridge theoretical understanding with real-world embedded software development skills

Course Learning Outcomes:
After completion of this course, students will be able to:

1. Introduce the fundamentals of Real-Time Operating Systems (RTOS) and Embedded Linux environments.
2. Develop embedded applications using multitasking, scheduling, and synchronization mechanisms.
3. Apply Linux command-line tools, scripting, and file system operations relevant to embedded development.
4. Deploy real-time embedded applications on hardware platforms.
5. Improve the ability to communicate effectively through written lab journals

Prerequisite: Basic knowledge of microcontrollers, embedded systems, and Linux programming

Course Content		
Unit No.	**Description**	**Hrs**
1.	Blink LED using RTOS Task (FreeRTOS)	**02**

2.	Demonstrate Two Tasks craetion with Different Priorities	**02**
3.	Demonstrate Task Delay and Software Timer	**02**
4.	Implement Inter-task Communication using Queues and Semaphores	**02**
5.	Develop Event Flag Based Task Synchronization in FreeRTOS	**02**
6.	Handle External Interrupts and Context Switching in FreeRTOS	**02**
7.	Boot Embedded Linux on Raspberry Pi/BeagleBone	**02**
8.	Write and Run a Shell Script to Display Current Processes and Memory Usage	**02**
9.	Explore Linux File System and Permissions (chmod, chown, ls -l)	**02**
10.	Create a Makefile for Multi-file C Program on Linux	**02**
11.	Create a Simple Character Device Driver for GPIO Toggle	**02**

References –

Text Books:

1. Raj Kamal, "Embedded Systems: Architecture, Programming and Design", McGraw Hill Education
2. Qing Li, Caroline Yao, "Real-Time Concepts for Embedded Systems", Elsevier / CMP Books
3. Jean J. Labrosse, "MicroC/OS-II: The Real-Time Kernel", CRC Press

Reference Books:

1. Christopher Hallinan, "Embedded Linux Primer: A Practical Real-World Approach", Pearson / Prentice Hall
2. Karim Yaghmour, "Building Embedded Linux Systems", O'Reilly Media
3. Derek Molloy, "Exploring BeagleBone: Tools and Techniques for Building with Embedded Linux", Wiley

Class: - **Final Year B. Tech**	Semester-**VII**
Course Code: **EC4194**	Course Name: **Microwave Engineering Lab**

L	T	P	Credits
-	-	2	1

Course Description:
The Microwave Engineering Laboratory course offers students a hands-on learning experience focused on the practical aspects of microwave engineering. This laboratory course complements the theoretical concepts learned in the Microwave Engineering theory course, providing students with essential skills in designing, constructing, and analyzing microwave circuits and systems.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Measure parameters of microwave devices and networks.
2. Analyze microwave devices and networks.
3. Use CAD tools to simulate microwave devices and networks.

Prerequisite: Basic knowledge of Electromagnetic engineering and Microwave Engineering courses

Course Content		
Unit No.	**Description**	**Hrs**
1.	To study the characteristics of reflex klystron.	02
2.	To study the characteristics of GUNN diode/PIN diode.	02
3.	Characterization of E-Plane, H-Plane and Magic (Hybrid) Tee.	02
4.	Characterization of microwave Isolator and Circulator.	02
5.	Characterization of Microwave directional couplers.	02
6.	Characterization of Microwave attenuators.	02
7.	Microwave measurements using a Vector Network Analyzer - 1. Return loss 2. Insertion Loss 3. Bandwidth 4. Smith Chart.	02
8.	Simulation of Rectangular wave guide using CAD tool.	02
9.	Simulation of circular wave guide using CAD tool.	02
10.	Simulation of Microwave directional couplers using CAD tool.	02

Text Books:

1. D. M. Pozar, Microwave Engineering, 3rd Ed.; John Wiley & Sons Inc
2. S. M. Liao,Microwave devices and Circuits, 3rd Ed., Prentice Hall of India

Reference Books:

1. H. J. Reich, J.G. Skolnik, P.F. Ordung, H. L. Krauss; Microwave Principles, Affiliated East West Press Ltd.
2. R. E. Collin, Foundations for Microwave Engineering, 2nd Ed, Wiley-IEEE Press
3. Ananjan Basu, An Introduction to Microwave Measurements, CRC Press

Class: **Final Year B. Tech**	Semester - **VII**
Course Code: **EC4214**	Course Name: **Wireless Sensor Network Lab**

L	T	P	Credits
-	-	2	1

Course Description:
This practical course emphasizes the implementation and simulation of Wireless Sensor Network (WSN) concepts. It provides students with hands-on experience in simulating sensor networks, analyzing data, designing protocols, and evaluating performance. By leveraging Python libraries and tools, students will bridge the gap between theory and practice, applying their knowledge to model, simulate, and analyze real-world WSN scenarios effectively.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Design and simulate Wireless Sensor Network (WSN) topologies and operations using Python, focusing on the analysis of performance metrics such as energy efficiency, latency, and throughput.
2. Develop and optimize algorithms for WSN clustering, routing, and localization, ensuring improved energy efficiency and network scalability.
3. Evaluate strategies to address challenges related to energy consumption, scalability, and environmental constraints in WSNs.
4. Implement real-time sensor data acquisition and visualization using Python-based tools, leveraging advanced analytical techniques for effective data interpretation and decision-making.

Prerequisite: Basics of Python programming, Networking fundamentals, Probability and statistics for data analysis, Basic understanding of Wireless Sensor Network concepts.

Course Content		
Unit No.	**Description**	**Hrs.**
1.	Create and visualize a WSN topology using Python, simulating node placement, and establishing connectivity.	**02**
2.	Simulate SMAC and B-MAC protocols in Python, analyzing their energy efficiency and duty cycle performance.	**02**
3.	Develop a Python script to implement clustering algorithms like LEACH and evaluate energy distribution among clusters.	**02**

4.	Implement energy-efficient routing protocols in Python, analyzing data delivery performance with geographic routing.	**02**
5.	Simulate localization methods using range-based and range-free techniques, and visualize node positions in a simulated environment.	**02**
6.	Generate and process synthetic sensor data in Python, using libraries like Matplotlib or Seaborn to visualize data trends.	**02**
7.	Simulate time synchronization algorithms in WSNs and implement task scheduling techniques for optimized network performance.	**02**
8.	Implement secure communication protocols in WSNs and analyze their impact on overall network performance.	**02**
9.	Apply clustering or classification techniques to sensor data analysis.	**02**
10.	Simulate a real-world WSN application, such as environmental monitoring or smart agriculture, and evaluate its performance metrics.	**02**
11.	Mini project.	**02**
12.		**02**

Text Books:

1. Holger Karl, Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, Wiley.
2. Feng Zhao, Leonidas Guibas, Wireless Sensor Networks: An Information Processing Approach, Morgan Kaufmann.
3. Kazem Sohraby, Daniel Minoli, Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, Wiley.

Reference Books:

1. Carlos De Morais Cordeiro, Dharma P. Agrawal, Ad Hoc and Sensor Networks: Theory and Applications, World Scientific.
2. Yang Xiao, Muhammad Ilyas, Wireless Sensor Networks: From Theory to Applications, CRC Press.
3. Sunggu Lee, Young-Ho Kim, Wireless Sensor Networks: A Systems Perspective, CRC Press.
4. D. P. Agrawal, Q. A. Zeng, Introduction to Wireless and Mobile Systems, Brooks/Cole.
5. Lajos Hanzo, Marco A. Khalighi, Thomas Keller, Wireless Multimedia Communications: Techniques, Standards, and Applications, Wiley.

Class: - **Final Year B.Tech**	**Semester-VII**
Course Code: **EC4234**	Course Name: **System Verilog Lab**

L	T	P	Credits
-	-	2	1

Course Description:
This course deals with design and verification of digital circuits and modules using system Verilog. The EDA playground will be used for the verification of digital modules.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Write system verilog code for given specification.
2. Interpret the results as per specification.
3. Use tools for simulation and verification of digital modules.
4. Analyze the results by comparing with interpreted values.
5. Demonstrate and communicate effectively through lab journals.

Prerequisite: Basic knowledge of Digital Design and Programming with HDL.

Course Content		
Unit No.	**Description**	**Hrs.**
1.	a. Write sytem Verilog code to design full adder using half adders. b. Write system verilog testbench and verify the functionality.	**02**
2.	a. Write system verilog model of 3:8 Decoder using: i. Boolean operators ii. Conditional Operators iii. Shift operators iii. Write system verilog code for Encoder. b. Verify the functionality using system verilog testbench. c. Compare the three versions write conclusive remark.	**02**
3.	a. Write System verilog code for 4-bit ripple carry adder. b. Verify the functionality exhaustively generating stimulus vector for all combinations using system verilog testbench.	**02**
4.	Write a system verilog model of: i. Negative edge triggered D flip-flop ii. Negative edge triggered T flipflop iii. Negative edge triggered JK flipflop	**02**
5.	Model and Verify: i. Single Port RAM ii. Dual Port RAM	**02**
6.	a. Design and Write a system Verilog model of a 10-state synchronous counter	**02**

	that asserts an output when count reaches 10. b. Verify the functionality using system verilog testbench.	
7.	a. Write a system verilog model for comparator. b. Verify the functionality using system verilog testbench.	**02**
8.	a. Design and write a system verilog model of universal shift register b. Verify the functionality using system verilog testbench.	**02**
9.	a. Write system verilog model for given FSM. b. Verify the functionality using system verilog testbench	**02**
10.	a. Using arrays of structure to model and instruction register in microprocessor design. b. Verify the operation of ALU used in microprocessor using system Verilog.	**02**
11.	Design and Verify Synchronous and Asynchronous FIFO using System Verilog.	**02**
12.	Verification of any of the Industry Standard Protocol – UART/SPI/I2C/APB/AHB	**02**

Text Books

1. Christian B Spear, System Verilog for Verification: A guide to learning the Testbench language features, III, Springer publications.
2. Vijaya Raghavan, System Verilog Assertions, Springer publications.

Reference Books:

1. Stuart Southerland, System Verilog for Design, II, Springer publications.

Class: **Final Year B. Tech**	Semester - **VII**
Course Code: **EC473**	Course Name: **Biomedical Signal Processing Lab**

L	T	P	Credits
-	-	2	1

Course Description:
This course focuses on understanding the sources, types, and characteristics of noise and artifacts in biomedical signals. Students will learn to design time-domain and frequency-domain filters for noise removal and apply various methods to analyze signal characteristics. Additionally, the course encourages exploration of alternative techniques for biomedical signal analysis in both time and frequency domains.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Perform basic preprocessing tasks such as filtering and noise reduction.
2. Apply time-domain and frequency-domain analysis techniques to biomedical signals using software tools such as MATLAB or Python.
3. Analyze various biomedical signals, such as ECG, EEG, and EMG, to identify characteristic features and interpret their physiological significance.
4. Demonstrate the ability to work effectively in team and communicate through written lab journals.

Prerequisite: Fundamental of MATLAB Programming, Signal Processing

Course Content

Unit No.	Description	Hrs
1.	Design IIR filter using BLT and IIV method.	02
2.	Design FIR filter considering any appropriate specification.	02
3.	Implement Auto and Cross Correlation in MATLAB.	02
4.	Design a Low Pass Filter of Defined Cut-Off Frequency to Remove the High Frequency Noises.	02
5.	Design a High Pass Filter of Defined Cut-Off Frequency to Remove the Low Frequency Noises.	02
6.	Acquire and Obtain the Limb Lead ECG Signal and Display.	02

7.	Compare Different Types of FIR Filter for LPF of ECG Signal.	**02**
8.	Compare Different Types of IIR Filter for LPF of ECG Signal.	**02**
9.	Perform a Spectral Analysis of ECG Signal.	**02**
10.	Detection of R Peak and R-R Interval from Acquired ECG Signal.	**02**
11.	Acquire and obtain the 20-20 Lead ECG Signal and Display.	**02**

Text Books:

1. D C Reddy, Biomedical Signal Processing, McGraw Hill.
2. R.M.Rangayyan Biomedical Signal analysis: A Case study approach, John Wiley & Sons.

Reference Books:

1. W. J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall.
2. Eugene N Bruce, Biomedical Signal Processing and Signal Modeling, John Wiley & Sons.

Class: Final Year B. Tech	Semester - VII
Course Code: **EC4254**	Course Name: **Industry Automation Lab**

L	T	P	Credits
-	-	2	1

Course Description:
The course provides an experiential learning on sensor, actuator, power devices, power converters, control circuits, drives and PLC ladder programming by conducting experiments. It aims to develop students' ability of developing program, analyzing the performance of the converters, interpreting the results and writing the report on the conduction of experimentation.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Develop a ladder program for the given application.
2. Use PLC to control the output devices.
3. Measure the performance parameters of the system.
4. Interpret the results of the experimentation.
5. Write report on conduction of the experiments.

Prerequisite: Basic knowledge of transducers, measurements, instrumentation and power electronics.

Course Content

Unit No.	Description	Hrs
1.	Develop and test ladder program for sequential control application of lamps/motors.	02
2.	Develop and test ladder program for sequential control application of DC/AC motors.	02
3.	Develop and test ladder program for the given application using timer.	02
4.	Develop and test ladder program for the given application using counter	02
5.	Develop and test ladder program to count the number of objects	02
6.	Develop and test ladder program for a Flashing Light Control	02
7.	Develop and test ladder program for a Traffic Light control.	02
8.	Develop and test ladder program to control speed of steeper motor.	02
9.	Develop and test ladder program to control speed of DC motor using controlled rectifiers.	02

10	Develop and test ladder program to control speed of DC motor using choppers.	02

Text Books:

1. Frank Petruzella, "Programmable Logic Controllers", McGraw Hill.
2. S.K. Singh, "Industrial Instrumentation and Control", McGraw Hill
3. C.D. Johnson, "Process Control Instrumentation Technology", Prentice Hall India
4. Webb and Reis, "Programmable Logic Controllers: Principles and Applications", Prentice Hall India.
5. M. H. Rashid, "Power Electronics Circuits Devices and Applications", Prentice Hall India

Reference Books:

1. Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education Asia.
2. Vedam Subramanyam, "Electric Drives – Concepts and Applications", McGraw Hill.
3. Krishna Kant, "Computer Based Process Control", Prentice Hall India

Class: **Final Year B. Tech**	Semester- **VII**
Course Code: **EC4274**	Course Name: **Soft Computing Lab**

L	T	P	Credits
-	-	2	1

Course Description:
This lab course provides practical exposure to implementing soft computing techniques using computational tools. Students will gain experience with fuzzy logic operations, membership functions, fuzzy inference systems (FIS), and neural network architectures. The lab emphasizes the design and theoretical testing of adaptive systems to address engineering challenges.

Course Learning Outcomes:
After completion of this course, students will be able to:
1. Implement fuzzy logic operations, including membership functions and FIS design, to solve engineering problems effectively.
2. Apply core principles of neural networks to create logical functions such as AND, NOT, XOR, and Hebbian networks.
3. Design and evaluate neural network architectures, including perceptron and Hopfield networks, to compute weights and address classification tasks.
4. Develop and present a mini-project demonstrating the application of soft computing techniques to practical challenges.

Prerequisite: Basic knowledge of MATLAB programming and python, set theory, logic design, and neural network fundamentals.

Course Content		
Unit No.	**Description**	**Hrs.**
1.	Perform fuzzy operations.	**02**
2.	Implement De-Morgan's Law.	**02**
3.	Generate AND not function using Neural network.	**02**
4.	Generate XOR function using Neural network.	**02**
5.	Plot various membership functions.	**02**
6.	Implement application using FIS editor.	**02**

7.	Generate Heb net using Neural network.	**02**
8.	Generate perceptron Neural network.	**02**
9.	Calculate weights of given patterns.	**02**
10.	Generate and test Hopfield network.	**02**
11.	Mini project based on soft computing applications.	**02**
12.		**02**

Text Books:

1. Ali Zilouchian, Mo Jamshidi, Intelligent control systems using soft computing methodologies, CRC Press LLC.
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley.
3. Dimiter Driankov, An Introduction to Fuzzy Control, Springer-Verlag Berlin Heidelberg, Wiley.

Reference Books:

1. S.N. Shivanandam, Principle of soft computing, Wiley.
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, euro-Fuzzy and Soft Computing, Prentice-Hall of India.
3. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice Hall.
4. James A. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson publication.

Class: - **Final Year B. Tech**	Semester-**VII**
Course Code: **EC4294**	Course Name: **Capstone Project Phase-II**

L	T	P	Credits
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Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Devise sound technical knowledge, for identified problem of project.
2. Propose engineering solutions to complex problems.
3. Demonstrate the skills and attitude in a professional way in a team.
4. Illustrate the component and cost optimization solutions wherever applicable.
5. Develop skills towards the use of modern tools and presentations.
6. Justify outcomes through simulation/ experimentation in an environmental and sustainable way.
7. Summarize project report in an ethical way.

General guidelines:
The capstone project phase-II of this semester carries 6 credits. The majority of project work shall be in VII semester. The project group from project phase-I will continue to work on the project selected during VI semester and submit the completed project work to department by the prescribed date usually two weeks before the end of VII semester as mentioned below:
1. Executed project
2. Project report

The capstone project phase-II report should be prepared using the format provided. Students should complete regularly progress work and get the approval from DPC.

Project evaluation:
The students shall be evaluated individually and group wise for his/her project through the quality of work carried out, the novelty of the concept, the report submitted and presentation etc.

The ISE evaluation of capstone project phase- II will be carried out for 50%. The assessments are carried out as per the rubrics given to the guides.

The ESE evaluation will be done as per schedule given by COE for 50%, where students have to present their entire project work carried out throughout the Sem-VI and Sem-VII. The evaluation will be done by panel of examiner containing guide and a faculty appointed by DPC.

Class: - **Final Year B. Tech**	Semester-VIII
Course Code: **OE4382**	Course Name: **Finance for Engineers (Online Course)**

L	T	P	Credits
2	-	--	2

Course Description:
In today's workplace, it is nearly impossible for an engineer to perform without considering the financial impact of every action on the organization's bottom line. Engineers need to be aware of issues such as cost reduction and capital investment and how their decisions can affect the financial statements. This course introduces basic financial management to engineers and technical personnel who need this knowledge to manage a profit center effectively. The course aims at providing students with an in-depth coverage of the various aspects of financial management.
It covers the assessing the financial health of the organization through ratio and cash flow analysis, sources of long term as well as short term finance. Decisions concern with financing, working capital and long-term investment. Class will focus on both the academic theories underlying the management of funds and the practical aspects of financial management.

Course Learning Outcomes:
After successful completion of this course, students will be able to,
1. Discuss the fundamental aspects of accounting and finance.
2. Apply theoretical knowledge and information for preparing various financial statements.
3. Analyze the financial information for solving managerial problems.
4. Evaluate financial performance of the organization for effective decision making.

Prerequisite: Basics of Mathematics

Course Contents

Unit No.	Description	Hrs.
1.	**Finance Terminologies & Financial Statement:** Key terms of Accounting and Finance, Accounting Principles underlying Preparation of Financial Statements.	4
2.	**Analyzing Health of a Firm:** Techniques of Analyzing Health of a Firm, Classification of Ratios – Liquidity, Leverage, Activity, Profitability, Analysis of Cash Flows.	4
3.	**The Management of Working Capital:** Need of Working Capital, Operating Cycle of Working Capital, Determinants of Working Capital, Preparation of Working capital statement.	4

4.	**Investment Decision Rules:** Investment Decision Rules, Evaluation Criteria for Investment Decision: Payback, ARR, NPV, PI & IRR, Decision Tree Analysis.	4
5.	**Long Term Financing:** Long Term Financing: Shares, Debentures, Loan capital, foreign capital, FDI, Euro issues & external borrowings, Venture capital financing.	4
6.	**Financing Decisions and Cost of Capital:** Risk & Return, Cost of Capital, Cost of Equity, Cost of Debt, Weighted Average Cost of Capital.	4

References –

Reference Books:

1. Paul Kimmel, J. Weygandt, D. Kieso, Financial Accounting.
2. S.N. Maheshwari & S.K. Maheshwari, Problems & Solutions in Advanced Accountancy, Vikas Publishing House Pvt. Ltd., New Delhi.
3. M.C. Shukla, T.C. Grewal & S. C. Gupta, Advanced Accounts, S. Chand.
4. M. Y. Khan & P. K. Jain, Financial Management, Tata McGraw-Hill Publishing Company Limited, New Delhi.
5. Prasanna Chandra, Financial Management, Tata McGraw-Hill Publishing Company Limited.

Note: - Being online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments within specified time.

Weightage: 25% weightage for unit wise assignments + 75% weightage for final exam.

Final exam will be held at college campus.

Class: -**Final Year B. Tech.**	Semester- **VIII**
Course Code: **OE4362**	Course Name: **Engineering Management & Economics**

L	T	P	Credits
2	-	-	2

Course Description:
Engineering management is the integration of management principles with engineering practices. It is a specialized field that focuses on effectively leading engineering teams and managing technical projects. This course is structured into two key modules: Engineering Management and Engineering Economics. The first module is centered on building the managerial skills necessary to guide, mentor, and inspire technical professionals in their engineering roles. The second module delves into engineering economics, a vital area for engineering firms to maintain their competitive advantage and market presence, focusing on economic decision-making.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Develop administrative, organizational, and planning skills to effectively manage and execute engineering projects.
2. Create bar charts and milestone charts to track and manage project progress.
3. Analyze profit and cost data, conducting economic evaluations to make informed, optimal decisions.
4. Calculate depreciation using various methods.

Prerequisite: Basics of Mathematics

Course Content

Unit No.	Description	Hrs
1.	**Managerial skills:** Theories of Management Principles of Management (by Henry Fayol), Functions of Management, Planning, Organizing, Staffing, Directing, Co-Ordination, Communication, Motivation and Controlling.	04
2.	**Organizational skills:** Levels of management, Organizations-elements, types and characteristics of organization, Management by Objectives. (MBO)	04
3.	**Planning Tools:** Methods of scientific management- Critical Path Method (CPM), Programme Evaluation & Review Techniques (PERT), Network Crashing, Bar Chart, Mile-Stone chart, Gant Chart.	04

4	**Methods of Economic Analysis:** Economic equivalence, Methods of comparison of alternatives- Present Worth Method, Rate of Return method, Benefit-Cost ratio method.	04
5	**Make or Buy Decision:** Approaches of make or buy decision-Simple cost analysis, Economic analysis, break-even analysis, Payback analysis.	04
6	**Depreciation:** Methods of Depreciation- Straight line method, Declining balance depreciation, Sum of years digits method, sinking fund method, service output method.	04

References -

Text Books:

1. Gilbert Daniel R, Freeman R. Edward and Stoner James A. F, "Management" Pearson Education.
2. Harold Kerzner, "Project Management- A system approach to planning, scheduling and controlling", John Wiley & Sons Inc.
3. Punmia B. C. and Khandelwal K. K, "Project Planning, Scheduling and controlling with PERT and CPM", Laxmi Publications Pvt. Ltd.
4. Paneer selvam R, "Engineering Economics", Prentice Hall India Learning Private Limited.

Reference Books:

1. Cannice Mark V, Koontz Harold and Weihrich Heinz, "Management", McGraw Hill Education (I) Pvt. Ltd.
2. Blank Leland and Tarquin Anthony, "Basics of Engineering Economy", Tata McGraw-Hill.
3. Mithani D. M, "Managerial Economics- Theory & Applications", Himalaya Publishing House-New Delhi.

Note: - Being online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments as per schedule.

Weightage: 25% weightage for unit wise assignments + 75% weightage for final examination.

Class: - **Final Year B. Tech**	Semester-**VIII**
Course Code: **IP4024**	Course Name: **Industry Internship & Project**

L	T	P	Credits
-	-	--	12

Course Description:

Internship is designed to expand the depth and breadth of academic learning of students in their particular areas of study. It is an opportunity for students to receive experience in applying theories learned from the classroom to specific experiences with the community and work world. An internship can also heighten awareness of community issues, motivate students to create opportunities, embrace new ideas, and give direction to positive change. A successful internship can give valuable information in making decisions about the direction of future studies or employment. An internship is an opportunity not only to use and develop industry-related knowledge and skills, but also to enhance some of the skills that are transferable to any professional work setting. Students from Final year B.Tech are eligible to do this internship. Selected candidates by college will be permitted for internship of minimum 20 weeks in 8th semester. During this Internship, it is expected that students should identify the problems arising in the industry related to Engineering, and they have to give the solution to the company.

Course Learning Outcomes:

1. Internship

After the successful completion of the IIP- II the student should be able to

1. Examine the functioning of the company on the terms of inputs, transformation process and the Outputs. (products and services)
2. Develop an attitude to adjust with the company culture, work norms, code of conduct.
3. Recognize and follow the safety norms, Code of conduct.
4. Demonstrate the ability to observe, analyse and document the details as per the industry practices.
5. Interpret the processes, systems and procedures and to relate to the theoretical concepts- studies.
6. Develop the leadership abilities, communication.
7. Demonstrate project management and finance sense.

2. Project

After the successful completion of the project, the student should be able to;

1. Identify the project/problem in the domain of a program relevant for the company.
2. Compile the information to the pertaining to the problem identified.
3. Analyse the information using the statistical tools/ techniques.
4. Develop the feasible solution for given problem.
5. Analyse the impact of the project on the performance of company/department.

Course Content

I. Internship:

During Internship, Students should follow guidelines given below.

1. After joining the industry students should learn all the departments and their workings. Furthermore, student should understand how each department of industry is interlinked with one another.
2. Student should correlate the theoretical aspects learned in academics with industry practices.
3. Students should gain a knowledge of new technologies which industry follows.
4. Students should follow the professional codes and ethics.
5. Students should follow all rules and regulations of industry. Special care should be taken regarding safety.

- **Work Diary:**

Work Diary will be provided to each student, which contains details regarding internship, do's and don'ts and evaluation scheme. Student is required to write the Diary regularly and get it signed by the industry guide periodically. During the visit of Mentor, assigned to the student should be able to go through the Diary to access the work done and write the remarks/ instruction. At the end of internship, student should submit the duly completed diary to the department.

- **Duration:**

The internship duration is of one complete semester (approximately 20 weeks) between 1st January to 30th May of the respective academic year. Biometric attendance on working days is compulsory.

II. Project:

Students should select technical problems occurring within the industry as a project in consult with industry & Institute mentors.

- **Evaluation**

Faculty Mentor will be assigned to each student by the Institute who will monitor the progress of internship and project and help the student to sort-out any issues/ problems arising. Mentor of student from college will visit the industry as per the schedule given below.

Sr.No.	Evaluation	Period
1.	At the beginning of the program for orienting Students to the company and finalize the project	During 2nd Week
2.	Review-I (ISE-1)	During10thweek
3.	Review-II (ISE-2)	During15thweek
4.	Review-III (ESE)	During20thweek

*Review-III is end semester examination (ESE), which will be conducted at institute.

*During ESE, students should submit, Project & internship report, Work diary, Internship & project completion certificate issued by industry etc. to respective departments.

Class: - **Final Year B. Tech**	Semester-**VIII**
Course Code: **RE4044**	Course Name: **Research Internship**

L	T	P	Credits
-	-	-	12

Course Description:

Research experience for undergraduates is important not only for conducting research on a topic that has an impact on a current research activity, but also as a tool to enhance undergraduate education. For the engineering technology students, research experiences allow them to carry out in-depth study of engineering concepts, while emphasizing hands-on experiences and practical applications. Participating in research projects strengthens the student's resume, and fulfills the requirements of present-day employers, who demand sound engineering skills in their employees.

Course Learning Outcomes:

After completion of this course, the student will be able to,

1. Investigate the technical literature.
2. Recognize and evaluate theories, practices, and/or research on a chosen topic by conducting a thorough literature review and submitting a written integrative, critical summary of the current literature.
3. Design a research problem and develop a methodology.
4. Develop and implement an advanced original research or creative project.
5. Develop the ability to explain the conceptual viability of the project and describe the major components involved.
6. Develop advanced discipline-relevant skills and competencies.
7. Write a research report and paper.

Course Content

Students should carefully discuss with their research advisor about time expectations to complete the research project.

Degree to which students meet expectations: The following is a minimum set of expectations for every student enrolled for this course for credit:

1. Perform a background literature search and review.
2. Develop a project plan.
3. Perform experimental work or applied experimental work.
4. Write and present a research report.
5. Write and submit research paper to any reputed journal/international conference.

To submit or publish the research paper in any reputed journal/international conference is a necessary criterion to become eligible for End semester Examination (ESE).

Quality of the final report and oral presentation: The research advisor will provide clear expectations of the desired format, content, and deadlines of the final report. The research advisors will grade the final report.

Attendance: In order to provide the measure of performance, the research advisor is expected to complete a two-mid-term evaluation with the student, accompanied by recommendations for improvement for the remainder of the term. The mid-term evaluation with the student should be accompanied by a one-on-one meeting between the research advisor and the student.

Absences and Make-up Work: Requirements for attendance is as per RR of the Institute

Evaluation

Faculty guide will be assigned to each student by the Institute who will monitor the progress of research project and help the student to sort-out any issues/ problems arising. Schedule of evaluation will be as given below.

Sr.No.	Evaluation	Period
1.	Review-I (ISE-1)	During10thweek
2.	Review-II (ISE-2)	During15thweek
3.	Review-III (ESE)	During20thweek

*Review-III is end semester examination (ESE).
*During ESE, students should submit research Project report, proof of submission of research paper to reputed journal/international conference to respective departments.
*If student is doing research project in outside organization (Research Lab/ institutes), he/she should submit project completion certificate given by outside organization.

Class: - **Final Year B. Tech**	Semester-**VIII**
Course Code: **ED4104**	Course Name: **Project Management**

L	T	P	Credits
2	-	--	2

Course Description:
To improve and update knowledge of new entrepreneurs in the areas of project preparation & appraisal techniques; decision-making process in the sector of industrial, infrastructure & sustainable opportunities that would lead to improved viability, returns and effective investment decisions. Writing a business plan which can gain interest of the fund providers like venture capitalists and other sources of funding.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Develop a Comprehensive Business Plan for selected business.
2. Evaluate Project Viability Through Financial Appraisal.
3. Analyze the Environmental and Technical Aspects of a Project.
4. Apply Project Management Techniques.
5. Assess the Commercial Feasibility of a Business Opportunity.

Prerequisite: General knowledge of economics & clear concept about own business model.

Course Content

Unit No.	Description	Hrs
1.	**Project appraisal** -Project Development Cycle, Preparation of feasibility studies, project formulation, screening for pre-feasibility studies, stages of feasibility report preparation, Project Analysis including Market Analysis, Technical Analysis & Financial Analysis, Various analytical techniques and integrating the data gathered into a full-fledged business plan.	04
2.	**Project Analysis**-Environmental Analysis, Risk Analysis, Infrastructure Development & Financing, Risk Management, Risk identification, Qualitative risk analysis, Quantitative risk analysis, Risk planning and control, National Cost-Benefit Analysis, Financing Sustainable Opportunities. Sustainability and Green Business Practices.	04
3.	**Business Plan:** What is business plan, Entrepreneurial opportunities and Business Plan. Preparing business plan. (Practical Exercises on preparation of business plan) Components of Business Plan, Executive summary, other components. Project report contents.	04
4.	**Commercial Appraisal:** Economic feasibility and commercial viability, market analysis, Market Research, Industry Analysis, Competitor analysis, defining the	04

	target market, market segmentation, market positioning, building a marketing plan, market strategy.	
5.	**Technical Appraisal:** Operation and Production Plan: Types of production systems, Product design and analysis, new product development, location and layout decisions, project layout, plant and technology choices, product specification and customer needs, production planning and control, Commercializing Technologies	04
6.	**Financial Appraisal:** pro forma income statements, financial projections, working capital requirement, funds flow and Cash flow statements; Ratio Analysis. **Project Management Techniques**: Identifying organizational structures Estimating costs and budgeting Using critical path project management tools (WBS, Gantt chart, Project Network Diagram) Establishing the critical path Tracking project milestones Using the program evaluation and review technique (PERT tool) Using process improvement tools (Fishbone, SIPOC) Managing time Controlling quality	04

References -

Text Books:

1. Dwivedi, A.K.: Industrial Project and Entrepreneurship Development, Vikas Publishing House

Reference Books:

1. Bangs Jr., D.H., *The Business Planning Guide,* Dearborn Publishing Co.
2. Katz, J.A. and Green, R.P., Entrepreneurial Small Business, McGraw Hill.
3. Mullins, J. and Komisar R., Getting to Plan B, Harvard Business Press.
4. O'Donnell, M., The Business Plan: Step by Step, UND Center for Innovation.
5. Scarborough, N.M. and Zimmerer, T.W., Effective Small Business Management, Pearson.
6. Pickle, H.B.and Abrahamson, R.L., Small Business Management, Wiley.
7. Desai, V., Dynamics of Entrepreneurial Development & Management, Himalaya Publishing
8. Kao, J., Creativity & Entrepreneurship, Prentice Hall.
9. Singh, Narendra, Project Management & Control, Himalaya Publications.

Class: - **Final Year B. Tech**	Semester-**VIII**
Course Code: **ED4044**	Course Name: **Commercial Aspects of the Project**

L	T	P	Credits
2	-	--	2

Course Description:
To familiarize students with accounting, mechanics of preparation of financial statements, understanding corporate financial statements, their analysis and interpretation.
The objectives of the course are to build the skills, frameworks and knowledge in entrepreneurial finance. Students will study the financing of small and medium sized businesses & Financial management from the perspective of both the entrepreneur and investors.
This course will also give overall understanding of marketing management which will help them in developing their own marketing decisions & in understanding the importance of market survey techniques. It will help them in conducting suitable market survey for their own selected products.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Interpret basic Accounting and Financial Terminologies.
2. Prepare & analyze financial statements.
3. Apply basic principles of marketing.
4. Apply knowledge of marketing mix for any organization.

Prerequisite: General knowledge of economics & clear concept about own business model

Course Content

Unit No.	Description	Hrs
1.	**Accounting Terminologies:** Meaning, nature, functions, types of accounting; generally accepted accounting concepts, principles and conventions; double entry system. Accounting Records: Fundamentals of record keeping, the accounting process, Computer-based accounting systems. Accounting cycle.	04
2.	**Financial Management** – Definition, nature, objectives, functions and scope of financial management, Preparation of financial plan – its objectives, essential features, consideration in formulating financial plan	04
3.	**Financial Statements:** Balance sheet: assets, liabilities. Income statement: concept of income, concept of expenses, concept of gain and losses. Components of the income statement. Cash flow statements: purpose, components, concept, Process.	04

4.	**Nature & Scope of Marketing** – Evolution, core marketing concepts, selling concept, marketing concept, Holistic marketing concept, portfolio approach-BCG matrix. Marketing Research- Concept & practice, Steps in Marketing Research.	04
5.	**Marketing Environment and STP:** Demographic, economic, political, legal, socio cultural, technological environment (Indian context); environmental scanning to discover marketing opportunities, Segmentation, Targeting and Positioning, difference between segmentation, targeting and positioning.	04
6.	**Marketing Mix: Product, Price, Promotion and Place.** **Product Decisions:** Concept of Product, Levels of Product, Product Mix Decisions, Product Line Decisions, Individual Product Decisions, Branding, Product Life-cycle - Stages. **Pricing Decisions:** Meaning, Factors influencing Pricing Decisions, Methods of Pricing **Place Decisions:** Meaning, Channels of Distribution **Promotion Decisions:** Elements of Promotion Mix, Advertising, Publicity, Sales Promotion, Personal Selling, Direct Marketing and Public Relations,	04

References -

Text Books:

1. Maheshwari, S.N. and Maheshwari, S.K., Financial Accounting, Vikas Publishing House.
2. Leach C.J. and Melicher, R.W. Entrepreneurial Finance, Thomson.
3. For B2C = Kotler, P., Keller, K.L., Koshy, A. and Jha, M.: Marketing Management, Pearson.
4. For B2B = Sarin, S. Strategic Brand Management for B2B Markets, Sage.

Reference Books:

1. Ghosh, T.P., Financial Accounting for Managers, Tax-mann Allied Services.
2. Gupta, A., Financial Accounting for Management, Prentice Hall.
3. Jain, S.P. and Narang, K.L., Advanced Accountancy, Kalyani Publishers.
4. Smith, J.K., Smith, R.L. and Bliss, R.T., Entrepreneurial Finance, Stanford University Press
5. Smith, J.K. and Smith, R.L., Entrepreneurial Finance, Wiley.
6. Rogers, S., Entrepreneurial Finance, McGraw Hill.
7. Chandra, P., Financial Management, McGraw Hill.
8. Kotler P. & Armstrong, G., Principles of Marketing, Pearson.

Note:

1. Lectures of this theory course will be conducted through online mode.
2. Recorded videos will be made available to students on MOODLE platform.
3. Faculty will upload three lectures per week and links will be shared on every Monday.

4. Students need to appear in Unit Test-1, Unit Test-2 and ESE in college campus as per the regular practice.
5. Faculty of concerned course will take the decision regarding modes of In-Semester Evaluation (ISE).

Class: - **Final Year B. Tech**	Semester-**VIII**
Course Code: **ED4064**	Course Name: **Entrepreneurship Development Program (EDP)**

L	T	P	Credits
-	-	--	1

Course Description:
Student will attend short term intensive EDP program organized either in house or by any authorized agency approved by CIIED.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Apply knowledge of engineering, economics, marketing and finance for formulation of business plan, starting & managing new business.

Prerequisite: General knowledge of business & clear concept about own business model.

Course Content:

1 Student will undergo training programs organized by CIIED.
Programs on marketing, Finance management, project report preparation by professional agencies. Students are required to apply this knowledge for preparing final project report.
2. Student will complete online certification course- **Entrepreneurial & Employability Skill Development Program** by Singapore polytechnic in association with Jugad Funda & Shivaji University, Kolhapur or any other approved agencies.
Evaluation- ISE **50** marks by mentor for-
1.Completion of online certification course- **Entrepreneurial & Employability Skill Development Program** by Singapore polytechnic in association with Jugad Funda & Shivaji University, Kolhapur or any approved agencies.
2. Active participation in programs by completing various activities/assignments in program.

Class: - **Final Year B. Tech**	Semester-**VIII**
Course Code: **ED4084**	Course Name: **Entrepreneurial Internship**

L	T	P	Credits
-	-	-	11

Course Description:
Student will prepare technically feasible and economically viable detailed project report including market survey.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Apply knowledge of engineering, economics, marketing and finance for preparation of project report.
2. Make commercial, technical and financial appraisal of project.

Course Content

Student will start working on collection of data required for business plan. During semester he may require to visit various support organizations, similar industries, suppliers of raw materials, machinery, special service providers. He has to conduct market survey. For this student can go out of campus with prior permission of mentor. Mentor should maintain this record. Students are required to work independently by taking guidance from mentor/Head CIIED/faculty on expert panel of CIIED.
Product prototype & execution of business operation is must & it should be validated by Departmental ED committee.
Continuous efforts taken by student should be observed by mentor for ISE evaluation. At the end of semester detailed project report will be presented before Expert committee for ISE evaluation of 100 marks.
Then student will appear for ESE. Project report evaluation &assessment will be done by a panel of experts appointed by COE.

Evaluation	Weightage	Particulars	converted Marks
ISE	10%	Preliminary project report	10
	20%	Market Survey	20
	20%	Completion of Legal Aspects	20
	50%	Final Report	50
ESE	100%	ESE -Final Report	100

Class: **-Final Year B. Tech.**	Semester- **VII**
Course Code: **REH401**	Course Name: **Intellectual Property Rights**

L	T	P	Credits
-	-	-	2

Course Description:
This course provides a comprehensive introduction to the principles and practices of Intellectual Property Rights (IPR) with a focus on their application in the fields of science, technology, and engineering. Students will explore the various forms of intellectual property, including patents, copyrights, trademarks, trade secrets, and industrial designs, and understand their legal, economic, and ethical implications. The course covers the process of securing and enforcing IP rights, the role of international agreements and organizations, and the challenges posed by emerging technologies. Through case studies, practical exercises, and discussions, students will gain the knowledge and skills necessary to protect and manage intellectual property in a globalized and innovation-driven world.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Explain the basic concepts and importance of Intellectual Property Rights.
2. Identify different types of intellectual property and their relevance in the technology sector.
3. Analyze the legal aspects of IPR and its implications for innovation and business.
4. Apply IPR principles to protect inventions, designs, and creative works.
5. Evaluate the ethical and societal impact of IPR in a global context.

Prerequisite: Write prerequisite required to study this course.

Course Content

Unit No.	Description	Hrs.
1.	**Introduction to Intellectual Property Rights:** Definition and importance of Intellectual Property (IP); Historical evolution of IPR; Types of Intellectual Property: Patents, Copyrights, Trademarks, Trade Secrets, Industrial Designs, Geographical Indications; Role of IPR in innovation and economic development; Overview of global IPR systems (WIPO, WTO, TRIPS Agreement).	04
2.	**Patents:** Concept of patents and patentability criteria (novelty, inventive step, industrial applicability); Types of patents: Utility, Design, and Plant Patents; Patent application process: Filing, examination, and grant; Patent infringement and enforcement; Case studies on patent disputes in technology sectors; Introduction to Patent Cooperation Treaty (PCT) and international patent filing.	04

3.	**Copyrights and Related Rights:** Concept of copyright and its scope; Subject matter of copyright: Literary, artistic, musical, and software works; Rights of copyright holders and limitations (fair use, public domain); Copyright registration and enforcement; Digital rights management and challenges in the digital era; Case studies on copyright infringement in software and media.	04
4.	**Trademarks and Industrial Designs:** Concept of trademarks and their importance in branding; Types of trademarks: Word marks, logos, service marks, collective marks; Trademark registration process and infringement; Concept of industrial designs and their protection; Design registration and enforcement; Case studies on trademark and design disputes.	04
5.	**Trade Secrets and Geographical Indications:** Concept of trade secrets and their protection; Legal framework for trade secrets (e.g., NDAs, confidentiality agreements); Geographical Indications (GIs): Concept and significance; Protection of GIs and their role in promoting local products; Case studies on trade secret theft and GI disputes.	04
6.	**IPR Management, Ethics, and Global Perspectives:** IPR management in technology transfer and commercialization; Licensing and assignment of IP rights; IPR in open innovation and collaborative research; Ethical issues in IPR: Biopiracy, patenting life forms, and access to medicines; Global IPR trends and challenges: Counterfeiting, piracy, and cross-border enforcement; Role of IPR in startups and entrepreneurship; Future of IPR in emerging technologies (AI, blockchain, biotechnology).	04

References –

Text Books:

1. Roger E. Schechter, John R. Thomas, "Intellectual Property: The Law of Copyrights, Patents, and Trademarks", West Academic Publishing.
2. David Bainbridge, "Introduction to Intellectual Property", Oxford University Press.

Reference Books:

1. Robert Merges, John Duffy, "Patent Law and Policy: Cases and Materials", LexisNexis.
2. David Wright, "Intellectual Property Rights: A Practical Guide for Engineers", Wiley.

Note: - Being online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments as per schedule.

Class: -**Final Year B. Tech.**	Semester- **VII**
Course Code: **REH403**	Course Name: **Research Project (Synopsis) Phase-I**

L	T	P	Credits
-	-	-	2

Course Description:
This course is designed to guide B. Tech. students through the initial phase of their research project, focusing on the development of a comprehensive research synopsis. Students will be introduced to the fundamentals of research methodology, including problem identification, literature review, research design, and ethical considerations. The course emphasizes the formulation of clear research questions, the selection of appropriate methodologies, and the preparation of a well-structured research proposal. Through mentoring sessions, students will learn to conduct systematic literature reviews, design research frameworks, and present their synopsis/proposal effectively. The course aims to equip students with the skills necessary to plan, propose, and defend their research projects, setting a strong foundation for the successful execution of their research in Phase 2.
The evaluation process is designed to assess students' understanding and application of research concepts. It includes in Semester Evaluation (ISE - 50%) and End-Semester Evaluation (ESE - 50%) comprises presentation sessions.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Demonstrate an understanding of research methodology and project planning.
2. Identify a research problem with clear objectives and questions.
3. Conduct a systematic literature review using appropriate sources and tools.
4. Develop a research synopsis with a well-defined methodology and expected outcomes.
5. Present research synopsis/proposal effectively.

K. E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Final Year B. Tech Syllabus
To be implemented for 2022-26 Batch
Department of Electronics and Telecommunication Engineering

Class: -**Final Year B. Tech.**	Semester- **VII**
Course Code: **REH405**	Course Name: **Research-Specific Core Course-I (Online NPTEL Course)**

L	T	P	Credits
-	-	-	3

Course Description:
Students can opt for online certification courses and produce certificate.
1. The student should select the course in consultation with mentor on NPTEL platform related to project area.
2. The course should be minimum 25 hours' duration and should have certification facility. Students should complete courses and get a certificate. The certificate copy should be submitted to the mentor. The evaluation process is designed to assess students' understanding of core concepts related to project area. It includes in Semester Evaluation (ISE - 50%) and End-Semester Evaluation (ESE - 50%) comprises presentation sessions.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Explain the key concepts and insights gained from the NPTEL course.
2. Apply concepts, tools, and methodologies learned from the NPTEL course into their ongoing research Project.
3. Analyze research-specific problems using the knowledge acquired from the online course.
4. Identify the real-life applications and practices of courses studied.

Class: **-Final Year B. Tech.**	Semester- **VIII**
Course Code: **REH402**	Course Name: **Research Project Phase-II**

L	T	P	Credits
-	-	-	11

Course Description:

This course is designed to guide B. Tech. students through the execution and reporting phase of their research project, building on the foundation laid in Phase 1. Students will implement the research plan outlined in their synopsis, focusing on data collection, experimentation, analysis, and interpretation. The course emphasizes the application of research methodologies, tools, and techniques to address the research problem effectively. Through regular mentoring sessions, students will refine their research approach, troubleshoot challenges, and ensure adherence to ethical guidelines. The course also focuses on the preparation of a detailed research report and the presentation of findings.

The evaluation process is designed to assess students' ability to execute their research plan and communicate their results effectively. It includes In-Semester Evaluation (ISE - 50%) and End-Semester Evaluation (ESE - 50%), comprising progress reviews, report submissions, and final presentations.

Course Learning Outcomes:

After successful completion of the course, students will be able to,

1. Apply appropriate analytical tools and techniques to process and interpret research.
2. Identify and address challenges encountered during the research process.
3. Prepare a comprehensive research report detailing the objectives, methodology, findings, and conclusions.
4. Communicate research outcomes effectively through written and oral presentations.
5. Demonstrate ethical guidelines and standards throughout the research process.