K.E. Society's

Rajarambapu Institute of Technology, Rajaramnagar

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

Curriculum Structure and Evaluation Scheme

To be implemented for 2022-26 Batch

Department of Electrical Engineering

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

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

Course Code	Course	Teaching Scheme				Evaluation Scheme					
		L	T	P	Credits	Scheme	Theory (%Marks)			Practical (%Marks)	
							Max	Min. for Passing		Max	Min. for passing
EE3034	Power System Analysis	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
EE3054	Control System	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Program Elective -I	2	-	-	2	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		---	---
SH3034	Scholastic Aptitude I	2	-	-	2	ISE	20	40	40	---	----
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
	Multidisciplinary Minor-IV	1	-	2	2	ISE	--	--	--	50	50
						ESE	--	--	--	50	50
EE3514	Control Systems Lab	-	-	2	1	ISE	--	--	--	50	50
						ESE	--	--	--	50	50
EE3534	Microcontroller Lab	-	-	2	1	ISE	---	---	--	50	50
						ESE	---	---	--	50	50
EE359	Advanced Software Lab	-	-	2	1	ISE	---	---	--	100	50
EE3554	Technical Aptitude-III	-	-	2	1	ESE	--	---		100	50
EE3574	Summer Internship	-	-	-	2	ISE	---	---	---	100	50
	TOTAL	**17**	**-**	**10**	**24**						
	TOTAL CONTACT HOURS	**27**									

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

Total Contact Hours/week : **27**

Total Credits : **24**

Technical Aptitude Courses : Power System Analysis, Control System, Microprocessor and Microcontroller

Program Elective-I

Sr. No	Course Code	Domain	Course
1	EE3094	**Power and Energy Systems**	Energy Storages Technologies
2	EE3114		Restructured Power System
3	EE3134	**Drives and Control**	Digital Signal Processing
4	EE3154		Electrical Utilization and Traction

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

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Curriculum Structure and Evaluation Scheme

To be implemented for 2022-26 Batch

Department of Electrical Engineering

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

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
EE314	Power System Protection	2	-	-	2	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50	40	---	---
EE3044	Power Electronics	3	-	-	3	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50	40	---	---
EE316	Research Methodology	2	-	-	2	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50	40	---	---
	Program Elective-II	3	-	-	3	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50	40	---	---
	Open Elective-II	3	-	-	3	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50	40	---	---
	Multidisciplinary Minor-V	3	-	-	3	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50	40	---	---
SH3064	Scholastic Aptitude II	2	-	-	2	ISE	20	40	---	---
						UT1	15		---	---
						UT2	15		---	---
						ESE	50	40	---	---
EE3544	Power Electronics Lab	-	-	2	1	ISE	--	--	50	50
						ESE	--	--	50	50
EE360	Automation and Control Lab	-	-	2	1	ISE	---	---	100	50
EE362	Power System Protection Lab	-	-	2	1	ISE	---	---	100	50
EE3564	Technical Aptitude IV	-	-	2	1	ESE	--	--	100	50
EE3584	Capstone Project Phase I	-	-	2	1	ISE	--	---	100	50
	TOTAL	**18**	**-**	**10**	**23**					
	TOTAL CONTACT HOURS	**28**								

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

Total Contact Hours/week : 28

Total Credits : 23

Technical Aptitude Courses: Power System Protection, Power Electronics, Electromagnetic Fields

Program Elective – II

Sr. No.	Course Code	Discipline	Course
1	EE3064	**Power and Energy Systems**	Electrical Energy Conservation and Auditing
2	EE318		Battery Management Systems
3	EE3104	**Drives and Control**	Advanced Control Systems
4	EE3124		Application of Microcontrollers in Electrical Engineering

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
11	OE3182	Industrial Drives	Electrical Engineering
12	OE352	Image Processing	Electronics & Telecommunication Engineering
13	OE354	Fuzzy logic and Neural Network	Electronics & Telecommunication Engineering
14	OE356	Project Management	Mechanical Engineering
15	OE3284	Supply Chain Management	Mechanical Engineering
16	OE3324	Entrepreneurship Development	Mechanical Engineering

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Curriculum Structure and Evaluation Scheme

To be implemented for 2022-26 Batch

Department of Electrical Engineering

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

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

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
EE411	Solar and Wind Energy Systems	2	-	-	2	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
EE413	Electrical Vehicle	3	-	-	3	ISE	20	40	40	---	---
						UT1	15			---	---
						UT2	15			---	---
						ESE	50	40		---	---
EE4034	Electrical Drives	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		—	—
	Program Elective-IV Lab	-	-	2	1	ISE	–	—	----	100	50
EE473	Solar and Wind Energy Systems Lab	-	-	2	1	ISE	–	—	----	100	50
EE475	Electrical Vehicle and Drives Lab	-	-	2	1	ISE	–	—	----	50	50
						ESE	–	—	----	50	50
EE4594	Capstone Project Phase-II	-	-	6	3	ISE	--	---		50	50
						ESE	--	---		50	50
	TOTAL	**14**	**-**	**12**	**20**						
	TOTAL CONTACT HOURS	**26**									

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

Total Contact Hours/week : 26

Total Credits : 20

Program Elective-III

Sr. No.	Course Code	Discipline	Course
1	EE4054	**Power and Energy Systems**	Power System Dynamics and Control
2	EE4074		HVDC Transmission Systems
3	EE4094	**Drives and Control**	Nonlinear Control Systems
4	EE429		Power System Operation and Control

Program Elective-IV Theory

Sr. No.	Course Code	Discipline	Course
1	EE4134	**Power and Energy Systems**	High Voltage Engineering
2	EE4154		Power Quality and Harmonics
3	EE4114	**Drives and Control**	FACTS Controllers
4	EE4174		Smart Grids

Program Elective-IV Lab

Sr. No.	Course Code	Discipline	Course
1	EE465	**Power and Energy Systems**	High Voltage Engineering Lab
2	EE467		Power Quality and Harmonics Lab
3	EE469	**Drives and Control**	FACTS Controllers Lab
4	EE471		Smart Grids Lab

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

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

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

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.

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Model II: Research Internship (RI)

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
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 Exam

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.

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Model III: Entrepreneurial Internship (EI)

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
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	
	Total	**-**	**-**	**-**	**16**						

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

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.

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

- 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 Basket Name	**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	Automobile 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	
Electrical Power System	1	EEMD201	Electrical Power Generation	III	Electrical Engineering
	2	EEMD202	Power System	IV	
	3	EEMD301	Electrical Machines	V	
	4	EEMD303	Electrical Technology	V	
	5	EEMD302	Smart Grid	VI	
Electronics System Design	1	ECMD201	Electronics Devices and Applications	III	Electronics &Telecommun
	2	ECMD202	Electronics Communication Systems	IV	

Multidisciplinary Minor Baskets					
MDM Basket Name	**Sr. No.**	**Course Code**	**Course Name**	**Semester**	**Offered by Department**
	3	ECMD301	Advanced Communication Systems	V	ication Engineering
	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	

Rajarambapu Institute of Technology Electrical Engg. Department Rajaramnagar

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

B.Tech. in Electrical 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	EEDM5XXX
2	DM-II	EEDM5XXX
3	DM-III	EEDM6XXX
4	DM-IV	EEDM6XXX
5	DM-V	EEDM7XXX
6	DM-VI	EEDM8XXX

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 Electrical Engineering with Honor and Multidisciplinary Minor

B.Tech. in Electrical 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	EEH5XXX
2	Honor - II	EEH5XXX
3	Honor - III	EEH6XXX
4	Honor - IV	EEH6XXX
5	Honor - V	EEH7XXX
6	Honor - VI	EEH8XXX

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 Electrical Engineering-Honors with Research and Multidisciplinary Minor

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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 Electrical 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 %) Max.	Min. for passing		Practical (Marks %) 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 %) Max.	Min. for passing		Practical (Marks %) 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

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Final Year B. Tech. Syllabus
To be implemented for 2022-26 Batch
Department of Electrical Engineering

Class: **-Final Year B. Tech.**	Semester- **VII**
Course Code: **EE411**	Course Name: **Solar and Wind Energy Systems**

L	T	P	Credits
2	-	-	2

Course Description:
This course offers a comprehensive exploration of solar and wind energy technologies, emphasizing the principles, design, operation, and integration of renewable energy systems. Students will examine the core concepts of energy conversion, system components, and assess the economic and environmental implications of implementing solar and wind power solutions.

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

1. Interpret the knowledge of physics of solar power generation and the associated issues.
2. Examine I-V Characteristics of Solar cells, MPPT, Solar Power plants and their Classification
3. Analyze the characterization of electricity generation from the wind and its integration issues.
4. Identify suitable power electronic converter for wind energy systems
5. Address technical challenges in integrating renewable systems into power grids

Prerequisite: Power System, Power Electronics, MATLAB/ Simulink.

Course Content

Unit No	Description	Hrs.
1	**Basic Concepts of Solar Energy & Solar Cells:** Introduction to solar energy. Characteristics of Solar Radiation & Radiation Spectrum. Solar Constant. Air mass ratio. Solar radiation measurement & Instrumentation. Types of Solar Cells - Mono crystalline & Poly crystalline. Solar cells-Energy requirement, Basic operation, construction & concepts.	04
2	**olar Cell Characteristics, Classification of PV Systems:** Solar cell IV characteristics. Maximum Power Point. Cell efficiency & Fill factor. Effect of Irradiation and Temperature. Principles of Maximum Power Point Trackers. PV Arrays and Modules. Balance of Systems (BOS) - Inverters, Batteries, Charge controllers. Classification of PV Systems - Standalone PV system - Grid Interactive PV System- Hybrid Solar PV system.	04

3	**Fundamentals of Wind Turbines:** Power contained in wind - Efficiency limit for wind energy conversion. Design of wind turbine rotor: Diameter of the rotor - Choice of number of blades - The tower- Transmission system and Gear box - Power speed characteristics - Torque speed characteristics. Wind turbine control systems - Pitch angle control, Stall control, Yaw control, Control strategy.	**04**
4	**Wind Power Generation Schemes:** Criteria for classification-Fixed and Variable speed wind turbines- Electrical Power Generators-Self excited vs. Grid connected Induction Generators. Classification of Wind Power Generation Schemes. Advantages of variable speed systems.	**04**
5	**Self Excited Induction Generators:** Induction Generators-Basic Principle of operation-Operation in self-excited mode-Initial Voltage build up - Limitations. Methods to overcome limitations - Controlled firing angle scheme with AC side capacitor-Inverter/converter system with DC side capacitor.	**04**
6	**Grid Integration of Wind Turbine Systems:** Grid Connected Induction Generators Operation - Single output system with Fixed speed - Double output system with variable speed - Grid connected Synchronous generators Operation - Wound field Synchronous generator-Permanent magnet Synchronous generator. Grid connected Wind Turbine systems – Features and configuration - Interface Requirements - Synchronizing with Grid - Power Flow between Two Synchronous Sources - Effect of a Wind Generator on the network	**04**

References -

Text Books:

- K. Sukhatme, S.P. Sukhatme, Solar Energy, Tata McGraw Hill
- Chenming Hu and Richard M. White Solar Cells from Basics to Advanced Systems, Tata McGraw Hill Education Private Limited.
- Siegfried Heier, Grid integration of wind energy conversion systems, John Willy and Sons Ltd

Reference Books:

- T. Ackermann, Wind Power in Power Systems, John Wiley and Sons Ltd

Class: - **Final Year B. Tech.**	Semester-VII
Course Code: **EE413**	Course Name: **Electrical Vehicle**

L	T	P	Credits
3	--	--	3

Course Description:
This course is an elective course in Electrical Engineering This course introduces the fundamental concepts, principles and analysis of electric and hybrid electric vehicles.

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

1. Discuss Conventional Vehicles and Powertrains
2. Analyse the electric drive mechanism.
3. Investigate Battery Management Systems
4. Classify hybrid electric vehicles
5. Describe plug-in hybrid electric vehicles and electrical infrastructure.

Prerequisite: Electric machines, Power electronics, Power Systems

Course Content

Unit No	Description	Hrs
1	**Introduction to Electric Vehicles:** What Is an Electric Vehicle? Engineering philosophy of EV development, Overview of EV Challenges, Pure Electric Vehicle, Hybrid Electric Vehicle, Gridable Hybrid Electric Vehicle, Fuel-Cell Electric Vehicle, Overview of EV Technologies, Motor Drive Technology Energy Source Technology, Battery Charging Technology, Vehicle-to-Grid Technology	06
2	**Fundamentals of Vehicles and Powertrains:** EV configurations, EV Parameters, Longitudinal Vehicle Model, Longitudinal Resistance, Total Tractive Force, Maximum Tractive Effort and Powertrain Tractive Effort, Vehicle Performance, Braking Performance and Distribution, Vehicle Power Plant and Transmission Characteristics	06
3	**Electric Propulsion Machines:** Machine specifications, DC Machine, equivalent circuits and equations, Using DC Machine for EV Powertrain, Permanent Magnet Brushless Motor Drives, Surface-Permanent-Magnet AC Machines, Interior-Permanent-Magnet AC Machine, Switched Reluctance Motor Drives, Applications of drives in EV.	06

4	**Battery Management Systems in Electric Vehicles:** Basic definitions, SOC Estimation methods, Battery Management System: Definition, Parts: Power Module, Battery, DC/DC Converter, Battery System Balancing, Centralized BMS, Distributed BMS, communication channel, Safety in Battery Design, Battery Pack Safety, Battery Standards & Tests, Practical examples of BMS, BMSs in Future Generation	
5	**Hybrid Electric Vehicles:** Introduction to Hybrid Electric Vehicles and Hybrid Electric Powertrains, series hybrid, parallel hybrid, power split hybrid, Introduction to Hybrid Powertrain Components, Regenerative Braking Systems, Introduction to Hybrid Powertrain Controls, Driving Cycles and road conditions, fuel economy, HEV Technologies, Classification Based on Their Powertrain System, Challenges in HEV Design and Realization, Plug-In Hybrid Electric Vehicles.	**06**
6	**Plug-in Hybrid Electric Vehicles and Electrical Infrastructure:** Introduction, Components of PHEVs, Operating Principles of Plug-in Hybrid Vehicle, Plug-In Hybrid Vehicular Architecture, Fuel Economy of PHEVs, power management, component sizing, Control Strategy of PHEV, PHEV-Related Technologies and Challenges, PHEV Market, EV and PHEV charging infrastructures , Requirements of EV/PHEV Batteries, power electronics for PEV charging, grid tied home and public systems, EV battery charging specifications and safety issues, charging modes, V2G and V2G technology. impact of Charging and V2G power flow on the grid	**06**

References

Text Books:

- Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press
- Ali Emad, Advanced Electric Drive Vehicles - CRC Press
- Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press.

Reference Books:

- K. T. Chau, Electric vehicle Machines and drives Design, analysis and application, Wiley
- John G Hayes, G Abas Goodrazi, Electric Powertrain Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John Wiley & Sons
- C. C. Chan, K. T. Chau - Modern Electric Vehicle Technology, Oxford University Press

Class: **Final Year B. Tech.**	Semester-**VII**
Course Code: **EE4034**	Course Name: **Electrical Drives**

L	T	P	Credits
3	--	--	3

Course Description:
The objective of the course is to study the concepts and applications of electrical drives. The students may extend and apply their knowledge and skills through this course for modern applications like Electric Vehicles, Hybrid Electric Vehicles and Industrial Drives.

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

1. List the parts of electrical drives, advantages and factors affecting the choice of electrical drives.
2. Interpret the equivalent parameters, stability and components of load torque for a given motor-load system.
3. Apply power electronics converter and their control techniques to control dc drives.
4. Estimate the performance parameters of dc drives controlled by rectifiers and choppers.
5. Describe stator side and rotor side control of induction motor drive.
6. Explain the special motor drives for industrial applications.

Prerequisite: Electrical Machines, Power Electronics, Control Systems

Course Content		
Unit No	**Description**	**Hrs.**
1	**Fundamentals of Electrical Drives:** Introduction to drives, concept of electrical drive, block diagram of electrical drive, parts of electrical drive, nature of loads and their characteristics, motor-load system, fundamental torque equation, equivalent values of drive parameters, steady state stability of electrical drives, factors affecting choice of electrical drives.	06
2	**Rectifier Fed DC Drives:** Introduction, classification, speed control and electric braking of DC Motors, single phase half and full controlled converter fed dc motor drives, dc series motor drives, introduction to four quadrant operation and single phase dual converter fed dc motor drive, three phase half and full converter fed dc motor drive, four quadrant operation and three phase dual converter fed dc motor drive, closed loop control of converter fed dc drives.	06

3	**Chopper Fed DC Drives:** Introduction, principle, configuration and classification of chopper, one, two and four quadrant chopper fed separately excited dc motors drive, chopper fed series dc motors drive, closed loop control of chopper fed dc drives.	**04**
4	**Stator Side Control of Induction Motor Drives:** Introduction, speed control and torque-speed characteristic of three phase induction motors, three phase ac voltage controller fed induction motor drive, variable frequency characteristics, V/f control, voltage source inverter (VSI) fed induction motor drive, current source inverter (CSI) fed induction motor drive, comparison of VSI and CSI drives.	**08**
5	**Rotor Side Control of Induction Motor Drives:** Introduction, conventional rotor resistance control, static rotor resistance control, concept of slip power recovery, slip power recovery schemes, static Kramer drive, static Scherbius drive. Field Oriented Control (FOC) and Direct Torque Control (DTC) of Induction Motor Drive.	**06**
6	**Industrial Applications of Electrical Drives:** Stepper motor drives, SRM drives, BLDC motor drives, Solar powered pump drives, battery powered drives for vehicles, configurations of EV and HEV	**06**

References -

Text Books:

- Gopal K. Dubey, "Fundamentals of Electrical Drives," Narosa Publication.
- Vedarn Subrahnyarn, "Electrical Drives Concept, and Application," Tata McGraw Hill Publication.
- N. K. De, P. K. Sen "Electrical Drives" PHI Delhi
- Meherdad Ehsani, Yimin Gao, Sabestien E Gay, Ali Emadi "Modern Electric, Hybrid Electric and Fuel Cell Vehicles," CRC Press

References Books:

- B.K. Bose, "Modern Power Electronics and A.C. Drives," Pearson Education.
- P. C. Sen, "Principles of Electric Machines & Power Electronics" Wiley Publication,
- S.K. Pillai, "Analysis of Thyristor Power Conditioned Motors," Universities Press.
- Iqbal Husain, "Electric and Hybrid Vehicles," CRC Press

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 Electrical Engineering

Class: **-Final Year B. Tech.**	Semester- **VII**
Course Code: **EE4054**	Course Name: **Power System Dynamics and Control**

L	T	P	Credits
3	-	-	3

Course Description:
This course explores the evolution and structure of modern power systems, emphasizing control methods, operating states, and stability challenges. It covers the analysis of dynamical systems, focusing on equilibrium, small and large disturbance stability, and modal analysis. Students will study the mathematical modeling of synchronous machines, including per-unit representation and transient characteristics. The course also introduces modeling of excitation and prime mover systems, and examines stability issues in interconnected power systems, such as frequency stability, load sharing, and voltage stability.

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

1. Analyze the structure, control methods, and operating states of modern power systems
2. Evaluate the dynamic behavior of power systems under small and large disturbances
3. Design mathematical models of synchronous machines, including rotor-dependent parameters, D-Q transformations, and per-unit system representations
4. Develop models for excitation and prime mover systems, incorporating control system components
5. Critique the stability of interconnected power systems, including relative motion stability, frequency stability, voltage stability, and torsional oscillations in single and multi-machine systems.
6. Propose advanced solutions for enhancing power system control and stability by integrating theoretical knowledge with practical system dynamics and control strategies.

Prerequisite: Mathematics for Engineering, Power system analysis, Electrical machines, Control systems

Course Content		
Unit No	**Description**	**Hrs.**
1	**Introduction to Modern Power Systems and Stability:** Evolution of power system, Structure of a power system, power system control, control methods, operating states, control hierarchy, Stability Problems faced by Power Systems. Impact on Power System Operation and Control	**06**
2	**Analysis of Dynamical Systems:** Concept of Equilibria, Small Disturbance Stability and Large Disturbance Stability. Example: Single Machine Infinite Bus System. Modal Analysis of Linear Systems. Analysis using Numerical Integration Techniques	**06**
3	**Modeling of a Synchronous Machine:** Physical characteristics, Rotor Position Dependent model. Mathematical Modeling of Synchronous Machine, Mutual and self-Inductances D-Q Transformation (Park's Transformation). Model with Standard Parameters. Steady State Analysis of Synchronous Machine	**06**
4	**Per unit representation of synchronous machine:** Stator quantities, stator and rotor voltage equations, per unit stator and rotor flux linkage equations, per unit system for rotor, per unit power and torque, equivalent circuits for d-q axis. Synchronous machine under steady state. Transient characteristics of synchronous machine	**06**
5	**Modeling of Excitation and Prime Mover Systems:** Physical Characteristics and Models. Control system components, Simplified Representation of Excitation Control, Excitation system, Modeling, standard. Block Diagram,. Excitation System Controllers. Prime Mover Control Systems	**06**
6	**Stability Issues in Interconnected Power Systems:** Single Machine Infinite Bus System. Multi-machine Systems. Stability of Relative Motion. Frequency Stability: Centre of Inertia Motion. Concept of Load Sharing: Governors. Single Machine Load Bus System: Voltage Stability. Torsional Oscillations.	**06**

References -

Text Books:

- P.Kundur, Power System Stability and Control, McGraw Hill Inc, New York

Reference Books:

- K.R.Padiyar, Power System Dynamics, Stability & Control, B.S. Publications, Hyderabad.
- P.Sauer & M.A.Pai, Power System Dynamics & Stability, Prentice Hall

Class: **-Final Year B. Tech.**	Semester- **VII**
Course Code: **EE4074**	Course Name: **HVDC Transmission Systems**

L	T	P	Credits
3	-	-	3

Course Description:
This course provides a comprehensive of HVDC transmission systems, covering the fundamental concepts, design, operation, and control techniques. It explores the historical development and modern trends in HVDC technology, including a detailed comparison with HVAC systems. Students will learn about the various types of HVDC converters, their operation, and pulse-width modulation techniques. The course delves into critical aspects such as converter faults, protection mechanisms, harmonics, and the role of filters in ensuring system stability. Additionally, the course introduces multi-terminal HVDC systems, focusing on their applications, control strategies, and protection schemes. By the end of the course, students will gain in-depth knowledge essential for working in HVDC system design, maintenance, and innovation

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

1. Explain HVDC transmission system merits, types, and structure.
2. Analyze HVDC converters and their control strategies.
3. Explain various faults and their protection technique in HVDC systems.
4. Design AC and DC harmonic filters to mitigate harmonics in HVDC systems.
5. Elaborate the operating principle, types, and control strategies of MTDC systems

Prerequisite: Power System-I, Power System-II, Power System Protection, Power System Operation and Control, Power Electronics.

Course Content

Unit No	Description	Hrs.
1	**Introduction of HVDC transmission:** Historical development, Comparison of HVDC & HVAC transmission system, Type of HVDC links, Converter station structure, Applications of HVDC transmission, Modern Trends in HVDC technology.	06

2	**HVDC Converters:** Selection of semiconductor valve, Analysis of Line commutated converter – 6 & 12 pulse, Voltage source converter – two & three level, Pulse width modulation techniques.	06
3	**HVDC converter control:** Principles of DC link control, Converter control characteristics, System control hierarchy, Firing angle control, Current controller, Excitation angle control	06
4	**Converter faults and protection:** Commutation failure, Arc through, Misfire, Current extinction, Short circuit in bridge, Over voltage in converter station. Protection against overcurrent, Protection against overvoltage.	06
5	**Harmonics & Filters:** Introduction, Generation of harmonics, Types of harmonics, Impact of harmonics, Mitigation techniques, Design of AC & DC harmonic filters, Active harmonic filter	06
6	**Multi-terminal DC (MTDC) system:** Introduction, Applications of MTDC system, Types of MTDC system – series and parallel, Control of MTDC system – current margin and voltage limiting control, Protection of MTDC system.	06

References –

Text Books:

- K. R. Padiyar, HVDC Power Transmission Systems, New Age International Publishers
- S Kamakshaiah and V Kamaraju, HVDC Transmission, TMH Publications

Reference Books:

- J. Arrillaga, High Voltage Direct Current Transmission, Peter Peregrinus Ltd.,
- E. W. Kimbark, Direct Current Transmission, Wiley- Inder-science,
- Vijay K Sood, HVDC and FACTS Controller Springer Publication

Class: **-Final Year B. Tech.**	Semester- **VII**
Course Code: **EE4094**	Course Name: **Nonlinear Control Systems**

L	T	P	Credits
3	-	-	3

Course Description:
The course deals with analytical tools to analyze nonlinear systems. The course introduces common design approaches for synthesizing nonlinear feedback controllers at the graduate level. The emphasis of the course is on both the practicality and usefulness of different nonlinear feedback controller design methodologies as well as theoretical development, so that the student will have the necessary theoretical background after completing the course

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

1. List different types of non-linearities present in the system.
2. Analyze non-linear systems using analytical and graphical methods.
3. Comment on the stability of nonlinear systems using various approaches.
4. Apply Lyapunov stability criteria for nonlinear system.
5. Develop mathematical model of real-time nonlinear systems.

Prerequisite: Mathematics - linear algebra, differential equations; Control Systems - linear system, state-space

Course Content

Unit No	Description	Hrs
1	**Introduction to Nonlinear Systems:** Review of mathematical preliminaries; Linear vs Nonlinear systems; nonlinear models and characteristics; behaviors of nonlinear systems – frequency-amplitude dependence, jump resonance, subharmonic oscillations, limit cycles, frequency entrainment; common physical nonlinearities and examples.	06
2	**Analysis of Nonlinear Systems:** Concept of phase plane analysis; phase trajectories; singular points and classification; analysis using phase trajectories; construction of phase trajectories or phase portraits using isocline and delta method; Existence of periodic orbits; Bifurcation.	06

3	**Frequency Domain Analysis:** Absolute stability, circle criterion; Popov criterion; Describing function; Describing function of nonlinearities like - dead-zone, saturation, relay with dead-zone, backlash; stable and unstable limit cycles; stability analysis; examples.	**06**
4	**Lyapunov Stability:** Stability definition and preliminaries; Autonomous systems: stability of equilibrium point; concept of definiteness of functions, positive, negative definite/semi-definite, indefinite functions; Lyapunov function; Lyapunov's stability theorem; stability of periodic solutions.	**06**
5	**Stability Criterion:** Linear systems, linearization of nonlinear systems about equilibrium point; Lyapunov's indirect method; stability analysis of nonlinear system using Lyapunov's theorem; stability of periodic solutions.	**06**
6	**Nonlinear Control Design:** Feedback linearization; Input-output linearization; full-state linearization; state feedback control; real-time nonlinear systems – mass-spring-damper system, tunnel diode circuit, DC-DC converter etc.; Nonlinear design tools, sliding mode control, Lyapunov redesign, backstepping.	**06**

References -

Text Books:

- Hasan A. Khalil, Nonlinear Systems, Prentice Hall
- M. Gopal, Control Systems: Principle and Design, Tata McGraw-Hill Publishing

Reference Books:

- M. Vidyasagar, Nonlinear Systems Analysis, Prentice Hall
- Alberto Isidori, Nonlinear Control System: An Introduction, Springer-Verlag
- Shankar Sastry, Nonlinear Systems: Analysis, Stability and Control, Springer

Class: **Final Year B. Tech**	Semester: **VII**
Course Code: **EE429**	Course Name: **Power System Operation and Control**

L	T	P	Credits
3	--	--	3

Course Description:
This course focuses on the principles and techniques used to manage and optimize the operation of electrical power systems. This course deals with load flow analysis, voltage control, frequency control, and economic dispatch economic operation. In addition, this course covers frequency and voltage stability in the power system.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Identify effective tools for economic operation of power system
2. Analyze different power flow methods
3. Model advanced control technique for power system.
4. Justify the need of power system security
5. Apply AI & ML concept to power system

Prerequisite: Basic Electrical Engineering Power system analysis, Electrical Machines

Course Content

Unit No.	Description	Hrs
1	**Economic Operation of Power Systems:** Introduction, incremental fuel cost, economic dispatch neglecting transmission losses, transmission loss as a function of plant generation, generation loss formula, and optimum load dispatch considering transmission losses, iterative method of solving coordination equation.	06
2	**Load Flow Studies:** Network model formulation, formation of Y bus, power flow problem, different types of buses, approximate power flow, Gauss Seidel method, Newton-Raphson method, Decoupled Power flow studies, Fast Decoupled power flow studies, comparison of power flow methods.	06
3	**Automatic Generation Control:** Single area load frequency control, speed governing system and characteristics, Multi area load frequency control; flat frequency, flat tie-line load and tie-line load bias control.	06

4	**Voltage stability and Control:** Reactive power and its relation to voltage control, location of voltage control equipment, methods of voltage control, excitation control, voltage regulators, tap changing transformers, induction regulators, reactive power control, short circuit capacity, rotor angle stability and voltage stability, SIL, voltage stability limit.	**06**
5	**Power System Security:** Factors Affecting Power System Security, Contingency Analysis, AC Power Flow Security Analysis, Concentric Relaxation, State Estimation.	**06**
6	**Applications of AI & ML in Power Systems:** Applications of Neural network-based power system estimators and controllers, Application of ANN for security assessment, Schedule Maintenance of power system using Genetic Algorithm, Energy Market forecasting, Fault identification and localization.	**06**

References -

Text Books:

- D. P. Kothari and I. J. Nagrath, Modern Power System Analysis, Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi,
- Ashfaq Husain, Electrical Power Systems, Fifth Edition, Dhanpat Rai & Co.
- P. Venkatesh, B.V. Manikandan, S. Charles Raja and A. Srinivasan, Electrical Power Systems: Analysis, Security and Deregulation, PHI Learning Private Limited, Haryana.
- Anuradha Srinivasaraghavan, Vincy Joseph, Machine Learning, Wiley

Reference Books:

- Chakrabarti & Haldar, Power System Analysis: Operation and Control, Prentice Hall of India,
- C. L. Wadhwa, Power System Analysis, New Age International
- P. Kundur, Neal J. Balu, Power System Stability & Control, IEEE.
- El-Hawary M.E., "Electric Power Applications of Fuzzy Systems", Wiley-IEEE Press

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 Electrical Engineering

Class: **-Final Year B. Tech.**	Semester- **VII**
Course Code: **EE4134**	Course Name: **High Voltage Engineering**

L	T	P	Credits
3	-	-	3

Course Description:
Electrical insulation forms the foundation of modern power system networks. Throughout their operational lifespan, various dielectric materials used in insulating systems face diverse stresses. Understanding the core properties of these materials and the mechanism behind their potential failure is crucial for effective and efficient design. In today's competitive market, the push for extra-high voltage transmission and the operation of equipment near design thresholds demand rigorous design protocols and stringent testing standards. Consequently, high voltage insulation technology has evolved significantly, driven by advancements in testing, measurement, and the development of innovative materials.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Interpret the significance of high voltages and high currents
2. Design and analysis of high voltage
3. Outline the need of high voltage equipment's testing and procedures of electrical devices
4. Identify different methods for measurement of high voltage and high current
5. Examine the over voltage and insulation co-ordination

Prerequisite: Fundamentals of Electromagnetics, Electric Power systems, Electrical Measurements

Course Content

Unit No	Description	Hrs.
1	**Introduction to High voltage engineering:** Electric field stresses. Gas/ Vacuum as insulator, Liquid dielectrics. Solids and composites, Estimation and control of Electric stress, Numerical methods for electric field computation. Applications of insulating materials in transformers, rotating machines, circuit breakers, cables, power capacitors and bushings. Measures relating to Safety and Electric Supply: Overview of Central Electricity Authority Regulations, 2022 section (3) of section 177 of the Electricity Act, 2003 (36 of 2003) read with sub-rule (2) of rule 3 of Electricity Act. Electrical Installations in Stand-By generating stations and Captive substations.	05

2	**Breakdown in Liquid and Gases Dielectric materials:** Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases, Panchen's law. Liquid as Insulator, pure and commercial liquids, breakdown in pure and commercial liquids	07
3	**Breakdown in Solid Dielectric materials:** Intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice, Breakdown in composite dielectrics, solid dielectrics used in practice.	06
4	**Generation & measurement of high voltages and currents:** Generation of High Direct Current Voltages, Generation of High alternating voltages, Generation of Impulse Voltages, Generation of Impulse currents, Tripping and control of impulse generators. Measurement of High Direct Current voltages, Measurement of High Voltages alternating and impulse.	06
5	**Testing of materials & electrical apparatus:** Measurement of D.C Resistivity, Measurement of Dielectric Constant and loss factor, Partial discharge measurements. Testing of Insulators and bushings, Testing of Isolators and circuit breakers, Testing of cables, Testing of Transformers, Testing of Surge Arresters.	06
6	**Over voltages and insulation co-ordination:** Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, Principles of Insulation Coordination on High voltage and Extra High Voltage power systems.	06

References -

Text Books:

- C.L.Wadhwa, High Voltage Engineering, New Age Internationals (P) Ltd.
- M.S.Naidu and V. Kamaraju, High Voltage Engineering, TMH Publications

Reference Books:

- E.Kuffel, W.S.Zaengl, High Voltage Engineering: Fundamentals, Elsevier
- Ravindra Arora, Wolfgang, High Voltage Insulation Engineering, New Age Internationals (P) Ltd.

Class: - **Final year B. Tech**	Semester- **VII**
Course Code: **EE4154**	Course Name: **Power Quality and Harmonics**

L	T	P	Credits
3	--	--	3

Course Description:
This course provides an in-depth understanding of Power Quality (PQ) issues, their impact on electrical systems, and methods for managing and improving power quality. Students will explore key concepts such as voltage quality, harmonics, voltage sags, and interruptions. The course will cover the fundamentals of power quality monitoring, measurement techniques, and data analysis. Students will also learn about the different types of harmonic distortions and their effects on power systems and communication networks. The course will emphasize practical solutions for mitigating power quality problems using various techniques

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

1. Analyze power quality problems with interruptions
2. Explain Power Quality Standards with Monitoring techniques
3. Elaborate harmonics with various measurement techniques
4. Design Harmonics mitigation solutions

Prerequisite: Power system, Electric Circuit Analysis and Mathematics.

Course Content

Unit No	Description	Hrs.
1	**Introduction to Power Quality**: Voltage quality, power quality evaluation, procedures, term and definitions: general classes of power quality problems, transients, long duration voltage variation, short duration voltage variations, voltage imbalance, waveform distortion, power quality terms.	06
2	**Voltage Sags and Interruptions**: Sources of sags and interruptions, estimating voltage sag performance, fundamental principles of protection, motor starting sags.	06
3	**Power Quality Monitoring**: Monitoring considerations, power quality measurement equipments, assessment of power quality measurement data, application of intelligent systems, power quality monitoring standards.	06

4	**Fundamentals of Harmonics**: Introduction; generation of harmonics; types of Harmonics; effect of harmonic on power factor and communication network,etc.; THDs; harmonics indices.	**06**
5	**Measurement of Harmonics**: Instrumentation techniques, Analog and Digital Methods, presentation of harmonic data and Interruption, case studies, Harmonic Standard and future trends.	**06**
6	**Mitigation of Harmonics**: In-line reactors or chokes, Zigzag transformers, Passive filters, Shunt passive filters, Series passive filters, Low-pass broadband filters, C filters, Active filters.	**06**

References -

Text Books:

1. Electrical Power system quality by Roger Dugan
- Power Quality Problems and Mitigation Techniques by Bhim Singh, Ambrish Chandra, Kamal Al-Haddad; John Wiley & Sons Ltd

Reference Books:

- Francisco C. De La Rosa, Harmonics and Power Systems, CRC Press.
- C. Sankaran , Power Quality , CRC press.Power Quality Problems and Mitigation Techniques by Bhim Singh, Ambrish Chandra, Kamal Al-Haddad; John Wiley & Sons Ltd

Class: - **Final Year B. Tech**	Semester- **VII**
Course Code: **EE4114**	Course Name: **FACTS Controllers**

L	T	P	Credits
3	--	--	3

Course Description:
Flexible AC transmission systems are state-of-the-art control and protection systems in the power system. The FACTS Controller course covers the advanced technologies used to enhance the stability, efficiency, grid capacity and performance of electrical power systems. It focuses on various FACTS Controller devices, such as SVC, TCSC, and UPFC, that manage voltage, reactive power, and power flow in transmission lines.

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

1. Examine the importance of controllable parameters and benefits of FACTS Controllers.
2. Compare the operation of SVC and STATCOM
3. Analyze the functional operation and control of series compensation
4. Describe the principles, operation and control of voltage & Phase angle regulator
5. Explain combined & special purpose FACTS controllers

Prerequisite: Power Electronics and Power Systems

Course Content

Unit No	Description	Hrs
1	**FACTS Concepts:** Opportunities for FACTS, Power Flow in an AC System, Transmission line Loading Capability, Importance of Transmission line Controllable Parameters, Basic Types of FACTS Controllers	06
2	**Voltage source converters:** Rectifier: operation & control, Inverter: operation & control, voltage control technique, Bi-directional inverter Topologies, Multilevel Inverter Topologies, Harmonics analysis, Generalized Technique of Harmonic Elimination	06

3	**Static Shunt Compensators:** Objectives of Shunt Compensation, Stability Analysis, Methods of Controllable VAR Generation – TSC & TCR, Static VAR Compensators (SVC), Static synchronous compensator (STATCOM), Comparison Between STATCOM and SVC	**06**
4	**Static Series Compensator:** Objectives of Series Compensation, Stability Analysis, Variable Impedance Type Series Compensators – GCSC, TSSC, TCSC, Switching Converter Type Series Compensators – SSSC	**06**
5	**Static Voltage & Phase angle Regulators:** Objectives of Voltage and Phase Angle Regulators, Thyristor-Controlled Voltage and Phase Angle Regulators (TCVRs and TCPARs), Switching Converter-Based Voltage and Phase Angle Regulators, Hybrid Phase Angle Regulators	**06**
6	**Combined & Special Purpose Compensators:** Introduction, The Unified Power Flow Controller, The Interline Power Flow Controller, Generalized and Multifunctional FACTS Controllers, Thyristor-Controlled Braking Resistor	**06**

References -

Text Books:

- Hingorani, N.G. and Gyragyi,L., Understanding FACTS :Concepts and Technology of Flexible AC Transmission System, Standard Publishers and Distributors
- K. R. Padiyar, FACTS controllers in power transmission & distribution, New age international publication

Reference Books:

- Sang, Y.H. and John, A.T., Flexible AC Transmission Systems, IEEE Press
- Mathur, R.M. and Verma, R.K., Thyristor Based FACTS Controllers for Electrical Transmission Systems, IEEE Press

Class: **-Final Year B. Tech.**	Semester- **VII**
Course Code: **EE4174**	Course Name: **Smart Grids**

L	T	P	Credits
3	-	-	3

Course Description:
The course deals with smart grid introduction, technologies, communication and applications of renewable sources for developing smart grid

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

1. Discuss the smart grid
2. Develop smart grid architecture
3. Explain various smart grid technologies
4. Identify communication and information technologies for smart grid
5. Describe smart metering and distribution automation equipment's

Prerequisite: Mathematics - linear algebra, differential equations; Control Systems - linear system, state-space

Course Content		
Unit No	**Description**	**Hrs**
1	**Introduction to smart grid:** Basics of power systems, definition of smart grid, need for smart grid, smart grid domain, enablers of smart grid, smart grid priority areas, regulatory challenges, smart-grid activities in India, Comparison between smart grid and micro grid.	06
2	**Smart grid architecture:** Smart grid architecture, standards-policies, smart-grid control layer and elements, network architectures, IP-based systems, power line communications, supervisory control and data acquisition system.	06
3	**Communication technology in smart grid:** Introduction to Communication Technology, Two Way Digital Communications Paradigm, Synchro-phasor Measurement Units (PMUs) – Wide Area Measurement Systems (WAMS), Power quality by use of smart meters	06

4	**Information technology in smart grid:** Data communication, Dedicated and shared communication channels, Switching techniques- Circuit switching, Message switching, Packet switching, Standards for information exchange, Information security for the Smart Grid, IOT for Power systems, home	06
5	**Smart metering:** Evolution of electricity metering, Key components of smart metering, An overview of the hardware used, Communications infrastructure for smart metering and protocols for smart metering	06
6	**Fundamentals of Reliability Engineering:** Introduction to Reliability: Definition, importance, and reliability in power systems. Basic Reliability Concepts: Failure rate, mean time to failure (MTTF), mean time to repair (MTTR), availability, and unavailability. Reliability Parameters.	06

References -

Text Books:

- Janaka Eknayake, Smart Grid- Technology and applications, Wiley publications
- A.G. Phadke and J.S. Thorp, Synchronized Phasor Measurements and their Application, Springer.

Reference Books:

- S. Borlase, Smart Grids, Infrastructure, Technology and Solutions, CRC Press
- G. Masters, Renewable and Efficient Electric Power System, Wiley–IEEE Press
- T. Ackermann, Wind Power in Power Systems, Hoboken, N J, USA, John Wiley

Class: - **Final Year. B. Tech**	Semester-**IV**
Course Code: **EE465**	Course Name: **High Voltage Engineering Lab**

L	T	P	Credits
-	-	2	1

Course Description:
This laboratory course emphasis on imparting the practical knowledge and understanding of basic principles, characteristic, performance and testing of high voltage engineering equipment's. The course will orient students to understand the theoretical and practical dimensions. In this lab course, students will be familiar with the use of different equipment's and safety precautions on workplace.

Course Learning Outcomes:
After successful completion of the course, students will be able to,
1. Perform experiments on different insulating materials to check dielectric strength
2. Study different high voltage AC and DC generation system.
3. Study impulse generation system.
4. Study Partial Discharge Testing.

Exp. No.	Description	Hrs.
1	To find breakdown voltage of solid insulating materials.	02
2	To find breakdown voltage of liquid insulating materials.	02
3	Study of Generation of High AC Voltage – Using cascade transformers or resonant circuits.	02
4	Study of Generation of High DC Voltage – Using rectifiers and voltage multipliers.	02
5	Study of Measurement of Impulse Voltage – Using voltage dividers and peak voltmeters.	02
6	Study of Measurement and analysis of partial discharges in cables and transformers.	02
7	Study of switching surges and lightning impulses	02
8	Simulation of insulation coordination in power systems.	02
9	Simulation of power frequency withstand and breakdown voltage of cables.	02
10	Study of Flashover and puncture tests on pin/post insulators	02

Class: **Final Year B. Tech.**	Semester-**VII**
Course Code: **EE467**	Course Name: **Power Quality and Harmonics Lab**

L	T	P	Credits
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Course Description:
This course focuses on the practical understanding and analysis of power quality issues caused by nonlinear loads and transient conditions in electrical systems. Students will explore key phenomena such as voltage sag, swell, flicker, and harmonic distortion through experimental setups and simulations. The course covers methods to mitigate current harmonics using filters, the effects of capacitor switching transients, and the impact of unbalanced and nonlinear loads in three-phase systems.

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

1. Analyze the impact of nonlinear loads on power quality under various conditions.
2. Demonstrate voltage and current distortions in LED loads and their mitigation.
3. Design and evaluate filters to reduce current harmonics in electrical systems.
4. Study capacitor switching transients and their effects on the power network.

Prerequisite: Electrical Machines Lab, Power Electronics Lab, Control Systems Lab

Expt. No.	Title of Experiment	Hrs.
1	Introduction to different power quality parameter	02
2	Demonstrate various power quality measurement instruments	02
3	Demonstrate voltage sag and swell using Simulink	02
4	Study the neutral current of unbalanced load using Simulink	02
5	Study the Capacitor Switching Transients using Simulink	02
6	Make a use of power analyzer to measure various parameters of load	02
7	Perform detailed harmonic analysis of nonlinear load	02
8	Case study on harmonic filter design	02
9	Demonstrate mitigation of harmonic using filters in Simulink	02
10	Industrial visit to identify and analyze real time power quality issues	02

Class: - **Final Year B. Tech**	Semester- **VII**
Course Code: **EE469**	Course Name: **FACTS Controllers Lab**

L	T	P	Credits
--	--	2	1

Course Description: 'FACTS Controllers' laboratory is offered as the core course in Electrical Engineering undergraduate program. This course focuses on various techniques of reactive power compensation and voltage support. This course deals with the practical performance, simulation tools on studying of various FCATS Controller devices like Static Var Compensators (SVC), Unified Power Flow Controllers (UPFC), and STATCOMs to enhance the stability and efficiency of power transmission.

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

1. Explain different types of reactive power compensation methods.
2. Illustrate the operation of SVC compensation
3. Describe the operation of VSI in UPFC for reactive power compensation.
4. Demonstrate STATCOM for voltage support in power systems.
5. Gain proficiency in using power system simulation tools

Prerequisite: Power System, Power Electronics, MATLAB/ Simulink.

Expt. No	Title of Experiment	Hrs.
1	Three phase voltage source inverter operation	02
2	Dynamic response of the SVC for voltage regulation	02
3	Power flow operation of Thyristor Controller Reactor (TCR)	02
4	Power flow operation of Thyristor Switched Capacitor (TSC)	02
5	Steady-state operation of a 100-Mvar STATCOM on a three-bus 500-kV system for voltage support	02
6	Improvement of transfer power capability using TCSC for a long transmission line	02
7	Power flow control using a Unified Power Flow Controller (UPFC) for a 500 kV transmission system	02
8	Transient stability analysis of multi-machine systems with Power System Stabilizers (PSS) and Static Var Compensator (SVC).	02

K.E. Society's
Rajarambapu Institute of Technology, Rajaramnagar
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Final Year B. Tech. Syllabus
To be implemented for 2022-26 Batch
Department of Electrical Engineering

Class: - **Final Year B. Tech**	Semester- **VII**
Course Code: **EE471**	Course Name: **Smart Grids Lab**

L	T	P	Credits
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Course Description:
'Smart Grid' laboratory is offered as the core course in Electrical Engineering undergraduate program. The Smart Grid Lab aims to answer energy transition-related queries. Direct management of energy generation and consumption, particularly electrical energy, has become essential as a result of the energy shift. This course addresses opportunities of integration of renewable energy sources with conventional grid using smart meters.

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

1. Comprehend understanding of smart grid structures, components, and their role in modern power systems
2. Analyze and simulate power flow in renewable energy systems and grid integration
3. Analyze and evaluate parameters of electric vehicle batteries using advanced battery management systems
4. Simulate and analyze microgrid systems and understand vehicle-to-grid applications for frequency regulation and power quality improvement
5. Explore smart grid sensors, instruments, and SCADA systems in real-time

Prerequisite: Power System, Power Electronics, MATLAB/ Simulink.

Expt. No	Title of Experiment	Hrs
1	Study of smart grid structure and components	02
2	Demonstration of power flow with wind power generation	02
3	Demonstration of power flow analysis on 250W solar PV system	02
4	Analyze various parameters of electric vehicle battery using Smart BMS application.	02
5	Demonstration of a 100kW grid connected PV array	02
6	Simulate and analyze a small scale microgrid system for 24 hours	02
7	Demonstration of a vehicle-to-grid system for frequency regulation in microgrid system	02

8	Demonstration of harmonics mitigation by using capacitor bank	**02**
9	Demonstration of grid connected 300kWp solar rooftop project	**02**
10	Study of smart grid sensors and instruments	**02**
11	Visit to substation automation (SCADA) center	**02**

Class: - **Final Year B. Tech.**	Semester-VII
Course Code: **EE473**	Course Name: **Solar and Wind Energy Systems Lab**

L	T	P	Credits
-	-	2	1

Course Description: This laboratory course emphasis on imparting the practical knowledge and understanding of basic principles, characteristic, performance and testing of Solar and Wind technology. The course will orient students to understand the theoretical and practical dimensions. In this lab course, students will be familiar with the use of different equipment's and safety precautions on workplace.

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

1. Prepare report on renewable energy resource assessment.
2. Demonstrate the operating characteristics of PV modules
3. Demonstrate the effects of tilt angle and shadowing on PV modules
4. Operate and maintain squirrel cage and DFIG based wind generation systems.
5. Demonstrate the important of tip speed ratio for standalone wind turbine system.

Exp. No.	Title of Experiment	Hrs.
1	Prepare the report on renewable energy potential in India	02
2	To plot I-V & P-V characteristics for P-V module	02
3	To demonstrate I-V & P-V characteristics for series and parallel P-V module.	02
4	To study the effect of variable tilt angle on PV module.	02
5	To demonstrate effect of shading on PV module output power.	02
6	To calculate power flow in PV system with DC load.	02
7	Prepare the report on working system of 300 kWp solar system at RIT	02
8	To analysis effect of wind speed on wind farm output power	02
9	To understand Wind generation emulation using induction motor acts as Induction generator	02
10	To study tip speed ratio at different wind speed.	02

Class: **Final Year B. Tech.**	Semester-**VII**
Course Code: **EE475**	Course Name: **Electrical Vehicle and Drives Lab**

L	T	P	Credits
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Course Description:
This course aims to demonstrate the knowledge of Electrical Machines, Power Electronics, and Control Systems practices to various industrial applications where motion control is required. Student may extend the knowledge and skills through this course in robotics, electric drive trains, lifts, elevators and electrical vehicles.

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

1. Analysis performance of electric vehicle in the form of power, torque, and weight
2. Demonstrate AC and DC drives, fed from various power electronics converters
3. Examine closed loop control of electrical drive system
4. Analyze performance of electrical drives by plotting speed-torque characteristics
5. Compare performance of electrical drives using speed-torque characteristics

Prerequisite: Electrical Machines Lab, Power Electronics Lab, Control Systems Lab

Expt. No.	Title of Experiment	Hrs.
1	Introduction to Wiring harness of two wheeler electric vehicle	02
2	Demonstrate Power, Torque analysis of two wheeler electric vehicle	02
3	Demonstrate Power to weight ration analysis of EV drive train	02
4	Demonstrate working of 3-phase half converter fed DC drives	02
5	Demonstrate working of 3-phase full converter fed DC drives and draws the characteristics.	02
6	Demonstrate working of Chopper motor controller for DC series motor drive	02
7	Demonstrate working of Chopper controller using MOSFET to control DC motor	02
8	Demonstrate working of Four quadrant operation of DC motor drive using chopper	02
9	Study (V/f) scheme for 3-phase induction motor drive	02
10	Study Vector Control (FOC) of induction motor drive	02
11	Study Slip Power Recovery (SPR) scheme for 3-phase induction motor drive	02
12	Demonstrate working of BLDC Motor Drive	02

Class: - **Final Year B. Tech**	Semester-**VII**
Course Code: **EE4594**	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:

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

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

Reference Books:

- Cannice Mark V, Koontz Harold and Weihrich Heinz, "Management", McGraw Hill Education (I) Pvt. Ltd.
- Blank Leland and Tarquin Anthony, "Basics of Engineering Economy", Tata McGraw-Hill.
- 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:
i) perform a background literature search and review,
ii.) Develop a project plan,
iii.) Perform experimental work or applied experimental work,
iv.) Write and present a research report.

iv) 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 criteria 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 target market, market segmentation, market positioning, building a marketing plan, market strategy.	**04**
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:

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

Reference Books:

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

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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:

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

Reference Books:

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

Note:

- Lectures of this theory course will be conducted through online mode.
- Recorded videos will be made available to students on MOODLE platform.
- Faculty will upload three lectures per week and links will be shared on every Monday.
- Students need to appear in Unit Test-1, Unit Test-2 and ESE in college campus as per the regular practice.
- 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:

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

Reference Books:

- Robert Merges, John Duffy, "Patent Law and Policy: Cases and Materials", LexisNexis
- 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.

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.

- The student should select the course in consultation with mentor on NPTEL platform related to project area.
- 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.